UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

TECHNICAL WORKSHOP ON THE IMPACTS OF DRY-STORAGE CANISTER DESIGNS ON FUTURE HANDLING, STORAGE, TRANSPORTATION AND GEOLOGIC DISPOSAL OF SPENT NUCLEAR FUEL IN THE UNITED STATES

Tuesday

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Embassy Suites
1250 22nd Street, NW
Washington, DC 20037

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(Continued)

MORNING PLENARY SESSION

8:00 a.m.

EWING: It’s my pleasure to welcome everyone back to the second day of our workshop. In case you weren’t here yesterday, my name is Rod Ewing. I’m the Chair of the Board of Radioactive Waste Management.

Let me say just a few words about what we learned yesterday, and then I’ll turn the podium over to Nigel Mote, the Executive Director for the NWTRB. And he’ll outline the day’s activities, which you’ll know from yesterday, this is the day where we really get to interact and argue over what we should do with these packages, canisters of spent fuel, as they accumulate around the country.

So I think we were, in fact, very privileged to have the presentations that we listened to yesterday, because they, in a very explicit, almost frightening way, outlined the scale of the problem that faces us.

(Pause.)

So the scale of the problem. What we learned yesterday is, already around the country we have some 1,500 dry storage systems that are in use. Most are metal welded containers. There are 26 welded metal canister designs. At the 12 shutdown sites we have 17 canister designs, 8 storage overpack designs, and 8 transport overpack designs. So we have a wide variety of canisters or packages of different dimensions and different mass. And to add to that complexity, some are and some are not certified for transportation. And so to move them from the site to an interim storage facility or to a repository seems to call out for repackaging.

So in that context we had presentations on what repackaging means, what is the scale of that effort, and we learned that it's a lot of packages, and it will cost a lot of money, roughly speaking many billions of dollars. Even if we want to embark on this expensive and large-scale effort, we have dry storage canisters on sites which no longer have the facilities for handling or repackaging those materials. And even for dry storage canisters on sites with operating reactors there are operational constraints on what can be done in the context of ongoing reactor operations. The mechanical process, the physical process of opening the welded packages is not only expensive, it's not only complicated, but one has to consider exposure to workers.

So with all of that complexity, the next thought is, well, why can't we just move these large packages directly to a repository and leave them there? That skips over the complexities that we face. We had an introduction to some of the implications of, let's call it, direct disposal of these dry cask packages. And the introduction focused mainly on the size, moving these large objects underground, and the heat load and the impact of the heat load in the context of different geologies. And so in this case the higher thermal conductivity of salt makes salt an attractive possibility.

But I'd like to suggest where we fell short a little bit yesterday, mainly due to limitations in time, is we didn't ask the fundamental question at the disposal end: What is the role of the waste package in terms of the barrier functions that we need for the successful long-term performance of a geologic repository?

If we look around the world, it seems to me that the message is that the waste package and the materials we use in the design of that package is quite important. And I'm thinking of the copper canisters with the small number of fuel elements in each kept to a low, low temperature. This would be the case in Sweden and in Finland.

Also, recalling our experience with the Yucca Mountain project where over time the waste package became very important, and we passed through a number of different designs and finally ended up with a package made of a very corrosion-resistant material, an alloy, supplemented by drip shields. So the near field containment, the physical containment of the waste seems to be very important to the long-term performance.

There are other questions that have come to my mind, thinking of salt as an example, and just to try to stimulate some of the discussion. In salt the main failure mode is human intrusion; that is, just drilling through the repository. So a simple question--probably the answer is complicated--is: Is there a difference between drilling through a very large waste package with lots of fuel elements versus a much smaller one? Does that affect the long-term performance of the repository and its ability to comply with regulations?

And then, finally, a question that goes well beyond what we can do in this workshop but finally is mainly the more important issue: How do we harmonize or blend the difference perspectives? The utilities have a problem today, which they're trying to deal with and solve. There will be some organization in charge of waste management, and they'll be dealing with the waste and applying for or submitting a license on performance that will extend for hundreds of thousands of years. So there has to be, for us to move the whole system forward, in my opinion, some compromise, some blending, some sense of what the final or long-term purpose of these activities actually will be.

And this blending is not very easy, because it depends on the time frames. The time frame for utilities is today, this year, next year, the next ten years. The time frame for geologic disposal is hundreds of thousands of years. And the role of the package in those two time frames is one of the subjects we want to or I hope we address today.

So I'll stop with that bit of introduction and a few thoughts, and I'll turn this over to Nigel, who will explain to you the logistics and also the goals of what we'll be doing for the rest of the day. Thank you.

MOTE: Good morning, everybody. Sound okay? Okay. Hands up everybody who had nightmares last night about the number of canisters and the potential for repackaging.

I'd like to start right now by being even more informal than yesterday. I've got a lavalier on, because I'm going to have to walk down the room. And you'll see there are three wall charts here. That's going to be part of what I'll talk about. During the two breakout sessions we'll actually have those down the walls of this room and the other room, which I'll come to in a minute. But I put those up just for examples that I'll come to. So if you're wondering what they are, they're part of what I'm going to talk about now.

Before I start on this formal session, I'd like to say that the overheads I'm going to use have not been printed. There are not copies that you can take away, because we (inaudible) that during some of the dry runs yesterday. They will be available, as will all of the overheads, on the Board's Web site, nwtrb.gov. You can find that very easily by Googling the Board’s name. All of the overheads will be on the Web site, we’re thinking, the first couple of working days after we get the workshop finished.

I’d like also to point out for those of you who may never have seen it that there are two cards like this available on the table outside. They are different, and you may not realize they’re different unless I point that out. One of them is to let you ask questions in the breakout sessions that we’re coming to shortly. And that is, there will be some people who do not want to ask questions for fear of exposing their lack of knowledge, which is absolutely immaterial here, because we all lack knowledge in the areas that we’re not familiar with, and we do want to share as much as possible between the expertise of the groups and the representation from organizations and the individuals who are here.

So, please, if you have a question and you don’t want to ask it yourself, please fill a card out and give it to any of the staff or Board members, and they’ll make sure that it gets worked into the system somehow. We are going to be limited on time, so it may be something that we get dealt with in the Board considering it when the report is written, but we would like all the input that we can have.

The second card is one to put your name on the Board’s registry of people who receive e-mail notices about meetings and reports. You can select what you receive, you can select how you receive it, whether it's electronic or in hard copy; but if you would like to be on the Board's mailing list for something, please fill a card out and leave it on the desk outside.

This session--the two breakout sessions that we're coming to are very informal, and we'd like to have them as inclusive as possible for everybody to say things, ask questions, clarify, and so on. We are trying to identify the issues. This was said yesterday by Rod a couple of times. We do not have time to resolve them. I'm sure most of the people who do these things like techies--and most people here being techies--would have looked at the number of options on some of the charts that you saw yesterday, and you'll know that--well, let me start by walking around.

This chart down here on the side wall, for those of you who can't see it clearly, you'll see there's a diagonal and there's a bunch of squares. And each of those squares or cells represents a potential area where there will be issues in what we're talking about. And if you do the math, you'll see that there's over a hundred squares, and we have 180 minutes, so that works out to 1.8 minutes per square. If we try to stop and resolve everything in all of those cells, rather, not squares, it's an impossible task. So we're not trying to resolve anything; we're trying to identify issues in the areas that we are considering here. We're not trying to resolve them.

The Board has a mandate, and the mandate, as most people will know, is technical. That's why "technical" is in the name, the Nuclear Waste Technical Review Board. So normally we don't deal with cost and policy and those sort of things. We cannot do that as an organization, but we can record things that are said in the sessions, and we will do that in the report that we'll prepare.

We're looking at spent fuel management at different stages, all the stages from cask canister loading at the utility sites are. Storage, which could be an independent central storage installation out at the utility site, certainly includes transportation. In one of the cases it would include repackaging, which could be at a central storage facility. It could also be at the utility site. It could be at the repository site. If there is a central storage facility, there could be further storage. There could be further storage at the repository site at a separate storage facility.

After central storage facility, there would be further transportation. There may need to be overpacking for disposal if there isn't direct disposal of the containers. There's emplacement in the repository. And, as Rod just said, postclosure is an issue which often gets shortcircuited, because it isn't an operation that people think about. You're not actually doing anything active over the next hundred thousand years, but postclosure is a very important part of this, and we need to be sure that we include that in the discussion.

Those are single issues, single items, single operations. And the other thing that the Board has always been very insistent on is that everything in this area needs to be considered on a system basis. So we're not looking at stovepiping certain areas and operations. We need to examine the interactions between all these stages and operations, and that's what that chart is that I'll come to in a minute.

The logistics for the day, we have two sessions, and at the end of this presentation I'm going to ask for a show of hands, because this room will be used for one breakout session. We have another room which will be used for the other breakout session, and that room is the Embassy Room? I think it's the Embassy Room, and it's across the other side of the breakfast area. And that room is smaller than this; it's about half the size. So why we want a show of hands is that whichever breakout session is going to have more people wanting to go to it will stay here, and the smaller population will go to the other room.

And so we will ask--we'll separate that way. And we need a few minutes to set up when we've decided which room is which, because we have different wall charts for the two sessions, and we need a few minutes to put those on the walls.

We can move between sessions, but yesterday when we had a dry run and we were talking to the facilitators who will be involved heavily in the two breakout sessions, they said they thought from experience it would be potentially possibly disruptive if we have people moving from one to another and raising issues that came up in one in the other session, because each will have its own dynamic, its own flow. And so if you do move between sessions, we would ask you to be, not restrained, but careful not to come in with ideas from one and derail the discussion that is going on in the other session.

We have three hours until the lunch break. That doesn't close--it closes the session, but it doesn't close input. And I'll come back to that in a minute.

There will be facilitators in each session, one in each session, and they are to guide, encourage, cajole, keep control on target, keep on the time scale. They are to tease out the discussion and, one of the main points, not let the discussion get into trying to resolve the issues, but stay on what are the issues, how do you define them, what are the fundamental points, and what is it that comes from that that needs to be recorded in the report that will come from this meeting.

There are flow paths and interaction matrices. They’re the diagrams I’ll come to in a minute.

Two Board members will be in each of the breakout sessions to take notes. And I don’t mean like a secretary, but each pair of Board members have interests and expertise in the areas of concern to the relevant breakout session that they’re in. And so we have two nuclear engineering Board members who will be in the repackaging session, for example. They know what this is about, and they will be recording not just the words, but the interpretation of what’s coming out of the discussion so that we catch the essence of what the issue is and the background. When we come to write the report, which will be a staff issue, the Board members will be there, having had the involvement of recording this with their own expertise so that we catch it the correct way.

Also, in the afternoon they will give feedback into a joint session, which will be back in this room, on each of the two sessions. So the session on repackaging will have two Board members who will feed back into the plenary this afternoon the essence of the discussion that came out of the issues on repackaging; similarly, for the breakout session on direct disposal. And that will allow everybody who didn’t sit--everybody’s in one session, and that will allow everybody to hear what happened in the other session. And so that’s the opportunity for cross-fertilization. So if you’re in the breakout session on repackaging and you want to bring something into the discussion about direct disposal, the afternoon is the best place to do that.

This is being transcribed; yesterday was transcribed; both of the breakout sessions will be transcribed. And that allows us (inaudible) to rewind. That means that we can go back and revisit a discussion to try and make sure that we capture the points correctly.

The flowcharts, I’m going to walk down the room in a minute and point some issues out here. The first session, the breakout session, is a session that includes repackaging. As we heard yesterday, there’s why, where, when, and whom. They’re all variables; they’re all important. We will not be trying to resolve that. We will be saying, What are the issues and what’s affected and where might the repackaging occur, what are things that might affect it, but not trying to resolve any of those issues.

In the repackaging session, we’ve got to be looking at a large number of flow paths. This is the flowchart that the staff put together for the repackaging discussion. And you can see this is the spent fuel pool at the reactor, this is an independent spent fuel storage installation at the reactor site, this is an interim storage facility, this is the repository site. And I know you can’t all see that.

That’s why we’ve got multiples of these to put down the walls so everybody can see one of these during the discussion.

What we have here are the flowcharts. The blue lines are bare fuel. Some fuel is there in dry storage casks now; and so even though this is focusing on repackaging, some of the fuel will not need to be repackaged because it isn’t yet packaged. It’s bare fuel assemblies in bolted spent fuel casks. And so the blue, for example here, is bare fuel. The green is large storage containers. And you can see that this is a complicated diagram. We’ve put that together to represent what we think the primary material flows.

And so there are many flow paths. There may be many more than we have there. We’re not trying to limit it. This is to stimulate the discussion. So we’re looking for as much involvement as possible; and if there are issues that come from flows that are not shown on there, we certainly want to identify those as well.

In this scenario, after repackaging you’re looking at smaller containers, so potentially transportation is easier. I’m saying that with some reservation. Easy is a strange word to use in this context, but it doesn’t have some of the challenges that you do with trying to move the large storage containers. And so the consequence of having smaller containers is you have many more of them, so there’s implications there for transportation.

And I'm only picking a few here for example. This is not to try and steer the discussion this afternoon.

In the other session, direct disposal of large canisters, you're not looking at repackaging. This is the workshop that's over there, and you see it's a much simpler flowchart to the extent we have delved into this. Again, this is the reactor site with a reactor pool and independent spent fuel storage installation. This is the central storage facility if there is one, this is the repository site, and potentially you can see this is a much simpler flow diagram than the Session 1 flow diagram.

For the consequences, you have no repackaging. There is some packaging to do, because some of it is in bare fuel. And that's the blue lines on that chart. Less flow paths, but there may also be more than we have shown there. And, again, we're not trying to limit it to these. We're trying to be as inclusive as possible. And the consequence is that you've got hot and heavy all the way: large containers, larger heat load, obviously more fissile material, more radioactive material. And we're looking at taking that all the way through to the repository and then looking at what happens underground in the long term.

So that's what we tried to capture on the flowcharts that we'll be using.

And then we have--the other set of wall charts that we have are the ones that I have. I have one of them pinned up down there. And I hope those of you at the back can see enough of that to be able to read at least the principles. And I'm going to put a couple up in just a minute, but before I do, let me go through some things here.

What we're trying to do is to make sure that we cover all the bases. We're not going to go through those interaction matrices cell by cell. The discussion will take its own path through the issues that we're going to have under discussion. The rapporteurs will make sure that the conversation keeps moving and doesn't get stuck, and we're trying to cover as much as we can on that. We will be open for comments afterwards, so don't think at the end of today, if you haven't got your point through, that's the end. And I'll come back to that point in just a moment.

On the matrix--each of the matrices--you go along the diagonal from top left to bottom right. You're following the flow of the path of materials that we have with the arrows on the two wall charts there. Above the diagonal, what we're looking at is the impact of a later stage on actions at an earlier stage. And I'll come back to that in just a moment. Above the diagonal is impact on later stages. Below the diagonal is impact on earlier stages. And we are looking at the interaction, the dynamics, as much as possible, not just individual operations.

So, as an example, this is--and I apologize for the quality. We've tried very hard to get this clear, and for some reason it doesn't happen. But I hope you can see enough of this to understand where I'm going. This is the diagonal; this is spent fuel in the spent fuel pool at the reactor site; this is canister loading; and these are operations all the way through to disposal. You cannot see the color very clearly. This is the same pink color as we have on the flowchart, meaning the reactor site; this is transportation in white; this is meant to be the same color as the light green for the central storage facility; and this is the repository site.

And the others on here are meant to show you where the discussion can go, encouraged by the facilitators. If you look at this cell, which is canister loading, B-2, and this one here, which is E-5, transportation, the words there say, "What is the impact of canister design on transportation?" So that discussion would be, you've made decisions about the canister loading. That includes the design of the canister, the operations, the materials. And the question to be answered is: What is the impact of that design, that decision, on transportation operations away from the reactor site? And the facilitators will encourage the discussion in that way.

This question here is: What is the impact of canister design on disposal? That is, the canister loading operation takes place there. This is disposal. And I'll follow Rod's lead and say, we have also fallen into the same trap and said disposal, and that must include post-disposal performance of the package, looking at engineered barriers, the type of geology, and the impact that has on the performance. And so this disposal cell down here is particularly important in the direct--well, in both of the scenarios, but it's going to be a big focus on the discussion of differences with the large containers.

The arrows down here--we've gone back the other way. This is transportation away from the reactor site. This is canister loading, as we said before. So that arrow will stimulate the discussion: What is the impact--and that is what it says here--What is the impact of transportation requirements on canister loading? So if you're going to transport something away from the site, what does that tell you about things that you need to take into account during the canister loading operations, planning for decision making, licensing?

So that is the dynamic that we're trying to get from the decision matrix, which is one example on the wall over there.

And I should say--I started out by saying this is meant to be the start of being very informal. If you have questions, please ask me. If I'm not getting the point across, please ask me. This is trying to set up the discussion in the breakout sessions, and I want to be sure that I'm getting the discussion points across.

So these are examples of the question--I've been through some of these--How does the spent fuel storage in the utility pool impact canister design? And that would be the path from A-1 to B-2, which is there. That's a different example from what I just said. A-1 to C-3 is that one. And we could go through that, and these are just example questions.

Like I said, these will be on the Web site, which maybe is not going to help. We wanted to have this printed but couldn't find anywhere to do that overnight. So apologies, but we don't have that printed.

This is, again, to show you not something to be dealt with now, but an example of how we will record this discussion for comment later and later input on the Web site.

This is a Word table. We have all of the dynamic flows. In this case it's Cell A-1 to Cell B-2. The example here is from Cell B-2 to Cell E-5--let me go back to here--so B-2 to E-5. So that one there, as one example of an issue that we put down just to tease out the discussion, is (inaudible) soluble boron is used in criticality analysis as the basis for canister loading. This is an issue that came up, I think, in Rob Howard's presentation yesterday.

If you qualify--if a storage cask is licensed based--if the loading of the storage cask is based on an assumption that there is soluble boron in the pool water, then that will be taken into account in the criticality analysis for cask loading. And if that is used as a basis for cask loading at utility sites, the possibility exists the canister may not meet the criticality requirements for transportation, because if during a transportation accident the cask were breached and there was water ingress, then the water that got in would not have the same soluble boron that was used to meet the regulatory requirements for loading the cask in the spent fuel pool.

I'm not going to go through all of that. That's an example of how this would be recorded by the two Board members in each of the breakout sessions so that we capture the points for the report.

I want to keep this fairly brief so that we can move into the breakout sessions, but these are other essential points. We are looking at commercial fuel primarily, not by desire, but because it's the right thing to do. It's the majority population of spent fuel in storage casks, and it is the main focus of attention, has been in the industry for a long time. DOE has its own spent fuel in containers that may need to be repackaged. And what we don't want to do is to look only at the commercial spent fuel and not take account of the fact that there may be a repackaging requirement for DOE spent fuel.

So this part, it’s out of sight, because we don’t have information on that at this workshop. It’s not out of mind, and we will try and find a way to fold that in during the preparation of the report. Certainly DOE EM, which is the majority owner of DOE spent fuel, know that we’re doing this and that we’re in discussion with them about how to handle that.

I’d like to ask that you help the rapporteurs. They have a difficult task. If I go back to this example here, this is what they’re going to be trying to capture, maybe not in that length of discussion for today, but in order for them to be able to capture the points correctly, some of which will be outside their own areas of expertise, what we’d ask is that you help them by giving them time. The facilitators will work with them on this. But if they need to clarify things, they’re going to need to ask that and make sure they capture things correctly.

Not everything can be reduced to sound bites. Maybe that’s a little trite, but what that’s meant to say is that there are some issues where there’s going to need to be discussion about how to capture things correctly, and one of the best times to do that is going to be during the sessions.

Nowadays there tends to be a focus on reducing things to very few words and make things very quick. This workshop we need to not do that, but to record things fully.

The workshop ends at 5:00, but the door remains open. What I mean by that is, we will close promptly at 5:00. We know the people, particularly who live in D.C., will want to get away to travel home. We will take comments and input after the workshop. The Web site is open, and we'll be looking for input to the extent anybody wants to give it. There is an e-mail address, november2013workshop@ nwtrb.gov. For those of you who registered, it's the same e-mail address that you used there. If you want to e-mail things in--questions, comments, answers, documents--you can do it that way. So that is the open door afterwards.

We will record the logs that the Board members take, the rapporteurs, these logs. We will post those on the Web site. Target will be early December, the week after Thanksgiving. If we have comments before then, we'll take account of the comments before we post those records, so we'll take account of those.

And then the final--and final doesn't mean the end, but it's the final ones that we will post on the Web site. Those we'll try and get posted by the 16th of December, taking into account any other comments that come in during that period.

The transcript we would expect to post by about the 16th of December. That’s the transcript from the workshop as a whole. And we’re looking at a Board report during the first half of 2014.

So that, I hope, sets the scene for not only the breakout sessions, but where we’re going with the report after that.

So there are the end of my slides.

Can I ask for any questions or input or comments? And, like I said, this is free range. The start of the breakout sessions is now, and we’d appreciate any input from anybody.

(Pause.)

Having no questions, okay, then to the next thing. Can we have a show of hands, please, who--Breakout Session Number 1 is the one that includes a discussion of repackaging with this flowchart here. How many people want to be in that session?

(Pause.)

Okay. And how many people want to be in the direct disposal of big containers session?

(Pause.)

I think the direct disposal is going to be in the other room, but not by a large margin. I would say that was 45-55 or 40-60. All right? Okay. Well, what we’d like is about ten minutes for the staff to be able to put the wall charts up, get everything set up, let the Board members get set up. So I'll look forward to everybody being back here after lunch. Thank you.

(Whereupon, the plenary session was adjourned and the attendees split into the two workshop sessions below.)

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 cell phone numbers as well if you want. So, thank you all very much, and we'll see you again.

(Whereupon, Session 1 was recessed for lunch.)

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. Design 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 dual-unit BWR2 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 origin 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 repackaged 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 limit, as 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 I know this 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 wrestle 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 loading 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 packaging. 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 loader (sic), 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 for 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 not 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 in bare fuels, 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 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, 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 before 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 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 was 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--in 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 18-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 get the helium amounts. 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 load in 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 point 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 have 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 CFCs. 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 were 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 design 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 point 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 milliram of 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 packaging under consolidated storage G. 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 continued--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—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 putting 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 be 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 of 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 is 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 is a 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 (inaudible) the disposal requirements played 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: Amongst 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 at 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, Session 1 was recessed for lunch.)

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

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

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

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

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

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

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

And the way we set up both of these was two five-minute presentations in the beginning, one from kind of an industry perspective, and we have Andrew Sowder, who will present five minutes. And I have asked him and Beatrice Brailsford in the back from the Snake River Alliance to kind of provide some input at the beginning to kind of get the juices flowing, and I'm trying to encourage them to be crisp in terms of identifying the issues. They'll be presenting some information just as a way of background. Beatrice is going to be talking about--not commercial--but she'll probably be talking about DOE spent nuclear fuel.

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

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

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

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

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

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

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

So I think this slide here or this image here is pretty telling. Basically, it's showing the accumulation of fuel assemblies in dry storage by year, starting here with Virginia, Surry--now Dominion's--kind of lead canister or cask experiment, you might say, all the way to today. Another one that I wanted to put in here--but, again, limited to five minutes--I don't have that much time. But, basically, for every fuel assembly that comes out of the spent fuel pool or goes into the spent fuel pool during refueling, one now has to go into dry storage. That's where we are today in the U.S. industry by and large. There may be a few plants left that have room in their pools, but pretty much we're on a steady-state basis, and it's not a good steady-state.

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

ZOBACK: Excuse me.

SOWDER: Yeah?

ZOBACK: Vertical scale on these drawings?

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

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

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

SOWDER: Yeah. So the actual scale here is the number of independent spent fuel storage installations here. And, meanwhile, we've called out basically two different points in time, you know, how that picture has changed just since 2004 to 2012, you know, essentially almost a doubling of both ISFSIs as well as assemblies in dry storage.

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

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

So, you know, again, I think we were asked from that point of view that we had looked at this in the past, recognizing that was for a specific site and geology. But, again, everyone has slightly different numbers and estimates; but, you know, this is what we based ours on. You have to make some assumptions projecting into the future; but, again, by and large, these dual-purpose canister systems are the lion's share in the U.S. What we've moved to are welded stainless steel systems.

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

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

So in terms of raising issues, I think this TAD system is one thing to bear in mind that I think was a very--at the time a very successful proposal and certainly was one that the industry supported in terms of moving to a more standardized canister. But, of course, at the time we also had a place to send things to, and we knew how to design that canister. So without a site, it’s very hard to actually design a canister that’s truly standardized.

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

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

So, again, certainly mass of these things becomes a real issue, a technical issue, not insurmountable but certainly challenging.

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

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

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

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

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

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

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

And then also this question of are we talking about thermal performance of the system under steady state conditions or when, in fact, it will likely just be a transient excursion of some kind of peak temperature. That’s a very different system than a steady state system.

LESLIE: Wrap it up…

SOWDER: I’m wrapping up here.

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

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

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

LESLIE: Okay, so to speak. So an example is--and this is kind of for everyone--is Andrew talked about a few things that kind of are taking--can I borrow your--that little green thing at the top there--the pointer. Okay, got it.

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

SOWDER: Right.

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

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

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

FRANKEL: No, it's--

LESLIE: Okay. Could you identify yourself?

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

LESLIE: Could you?

McCULLUM: Yeah, I'll do that.

LESLIE: I appreciate it. Okay. Beatrice?

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

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

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

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

DOE owns about 2,400 metric tons of spent fuel; 11 percent of that is at the Idaho National Laboratory. Of our inventory in Idaho, about 60 metric tons is defense, and the rest is non-defense. All of the Nuclear Navy spent fuel comes to Idaho, and until 1992 it came to Idaho to be reprocessed. Currently there are about 27 metric tons of Nuclear Navy spent fuel in Idaho, and more than half of that fuel came in after 1995.

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

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

A lot of the dry storage happens at what we call Building 603. It’s one of our more modern facilities. It is dry, but one of the reasons it’s dry is that they recently successfully repaired the leaking roof, and it depends on forced air ventilation to remove decay heat. We store spent fuel on rail cars in demonstration casks on a pad in below-ground vaults with a lot of--not a lot--but a few different configurations in a hot cell, and the Three Mile Island fuel is stored in an NRC-licensed facility.

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

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

I mentioned the fuel that comes out of ATR is newly generated and goes into water. It will probably still be generating fuel in 2023 when no more fuel is supposed to go into water. That problem might be exacerbated by--right now the Department of Energy is looking at refurbishing and restarting a reactor it closed in 1994 called the Transient Reactor Test Facility, TREAT.

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

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

And then I guess, finally, you know, all that fuel at Idaho--and it’s not a vast amount, I mean, I told you it’s a very small inventory. But it’s got 250 different attributes, you know, and all these things that you have to take into consideration. All that fuel, as it is getting ready for whatever happens next, the flow chart shows that it’s characterized and conditioned in what is called the Idaho Spent Fuel Facility. That is a licensed facility. The license is held by the Department of Energy. It has not been built. And its mission in the Mission Need Statement is to handle all the fuel at the Idaho National Laboratory.

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

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

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

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

BRAILSFORD: Yes.

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

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

McCULLUM: Rod McCullum, NEI. Am I on?

LESLIE: Yes.

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

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

In my world where time travel has not been invented yet, we can only go forward in time. We've loaded 1,700 of these things, 1,771 as of the end of the half year. We will have loaded over 3,000, most of them welded, by--and I don't want to start the repackaging session. Those guys are going to talk about all the reasons why it doesn't make sense.

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

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

LESLIE: Okay. And I'm going to turn one of the things you said back into an issue. So, again, Rod, you've raised a good way of thinking about it in the sense--in terms of how you treat things in the disposal space can influence what you do up ahead.

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

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

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

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

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

LESLIE: Okay, thank you, Rod.

And, Tito, I saw your hand.

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

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

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

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

So we have, in essence, two different problems, one of them, what do we do with the ones that we have already loaded, which we do not want to repackage? And in that context I agree with Rod's comment about we have an initial condition. But the other part of the problem is: What do we do with the ones that are going to be loaded in the future? And that's where I see the feedback mechanism coming from disposal back to Box Number 2.

LESLIE: Thank you, Tito.

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

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

There’s a question back here?

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

LESLIE: Yeah, that’s fine.

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

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

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

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

At another level you can design a canister so that it is small enough or it has enough other materials in addition to spent fuel that it can never go critical no matter its state of degradation. So that would be essentially the SKB approach. They have 4-PWR or 12-PWR assemblies per canister. They have a massive cast iron insert, and they project that the degradation of that system would never go to criticality.

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

LESLIE: So those are solutions--

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

LESLIE: Okay.

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

LESLIE: Okay, thank you, Ernie.

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

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

EWING: Close enough.

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

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

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

Now, I presume stainless steel will not last as long as Alloy 22. Right? And I think that may be important in compliance unless you change the geology. I mean, you could go to a better geology with your present initial conditions, but is that much flexibility in the system--is that the flexibility you would drive us toward? I mean, if I’m stuck with the initial conditions, can I then pick the repository environment?

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

LESLIE: Thank you, Ernie. And now--

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

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

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

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

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

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

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

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

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

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

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

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

BOYLE: William Boyle, Department of Energy. I hope to follow in Brian's footsteps and identify a potential issue. And it occurs, actually, before disposal, and it's related to the light green on the chart, which is "Consolidated Storage", which is not a given or a certainty, but certainly a possibility.

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

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

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

LESLIE: Thank you, Bill.

Tito, did you--

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

GUTHERMAN: Yes, as it relates--

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

There is a particular senator from a West Coast state who is very interested in how long that fuel is going to sit in some of those facilities.

LESLIE: Okay. Ernie, are you--

HARDIN: Yes, please.

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

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

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

Yeah, it would be tempting to say, look, let's let that disposal overpack be the comprehensive interface between any DPC and the disposal environment. Let's let it solve all of our problems. We can design it with thickness and materials such that it has containment lifetime that we require, and we can rely on that containment lifetime to keep water out so it never floods and we don't have to worry--we can screen out criticality at that point. So that's an attractive proposition. The gotcha there is that it may not be plausible to claim that kind of performance on a set of 10,000-plus overpacks.

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

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

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

LESLIE: If you can speak into the mic.

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

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

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

SISLEY: Steve Sisley.

LESLIE: Thank you, Steve.

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

So, hopefully, that completes the circle.

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

LESLIE: All right, go ahead, Rod.

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

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

SPEAKER: I don’t have it here.

LESLIE: Go ahead.

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

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

Well, that’s your initial condition again, but now you’ve got a team of scientists who are further refining their understanding of how heat affects the repository.

You've got heater tests in the rock or in the salt or in whatever geology you're in that are testing theories about how heat affects the way water moves. You've got 10 to 50 to 100 years to incorporate that result in amendments to your license for your repository.

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

LESLIE: Okay, thanks, Rod.

I'm going to go to the back, because I haven't heard anything, and I saw Steve had his hand up. And then we'll come back up. Thank you, Andrew, for reminding me, I still owe you. So we'll go Steve and then Andrew; all right?

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

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

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

So I think that while, yes, it's very important to understand the problems that are there and the problems that are being magnified all the time, but you're arguing how to beat a site rather than how to take advantage of a site. Taking advantage of a site involves understanding to a great extent how that site is going to work rather than, as unfortunately with Yucca Mountain, trying to figure out how to make it work.

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

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

LESLIE: Thank you.

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

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

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

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

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

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

LESLIE: It's slightly outside, but we've recorded it and you've got it in--

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

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

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

LESLIE: And now I'm going to come up to--thank you for passing that, Andrew--identify yourself.

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

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

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

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

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

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

ALSAED: Certainly. It's Halim Alsaed.

LESLIE: Okay, thank you, Halim.

Ernie and then Jean.

Thank you, Devonya.

HARDIN: Thank you. Hardin, Sandia. I have a collection of issues for you here, Bret.

LESLIE: Okay.

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

With that said, though, Dr. Ewing did mention Alloy

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

Okay, and here's another insight I'd like to try to share with you briefly. I think of these different alternatives in terms of how we would represent the safety case and what the probabilistic risk assessment would end up looking like. And is it plausible, and is it complicated, or is it simple? So no concept with an extremely complicated safety case is going to be easy to license.

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

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

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

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

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

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

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

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

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

LESLIE: Identify yourself.

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

Although the regulations for generic disposal in a deep repository will probably be evolving as time moves forward, I think the concept of performance-based risk informed will remain; and that makes the performance assessment a major part of the regulatory process. And maybe I’m missing something, but I think one of the contributions of the TAD was it, to some degree, simplified the performance assessment in that you had a restricted diversity of materials, a restricted diversity of configurations, that were being analyzed as part of the application and review.

And as you’re expanding that roster of different materials and different configurations and different types of waste packages going in, that will add complications to your

PA. And I don't know how to price out costs of complicated PA versus complicated packaging, but there are some trade-offs there. So I think we have to keep that in mind as we're trying to think in a performance-based risk-informed setting.

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

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

LESLIE: Jim, thanks.

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

RUBENSTONE: And just to clarify--

LESLIE: Jim.

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

So it just makes your performance assessment somewhat more challenging. Not saying it can't be done, but it does sort of add the burden there.

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

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

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

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

So, Halim, is that you?

ALSAED: Yes, yes, Halim Alsaed. The point I would bring up here is about the subset of canisters in storage right now, the 300 or so canisters, that are single-purpose for storage only, and they're not transportable based on their current design, because they don't meet either structural requirements or criticality requirements. VSE-24s at several of the sites, including Palisades, are an example of those canisters.

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

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

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

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

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

McCULLUM: I am ready.

LESLIE: Okay, there you go.

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

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

And then beyond that we may find of the 1,771 casks we can only do that or somehow complicate the performance assessment and specify it and tailor it for 1,631 of the casks. Well, then you might have a more limited set that you can't directly dispose of, okay? But, again, if you start out with that initial condition and you find you have an outlier and you have to deal with 50 outliers as opposed to 1,700 outliers, you really advance the system, and you put the performance assessors to good work to define that. And I think the guys that are sitting at computers where there's no radiation exposure and heavy lifts and disrupting of reactor operations, those are the guys that should be doing that work.

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

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

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

SISLEY: Steve Sisley, EnergySolutions.

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

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

LESLIE: Okay, thank you for that clarifying response.

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

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

But when you're looking at 100,000-to-a-million-year horizon, the idea that--it's going to fail. One way to look at it is, well, let's talk about managed failure and do putting in your DPCs--can that be accommodated within a risk perspective where a leaky repository is a much more equitable distribution of risk over time and could in essence improve your overall performance, again? Perhaps heresy--and I'd be happy to hear the responses to that--but we're talking about a systems approach and also, if we're talking about a performance-based compliance standard, it's not saying zero risk; and we're looking at uncertainties over tens to a hundred thousands of years. Thank you.

LESLIE: Thank you, Andrew.

Rod and then the back, because I--

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

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

Back row, either Jeff or Brian.

WILLIAMS: Yeah, this is Jeff Williams. I just want to comment on Steve Sisley's remark about these are not certified for transportation. Well, in fact, the storage ones are not certified for transportation, because they weren't really designed for transportation. So if you look at quite a bit--if you take the CONY (phonetic) canisters that are sitting down there, and then you go to the ones at Rancho Seco and you see the differences in design, to make them transportable, it's quite a bit different. They've got additional structural plates in them. They have flux traps in them. They have neutron absorber materials in them. So it would be quite a challenge, I think, to make those storage-only canisters transportable.

That was my only comment.

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

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

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

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

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

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

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

LESLIE: Thank you, Tito.

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

SPEAKER: I'd vote for a break.

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

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

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

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

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

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

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

So, again, that's kind of where we're at. You'll hear the ideas this afternoon being reported out. And if we totally missed the point, you'll have the opportunity to raise your hand, because that will also be facilitated so that we can clarify things there as well.

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

Okay. Yes, Rod. Hold on one second.

Devonya, did you manage to find paper?

DEVONYA: Yes.

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

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

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

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

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

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

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

LESLIE: Okay. Jean.

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

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

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

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

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

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

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

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

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

And identify yourself.

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

LESLIE: Efi--

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

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

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

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

Sorry, Andrew, go ahead.

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

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

I just want to point out one thing. In terms of context and perspective, the most extreme environment that the fuel will likely encounter in this system is while it's in the reactor, being driven very hard for a purpose. Once you get it out into storage and certainly hanging out in an inert environment at lower temperatures, if you look at this systematically, the fuel is not in an extreme environment. And so, again, I think a lot of times people tend to look at this in a compartmental fashion. But the fuel was designed to operate in a reactor, and the conditions it's experiencing under dry storage are actually very mild, and most of the fuel will do quite well.

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

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

HARDIN: Sure, this will be quick. Hardin, Sandia Labs.

On high burnup I have a perspective on thermal for you.

LESLIE: Thank you.

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

LESLIE: Okay. Well, I'll bring it back over here. So does that mean this is an issue for hundred-year storage at a reactor? Does it mean--and, again, I'm playing through this. Does that mean this facility doesn't get decommissioned for a hundred years? I'm being very--pushing the envelope here--but does it mean that you think about centralized storage for some part of it? How does that--given that you're going to have to store it before you transport it, that's pretty enlightening.

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

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

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

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

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

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

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

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

LESLIE: Thank you, Jean.

RUBENSTONE: I just wanted to get--

LESLIE: Identify yourself.

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

HARDIN: Yes.

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

And I understand Andrew’s perspective on the reactor environment being more aggressive than some storage environments is that if hydride reorientation is a phenomenon that we need to be concerned with and the information out there is developing, then there may be issues with what people refer to as a ductile to brittle transition in certain types of cladding as the fuel cools. So in some sense transportation of warmer but not very hot fuel may have a lower risk of degrading cladding than letting it sit for a hundred years at a given site. So there are different issues for the different legs of the concern.

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

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

LESLIE: Before you give up the microphone, let me ask a clarifying question. And I see a couple other new hands. And I still have Rod Ewing to get the mic to.

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

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

So I think this gets into some of the discussion of doing screening on individual canisters. Of the 1,700-odd that are out there now, some of them are probably already cooler than one would predict. And this circles back to another hat that I wear in the NRC about looking at some of our extended storage issues. In general, the constraint that people load to thermally going from pools to storage is, during the drying is when the fuel experiences the highest outside-of-reactor temperature. And there’s a 400C limit that NRC puts on that, because during the drying process, before you’ve backfilled it with the inert gas, in the vacuum the fuel is less effective at getting rid of its heat.

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

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

And I’ll put in another plug for DOE sponsoring this high burnup demo. One of the major benefits of this is not that it’s just going to be a “close it up and look in ten years”, but we want to try to get monitoring information, including temperature and other parameters in essentially real times so we can validate some of our models.

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

PHILLIPS: Thank you.

LESLIE: Your name?

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

So inevitably I fear we're going to be stuck with utilities doing what's best for them until we have an overall plan within the U.S. for what we're going to do. And it's actually got worse, because we haven't got any repository now, of course. It's actually got worse rather than better. It's a bit of a bleak assessment, but I don't think anything is going to happen until there's an overall system against which you can judge. Then you might be able to work with the utilities to get them to do stuff that will reduce overall costs and dose uptake throughout the entire system. But you won't do it until you've got that.

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

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

So, just to follow up on and give a counterpoint to

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

On the point of extreme environment, certainly in-reactor conditions for UO_2 are very extreme. But as a material, the really extreme environment for UO_2 is UO_2 in contact with water, a few bicarbonate molecules in it. So that’s where UO_2 alters very rapidly. So that’s the extreme environment, in other words, the disposal environment.

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

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

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

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

But the issue I want to raise is really--I can't tell you which box it is, because I think it's a whole bunch of boxes, and it's the value of data. And I think you mentioned it, you know, we're kind of assuming everything's performing--all of X canisters perform a certain way. And they've been sitting--some of them have been sitting on the ground for 25 years, right? We heard the problem's been around for 25 years? How are they performing in terms of temperature and things like that?

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

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

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

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

LESLIE: Just checking with my rapporteurs.

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

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

So all of that--you know, the whole point of, I think, my comment here is just to reaffirm what you had said; and I think everyone recognizes that need. And eventually the industry is working towards an aging management plan, because, again, these things weren't supposed to originally be aging to this extent where they needed an aging management plan, but given that's where we are today, you know, I think the recognition is there, and you need the data to support that so you understand what needs to be monitored and managed.

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

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

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

And Tito really formulated or threw out the three areas, three real concerns, which were the weight, the thermal effects, and the criticality, postclosure criticality. Those are the three he talked about. And then Rod mentioned maybe the fourth, which would be environmental stability. But is it possible that there really are engineering solutions based on good science to deal with all of these issues, that handling heavy things--I don't know, it's an engineering problem. Maybe there are ways to do that. So, to me, that doesn't seem to be a deal breaker.

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

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

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

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

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

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

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

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

LESLIE: Okay.

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

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

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

BONANO: Tito Bonano from Sandia. So, Gerry, to answer your question, there was another point, another nugget, that

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

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

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

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

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

And could you identify yourself?

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

And, you know, sure, there's a lot of things we can do moving forward to help future DPCs that would help this direct disposal of criticality. But, you know, we do have a backlog of 1,800 casks also that we will need to deal with, and that's going to grow over time. And, you know, going with the risk-informed approach is the proper way to address some of those issues concerning criticality with the existing canisters.

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

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

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

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

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

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

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

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

The more you know about those assemblies, their history in the reactor, how they were depleted, their specific design parameters, the more accurate your model is of that system. And generally that leaves you to determine that those assemblies are actually less reactive than, say, models for transportation.

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

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

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

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

LESLIE: Thank you, Halim.

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

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

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

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

LESLIE: Thanks for bringing that back.

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

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

CLEMMENS: Hi. Jack Clemmens with Chicago Bridge and Iron. As I’ve been listening to a lot of the discussions today, what struck me was, we’re saying it in a lot of different fashions, but until the repository is known, one of the things that we as an industry need to do is figure out how long can the fuel in its existing condition, whatever container or canister it’s in, stay where it’s sitting.

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

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

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

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

SPEAKER: We’re not doing solutions.

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

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

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

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

So we have many, many decades here of confident storage. You know, what we have here is a question of how to focus our efforts going forward, and I think that needs to be part of the narrative. I mean, we talk about placing constraints on things going forward, but before you can negotiate any of those constraints--I again refer back to the TAD example--there has to be something you're negotiating based upon.

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

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

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

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

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

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

LESLIE: Thank you. Ernie?

HARDIN: Right. Hardin, Sandia. I wanted to give a perhaps more respectful answer to the question about whether DPC direct disposal could exclude a geology. We think in terms of disposal concepts. We've written up a few of them that we think might work. And the bottom line is that it trades with time. So it's how long are you willing to decay store the fuel before it's disposed of?

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

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

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

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

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

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

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

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

And if it ends up that there's five potential geologies, and when we really get a good answer to that how long do we want to surface store question. If only three of them will work for direct disposal, great, we've just narrowed down the site selection process. And that should be the goal here, because I think if we keep punting, that's not serving anybody. So, yes, narrowing down geologies by fixing on direct disposal is progress.

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

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

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

LESLIE: Name?

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

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

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

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

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

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

This circles back to the question that Halim raised about getting the accurate data for how each individual cask has been loaded, what's in there. Some of those may be more amenable. A lot of the calculations that have been done have been done based on somewhat bounding conditions that may not apply in all instances. So there may be some subset of the existing loaded casks or ones to come that are more amenable to direct disposal as opposed to trying to make calculations or finding a geologic setting that allows all of the ones to be disposed.

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

EWING: Just a personal comment.

LESLIE: Rod Ewing.

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

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

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

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

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

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

LESLIE: Okay, thanks. We’re slowing down. I’m slowing down. But I think we’ve made good progress--well, I can’t talk and speak at the same time. But I want to check back in with Sue and Gerry. Are you feeling a little more comfortable about where we’ve been and where we’re going? And, again, I will remind folks that, you know, they’re trying to take as good a notes as possible. And if we’ve blown it, then I’m sure you’ll raise your hand and say, well, you know, we really meant to say that. So, again, give them some leeway this afternoon as they try to capture real time what they heard.

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

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

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

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

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

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

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

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

(Whereupon, the lunch recess was taken.)

AFTERNOON PLENARY SESSION

1:00 p.m.

EWING: All right. If you would take your seats, please, we'll get started in just a moment. Well, this afternoon the plan is to join together and hear from the rapporteurs about what happened in each of the two sessions. As you know we had two Board members in each session taking notes, trying to capture the wisdom that was expressed during the discussions. So I'll just turn it over immediately to Board member Lee Peddicord who will give his summary, and then we'll have a facilitated discussion. The same facilitator who was in the session will lead us through the discussion. And this is, again, another important opportunity for you to provide input to the discussions. So I really encourage you to do that.

All right, Lee.

PEDDICORD: Thank you, Rod.

So good afternoon. Am I on here? Can you hear me? Okay. So I am Lee Peddicord. I am a member of the Board. I am also a Professor of Nuclear Engineering at Texas A&M University.

SPEAKER: Moo.

(Laughter.)

PEDDICORD: There can't be that many Longhorns in the room, really. I want you to do a better job here though.

And I want to introduce my co-rapporteur, Professor Paul Turinsky, from North Carolina State University. So Paul has asked me to share that anything that I'm going to be talking about this afternoon with which you disagree is all things that he has put into the program.

So the intent here is to go through our endeavors in the breakout Session 1 which dealt with the possibilities including repackaging. So note that that's this diagram here on the left. It's so much more complicated and challenging than the diagram over here on the other side, on your right. And so they have a really nice presentation. I'm afraid that mine doesn't meet that standard, but we're going to go through this.

So what we as rapporteurs were doing was working off the matrices that we had been provided with the idea of trying to link the different elements in the matrix and those connections and the issues, the technical issues that relate to one another. I can report at the outset that I failed miserably in that endeavor.

You know, that--I'm very charmed by that television commercial that talks about people, what they really would like to do--you know, and this is what you do in retirement. You want to be a pilot, you want to be a gardener, things like that. I have discovered that in retirement I'm not going to be a court stenographer after sitting there for three hours trying to type, well, you're going to see the results of this.

And times are tough and budgets are tight in higher education. Being down in Texas, I want all of you to plan a lengthy road trip over the Christmas holidays so you use up a lot of petroleum from the Permian Basin and we get the severance taxes from that to continue to support us in the way that we're accustom to in Aggieland.

So we're going to go through this. One of the things as a professor I'm going to want to do is make some homework assignments. Okay? So what I have attempted to do is capture the remarks that were made in our session. And very quickly I started putting--labeling these in terms of the chronological order because we're going to have the transcript of the session as well. And I started putting labels on there of the people that made the remarks, and you're going to either see a name or your affiliation. So if we go according to the game plan, this is actually going to be up on a website at some point, and you can dive in and put it right, of what you really wanted to say as opposed to my version of what I thought you said. So I hope you'll have that opportunity and feel free to do that.

Now, to accomplish this, we were working off a template that looked like this. You hadn't seen this, but this was a connection again of the various elements of that matrix to each other. So if we started off with A1 over there in the top, upper corner, there were elements then that would link it to B2 and all the way down to K11 which was final disposal. And in a perfect world--which I would have to report we didn't quite accomplish this morning--in a perfect world we would have all the sets of comments that would have filled in just as Nigel had outlined connecting the boxes of that matrix. I tried to do that for about the first five, okay, and then it went off the tracks. So what I'm going to report to you then is the summary of remarks that by and large fall under the other category of additional comments because I wasn't quite sure where they plug into this nice matrix of things.

So I'm going to kind of go through these. Of course we saw a lot of--there were overarching comments that really bound a lot of things together. And I think those are a lot of the main points. But there was a lot of interesting detail and technical details as well. So with that basis, I hope you will endeavor to sign onto this. And let's kind of go through this. And I hope you're going to be seeing this. Is this officially readable to you all? Okay. Well, that blows the second part of my plan out of the water.

Can you make that bigger, Bill?

HARRISON: Maybe. I think it's a little blurry.

PEDDICORD: Can you make it unblurry too? Bigger and unblurry, that's my aspiration in life, bigger and unblurry. There we go. Now do we have everything? Are we going to pretend that's it?

Okay. So how are you doing back there? You were the one shaking your head no, you couldn't read it. Still can't read it?

You know, I am teaching the freshman in Nuclear Engineering at Texas A&M University, and I don't let them get away with this stuff, you all camping out in the back of the room on your laptops plugged into the wall and things like that. It used to be in earlier years I would throw erasers at them, but we don't have erasers anymore. So it's hard to come up with punitive measures for the freshmen to kind of get them to pay attention. So you guys are lucky back there. You're settled in. You're plugged in. And all I can do is hope to blind you with my laser pointer here.

So, okay. So on this basis let's kind of walk through this. Now, what we won't be able to do is kind of do realtime editing on this. We don't have the time. I don't have the energy, and so on. So we're going to try to step through this. And as I say, the main thing I want you to see is where there is the links back to whomever made these comments and so on and an invitation then to jump in and within the next couple of weeks, I think, to make them right.

Dr. Zoback, there's room up here. Come on up.

Come on up.

DANIEL: There's seats up here if anybody wants to move up here.

PEDDICORD: Yeah. If you're going to sit there and squint--

DANIEL: There's four seats right here.

PEDDICORD: --and make me feel badly, you're going to have to relocate to the front of room.

DANIEL: We can put chairs up here. We'll accommodate anybody who wants to move up.

PEDDICORD: So either--

DANIEL: Diane, there's a seat here.

PEDDICORD: So either no sitting there and squinting, or get up here.

DANIEL: What we're trying to do here is we want to run through these comments or these issues, and if there's something that we can add, you know, briefly that will help refine the issue or to make it more complete, we want to capture that. And Dr. Turinsky here is going to do that in longhand. Like Lee said, we're not going to do it in realtime, but we want to capture that additional thought. Okay?

PEDDICORD: You guys are going to look so good.

DANIEL: So if there is something, don't hesitate. Raise your hand. We'll bring you a microphone, and we'll get that information. And as, again, as Nigel said and Lee also said, there's going to be a period of time after you leave here if you want to add something else based upon a conversation tomorrow or a week from now, you can still do that. Okay?

So go ahead, Lee.

PEDDICORD: Okay. So let's give this a try. So we're starting out, again, these numbers here are the order in which the comments were made during the session if that will help you think back. It's certainly going to help once the transcription is available and so on.

So we started off, and I don't know if I have this, this was to link A1 to B2 over here. And I don't even know if that's in the right spot. But we started off with this discussion at shutdown plants without a spent fuel pool, the need for repackaging and so on. Nigel Mote--Nigel, where are you? Hand up. Okay.

Nigel interjected some of the experience in moving into dry casks and so on. We heard from Areva about the possibility of the mobile repackaging and so on. And the fact that three options are under consideration for this, not necessarily well-developed.

I don't remember who made these comments. I don't know. This was somebody sitting over here. And so again, I apologize. I didn't get them linked back properly to you all.

But then--Bob Einziger, where are you? So we had a lot of input from him on assumptions of what could be done in terms of this repackaging and so on.

It was noted several times, and there are some of these things that are quite recurring, that on the chart over here where we have multiple loading and unloading functions, the whole issue of standardization--again, this became a theme very much to our conversations and so on as did this next one of how one step in the process very much links back to other steps as well with the real bottom line being it's very challenging until we have really a definition for the requirements of the repository because this will feedback will the way up into virtually all the previous steps.

And this was from Rob Howard.

Rob, where are you?

Okay. There he is, sitting in the back of the room as well too.

So this is an indication of the identifiers you'll find in the remarks.

Bill, let's start scrolling down.

Yes?

MAKHIJANI: This is Arjun Makhijani.

PEDDICORD: Okay. Paul--

MAKHIJANI: Some of this is not quite how I remember it.

And--

PEDDICORD: Okay. What would you add, Arjun?

MAKHIJANI: Could we go down? Could we go back up?

PEDDICORD: Back up, Bill.

MAKHIJANI: So for instance, in the first bullet I think it was Dr. Einziger who said that the mobile--or he also said mobile option, it's very important. They're not three dry transfer options as that would imply. One is completely theoretical, the mobile one.

PEDDICORD: Well, let's ask Areva. That's their section.

MAKHIJANI: That's correct. So my memory is--although I'm getting on in years. Then it was also said that the cost of the dry casks would be very high not in the--of the transfer system if you're going to do because hot cells would be required. They'd be very expensive. And the cost may be--you're thinking tens of millions, maybe a zero might be added.

So the second bullet, the--only one vendor is reloading damaged fuel. That's actually not accurate. They're--it said that only one at one--in my memory, only one reactor site is loading failed spent fuel--loading high burnup fuel in failed fuel cans for dry storage. It's completely different than what's been written there.

And so I'm a little--I'm pretty uneasy about what

I'm seeing in these notes.

PEDDICORD: Well, that's why it's going to be up on the website for further comment.

MAKHIJANI: Okay. Well, think--

PEDDICORD: So Paul, did you get that?

MAKHIJANI: --my comment would be that you please verify these bullets against the transcript before you post them as anything official. Because I think that they're pretty inaccurate.

DANIEL: Yeah. And we're definitely going to do that, Arjun. So thank you.

PEDDICORD: And some of these other things did get captured later on. You'll see the points you were making because they arose later in the conversation, not at this point.

MAKHIJANI: But the second bullet is really inaccurate. It's not what was said. So what's written there is not correct. And that's the only point I want to make. I'm not trying to redo the conversation.

PEDDICORD: Okay. So we've got that down.

MAKHIJANI: I just hope that the notes will be accurate.

DANIEL: We've got it captured. Thank you, Arjun.

LOMBARD: Okay. Thank you. Mark Lombard, Nuclear Regulatory Commission. I'm sorry I wasn't here this morning, but if you get out of the box a little bit when you talk about dry transfer options, I think we're looking at above ground dry transfer options. And you may look at below ground or grade level where you actually dig a hole and start moving the fuel actually at the grade-level type. So we need to be a little creative as we look forward. And the collective "we." When I say "we," I mean a collective we. As you know, NRC only independently regulates.

The second note, bullet number four, I mean, NAC has given us information that they are loading all high burnup fuel into cans. So I'm not sure Bob meant reloading damaged fuel, but there's--yes, there are some fuel assemblies that are damaged, other fuel assemblies that are high burnup fuel that are not damaged that are still being loaded, not reloaded, but loaded into cans by NAC.

PEDDICORD: And the above grade/below grade comment didn't surface this morning, but that's a good one to add in. And, please, ask Bob to dive in because his name shows up a lot in this.

ZOBACK: Mary Lou Zoback, Board. What's the experience in Iraq with high-level waste that I don't know about?

PEDDICORD: Well, this--you may want to go offline with this, but--

ZOBACK: Okay.

DANIEL: Let me find that. I got one.

MOTE: Nigel Mote, staff. I don't think it needs to be offline. After the first Gulf War, NAC packaged spent fuel from the bombed Iraqi reactor. And that was all done using dry transfer. I made the point, it's a refinement, and we didn't catch all of this. The small assemblies, the research reactor assemblies, I don't know what the burnup was. But in terms of demonstrating that you can use dry transfer for spent fuel, that was done. It was done as an exemption, so this is not something that was done programmatically. But in terms of technically demonstrating that you can handle dry fuel and perform dry transfer operations, that has been done.

ZOBACK: Okay.

MOTE: Different fuel, different time, different circumstances, but technically, it's a significant data point.

DANIEL: Folks, if when you talk in the microphone, don't forget to give us your name and your affiliation if you're affiliated with a group, and then slide the microphones to the center so we can grab them quicker after you speak. Thank you.

Go ahead, Lee.

PEDDICORD: Going on, we are now going in chronological order.

Earl, where are you? My name is Earl, Earl Easton. Are you back there?

Then was asking some questions about some regulations and how it's determined who does the repackaging. Marvin Resnikoff, is he still with us? Yep, there he is. Okay.

Start delving into the standard contract, this came up quite a bit over the--this came up quite a bit in various forms over the course of the discussion. This was one of the earliest point in times; it was raised in the morning. This is what I captured to this.

We were talking about the motivation for the utilities going into large canisters, how this relates to the standard contract. And because this was meant to try to fit into the matrix, we had the comment from Areva who is our representative--on these implications on dry storage retrievability and so on. And again, I encourage all of you to edit these when you have the chance. This was the first cut at this.

LOMBARD: Mark Lombard, NRC. I just to want provide a little clarification. Yesterday, the gentleman from DOE from Washington, D.C., did provide some feedback on Part 72. And his recollection of Part 72 is that it may cover repackaging activities. And I took a look at 72 this morning. And you look at 72.2, the scope, and it says, "72-A1. Power reactor spent fuel to be stored in a complex that is described and constructed specifically for storage of power reactor spent fuel."

Later on in 72-A2, the term "monitored retrievable storage installation" or MRS is derived from Nuclear Waste Policy Act. Obviously, it includes any installation that meets this definition. If you go further into 72, the definition of an MRS, then this--I think this is where some of the potential confusion may come up in 72, that "An MRS is a complex design constructed and operated by DOE for the receipt, transfer, handling, packaging, possession, safeguarding, et cetera, of storage of spent nuclear fuel."

Later on in Part 72, it talks about the emergency planning requirements and says if there's repackaging, that there will be specific emergency planning requirements placed upon that facility.

So again, Jeff, we've got to delve into 72 a little bit more. It's not exactly clear. I didn't get a chance to look at the statements of consideration on it. But it deals--still needs a little bit more analysis to determine what scope 72 will actually cover.

PEDDICORD: Okay. So if we move along a little further, we get into a set of comments that again are relating final disposal to other parts of it.

So, Arjun, these were comments that you were inserting, and so I encourage you to take a look at them and see if you want to modify any of these in terms of the repository and the characteristics and how it dictates the answers to some of the earlier questions. That again was a theme that came up several times in the course of the discussion.

Peter Swift from Sandia talked about designing a generic canister, some of the possibilities. And there is work underway at Sandia.

And Diane--

CURREN: Diane D'Arrigo or me, Diane?

PEDDICORD: I think it's you. I think this was some of the questions you had about a standardized canister for all disposal sites. And again, Peter Swift amplified on that a bit as well too. So again, rather than go through this in detail, please, take advantage of the opportunity to go to the website and if you want to expand on these and other comments and points you've raised as well too.

And then Nigel Mote had also contributed to this discussion in terms of it would be good to know what the geology is that we're going to go into.

Do we have a microphone?

CURREN: This is Diane Curren. I have a process question. Are you going to go back and go through the transcript and revise the notes?

PEDDICORD: Uh-huh.

CURREN: Because frankly what I'd rather do is wait for your more complete version and then comment on that rather than all of us doing the same thing.

PEDDICORD: Well, let me ask Nigel what the order of march is.

MOTE: I'd rather not be the arbiter. I think it's whatever the group feels is the best use of their time.

PEDDICORD: So we had a--so the comment was to reconcile this with the transcript before inviting further comment. Did I say that correctly?

MOTE: One of the intentions of this session was to let--in this case the participants of Session 2--know some of the main points that came out of Session 1 so that there's an opportunity to say well, we didn't hear that one in our discussion; but, you know, it's relevant to ours as well. Not that's something that the Board can take on but maybe not as completely as if the participants here have a chance to do the same thing.

Right. You look like you're about to make a comment.

EWING: Just to add to the discussion and maybe the confusion. In my view, the purpose of these--of this afternoon's session is to allow everyone to get a taste of what was discussed in the session that they weren't in. It's probably not possible or useful at this stage to be necessarily correcting and worrying about comparing things to the transcript. You should certainly speak up if you think things aren't--the conversation's not captured. What we need to know is what was the nature of the conversation. And it certainly fine to continue the discussion and arguments in this afternoon's session.

So what we want to do is be sure that you've had every opportunity to participate in or hear a report from both sessions. And we're not writing a report right now. So we needn't get every detail correct.

Nigel, is that fair?

MOTE: Yes. Absolutely.

EWING: Okay.

PEDDICORD: Bill, let's steam on.

CURREN: And I don't mean to go--I think for a minute I just need to go back and understand better what the overall process is here. And I understand what you're saying about this afternoon. But I was assuming this group is going to prepare some kind of summary report of what were the findings and recommendations and share that with the relevant authorities. And that's really what I'm interested in having some further opportunity to comment on and say, okay, did you capture such and such. And you don't have to take any comment, but to be able to give it to you, will that be part of this process?

DANIEL: That's what we should--

CURREN: Well, but I really--I mean, I'm--no offense, but this is really hard to do. I think you did as best you could summarizing long comments by people, by many different people. And it's difficult to capture the complexity of a discussion like this. And I don't think that what's happening now is going to get at it. If this is what we're using--if there is what you're going to--the corrections here and the main thing you're going to use, and I, frankly, I don't want to have to do it myself. I want a chance to see, well, what do you really think did happen here today on a piece of paper and comment on it.

DANIEL: Diane, let me try to address your concerns a little bit. We want to be sure that we generally captured the essence of what was said earlier. And that's what we're trying to portray here. We're not going to be able to capture every detail of what was said. And when the report is written or as a draft report is written, they're going to refer back to the actual transcript of what was said. But for this purpose or what we're trying to do now, we're trying to generally characterize what was discussed so that everybody can hear. And if there is anything else that might be added.

We're not try--this is not like the final "this is what it's going to say" or whatever. That's going to come--has yet to happen. So just generally speaking, Lee is going to talk about the general essence of what we discussed earlier. If somebody sees some glaring problem, something missing, or some distortion, we want to have that brief discussion now and move on. Does that help?

LESLIE: And Rick, this is Bret. Now, I'm not the facilitator. I put my staff hat on. And this is what we presented in the other room which is really the next steps. And I think it's a process--what--this was the first effort of the folks, the rapporteurs, to try to capture things realtime. By December 2nd we're going to use the notes we have and put that on the web so that people can better understand what the issues are.

The people who've participated today, if we've mischaracterized, we're looking for feedback by the 16th of December. Kind of, if you see these things and we're not on the right page, that's an opportunity to do it. That's the process in terms of how we're trying to get some additional feedback. Again, what Rod said and Nigel said, today, right now, this session is so that everyone can hear what the other session heard. And if we're way off base when Lee goes through or when Jerry goes there, send us an e-mail or write it down on a card and help us to get something posted earlier on that's more fitting with what you tried to say.

PEDDICORD: Arjun.

MAKHIJANI: You know, I--Arjun Makhijani. Really now I think it would be--first of all I don't think December 2nd or

December 16th is enough time especially if we get the transcript on December 16th. We wouldn't have a chance to consult it before and refresh our memories as to what was said. So I would suggest that we carry this over at least into early January. We have also got NRC deadlines on December 20th.

Secondly, you know, for me, this--I echo what Diane said--this is not useful to try to say what's really inaccurate because I'm going to want to talk about every single item because my understanding of what was said is different than everybody else's. And we can have an endless discussion about what was important without trying to recapture all the details. I want to hear what the Board and Board members and staff got out of the discussion so I have an understanding of what you got out of it and what you're taking to the report writing. And I hope that you will really seriously consult the transcript and fix this thing because right now in its current state it's not--you know there was an Arjun-related comment. I didn't jump up and say anything because it would take me five minutes to fix that.

Now, I really think that it would be better if we hear what the NWTRB got out of the two sessions and then have a discussion out of that. My suggestion.

DANIEL: Thank you, Arjun.

You know, oh, go ahead.

EWING: So speaking out consulting the Board and with all due respect, I think the Board would not want to say in some general way today what we got out of it. What we're doing is trying to get information. Now, it may be the way we're capturing the information and the discussion is not satisfactory. I share your frustration. But the main purpose is to get as much input as possible so that when we look at the transcript, when we look at these records, important topics aren't left off. But to get realtime response from the Board I would say is inappropriate.

DANIEL: All right. So we're going to move on. We're going to attempt to go through these issues. Lee is going to attempt to talk about them. Again, if we see glaring gaps or something or you think we can better characterize something, please, speak up. And as Rod said and Nigel has mentioned that there's going to be transcripts that compare to the issues. These will be written in much finer detail, and you'll--they'll be available to you at a later date, soon.

EWING: So to everyone, I would say that particularly in the sessions that you participated in, as we scroll through these topics, there's perhaps not much satisfaction in simply listing "X said something on Y." But if they're important topics that you think were discussed to advantage or not discussed well enough, then this is the time to bring that up and to our attention so that it's not left out.

GREEVES: John Greeves. Just you're time limited here. Can somebody just tell me what the five issues that rose to the top were?

PEDDICORD: Okay.

GREEVES: That's what I was expecting. I didn't attend a session, but if you could just--what were the high points? You don't have to formulate an opinion on them, just what did you sense were the issues of concern to people? What were those fives?

DANIEL: I'm making up five.

PEDDICORD: Well, I'll endeavor to do that and probably will go to somebody else and we'll have five others. So a number of things emerged. As I say, at the top level I think one of the really important points is that as you look at this diagram, that matrix, and so on, until you have characteristics of your repository find, it's difficult then to define a lot of the parameters around these earlier steps.

Conversely, if that was known, if you knew what kind of geology you were going to go into, even more specifics about the site and so on, it would help immensely in defining the requirements for many of these other steps in the process. So if there was kind of an overriding point, I think that was one of the most compelling.

Then as you drill down, there was a lot of information in terms of what are the various regulations--and looking to our NRC colleague again--in terms of perhaps inconsistencies because you have different regulations, whether it relates to thermal load, criticality, and so on. As you move from an initial storage, say a spent fuel pool to transportation, interim storage, disposal, and so on, some of these are not defined yet; but even now there are inconsistencies in these. And it was reported to the group that these are things that are under study. But differences between Part 71 and Part 72 and so on, so that's an ongoing effort, but it's also affected by this first--this first comment I made.

GREEVES: That's two. I expected them.

PEDDICORD: Okay. Well, you wanted the top five. Then yes, then we got into a lot of discussions on the transportation, the modes of transportation, and what things are going to look like that are going to be transported, what are going to be repackaging requirements to satisfy various elements of the transportation infrastructure, if you're going up--

Just a second. I'm getting prompted here. Whisper louder.

Size of casks, for example, and so on--

You weren't even in our session were you? Oh, were you? Where were you sitting? I missed you. Okay. That's right. Wish you sat closer. You could have typed all this stuff in. It would have been better.

So the transportation as it fits into this, and of course we've got two elements in this particular scheme of the transportation piece of it as well too. Some discussions can eliminate one of those. Could you do something at one point? Because it might also eliminate a repackaging element.

Another thing that was brought up is--both on a location sense and a temporal basis--where you do the repackaging. Because we're talking about the storage at various possibilities of some significant length of time, maybe many decades, maybe 100 years, and so on. And so as a result, it depends on where one chooses in this progression of events of where to do that. Again, it impacts things later on; and where you do it, it impacts things again earlier.

LOMBARD: Sorry, Lee. Mark Lombard again. I appreciate what the Board has done because this is really--it's at least a three-dimensional issue. And you've taken this two-dimensional table and have used it to try to put it in a three-dimensional space. But I think you've touched upon a key point here. It's really almost a flow chart, a decision flow chart. And, you know, depending on where the repository is or what geological make up it may have takes you down one path or another.

So it's--I appreciate what you're trying to do. It's really difficult to do it in even a two-dimensional, three-dimensional-type table. A flow chart might help us see it a little more easier. But then again, it becomes more complicated as far as trying to roll that up in a report.

PEDDICORD: Okay. How many have we gotten so far?

DANIEL: I think we're on--

SPEAKER: You said four.

DANIEL: That's--

PEDDICORD: We're at four? Okay. I only need one more, huh.

SPEAKER: Maybe five. I don't know what you did.

PEDDICORD: So Peter Swift points out--

Thank you all here in the front row. Step forward here.

So the other element that comes in, although less of an element for the Board because of our technical focus, is the issue of cost and so on. But we're talking about--and again, depending on the choices that were made--very significant costs and being directly affected by the design of this and so on and the cost.

There was another one I wanted to mention and it's skipped my memory at the moment.

TURINSKY: Lee, you want me to pick up?

DANIEL: Yeah.

PEDDICORD: Yeah, oh, Paul--

DANIEL: Paul's going to pick up here--

PEDDICORD: He's got the notes.

DANIEL: --and maybe add a couple things.

Go ahead, Paul.

TURINSKY: Yeah, I have the advantage of having notes in front of me. Some of these probably Lee has said already. One thing was basically the conflict of interest, the way we're structured between the people who store the fuel, the utilities, and those who are responsible for basically transporting it and eventually placement in the repository which is the government. And they have each their own objectives, and sometimes those objectives don't align when you look at the overall life cycle of the fuel. And that's different than let's say in Sweden.

Another thing was how--it was mentioned in the NRC, but in--I would generalize it, how is safety factored in over the whole life cycle of the fuel. So things you may do now which may be beneficial for safety may actually have some adverse effects later on that overwhelm the savings that you had near term in the safety arena. We didn't talk that much about safety. I was glad that someone finally brought those points up. Okay.

Impact to transportation on upstream/downstream. And this upstream/downstream impacts everything on it. And when the final downstream step is undefined, what the implications are that are--it's--you're making basically decisions in a much larger space, possible space, than if we did have a back-end-defined, final repository. But we don't, and that's the reality that we have to live with.

Inconsistencies between storage and transportation in particular in critical requirements was raised, and actually Gene was well aware of that problem. It's already reflected in his write-up.

The diversity of basically the canisters and casks throughout the whole system, whether it's shipping, unpacking, et cetera, they were going to basically repack at a consolidated fuel storage facility. These folks are going to have to handle maybe 30 different designs there, and that has implications, obviously, in investments and in court practices in that regard.

Where to repackage and when to repackage, I think Lee mentioned that already. Are we doing it at reactor sites? Are we doing it at the repository? Are we doing it at a consolidated fuel system, and when do we repackage? If we're going to basically consolidate storage, do we repackage on receipt? Do we repackage when we're shipping out again to the repository?

Pros and cons of dry and wet storage in regard to basically fuel long-term behavior in the repository, the thermal cycling effects.

DANIEL: All right. Is that--is that it, Paul?

TURINSKY: And then this overall thing that decisions we make in the near term may have very adverse or beneficial effects in the long term.

DANIEL: Okay. Thank you very much.

Diane.

CURREN: Yeah. This is Diane Curren. I want to follow up on that last comment about the long term versus the short term. And Lee, you know you said one of the most important issues, and I agree, is that we don't have the repository characteristics, and they should have an effect on the decisions that are being made today about storage. But by the end of our meeting it was said that the decisions we are making today could foreclose choices about a repository. So it works both ways. That--

DANIEL: Can you say that again, Diane?

CURREN: People are making decisions today about methods of spent fuel storage that could end up driving or limiting a decision about what's a suitable repository. I thought that was pretty amazing.

PEDDICORD: One other thing that in my list of five that I thought was very interesting is a lot of discussion of very long-term storage. And again, Bob Einziger from the NRC pointed out that the NRC does not license for long periods of time, infinite periods of time, it's usually a 40-year basis. And as we move forward and get to more and more reactors that have been shut down, it raises a quite interesting possibility that if they would come up for relicensing but don't meet the relicensing criteria, what kind of situation do you have there? What kind of pickle are you in at that point?

I'd say it's not something I hadn't thought of before, but that's incredibly interesting that we get into this conundrum of having fuel on sites that don't meet the relicensing criteria because these are going to come up periodically. And as we are talking for many, many decades, there may be through--one or two or three of these needs for relicensing.

So the devil can be certainly in the details on this. And that was really an important point as we kind of refocused our thinking on what reality means there in the regulatory space.

RESNIKOFF: Marvin Resnikoff. I'm unclear about the timing of it all. If a repository will--finding a repository will take another 20 or 30 years. Then how is that going to influence the cask design? The utilities are right now, you know, proceeding with filling up dry storage casks, so that decision is already going to be made for us. I'm confused about the timing.

PEDDICORD: I don't have any particular answer on that either. I think you're right. I mean, yeah, I think you've hit it spot on.

Rod, are you--you're sitting there poised.

EWING: Just a comment. First to bring something from the other session to this discussion.

I think Diane, it's important to realize that in the other session there was I would say strong advocacy for the idea that actually the large casks should drive the selection of the geology in the repository. And people can speak to the issue, but the point was that this is the problem in front of us today, and this is the initial condition that we have to deal with. And so somehow let's deal with it, and then the repository will have to fit the decision that we make today.

Now, my counterpoint to that is that if we limit our options on geologic disposal by early decisions of that type, it's not clear to me that we'll have a repository. And so those are two points of view. But the dilemma is how to reconcile them because we're talking about risk over two very different time frames. And so as a Board member this is quite a challenging question. And we have to get it out, I think, to policy makers so that they realize the pros and cons of decisions at either end, from looking from the repository perspective or looking from the perspective of the utilities.

DANIEL: Adam.

LEVIN: Yeah, Adam Levin. As I sat and listened to the discussion today, I have a very different take-away. And my take-away is that I'm not--it's not clear to me that there's things that we're doing today that are going to preclude disposal options in the future, particularly if we have a facility, a centralized facility whereby we can repackage spent fuel into disposal-facility-appropriate canisters. So in my view I think the appropriate question here is are we pursuing activities today that preclude decisions about disposal later? I think that's the right question.

DANIEL: Okay. Mark.

LOMBARD: Thank you. Mark Lombard, NRC.

Paul, I would--you have great notes about the safety aspects and that they need to be holistically carried throughout the whole back end or the middle of the back end or the front of the back end. But also don't forget security requirements. Because as fuel, depending on how long it sits, this fuel may get to the point where it's below the level that it's self-protecting. You know, that's defined in Part 73. So you've got to keep that in mind as well.

And Adam brings up a good point. It depends on how long the spent fuel is in storage, and waste confidence looks at repackaging every 100 years. If spent fuel sits for 60, 80, 100 years, then you may be repackaging anyway depending on the robustness of the dry cask storage system that it's sitting in. So again, it's part of that flow chart that takes you down different paths.

DANIEL: Any other issues, comments on Session 1, repackaging of spent nuclear fuel?

Arjun?

MAKHIJANI: Yeah. Arjun Makhijani. There was a call for defining what failed spent fuel is at one point, and that surprised me a little bit actually. And then there was a comment made about the difference between the U.S. and France where in France they do failed fuel transfers only in pools. Whereas here, failed fuel does not include fuel that is damaged with pinhole leaks, for example. Whereas abroad it might be considered damaged. So that in ordinary storage, this is what--I believe Bob Einziger said this--is that here we have spent fuel in storage that has pinholes and other types of damage which are not regarded as damaged. And so the question arises are we going to identify these? Are we going to maintain spent fuel--spent fuel pool infrastructure for repackaging given--and the point that I raised was that in 2001, before all of this happened with Yucca Mountain being off the table--or at least temporarily off the table possibly, I don't know, nobody knows--that the NRC said we don't worry about how we're going to transfer damaged spent fuel from one canister to another. We'll know it when we come across the problem and we'll deal with it at that time in a formal petitioned response. And I think the time for that is now and maybe the NWTRB might politely nudge the NRC in that direction that they need to deal with this.

DANIEL: Thank you, Arjun.

Robert in the back.

SANCHEZ: Thank you. Robert Sanchez with GAO. I think I made the point, and I think several other people have made the point in this session that although this is a technical conference looking at technical issues, there are a lot of nontechnical drivers that may be making or forcing a selection of the different technologies that we have. They may be cost drivers; they may be social, political drivers. The utilities are going to be--you know, many of the reactors retiring at the same time. There's going to be a lot of different things that are nontechnical issues that may force certain decisions based on cost, based on what's certain and what's not.

And overriding all this, we have a consent-based approach which is going to involve the stakeholders, local and state governments. And that may have an impact as well that are nontechnical issues but may very well drive some of our decisions.

DANIEL: That's a good point because Tito, that was something you brought to me about your group over there, similar discussion. Yeah.

Okay. Any other comments?

Diane. Let me grab you a microphone.

D'ARRIGO: Diane, Nuclear Information and Resource Service. I raised a request that there be a technical review of the various options for managing the fuel at the reactor site at the long term without assumption that there would be transportation.

LOMBARD: Sorry. Mark Lombard, quick comment. So one of the--in my mind the biggest nontechnical issue is since there is no place to put--there is no repository that is a result--resulting in over 1800 dry cask storage systems around the country right now. If you look at the biggest issue in my mind it's we don't have--we haven't implemented the key pieces of the Nuclear National High Level Waste Storage and Strategy that was issued in January of 2013.

PEDDICORD: So we haven't had the opportunity to browse through the remaining 63 comments here that were recorded from this session. But I think you're going to have that chance. So again, please dive in, provide the input, get them sharpened up so they reflect the sorts of points you were wanting make and so on. And whatever order and process, these will start coming together, and this will form the basis, I think, of what the Board ultimately turns out of this process, concludes, recommends, and so on.

DANIEL: Any other comments on Session 1? All right.

Marvin.

RESNIKOFF: I wanted to lay out a heretical point that follows what Diane D'Arrigo said which is perhaps it may be better not even to have a repository. In other words, some of us may consider a repository just the Earth, an imperfect container compared to continual management of spent fuel where it is. I know that's not part of our discussion. We're always looking at how are we eventually going to get this material into the ground safely. But there is another alternative which is we don't get it into the ground, we just leave it where it is or in a centralized storage location forever.

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

Okay, folks, that concludes feedback from Session 1. I'm going to turn it over to Bret Leslie from here to go through Session Number 2. Thank you for your participation.

LESLIE: So we'll begin on Session 2 here in a second. We kind of did something different, and hopefully it's going to be received a little bit better. But let me--well, we did as best as we could trying to capture things as quickly as we could. And our rapporteurs were Sue Clark and Jerry Frankel. And Jerry's going to go through what we've kind of tried to distill.

One of the things we tried to do in that session was to kind of feedback maybe 35 minutes, 40 minutes before the end what the rapporteurs had heard so that we could adjust things. And so with that I'm going to turn it over to Jerry.

FRANKEL: Thanks. Thanks, Bret.

Yeah, what I would like to do is report is in Bret's words, the smaller but better session. That how he started it out this morning. You know, in my day job--I'm at Ohio State University, a Professor of Geoscience--I spend a lot of time trying to make sense out of, like, disorganized comments from graduate students. And then I do a lot of editing and writing and making PowerPoint slides and, you know, spreadsheeting. So I always thought I was really qualified to be an executive assistant to someone, but I think this morning we disproved that notion. So I am going to do the best I can.

Unlike my colleague, Professor Peddicord here, I'm going to take full responsibility for everything that I say here. Yeah, I do want to thank Sue Clark and Bret Leslie and also Roberto Pabalan and his staff, a Board staffer who helped us out this morning in organizing things. But this is really more or less my view of things.

As Bret indicated we're going to do this a little differently and not go through the laundry list of all of the comments. They were captured, but try to make a little sense out of it, and well, we'll see how well that works.

Really what we tried to do is envision a world where there was a goal of, you know, plan for spent fuel. And the plan was to do direct disposal. So what would that look like and what would be involved with doing that? And I think everyone in that room agreed that what the rest of you were talking about was kind of crazy. You know, so I mean, the idea of cutting open these packages and, you know, repackaging it, it's complicated, it's expensive, risky, you know, there's a lot of exposure risk. And it can be done, but just use that as the rationale to move forward. Obviously there are a lot of risks and complications with direct disposal, and in the end maybe repackaging wasn't. But this was kind of what was framing our discussion is that we need to think about direct disposal.

And as was discussed here a few moments ago, you know, the lack of a plan really impacts everything. So it's very hard to talk about all of this without knowing where the waste is going. But let's try to do the best we can.

All right. In this matrix, which, by the way, I should say that those of you who are in the room, you'll notice I spent the first half typing on the computer and was trying to fill out this form that Lee showed to bin all the comments into the right matrix. And we pretty much realized that wasn't going to work, so I gave that up. Although, it's an interesting exercise, it didn't really capture a lot of discussion that was going on. So I'm not going to frame what I have to say there except for the fact that you could, you know, you could do this backwards arrow from that bottom right diagonal cell into everything. And so it limits what we can talk about. But let's just ignore that for the moment and move forward.

The other thing is that we had a discussion about I would say--you know, I like Rod's comment about harmonization. You know, there's this discord that exists with the stakeholders. All right? And it seems that by--if we could in our idealized view of the world where a decision is being made for direct disposal, if that decision could be made, then it might be possible for all of the stakeholders, the Department of Energy, the regulators, the utilities, and the interested other parties to allow the discussion to move forward so we can frame things and make decisions and move forward. So that even making that one strategic decision, it would really help the whole program move onward. So I thought that was interesting.

Yes, Diane. I already learned your name.

D'ARRIGO: Diane. Nuclear Information and Resource Service--D'Arrigo. Can you tell us what direct disposal implies or what that--what you exactly mean by that? Is it going from the utility to the disposal site or what are you all assuming that means?

FRANKEL: Yeah. I guess that isn't really captured in any of the upcoming slides. So yeah, I discussed some of it, but yeah, okay. Yeah.

Well, yeah so--can I put that off for a moment? And, please, come back to that question if it isn't answered by what I described coming up. Okay?

D’ARRIGO: Okay.

FRANKEL: Yeah. It's probably best to do that.

Okay. I think the last background issue is the one that Rod mentioned is that if this decision is made for direct disposal, that could limit siting options. And that might be a bad thing, that we end up with no site that is suitable. Or maybe it's a good thing some people, that again by making these decisions, that allows us to move forward. And limiting options might be a good thing, but there could be an impact there. Okay, those are the background issues.

So the other--the comment here is that we might in this world of direct disposal try and separate out these two types of canisters, those that are existing already and those that will exist. And so with that you might want to, you might be able to handle them separately. So we have this situation where we already have canisters, and so maybe to answer your question, we might want to take those canisters and move them--well, maybe we have a consolidated storage facility where they're held. Or if they aren't, that doesn't happen, move them right into a repository. So that would be without cutting them open and putting them into another canister.

D'ARRIGO: Direct means not recontainerizing?

FRANKEL: That was Diane again. And direct would mean, right, without removing the fuel assemblies and putting them--moving them from let's say these existing ones, removing them from where they exist into another canister that's suitable for a repository. Okay? There might be some modifications that are made. There might be some of modifications that are made with an overpack, and I'll talk about that.

BAHR: Jean Bahr. All of the discussions were that it wouldn't be the canisters or the casks that would go directly into the repository but that there would in fact be an overpack on top of them. It's just that they wouldn't be unloaded into something else.

FRANKEL: Right. So we'll talk about that.

D'ARRIGO: This is Diane. I'm just trying to understand when--I am sorry if I'm repeating, but what would be--what's direct and what's indirect? It sort of implies we were doing indirect in here and you guys were doing direct.

FRANKEL: Well, I don't think that direct means that there's indirect. It's direct as opposed to repackaging.

BAHR: This is Jean. Yeah. It's either repackaging--either taking the fuel rods out of one package and putting them in another, or taking the package that the fuel rods are in and putting them into the repository. But probably putting something else around them before to begin with before they go--

D'ARRIGO: Is that direct?

FRANKEL: Right. So I would say it's repackaging or not repackaging. Maybe that's a better way to say it.

BAHR: Yeah.

LESLIE: So again, as a facilitator for that session, we did not look at repackaging. We looked at what are the implications of the 1700 on terms of getting it to disposal. Now, it could be stored at an interim storage facility, but it wouldn't be repackaged. It would be then transported to a repository. And so we framed the discussions and kind of the things there with that.

And it came out very quickly that you could try to capture this in two types of streams, those that we've already repackaged that could be directly disposed--and if you think about things differently, you might directly dispose some of the existing inventory that's going to be repackaged or packaged in the future, thinking about, yes, we're going to do direct disposal of these new higher burnup fuels for example. So we, the session, really looked at not repackaging the fuel.

FRANKEL: Right. Let me just say that my presentation is not very long, and so really, maybe if you just let me take five to ten minutes to do it and then we can have the discussion, it would be a better use of our time.

So, right, so the idea is that we have existing packages and those that will exist, so something like 1700. And there are a lot of designs. And these are relatively hot and heavy so the utilities are packing them in a certain way because of safety considerations, because of economic considerations. But they are what they are.

And the other thing associated with that is because of the many designs the regulators would have a complex job if, in fact, those were not to be repackaged and were to be put into a repository. It would be hard for them. But some thought, well, so what; they can handle that. But that is something that would come from that.

Okay. And then if we separate out those and say then let's look in the future, there's a possibility once we make the decision in our ideal world of direct disposal that we could change things, might optimize the canisters. And maybe this could be through regulation or through site selection criteria, some way that there are specific designs for those canisters that are required. And they may be suitable for storage, transportation, and disposal or not. And I'll talk in the next slides about what some modifications might be. But maybe you just put them into a canister that's suitable really to go right into a repository after storage but that wouldn't have to be handled again. It's a possibility. Okay. But then the question is really who pays for the higher costs that are associated with this optimized canister?

All right. So we really had the good luck to have had a very nice presentation made yesterday by Tito Bonano. And Tito listed three technical issues to which we added a fourth that was really brought up in the discussions. So weight--size and weight, really, thermal effects, criticality effects, and then this fourth one, environmental stability effects. And in the following slides what I hope to do is to just mention issues associated with each of those, a lot of which were brought up yesterday but I think also captured the discussion we had today about these issues.

So size and weight, of course there's difficulties associated with the transport handling and emplacement and retrievability--I'll say I'll mention that later--of large heavy canisters. But then you might think that engineering solutions are possible. This is just size thing. So the Egyptians built pyramids for god's sakes, big things, and so maybe there are simple engineering solutions to handling big things in reasonable ways.

And then furthermore, the future canisters, maybe they're designed differently, so maybe there are size restrictions that are put on them because we're focusing on direct disposal. And so the Swedes have smaller packages that allow them to handle them differently. Of course that leads to trade-offs in number, we can have more packages, there's more risk involved with more numbers. But some assessment can be made, an informed assessment about the right size to handle these kinds of things.

There was some discussion and there was no agreement about this, but a statement was made that storage canisters, they're not certified currently for transport, but maybe they could be was the comment, although, others thought that there were certain canisters that just never could be. But the idea is that it might simplify things a lot if you didn't even have to worry about putting them into canisters that would transport them, so--just reporting on the discussion here. I'm not taking any sides, but an interesting notion.

So that first was size and weight. The second was thermal effects. Well, the canisters that exist, some of them are hot. And so this will influence if it were to be done, influence the repository design. That means the geologic formation type, the drift spacing, and the canister spacing. So if you're dealing with hot canisters, of course you'd have to allow for that. And so there are costs associated with that. There are siting implications, a lot of implications. But it seems to me anyway, personally, that that could be handled through the right design and selection.

We talked about a lot about predisposal storage and cooling. And so this would have to be done in a smart way, so--and maybe for a long time. So, you know, it was said let's just never put them underground. Well, anyway, you might want to hold them above ground for a while, let them cool off more, and then that would impact the repository design if they could be cooled. So there was a lot of discussion on this, doing this in a smart way and allowing direct disposal.

So high burnup fuel has implications. Maybe longer storage is required because they're hotter. There was some discussion about transporting it at the right time, so there's this ductile to brittle transition having to do with hydriding of the cladding. So again, you have to do this in a smart way. Cool at the right place at the right time, transport at the right time. And again if we have a perfect world where we can specify canister design, well, then we can do it maybe in a way that allows for handling of these thermal effects.

Criticality, well, there was discussion about the need for better analysis of the existing canisters, the details of the fuel history, what's in each canister, and then making an informed decision. I'm not sure I captured all of that comment correctly. And just give me a minute and you can clarify that.

Future canisters might be altered to limit criticality, so again, a smart canister might have neutron absorbers embedded in some way, so again, separating what we have from what will come in the future. So I guess this was part of it--assessment of criticality in performance assessment. How you deal with criticality and form an assessment could affect the design. So, you know, is it--how that's considered.

LESLIE: So whether it's screened out just on probability or whether the regulation under Part 63 allows criticality potentially to be screened out on a risk argument based on probability and consequence.

FRANKEL: Right. Okay. The last of the four was the environmental stability in the repository. And really Tito didn't cover this, but I think the underlying assumption was that we can we can deal with it. So we have at this point unknown repository conditions, environment that is. So maybe it's saturated, maybe it's salt, maybe it's clay, maybe--whatever it is, that will be decided at some point.

And this actually is my specialty by the way, so my area is corrosion. So you might rely upon the expertise to come up with some smart overpacked design that will give you the required lifetime in whatever the repository environment will be. So direct disposal, I think to get to what Jean was saying here, direct disposal would probably require some protection against the environment. And Yucca Mountain really is an example where the engineered barriers allowed you to deal with all of the conditions that might or do exist within that mountain.

And in fact one of the things that came out of that was that Alloy 22 is a pretty good material, and we might consider that it's suitable for the environments like Yucca Mountain where as there are--other environments are being addressed around the world, and a lot of work has gone into the appropriate solutions to deal with the environmental resistance that's required in those situations.

So I think this is my last slide to try and capture some other things that came out. There was this issue of retrievability. And there was some discussion about well, what retrievability means. So is it canister based? A fuel assembly based? Retrievability related to disposal? How are you going to pull out heavy packages? Is there engineering solution to that?

There was some discussion about how handling of these heavy canisters could lead to gouging, galling, scratching of the surface which would then not meet the requirements according to some regulations. And that could be an issue as these heavy packages get handled. It's going to be hard not to alter their surfaces. That was a comment that was made.

Yeah, and I guess this point really could have been brought up previously as we have this--at least when I talked about separating from past or existing and future--but the possibility of multiple repositories might allow us to design them specially to handle different types of waste. So this could be existing versus future canisters or also maybe handle the DOE spent fuel or high-level waste differently, so bring up this issue of commingling. If you decide not to commingle, it gives you some design flexibilities that will allow a smart way to handle direct disposal.

So again, I hope that I captured the important thoughts that were brought up. There were a lot of other things. You know, I encourage those of you who were there to mention the comments that I didn't include that you felt were really important.

LESLIE: Jerry, that was great.

And I appreciate the audience allowing him to kind of walk through and get through his slides. And I'm sure he and everyone else in our session will be happy to answer questions or if there's clarifications needed. And so at this point I'm going to need my runners if people have questions or comments.

Rod?

And don't forget to identify yourself for the record. And I'm Bret Leslie.

EWING: Okay. Rod Ewing, Board. So first, this was a very nice and fair summary. I was there, and you've captured the major points. But still I'd like to offer a counterpoint. And I voiced this along the way, but perhaps not in a very articulate way.

So going back to your first slide, the rationale for direct disposal was that repackaging is complicated, expensive, and risky. So what I'd like to suggest is that if we look at--

FRANKEL: That was my own opinion by the way. I'm sorry if that didn't capture--probably didn't capture the crowd.

EWING: Yeah. So this is something to discuss. And what I want to say is if we look at geologic disposal, you know, licensing a repository, first I would say it's also very complicated, in fact, much more complicated than repackaging spent fuel. If you look at the performance assessment or the science that's required to support the performance assessment, you find models that go from the atomic scale to the scale of tens of kilometers. And we tried to roll all of those processes up into an analysis and then extend that over a one-million-year period.

So making a--building, licensing a successful repository, that's complicated. Expensive? Well, I think building repositories or studying them and failing is very expensive. It's on the scale of 10 to 15 billion dollars. And remember that in order to successfully move forward with the license, we have things like titanium drip shields for which there's considerable expense, certainly comparable to the expense of repackaging.

And then risky, well, this is a problem of what is risk today versus the longer term or from the perspective of geologic disposal. But I'd suggest that putting tens of thousands of metric tons of spent fuel in the ground at pretty shallow depths, 300, 500 meters, that's somehow risky and requires careful attention.

And then finally, it could be that repackaging for the repository performance, for enhancing repository performance, that may be the key to success for closing the fuel cycle, building a repository. So I think these are difficult things to weigh, but repackaging versus ensuring that you have really a robust set of barriers in your repository system, we have to analyze those trade-offs.

LESLIE: Thank you, Rod.

Are there other questions or comments? Okay. I'll go to Mary Lou and then to Ernie.

ZOBACK: Mary Lou Zoback, the Board.

And Jerry, you did a great job of capturing things. One thing that I felt dropped out maybe a little bit with the organization was the emphasis on the system's approach. And let me give one example that kind of came up in the other session.

The rationale that was given to--in our discussion for the larger and larger, dual-purpose canisters was that it's less expensive and involves less risk to the workers. But the reality is if that then means a whole lot of repackaging in a system's approach, there may be far more risk with the repackaging as the fuel rods have decayed and things like that.

So we've got to keep the risk perspective in--you can minimize risk for one factor at one part of the cycle, but ideally we can optimize a solution that minimizes risk throughout and benefits the nation rather than any individual stakeholder.

LESLIE: Thank you, Mary Lou.

And Ernie. And before you do it, I'm looking for hands or a motion and then that way I can kind of guide the proceeding. Thank you.

HARDIN: Ernie Hardin, Sandia Labs. I agree with the presentation. Thank you. And I wanted to add something to it which is that there was some discussion in our session about whether it was a good idea to look for a site for a geologic repository that favored direct disposal. And I wanted to point out to you that the same characteristics that make that site amenable to direct disposal also make it a good site for any geologic disposal purpose and for purpose-designed and build repackaging. So really I don't see a discrepancy there at all.

LESLIE: Thank you, Ernie.

Jean, and then we'll go to Arjun next after that.

BAHR: Jean Bahr, Board member. You referred in most of your slides to sort of optimizing future packages. And I think that one of the things that I heard in the session was that while that's maybe a laudable goal, I think there's a lot of institutional barriers to that actually happening. And it gets back to the lack of system-level approach and incentives to work at the system level that Mary Lou referred to. And I don't know how we overcome that in the way the system is structured now.

LESLIE: Thank you, Jean.

Go ahead, Arjun.

MAKHIJANI: Yeah. I really agree with the Chairman's sentiments here about repackaging and repositories and in part because not all risks are equal as we sit here. I think we have benefited to some extent from nuclear energy. It's in our grid, and we turn on the lights, and we get the photons. And when we look at--you know, even for those of us who don't like nuclear energy which is my well-known position, we still turn on the lights and we get the photons. I think so this is not just a matter of saying minimize risks or optimize risks in some way. I think it's who's going to bear the risks for the benefits that we got, and who's going to bear the cost for the benefits that we got?

And I do think the properly ethical position, at least in my world view, is that the closer it is in time and cost, properly done--and I do support a repository program--is much better than kind of kicking the can down the road so to speak and saying okay, future risks are the same as present risks. This is sort of a reverse discount problem. I think future risks are much worse than present risks.

Now, within the present generation how we excite equity, this is a very complicated question.

LESLIE: Thank you, Arjun.

I've got Diane. Are there other people who have comments? Okay. We'll go to Judy after Diane.

Go ahead, Diane.

D'ARRIGO: Diane D'Arrigo. I thought it was interesting that you hinted that there's a point in time where it's the best window to move the fuel. There's a time between when it's really hot and it has cooled down and then when it's too late maybe. And I wondered if you could elaborate on that a little bit.

FRANKEL: Well, I can give you my understanding which is really limited. So we saw yesterday how this cladding material can hydride, and so this is a little bit in my area that zirconium, when it corrodes, the reaction connected with the oxidation of zirconium would be the generation of hydrogen. Hydrogen is absorbed into the zirconium and it forms a compound. It's zirconium hydride that is unlike metal. It's a chemical compound that doesn't have good ductility. It's very brittle and can crack.

So it's not a good situation for the integrity of the fuel assemblies to have a rod to be stressing them on the condition--say subjecting them to a situation where they might be stressed and a condition where that stress would cause them to easily crack.

D’ARRIGO: How much time is there? When is that window is the question.

FRANKEL: Okay. Good question.

D’ARRIGO: And I guess for high burnup it's later.

FRANKEL: Right. So Diane--

D’ARRIGO: And so what you would want is to go to a final--do you want me to stop?

LESLIE: I want to try to get an answer for you. You're asking a question, and let me try to expand a little bit.

The person who actually was raising this had to leave to go back to NRC. So I'm looking for someone--

And, Peter, if you want to take a crack at it, why is there this window kind of thing?

And then we'll come back to you to see if that scratched your itch. Okay, Diane?

SWIFT: Peter Swift, Sandia National Laboratories. And there are others here who actually are expert in this. The point I would like to make is to caution against the idea that there's a point in time at which it is too late. We do believe that it does--the cladding will increase its brittleness as it ages, as it cools. It may turn out that it's quite transportable, even at very low temperatures. There's no particular reason to say there is some window out there at which point we will no longer be able to transport it. So and the other side, yes, it definitely does become--we believe it becomes more brittle as it cools.

Now, is there someone here who actually wants to add to that? Brady Hanson?

LESLIE: Peter, I'm going to--my rapporteur asked me to add to this as well.

Judy, we will get to you.

TREICHEL: Just to clarify what was said in the session, no one in the session ever said it was too late, it's just whether or not it's easier or more difficult depending on what point in time you're in. So the statement that it's too late actually came from an individual who was not in the session. And so that doesn't reflect what was said.

LESLIE: Diane, did that clarify things for you a little bit?

D'ARRIGO: The title of this whole day and a half included transport, and I think that we didn't really get into the risks of transport. And I want to make sure that it's reflected that at least some attendees feel like that is a significant factor and that just adding extra steps and more transport steps is a significant risk that should be factored in.

LESLIE: Thank you, Diane.

We'll go to Judy. Are there other people who are going to want to comment? Go ahead, Judy.

TREICHEL: On your third bullet--Judy Treichel, Nevada Nuclear Waste Task Force. On your third bullet you talk about the direct disposal helping to harmonize. In our session--and maybe it was only me that was concerned about it--we talked about an integration of the whole thing and perhaps some entity that was over the--you know, the nuclear waste god that was coordinating both what happens at utilities and what happens at the end. And obviously we don't have that now.

And right now the utilities are in charge of making the waste and deciding what to do with it, and choosing the packages that they like the best. And then everything else is supposed to fit itself into that. And it's a really difficult thing when you look at it. Are you working in the right direction? Or are you just setting up problems for yourself now that get bigger and bigger and bigger that you have to have more and more hurdles as you go along?

And there's been a lot of talk about whether the back end drives the front end or the other way, but right now we definitely have the front end in charge. And I think that is an overriding issue that has to be looked at here that will have a lot to do with how expensive, how risky, and how complicated everything else becomes.

LESLIE: Thank you, Judy.

I got Mark Lombard up here. Again, just feel free to catch my attention and I'll make sure I get to you.

LOMBARD: Mark Lombard, NRC. I want to be clear that there's a lot of analyses, lot of research ongoing now about high burnup fuel. And it's not conclusive whether or not or if it is possible or if it does occur at what temperature that that would occur. There's a clear indication that there is a ductile brittle transition temperature for high burnup fuel, and it depends on how high the burnup is. But it's not clear exactly when that occurred.

So it's something that we're continuing to analyze.

We're analyzing it. DOE's analyzing it. We're doing some work together. So it's not clear what time in the life cycle, if there is a ductile to brittle transition temperature, that it results in a degree of cladding failure. And again, that degree of cladding failure is not defined yet because the analysis is not completed yet. But it's not clear when that would occur. It might occur at 20 years. It might occur at 50 years. It might occur at 100 years. So we're continuing to look at that.

I just want to make it clear that it's more of a may, you know, may occur. Cladding failure may occur. Or there may be a mechanism that may cause cladding failure. And even if it does occur, we're still not sure yet what percentage it might cause of cladding failure. Even if--there's the other side of the safety issue here--even if you had--and this is if, big if, I want to be clear--if you had gross cladding failure, it's not clear--and we're doing research on this end as well--it's not clear that that would create a safety issue.

If you had what we call rubblization in the bottom of the canister, it's not clear that that would be a safety issue. And matter of fact a lot of folks are saying based on what we've done so far, that would not be a safety issue. So I want to just make sure we put this in the proper context.

LESLIE: Thank you, Mark.

And I've got one in the back, and then I'll come up to Lee here in a second.

SANCHEZ: Robert Sanchez with GAO. Just a couple of observations. I was not in this particular group. I was in the other one. But I have done a little bit of work on some of the social and political issues on the site, sort of outlined factors on this. And one of them is that if you are planning to do direct disposal, leave the spent fuel in the current canisters that they are, what's the incentive to do anything? There may be not much incentive to do anything. You could just leave them as they are. And, in fact, that kind of has been the current case for a long period of time. Kind of I think as someone mentioned as kicking the can down the road.

Another thing that I think is just a general observation with these charts is--and then granted, this is a technical conference. It does leave out the cost and social/political factors that really may be drivers behind some of these technical issues. And in particular one, for example, time frames.

If you leave the canisters just sitting where they're currently stored, time may dictate repackaging just over degradation over a period of time, and you may not have a choice. So there may be some other factors that may come into play that unless you think about some of these nontechnical issues, may have an impact on the technical issues.

PEDDICORD: Lee Peddicord from the Board. Question to Mark or maybe Jeff or DOE or lab folks if you're looking into this.

In terms of the ductile-brittle transition, have you all been able to characterize the advance clads, ZIRLO, the other ones, in terms of these characteristics? Ultimately, when we get to the end of lifetime of these reactors, the inventory may be in fact made up of the majority of the advanced claddings as opposed zircaloy.

LESLIE: Lee, thanks for your question.

I think Brady.

HANSON: Yeah. Brady Hanson from Pacific Northwest National Lab. And in this case I'm responding as I lead the experimental program for the storage and transportation work under the Used Fuel Disposition Campaign, so I report to Peter on this.

The answer is a very most definite yes. You will see in Mike Billone's presentation tomorrow that the DOE has continued the work that NRC started doing these ring compression tests on cladding. What Mike will present will show that we have looked at ZIRLO and M5. You will see that it is very much a characteristic of the cladding type.

What happens, and I want to echo what Mark said that, you know, I want to caution people that what has been done so far to date has been performed with what we call the radiohydride treatment at very high temperature, meaning 400 degrees C. I want to remind people that that is the peak clad temperature that NRC allows without the applicant having to jump through other hoops. And I can most definitely assure you that when you look at design basis for canisters and what their heat is, the companies, the fabricators, the utilities are very conservative in their models when they go to NRC with what temperature did we get to because they want to make sure they are well within those bounds.

What that means is you'll see people putting out that we've--here's what design basis is. When you don't load to design basis, your temperatures are actually much lower. You didn't even get into the region where this hydride reorientation is an issue. Similarly, when you see Mike's presentation tomorrow, you'll see that the issue comes about when you have very high hoop stress in the 120 to the 140 megapascal range.

There's an effort going on right now--so let me step back. So we have efforts as does NRC on defining what are realistic temperatures. Let's not all assume that everything is at 400. It most definitely is not. We have an effort going on and EPRI does as well right now to look at what are realistic end-of-life pressures in high burnup fuel rods. If it's not anywhere near as high as what it is to create these very high hoop stresses, again, then this is not a real issue.

So as Mark says, the testing was done at very high levels, near the regulatory limits, let's say. It did identify that yes indeed, the hydrides can reorient. It can lead to brittleness. And like I say, tomorrow you will see that it's a function of what temperature did it go to? What pressure was it at? What cladding type is it?

But again, as Mark said, what's the consequence? When you see the pictures tomorrow, you're going to see it basically looks like a through wall, very small crack. It's really no different than if you have a pinhole or hairline crack in the existing cladding.

So I want to caution people against jumping that this is really bad. I also to want throw in one other really neat thing. In the last few years both Japan and France--and we're starting a program at Oak Ridge this fiscal year to look at the effects of radiation damage in cladding because we all know that that reduces ductility. But the French and Japanese have shown that in the time frames of dry storage, meaning greater than a year and at the temperatures we're talking about, you would anneal out much of that radiation damage, and you've restored ductility. That's something that none of our models beforehand have taken into account.

So I just want to emphasize that within the DOE program under Peter, we have a very what I would call comprehensive testing and modeling program looking at all these aspects together including what are the loads during transportation? How much degradation can I have and still remain intact during normal conditions of transport? So I think you'll be happy when we're done. Just make sure we get enough money.

LESLIE: Thank you.

Other questions? Okay. Deborah, right in front of you. Right behind you.

PHILLIPS: Chris Phillips of Energy Solutions. I just wanted to come back on the comments made by Judy here and others about the utilities calling the shots for what size canisters they use, and rightly so because they want to minimize their costs. They want to minimize their work--radiation up--dose uptake. And they're not required or compelled to look at the overall system.

I would suggest that even when we had a repository in plan and an overall plan, it was hard enough then to get the utilities to take a different view. Without a repository at the moment and without a plan, I would venture to suggest it's virtually impossible. I mean, we've got to accept the fact that the utilities will do what is best for them to generate electricity, protect their workers, and indeed protect the rate payers who take the electricity.

So it's a question that we discussed this morning, but there was an overall factor there. I think you've got to just--we just have to accept that. It's not a very nice conclusion, but it's one I think we need to bear in mind until something changes and there's an overall plan that gives a rationale to go back to the utilities and say, "Well, now we want to talk to you about doing something different, and we're probably going to pay you to do something different." We're not going to get them to do something different.

LESLIE: Thank you, Chris.

And then Nigel.

MOTE: I hesitate to get in the middle of the other discussion, but one addition to that I think, and Adam can tell me if I'm speaking generically or there may be special cases. The utilities are in fact required to minimize their costs.

The public utility commissions and the public service commissions would take a dim view of any utility saying, "I'm going to go for small packages because 50 years from now, 100 years from now, 200 years from now, DOE or the implementer might decide that was the right thing to do. But I'm making the decision against my better commercial interests." I think the PFCs and the PUCs would not let them do that.

Adam, do you have--add to that?

LESLIE: Thank you, Nigel.

Other questions or comments on any of the slides that Jerry presented.

BADER: Was there any discussion--sorry. Sven Bader from Areva. Was there any discussion on how large these things can get?

LESLIE: No, actually. I'll answer. I don't think we talked about that at all. Only in the sense of looking, again, this bifurcation, looking at what's happened and what's stored and then saying if you're going to do direct disposal, is there some decision framework for figuring out what that is.

Ernie, and then we'll go to--

HARDIN: Very quickly. I mean, we stand on the numbers that Tito presented yesterday for size and weight.

LESLIE: Right. But I'm not--okay. And let me reframe--he's saying did you talk about how big it could be. Well, and I think that was his question.

BONANO: So I think--this is Tito Bonano from Sandia Labs. Right now some of the bigger packages are holding 36 to 37 PWR assemblies. When you start with the package itself, the DPC, you're talking about 50 metric tons. By the time you're at the overpack, you go up to about 70 to 80 metric tons. Then when you take the shielding, you're basically doubling that size, so you're now talking about maybe about 140, 160 metric tons. And then if you have to put it down a hoist and the weight of the car, so it's about 175 to 180 metric tons. So these are big honkers. I don't know how else to describe them.

LESLIE: Thank you, Tito.

Others questions? We'll go back and then come to you, Peter. All right?

LANTHRUM: Gary Lanthrum, NAC. Yesterday I think it was Tito presented some information that showed the thermal limits as a function of the geology, it's not of the packages, and looking at how various repositories, whether it's salt or sedimentary formation or hard rock, how they would perform under various temperatures. And I thought that was a major constraint. And in your slide you showed yesterday, you showed there would be a very long period of cool-down time for the large packages to be able to directly dispose of them. Did your group talk about that and the implications of even longer storage to meet the thermal limits of some of the rock formations?

LESLIE: Yes. The group did talk about that. We talked about it in a trade-off some. And I'll let anyone else that was in the session talk about it some more. But let me go to Peter first, and if there's anyone else who wants to expand upon what I just said, please do.

SWIFT: Peter Swift, Sandia National Laboratories. I was not in that discussion this morning. I was in the one in this room, but to some extent you could offset that thermal limit by going for larger and larger and larger spacing. There are other variables you can adjust in that. But--

Tito, you wanted to add to that?

BONANO: Yes. This is Tito Bonano. So in the presentation yesterday, yeah, I remember the slide that you're mentioning, Gary. I also showed another one that shows that the thermal conductivity of the geologic medium is a big factor in dissipating the heat.

A secondary factor in that analysis was the spacing between the waste packages. And I think very quickly when I was talking about the different disposal concepts, the different types of geologies, I looked--you know, I mentioned assuming 10,000 packages, give or take, by the year 2050 in the sole repository because of the heat dissipation capabilities, you look at maybe nine square kilometers of underground space. When you go to a hard rock, you're probably looking at about 14 or 15 square kilometers. When you go to a sedimentary rock, then you have to go to about 20 kilometers.

So you can manage the heat by spacing--the spaces between the waste packages and the spacing between the drifts. But the trade-off is, then you have a much more bigger aerial extent of the underground. So you have a much bigger chunk of real estate for the repository site. So those are some of the trade-offs that have to be dealt with.

LESLIE: Okay. If it's responding directly to Tito, then we'll take it. Otherwise, Peter has another one that--

LANTHRUM: It is.

LESLIE: Okay. Sorry.

LANTHRUM: Gary Lanthrum, NAC again. I'm just curious, because as you grow the footprint, not all rock formations are homogeneous. And you get fractures and other things that may--your actual extent may be much larger just because they're trying to find good homogeneous rock.

BONANO: Tito Bonano from Sandia.

Gary, you're absolutely correct. And I made a statement this morning that at this point in time you're only looking at generic geologic formations. You know, there's a big difference when we go to a specific site, when we have to characterize the site. So we may get surprises. At this point again I want to reiterate the fact that we're looking at generic geologic formations, not a specific site. And when we go to a specific site, the ball game may be completely different. So you're absolutely right.

LESLIE: Okay. Thank you. Rob, is this on the same topic?

HOWARD: It is.

LESLIE: Okay. We'll get back to Peter.

HOWARD: Yeah. One of the things that wasn't necessarily presented--

LESLIE: Your name?

HOWARD: Rob Howard, Oak Ridge National Lab.

--that wasn't presented yesterday. I mean, we talked about these thermal conductivities and the so-called thermal limits, but there was no correlation between these thermal limits and the safety of the entire repository system. So I've analyzed systems where, yeah, we've talked about high temperature issues. But then when you ask well, what's the safety implication? How does it affect the performance assessment? The way it affects the performance assessment is in the analyzability of the problem.

So if you have the data and the models to deal with it, that's another thing that you could adjust rather than saying well, we can make the drifts wider or space out the waste packages in a greater distance.

So I think we've ported the issue. We talked about it yesterday as well, we need to look at the entire system. Well, here's a case where we need to at least look at the entire repository safety system before we start talking about well, this is a hard thermal limit.

LESLIE: Thank you, Rob.

Peter, you want to--

SWIFT: Peter Swift, Sandia National Laboratories. The point I was going to make was that--the one we had up here on the slide when Jerry had the discussion of the smart engineering, things like the right overpack for the right geologic environment. Those observations apply equally to repackaging, what I'll call, and you'll hear me call it tomorrow, purpose-built canisters as opposed to the DPCs.

If you were to try to design a standardized canister now and then hopefully put a geologic environment-specific overpack on it 50 years from now, that might be--that's essentially the same as the smart engineering observations you came up with in the other room also.

LESLIE: Thank you, Pete.

Are there other questions or comments?

Arjun.

MAKHIJANI: Arjun Makhijani. You know, a lot of this discussion--I really like a lot of this discussion. It's very technically based. It's very factual. All the questions are--you know, we may not agree, but at least the questions are getting on the table.

One thing that disturbed me yesterday which I don't see coming up today is that we've now, at least as I heard, the DOE transitioned the idea that site selection will be consent-based. I didn't hear the idea that it would be science-based. And what we're talking about is the repository that is science-based which is connected to canisters choices, packaging, overpacks, repackaging. These, in my opinion, are the right kinds of considerations. But I see, starting with the BRC report but degrading somewhat from that, the Department of Energy talking about consent-based. And in my opinion, you can't actually have informed consent. You can have money-induced consent but not informed consent without doing the science first.

And what I would really love to see the NWTRB do is to lay down some parameters for a science-based process so that the other side of this governmental process can have some guidelines for how to go about this. Because some of us who support a repository but not a finite stream of waste would have--and also our concern about economic and social and environmental justice, would have a very, very hard time supporting a process that starts with consent. Because the recipe--and I told the BRC this--this is a recipe for environmental injustice.

And it's not theoretical. We've already seen the nuclear negotiator going around Indian reservations and so on. And they have their rights, but we need to reflect a little bit more. And I hope that the spirit that's animating this discussion can be brought outside the NWTRB.

So this, I really am happy with the kind of discussion that we're having.

LESLIE: Thank you, Arjun.

John, I'm going to go to Rod first.

EWING: Well, just to respond to Arjun. The Board has noted the difficulties with informed consent and what mechanisms might be available to communities so that they can really exercise judgment that's in their best interest, not their immediate economic interest. So this is a topic we're struggling with. And we've gone so far as to look at other countries which have practiced this process and tried to understand what parts of the process might be transferred to the U.S. So this is a subject under active consideration and discussion.

MAKHIJANI: Thank you very much. Arjun.

LESLIE: Yeah. Arjun said thank very much.

John.

GREEVES: Yeah. Just John Greeves. There's really two consent-based processes. So I think Arjun was referring to consent for a repository. Well, there's also a consent-based process for interim storage which is, let's say, less complicated than a repository. And my view is the science is brought to the issue with the licensing. All the science is going to have to be addressed in the licensing process. And the decision of a site has to go through two prisms, one is consent-based with some new legislation and a science-based process. So I'm comfortable it's going to happen. The hard part as many people have said is the consent-based process may be even harder than the science-based.

So I just wanted to clear the air on that. There really are two consent-based opportunities. And the first one I hope is less difficult than the second.

LESLIE: Thank you, John.

Other comments or questions? Just kind of where we're at, we're rapidly diminishing and coming up to a break, but we're not going to break early if people have questions.

Yes. Can you--thanks.

MAKHIJANI: I'd like to respond to that a little bit. Sorry I'm holding the stage a little bit more than is my due.

You know, we had a lot of discussion in the repackaging about high burnup, about failed fuel assemblies, and how much we don't know. And so I would suggest that saying simply that we should transport this stuff to a consent-based site and that all will be okay because we know how to build dry canisters, this is jumping the gun a little bit on a lot of issues out there. I mean, the NRC I think has listed--if memory serves me right--I'll say 20-odd issues of which around 20 were high priority research issues in relation to burnup that just in relating to burnup to which we don't know the answers.

Maybe the answers will all come out saying everything is hunky-dory. But today I don't think you can go to a community and say, "We're going to transport this. We're going to store it here for some indefinite period of time, 60, 50, 100, 200, 300 years, and then it's all going to be hunky-dory because we know that the fuel will be in good enough condition to be repackaged and disposed of." I don't think we know that.

And so to seek informed consent, even for--especially as we authorize high burnup fuel without really looking down the line, I think it's a little bit more complicated than what has been presented.

LESLIE: Okay. Thank you, Arjun.

Any other questions or comments? Okay, bringing it back to the process. I know we all appreciate your patience this afternoon as we struggled to try to capture things and reflect back to you what we heard. I appreciate your patience in allowing Jerry and Lee do as much as they could. And we also heard early on in the first session the concerns about the timing. And one of the reasons we need to take this break is so that the Board staff and the Board Chairman can talk a little bit about, although this is the next steps that we had laid out earlier today, what seems to make sense. So that's one of the things that's going to happen in the break.

And so let me tell you kind of what's going to happen going forth. We're going to break as soon as I finish. The break is actually a half hour. And that's because we have to kind of even distill what we heard here with some take-away messages. We want to leave you with a good feeling about what you've heard and what the next steps are. So at this point we're going to break until 4:00 o'clock when Nigel will come back with kind of the take-aways and moving forward. So thanks again for your attention and participation.

(Whereupon, the meeting was recessed for a short recess.)

LESLIE: If we could have people take their seats so that we can start this next portion of the meeting, first off, I hope everyone had a chance to enjoy your break. We took it as an opportunity to show that we’re listening to what you all had to say. And so we’re actually changing the agenda a little bit, and Nigel will kind of talk through some of the things that we heard, including what we had put up previously as the next steps.

So, I guess, with that, Nigel, why don’t you do it and explain what we’re going to be doing?

MOTE: Well, don’t let it ever be said that the Board does not respond to circumstances. We learned from the sessions this afternoon and the sessions this morning that capturing things our way doesn't necessarily capture things the right way for the mood of the participants here.

So instead of us giving feedback on the takeaways, what we'd like to do is to record the takeaways from the perspective of the participants. Instead of us putting our ideas down in the way that we had foreseen that and putting that on the Web site, we'd like to capture them in the way that Bret did as a facilitator in the other session.

We will then tidy those up, present them, and put them as a record of the takeaways on the Web site. And that's something that you can comment on, also comment on the transcripts when they're out, to make sure that issues that you have close to your heart or you heard discussed are recorded in the way that you think is appropriate to capture those points. That's not to say we'll change the transcript; but if you want to write in and say, There's a point recorded, and I think there was another aspect to this or there's an extension or I heard it another way around, you submit that to us, and we will record that as input to the record from the workshop.

So what we'd like to do is to, as I said, record the main takeaways from the body of the meeting. We will take comments on that for--we didn't define the date, but maybe a month afterwards. We'll try and get those on the Web site in the next week. The transcript will be on the Web site before the end of December, hopefully by the middle of December, and we would like comments by the middle of January on both of those documents, which will help us with the Board and the staff to write the report, including the input--including based on the input that we have from--that will take into account the input that we have from the workshop.

So can we start with overarching issues?

LESLIE: So before we do that--

MOTE: Go ahead.

LESLIE: --the facilitator always wants to make sure that the process is understood.

So the first microphone, I think, is to Diane, because I think she’s got a process question.

CURRAN: This is Diane Curran. Thank you, Nigel. I really appreciate the discussion and the process. And this is my first meeting of the Nuclear Waste Technical Review Board, so I want to honor what process you use.

But I want to tell you what I think would be most helpful to me as a representative of Eureka County and environmental organizations interested in the waste confidence issue. I am assuming that this body is going to do a report and make some recommendations, and I really appreciate the opportunity to participate in this part of it.

Right now I can’t remember all the things that we talked about today. And even after I read the transcript, I would prefer not to be the one with the job of going through it and figuring out what all the points are. I'd like to ask the staff to do--to look at what we say here today, add what you think was important, and let's use that list and not just depend on the outside participants to come up with a list. We really want to comment on what you're presenting. We want to participate in that by putting feedback in at the front end and also looking at whatever is some draft along the way saying, okay, did you get everything?

That's my comment.

LESLIE: Okay, thank you, Diane.

MOTE: I think there's a need to clarify some things here. The Board has a limited mandate. Limited doesn't mean that it can't do anything, but we have not discussed--in the staff we've discussed, but the Board has not discussed, making recommendations. But that's something that the Board would not normally do under this sort of circumstance.

The recommendations have an implication of defining who does what and when, and that's something that is beyond the scope of what we intended here. In the framework document that was in the briefing notes, what we said was we're trying to capture the issues, because resolving those and recommendations or what leads to resolution will take years, maybe decades. It will involve not the Board, but the implementer, the utilities. There will need to be extensive actions taken to make progress on these issues. And I think it's beyond the Board's mandate, beyond the Board's reach, to be able to do that.

So recording the issues doesn't mean that it won't lead to any action. Congress reads reports; the Department of Energy reads reports; but we would not be expecting to make recommendations. But I'll ask Rod to comment on that.

EWING: First I should say I'd hesitate to contradict the Executive Director, because he's been doing this longer. But, in fact, in our reports we do make recommendations. But what's important to our process is the Board has to meet and discuss and go over everything, and we just haven't had that opportunity. So as much as I appreciate that you would like to know what we think, there is no Board position at this moment.

And so this is an opportunity for us to get information and one last effort at soliciting what you think are the important issues and our ideas to put those issues up on the Web so that you see them all together again. And it doesn't mean you have to go back to the transcript and see if the transcript has some hidden issue. It's what you think is important, and the transcript is there in case you want it.

So we're just getting as much information as possible. We, the Board and the staff, will prepare draft reports that then we'll circulate among ourselves, and then the Board will finally issue a report. So we won't issue a report for review, a draft report.

LESLIE: Thanks.

EWING: I think that's our procedure; right?

MOTE: That's the procedure, yes.

LESLIE: So any other questions on the process?

BAHR: Just maybe--this is Jean Bahr--another clarification. We issue a report, and it will be a synthesis of what we've learned with all of your input. It won't be a report that says that the public thinks this. So we're not going to issue a report that will have your names on it as authors that you have to sign on to this, but what we're trying to do with this process is to learn as much as we can about all the perspectives so that we can come up with an informed decision. Is that a fair--

LESLIE: Correct. Okay. Other process questions, and then I'll open it up--

LOMBARD: But I would imagine that you would capture in the report the diversity of opinions that you had participating in the input that was given.

LESLIE: Yes.

LOMBARD: I'm sorry, Mark Lombard, NRC.

LESLIE: Thank you. So now the floor is actually open, and what I'm going to try to do--and this is--you know, you went through, you had some background yesterday that informed your discussions in your breakout sessions. We came back and reported. You might have heard something and changed your understanding. Maybe you heard the same issue described in each of the sessions, but now is your opportunity to kind of say, well, king for a day, this is the thing that I think is one of the things that drives it. And it might not be any of the things that was summarized, but it could be something that was summarized.

And so what I'm going to do as a facilitator is be directing traffic. And for those of you who were in my session, you'll know that I'll be taking notes as I'm directing traffic and trying to capture things. And, again, I'll be writing up my notes, and we'll be capturing all these and putting on the Web what you think are the takeaways.

So people with hands up will get microphones. Jerry, you're first and then Mark.

FRANKEL: Jerry Frankel, Board member. There was a comment that I forgot to make, probably several that I forgot to make. An important one--and maybe it's a good way to start off this discussion--and that is that today we considered direct disposal or repackaging. And the comment that was made in our session was that it's not necessarily either/or, that there are maybe some packages--canisters that are suitable for direct disposal of the type that we talked about and others that would be better handled by repackaging.

LESLIE: Okay. Mark.

LOMBARD: Mark Lombard, Nuclear Regulatory Commission. I think overarching--and this is my personal opinion, not an NRC position, just to be clear--that to get this whole effort--and I mean the whole effort--off top dead center and to get it moving forward, we have a high-level waste policy now or waste management strategy that was issued on January 13, 2013. If we had the impetus of approval or direction to move forward on that, implementing that high-level waste policy, that would certainly make a lot of these pathways a lot easier to see how we could get to the end point.

LESLIE: Thank you, Mark. Other people who have questions or takeaways that we want to capture or that you want us to capture? Or are you guys all just so tired and want to go--

MOTE: Well, let me start by stimulating one. I think I heard in the feedback from Session 2 the same comment that we had in Session 1, and that was to do with the dichotomy where there are different interests at different parts of the management operational program. Does anybody want to pick that one up? Because that one seemed to be a hot issue in both sessions.

LESLIE: Okay, I do have one. Jean, are you going to--okay, Ernie and then--

HARDIN: This will be quick. Ernie Hardin, Sandia Labs. Yes, my takeaway is that things are steadily getting more and more difficult to manage. The canisters are getting bigger; the analysis methods for criticality and thermal are getting more sophisticated, leaving less margin in there that we can play with for disposal; and the materials and construction design of the canisters are changing.

I learned today that Holtec has come up with a basket design, which is entirely made of aluminum, which might make a lot of sense.

SPEAKER: Metamic.

HARDIN: Okay, Metamic. But for corrosion purposes it behaves a little like aluminum, maybe not so well. So that's my sense of where this is going.

LESLIE: Thank you, Ernie. Jean and then--anyone else?

BAHR: Jean Bahr. I'm just responding to Nigel. One of the things that I heard related to these different interests in different segments is that there isn't a clear path that's going to harmonize those interests, and I don't know where we go.

LESLIE: Okay. And I think it was Robert that's back there that--

SANCHEZ: Robert Sanchez with GAO. It seems to me from looking at these issues for a period of years and listening to people here today that themes are still the same, and that is there are uncertainties. And although there are technical uncertainties, it doesn't seem as though any of those are real showstoppers. The real showstoppers are the non-technical uncertainties.

And I guess I'm revisiting this theme over and over again, but it seems to be one of those things that's kind of important, that there's not--it doesn't seem to me--hearing everybody here, there are solutions to the technical problems and challenges; but it's the non-technical ones that are the real drivers. And although it's great that we're all talking about the technical solutions, somewhere there's got to be a bridge between the technical approaches with the non-technical, I guess, the whole process, the whole siting process to consent-based--all that is non-technical, and that may be a pretty strong driver for a lot of the technical solutions.

LESLIE: Tito.

BONANO: Tito Bonano, Sandia. Robert, you're absolutely right. Unfortunately, right now we can't talk about site-specific issues, you know, we're not allowed to do that. But having said that, one of the things that we're doing at Sandia working with Hank Jenkins-Smith and his group at the University Oklahoma is understand how public preferences about specific technical issues could impact the technical work, the technical solutions, that we're looking at, and at the same time how can we do technical work that could help inform the public about those issues.

So I think, you know, we have recognized that at Sandia we have a joint center set up with the University of Oklahoma specifically for that purpose. And, you know, we do an annual survey that understands what the technical issues are and how the public may understand them or what are the concerns they have. So I think we have recognized that, at least in our shop, about an important component of the whole process.

LESLIE: Other folks? I hate to pick on people, but this is your opportunity. Rod, back there.

McCULLUM: I’ll try this. My takeaway is--oh, my name is Rod McCullum from NEI. I guess I want to say that this is the right issue for the Board to look at. This is an important issue. We have the reality of waste management today in the United States, which is the 1,700 loaded canisters, the ones we’re going to be loading every day from now until there is a repository, and we need to be solutions-oriented.

Before today there were exactly two parts of the Nuclear Waste Policy Act that were still functioning. One was this Board, and the other was the collection of the fee. The Court, as I think everybody in this room is aware, has now ruled that the collection of the fee is no longer working. And, indeed, the Secretary has been ordered to make a recommendation to congress to make a proposal to congress to change the fee to zero. That, perhaps more than anything else, might trigger action. I don't want to say "will" trigger action, because I've been at this too long. But there will be something before congress which is very significant with respect to all those things that impact the technical.

This Board's charter is technical, so you are the last remaining element of the Nuclear Waste Policy Act. What are you going to tell congress as it visits that question of whether to actually move forward again with that act or do something else? And I think this issue is so important. That's why you heard such a range of views. I look forward to your report.

LESLIE: Thank you, Rod. Other questions or comments? Right here? And don't forget to identify yourself.

BURK: Sandy Burk, Idaho National Lab. I know that we discussed a lot about timing. When is going to be important. And we look at that as the really long-term. But what if we had to anticipate doing something more immediate? How does that affect the whole repackaging or handling or what we're going to do? If we have a site that, for whatever reason, goes down--maybe it's an orphan site, maybe it's another site--and we have to move fuel out of there, what is the plan, and is that part of this discussion? I know that we've been talking about long-term, but what would we do if we had an emergency and we had to do something today?

LESLIE: And I'm going to, unfortunately, pick on NRC. And, Sandy, could you restate it so Mark could try to address the issue? And I'm assuming you were talking about commercial.

BURK: Right.

LESLIE: Okay. So, Sandy, could you restate it for Mark?

BURK: So, Mark, you probably already know, but I guess I'm just thinking, if there was, for whatever reason, I don't know what it could be. There could be an accident, there could be, you know, bankruptcy, there could be whatever it is. You have a site that has fuel, and now you're going to have to or the federal government is going to have to take responsibility, perhaps move it, I don't know. I mean, I don't know how that's affected in terms of what we're looking at here in terms of repackaging, transporting, whatever. But it's just something to consider.

LESLIE: Thank you.

MOTE: Sandy, maybe I can add a point to that. There was a discussion point, and I don't know that it was generic, but it is a specific issue that relates exactly to that. And that is, right now Jeff Williams yesterday in his presentation said that there is no fuel in canisters on the stranded sites which cannot be transported. There will come a time when economics says that one power station shuts down where there's fuel in canisters that cannot be transported. And that's part of the same issue, the time dependency of closing out solutions.

BURK: I guess I would just say in terms of transport, I mean, I don't think that's all worked out yet either. So, yeah, the fact that maybe they're in a canister that can be moved is--

LESLIE: Okay, thank you. Mark. And then let me go back to Gary.

LOMBARD: Just to be clear, I don't want to--Mark Lombard, Nuclear Regulatory Commission. I wanted to be clear, and I don't want--this may sound to some like punting it, but, really, our main function is to make sure that whatever is done is done safely and securely. So if it lands within the bounds of the certificate or license for that particular site, we would keep a close eye on it.

But, as Nigel pointed out, Jeff and crew have done a very good job of documenting the fuel at the stranded sites. And there are certificates that are coming up for expiration in a certain time period, and we'll deal with those, each one of them, re-evaluated on its own merits.

LESLIE: Thank you, Mark. I appreciate you allowing me to do that. I was having trouble trying to capture Sandy's point. So Gary.

LANTHRUM: Gary Lanthrum, NAC. Two things. One, if there were a crisis of some sort, even though the canistered fuel at the stranded sites is transportable, none of it could be transported for several years, because the infrastructure does not exist. There are no transport casks for that. Even though designs have been certified, they don't physically exist; and there's a long lead time to procure them.

One of the takeaways that I got that is important is that when you do a systems-wide analysis of overall risks, you get different conclusions about what might ought to be done. It could be different than what is done. And the differences are driven by the fact that there are incentives for people at the beginning of the used fuel cycle when it first goes into dry storage that have different drivers for what they do than folks at the end of that cycle. And if you do a systems-wide analysis, you might find that it is worth developing different incentives to align all of those parties.

Right now there is nothing that's driving that alignment, and each party is allowed to pursue their own special interests. And it may, in fact, be worthwhile coming up with incentives that would drive alignment if you did a systems-wide analysis.

LESLIE: Thank you, Gary. I had someone up here.

SALTZSTEIN: This is Sylvia Saltzstein from Sandia National Labs. It would be wonderful if the Board could think creatively about what steps can be taken even if congress doesn't make any decisions. Personally--and this is not Sandia's viewpoint, this is Sylvia Saltzstein's viewpoint--congress is not going to act on this any time soon. This is not a burning platform for them.

What can be done in light of the fact that that ties DOE's hands and NRC's hands for us as a community to move forward?

LESLIE: Thank you, Sylvia. And I'm trying to catch up and will turn around and see who has their hands raised. Okay, Jeff.

WILLIAMS: This is Jeff Williams, DOE. I just wanted to comment on a couple things. First, Nigel, you talked about how I said the canisters at the shutdown reactors are packaged such that they could be moved. They do have certificates for transportation and storage. And Gary is right that you need to go out and buy transportation casks, except for Humboldt Bay, which you can just get impact limiters, which still takes two years, and you need to put a seal on the top. So that's fine.

But the other thing I wanted to say, you brought up the fact that there are nine reactors that have fuel that's not in transportable storage casks--Oconee, Calvert Cliffs, and so forth--and they're not certified for transportation. What happens when those shut down at some point in time?

And we talked in the other session about the possibility of certifying those casks for transportation, and that could possibly be done; however, they weren't designed for that. They don't have the structural capabilities or the neutron absorbers and so forth to meet the transportation regulations.

In any event, I just wanted to bring that up as an issue, which would then go to NRC. Would NRC allow them to decommission their pools the same way as other reactors have done or not? But it will be NRC's job to determine what's safe under those situations. That's all.

LESLIE: Thanks, Jeff.

MOTE: Mark does not have a mic, so I'll say that NRC said maybe.

LESLIE: Okay. Yes, right behind you. John.

GREEVES: John Greeves. Just observing what I heard yesterday and today, the high burnup fuel issue, transportation, as I understand, there are no certificates of transport for high burnup fuel. Is that a roadblock, and what's the path forward on getting high burnup fuel certified for transportation? That's a question. Maybe you can't answer it today, Mark. But is it a barrier, and what's the path forward?

LOMBARD: Mark Lombard, Nuclear Regulatory Commission. I’m trying to remember the response that we made to the SONGS coalition, and I think we did say--and I’m not a hundred percent sure on this--that there are one or two packages that are approved for transport of high burnup fuel, but I’d have to verify that.

LANTHRUM: A clarification--Gary Lanthrum from NAC again. For those canisters that have been loaded with high burnup fuel in damaged fuel cans, those are transportable as is. And so it’s only the ones that have been loaded bare fuel. But there are ones that have been loaded in damaged fuel cans, and there are no transport impediments for those.

GREEVES: John Greeves. I’m talking about the whole fleet. High burnup fuel transportation, I think, is a problem and what are the barriers in the way of solving that problem. To me, they run through NRC.

LESLIE: Okay, thank you, John. And thanks, Gary, for clarifying that point. And I guess Mark will come back to this.

LOMBARD: Mark Lombard, NRC. You are correct. The burden of certifying those or approving those packages for transport does lie in us. As we talked earlier, there are several research projects that are ongoing on transportation of high burnup fuel. We have a project going on at Oak Ridge right now that's showing some very promising results relative to the transportation of high burnup fuel. We're not ready to roll those results out yet, but I think by the time we--and I use it collective--we as a nation are ready to have a place to put that high burnup fuel, whether it's an interim consolidated storage facility or a repository, we'll be ready to approve those for transportation.

LESLIE: Yes, Marvin.

RESNIKOFF: Marvin Resnikoff. My recollection after looking at the certificate of compliance for the NUHOMS container is 62,000 megawatt days per metric ton is the limit right now that's been certified.

LESLIE: Okay, thank you.

RESNIKOFF: And some fuel at SONGS is up to 67,000 megawatt days.

LESLIE: On the mic if you're going to--

WILLIAMS: This is Jeff Williams again. I think that's for storage, not for transportation.

RESNIKOFF: Yeah, for transportation it's worse.

LESLIE: Thank you. All right. Other questions and comments. And, kind of, just where we're at, we have about 15 more minutes before we're supposed to go to the Board Chairman. But I'm checking in with you to see how you're feeling. Don't want to rush anything, but at the same time I don't want to drag anything out either. So are there other takeaways?

MOTE: There’s one back there.

LESLIE: Okay, thank you. Sorry I didn’t see you.

CUMMINGS: Kris Cummings, NEI. I look around the room and see the people participating in this meeting, and I see we have a lot of non-governmental organizations, DOE, obviously the Board. One of the observations I’d make is having the Board engage with the industry, the nuclear power plants. There are some cask vendors here, not all of them, giving them an opportunity to give presentations, simply because they’re the ones who deal with these issues on an every-day-every-year basis. They’re the ones that go to the NRC and have to provide the safety case for them being able to say, yes, these are safe.

So that’s the observation I wanted to make was to get all the stakeholders, especially the nuclear plants, and I want to thank the people in the nuclear industry who did come and support this meeting today. But I don’t think that’s an accurate representation of the industry here. So just an observation.

LESLIE: Thank you, Kris. Looking around. Oh, yes, sorry. And I’m glad that--Hitesh, make sure you identify yourself.

NIGAM: Hitesh Nigam from Department of Energy. I was just listening to Gary and Jeff sing about the transportation issue. Just for everyone's information, Department of Energy continues to transport DRR and foreign research reactor fuel into its facilities. So I know it's not happening with the commercial fuel, but certainly Department of Energy is receiving fuel from all over the world, including all the research reactors, domestic and university research reactors in the United States and Navy.

LESLIE: And it's one of the things--and, again, I'm looking around--but one of the things that Nigel opened up, I think, this morning, which is we did not have a lot of discussion about DOE spent nuclear fuel. And I don't see Beatrice right now, but--oh, she's back there. But let me kind of summarize. It's not out of sight and not out of mind for at least some of the community, and so there was some discussion. It was captured a little bit by Jerry, but I just wanted to let you know that I think, if you go back to the transcript, there will be some things there that maybe didn't get explained real well this afternoon.

But, Hitesh, thank you for reminding me to talk to the DOE spent fuel.

MOTE: Maybe we can ask Hitesh. Are there any features of the DOE spent fuel systems that are markedly different that would warrant different inputs to discussion of the potential for repackaging?

NIGAM: That's a tough one. Just for everyone's information, basically we’re storing spent fuel at four different states, Colorado, Idaho, Hanford, and Savannah River site. And basically we are under status quo. We’re really not doing much with our spent fuel. Most of our fuel is at Hanford by weight, and it’s sitting in dry storage over there. Most of our fuel at Idaho is also in dry storage where we are required to move that fuel by 2035 in about 20 years or so, but it’s sitting there right now. We really haven’t made much progress.

We have some fuel sitting in wet storage at Savannah River site in South Carolina. That’s where we have just started to process some spent fuel, if you’re not aware. We’re processing aluminum clad fuel that’s in our inventory over the next four or five years or so. We still have this facility called H Canyon processing facility that is operational. They’re doing a lot of activities over there, including processing spent fuel to try to eliminate some of our inventory. But, of course, processing spent fuel generates liquid high-level waste that we’re trying to manage.

I’m not sure if that answers your question. But we’re really not doing too much at this time.

Go ahead, Jeff.

WILLIAMS: I’d like to say the largest difference between their fuel and these guys’ fuel, the utilities’ fuel, is that theirs is sitting in vaults in small packages that have lots and lots of flexibility, which you don't have at the utilities when you put the fuel in 37-assembly welded canisters that you're stuck with, the issue that you've been dealing with. If you go to Idaho, you can see there's vaults, Savannah River vaults and pools, and so forth. Lots and lots of flexibility. You don't have that flexibility with the utility systems.

NIGAM: And I also want to just reemphasize some of the points that Robert Sanchez made. I know this whole meeting we've been focusing on technical issues, but there are a lot of non-technical issues that probably would drive many of the technical issues that we've been discussing here.

And, you know, after being here for a day and a half or so--this is just me personally talking, not Department of Energy--seems like we're not going to make much progress over the next decade or two on this issue. I think the best scenario for us is status quo and trying to safeguard and secure our material that's sitting in our existing facilities. Again, that's more personal than my departmental opinion.

LESLIE: Thank you, Hitesh. Okay, I've got Marvin. Anyone else? Go ahead, Marvin.

RESNIKOFF: I didn't want to let this go by without also saying that DOE is going to accept liquid highly-enriched uranium slightly irradiated from Chalk River reactors in Canada. There will be several hundred shipments coming down I-81 to Savannah River plant.

LESLIE: Okay, thank you, Marvin. Other questions or takeaways on what we've heard over the last day and a half?

Thank you, Judy.

TREICHEL: You're welcome, Bret. Judy Treichel, Nevada Nuclear Waste Task Force. If you've noticed that there is a kind of lack of comment from people who comment all the time--Bea, me, others--it's because we're really here to get to the point where they're not making waste. The one thing that's not stopping, of course, is producing more and more waste. And as we see from all the charts, the problem is getting bigger, and we're being asked to solve a problem or think of things to make the problem smaller. And nothing is going to do that until you have a system that, as Nigel pointed out, the beginning end of it is profit-driven, so you do everything that makes money. And then by the end of it, a lot of those decisions that made more profit wind up costing more and making it far more difficult.

So there is not a lot for people like me to say about this, and I certainly am not going to stop participating, because I have an active interest, and so does Nevada. But it's very difficult to look at something that seems to be going in the wrong direction.

LESLIE: Thank you, Judy. Arjun. We'll get you a mic here.

MAKHIJANI: I just want to follow up a little bit on that. But I note that the most advanced repository program and one I've tried to learn as much from as I can is the Swedish program, and I thought it has gone about as well so far as any other example anyway, in my opinion.

And I think it hasn't been much remarked that their program matured in the context of a moratorium on nuclear power. And the interaction between that moratorium and the--because initially they had public resistance, as they have had everyplace else. And I think the interaction between that moratorium and the success of their program, at least so far, is worth examining. I know that recently they have kind of--there's some question as to whether there's going to be new nuclear power plants in Sweden or not, and that question is being reopened.

But the repository program matured in that, and my personal interest is to see how the end of nuclear power in Germany affects that. You know, it's been a very difficult debate in Germany, perhaps more difficult than anyplace else, and perhaps at least the question should be put on the table. I certainly don't have a view on--a studied view on what impact it has had, but it might have an impact.

LESLIE: Okay, thank you, Arjun.

MOTE: Well, maybe we can ask our German visitor to say whether he senses any difference in the receptivity for a location of a repository in Germany or easing in the development in the same way that Arjun is saying there may have been that impact in Sweden, although it’s very early days in Germany, and there have been several changes, so maybe it’s not stable enough yet.

BERLEPSCH: Thilo Berlepsch from DBE Technology in Germany, obviously. At least up to now, I don’t see any difference in the reactions of the public against the repository programs we’ve got in Germany. I think this will change once the last nuclear power plant is really off line, not any earlier. But maybe directly to the comment which--I forgot your name again.

MAKHIJANI: Arjun.

BERLEPSCH: Arjun. Sorry. What I saw in Sweden is that the public opinion was for quite a long time in favor of nuclear power, and it was only the policy which changed afterwards. And when you already talk about Sweden, then there’s another Scandinavian country, which is Finland, and they have been in favor of nuclear for a very long time. And I think they’re even more advanced in their repository program than Sweden is. They have got a license for the repository, and they are actually constructing it already.

LESLIE: Thank you, Thilo.

So kind of at this point I'm going to wrap up this discussion, and I'll remind you the process is that once this week is over and I can actually come up for air--because the Board has a public meeting tomorrow, and then we have some Board business the following day--that the summary of these bullets, in my words--I'm not relying on any sort of transcript--will go up as kind of what we heard in this session.

And, again, we're not requiring you to take any action now. I know that there are a number of public comment periods right now. There's the waste confidence that the community is working on. There is the high burnup test plan that's out for public comment. But if you want to, you can comment on these things; and also after you see the transcript, you can send in clarifying questions.

And I think at this point, if people are clear on the process, then I'm going to turn it over to Rod to take us out into the end. Thank you.

EWING: So normally at this point in our meetings we set aside time for public comment, and I just checked. No one is signed up to make public comment. I think that's because we have given everyone ample opportunity to speak. So we can move on to a few closing statements.

First, as the last functioning part of the Nuclear Waste Policy Act, I'd like to invite you to our open meeting tomorrow. It'll be in this room at 8 o'clock. There is some overlap of the topics, but it's not meant to be a follow-up to the workshop. But I think the topics will be of great interest, and I think you can get the agenda from the table outside.

I want to thank particularly all of the participants. This style of meeting is new for the Board. It wouldn't have worked without the presentations, particularly on the first day, very high-level and also thoughtful presentations from Pete Lyons, Allison Macfarlane, and others. But the interactions have been, I think, extraordinary, at least in my experience in this field.

This is our first effort at what I would call a participant-oriented meeting. You've seen us scrambling; you've seen us change the format as we moved along. So I'd ask you to let us know how we did and how we can improve. Is this the type of meeting that is useful and constructive? I've learned a lot, but it's a meeting for everyone. So please give us your thoughts and advice on that.

So the last comment is to tell members of the Board, we will meet at 7:30 this evening in the Embassy Room and begin to discuss and digest what we've learned at this meeting.

So, again, thank you all.

Nigel.

MOTE: Cards.

EWING: Oh, I need to be prompted. So if you want to stay in contact with the Board, there are cards outside. Please fill it out with your address and e-mail, and we'll be sure you get all of our materials. That reminds me to say thank you to our staff again. This was an extraordinary effort by our staff, and so we're very grateful, all of us.

LOMBARD: I'm sorry, Rod. Mark Lombard with the NRC. I want to give kudos to the Board for even setting this up. It was a very different format. I think there was a lot of great interaction, and thanks to you all for setting it up and hosting us. Thank you.

EWING: Thank you. And we're adjourned.

(Whereupon, the meeting was adjourned.)

C E R T I F I C A T E

I certify that the foregoing is a correct transcript of the Nuclear Waste Technical Review Board's Technical Workshop held on November 19, 2013, in Washington, DC, taken from the electronic recording of proceedings in the above-entitled matter.

December 15, 2013 ________________________________

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