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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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PUBLIC MEETING

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WORKSHOP ON DEVELOPMENT OF REGULATIONS FOR SPENT NUCLEAR FUEL REPROCESSING FACILITIES

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WEDNESDAY

SEPTEMBER 8, 2010

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The meeting convened, at the Hilton Washington D.C./Rockville Executive Meeting Center, 1750 Rockville Pike, Rockville, MD, at 8:30 a.m., Francis Cameron, presiding.

PRESENT:

FRANCIS CAMERON, Facilitator

SVEN BADER, AREVA

MARISSA BAILEY, NRC

JIM BRESEE, DOE

JOSE CUADRADO, NRC

YAWAR FARAZ, NRC

JOHN FLACK, ACRS

THOMAS HILTZ, NRC

MIRIAM JUCKETT, CNWRA

PRESENT: (CONT.)

MARSHALL KOHEN, NRC

MIKE LEE, NRC

ERIC LOEWEN, General Electric

ED LYMAN, Union of Concerned Scientists

ARJUN MAKHIJANI, IEER

ROD McCULLUM, NEI

ALEX MURRAY, NRC

PHIL REED, NRC

STEVE SCHILTHELM, Babcock & Wilcox

DANIEL PAUL STOUT, TVA

C-O-N-T-E-N-T-S

C-O-N-T-E-N-T-S (CONTINUED)

P-R-O-C-E-E-D-I-N-G-S

8:45 a.m.

MR. CAMERON: Okay, we're going to get started.

If you need coffee, make sure you get it now because it will disappear at nine o'clock, and there's tea out there also.

But good morning and welcome back for our second day of discussions. I thought yesterday was pretty fruitful and thoughtful, good discussions on two difficult topics and, also, a good learning experience for all of us who are involved in planning the workshops because I think we learned something about how to perhaps better tee-up the issues on the risk/safety segment for the Albuquerque workshop.

The Albuquerque workshop is going to be two full days instead of a day and a half, and it is scheduled for October 19th and 20th. We will be sending out notices to everybody about where that is going to be.

Jose, were we going to do another Federal Register notice on it? Public notice?

MR. CUADRADO: We had the date for the October workshop as the week of the 4th. So it would probably be appropriate to issue another one and

revise the dates.

MR. CAMERON: Okay. So there will be a notice. Because as typical with the meetings that we have in Washington, D.C., we get a lot of people who are professionally-interested in the subject, not a whole lot or perhaps any members of the, quote, "public". But usually, when we go out in the regions, there will be public interest in it.

I don't want to make any jokes about one of the companies here planning to cite a reprocessing facility in Albuquerque so that we can pack the halls or anything, but I think we will have more people from the public interested in this.

We are going to start with the design and operational aspects. Alex is going to tee that up for us.

As you already gathered, this doesn't run like a train, or maybe it does run like a train. We will be a little bit off-schedule perhaps, but we do need to start the security and safeguards discussion at 2:30 sharp because the NRC person, Marshall Kohen, who is going to tee that up for us, has to leave at 3:30. So we want to have him here for that full discussion.

We have Eric Loewen from General Electric

with us. And I'm going to just ask him to introduce himself.

MR. LOEWEN: Good morning. My name is Eric Loewen. I work for GE Hitachi Nuclear Energy down in Wilmington, North Carolina. I apologize for not being here yesterday.

What we are trying to do is commercialize the technology with, hopefully, a consortium of companies that was developed in our National Laboratories. Some of you might know it as the Integral Fast Reactor Program or the Advanced Liquid-Metal Reactor Program. So that is a technology that we call recycling, where you are actually using a fast reactor to get rid of all the transuranics.

So that is where we are coming from. We have been public about that with our grant that we got from the Global Nuclear Energy Partnership, and last week we talked about that in front of the Blue Ribbon Commission Subcommittee on Fuel Cycles and Reactor -- one of the subcommittees. It was chaired by Per Peterson and Senator Domenici.

So I am pleased to be here and want to learn. Thanks.

MR. CAMERON: And thank you for joining us.

Everybody did pretty well with this. If you want to talk, and I'm just doing this for your benefit, Eric, if you want to say something, we have been using the turn your name tent up on that.

Okay. Anybody have any questions, observations before we get started?

(No response.)

Mr. Murray?

MR. MURRAY: Thank you, Mr. Cameron.

Good morning, everybody. We would like to resume our discussions this morning. The area which we'll start off with, we sort of used these terms design and operational requirements. It basically is a catchall for several areas which come up in many of the regulations which either are or appear to be potentially applicable to reprocessing and recycling.

Next slide, please.

In NRC regulatory space, there generally are three areas. I have listed them here. Generally, there are some requirements and regulations which are somewhat prescriptive. There also are some regulations which usually have a risk or some sort of risk-informing involved. Sometimes there are some performance requirements identified. We discussed those yesterday afternoon.

And then, there are some other parts of the regulations which discuss minimum criteria or minimum requirements, and that was sort of touched on a little bit yesterday as well. And we are going to discuss those this morning.

Some of these minimum criteria include things like design criteria. These are sometimes called GDCs, General Design Criteria, in many parts of the NRC regulations. Part 50 has Appendix A on General Design Criteria. Part 72 has a whole section on General Design Criteria, et cetera.

In one part of the regulations, Part 70, they are called Baseline Design Criteria. Basically, the terms are used synonymously, but there can be some slight differences in how they are applied.

Another area of minimum criteria involve technical specifications. We are going to discuss those a little bit as well. And another area we will discuss has to do with the personnel or operators of potential future reprocessing and recycling facilities.

The key thing about minimum criteria or minimum requirements is that these add to the defense-in-depth: redundancy, diversity, independence, and, in essence, enhanced safety.

The next slide, please.

On this slide, I have just given a brief explanation about General Design Criteria, Baseline Design Criteria. Again, these are a minimum set of requirements that the NRC requires licensees or applicants to address. I have listed some of the attributes here.

The next slide, please.

Okay. We are discussing recycling, reprocessing/recycling facilities. Reprocessing facilities are production facilities, and they are currently regulated under 10 CFR Part 50.

Now Part 50 has General Design Criteria. These are referenced in a part of the regulation, 50.34. Appendix A lists them for nuclear power reactors.

Even though Part 50 applies to reprocessing facilities, it does not have any specific General Design Criteria for them. We will discuss that in a moment a little more.

There are some other parts of Part 50 which imply other potential General Design Criteria. There's an Appendix F which discusses waste; Appendix I, ALARA, on emissions and effluents; S is on seismic, et cetera.

And the staff has looked at this, and we have concluded that some General Design Criteria, Baseline Design Criteria, that are specific to reprocessing/recycling facilities may be needed.

Next slide, please.

Now when we started this work a year or so ago looking at potential General Design Criteria for reprocessing and recycling, we were perplexed because in the existing regulations there is actually a footnote to 50.34 that says General Design Criteria for chemical separations facilities are currently being developed. And we said, well, hold on, where's this going on?

And apparently, that is an artifact from the late seventies and early 1980s, when they were -- they, us, the NRC -- were developing some General Design Criteria. And I have listed on this slide those previously proposed Appendix B, Appendix P, excuse me, which listed 27 General Design Criteria in seven categories.

If I could have the next slide, please?

There was also a previously proposed Appendix Q, which dealt more with General Design Criteria that might be applicable to material control and accounting and physical protection. And again,

this had several, I guess it's 19, General Design Criteria in three categories.

Next slide, please.

Now we, the staff, have looked at this. We noticed the proposed regulations, the existing regulations right now do not have any thresholds for applying any of the General Design Criteria.

We also went through and thought, okay, from the list of General Design Criteria that are out there, be they in the existing Part 50, the two proposed appendices, Part 70, Part 72, we looked at those and said, well, there may be upwards of 10 potential categories and upwards of 70 or so potential General Design Criteria that could apply.

Next slide, please.

Here I have just given some of the potential categories that the staff has come up with. Some of these were discussed at the May public meeting.

Next slide, please.

Now let me move to another area of minimum criteria, minimum requirements, technical specifications. Technical specifications, a little hard to describe. They are sort of like, when you see them, you know what they are; you know what they mean.

Because reprocessing facilities are production facilities, technical specifications are required by the Atomic Energy Act. They are actually referenced currently in Part 50.36.

Part 50 has a very extensive discussion about technical specifications. There are guidance documents related to Part 50 which discuss technical specifications in lugubrious detail.

In the early 1970s, there even was a Federal Register notice which discussed proposed or potential technical specification categories for fuel reprocessing plants. Part 70 facilities are not required to have any technical specifications.

The gaseous diffusion plants, which are regulated under Part 76, another part of the NRC regulations, they have technical safety requirements, which are somewhat like, have some similarities to technical specifications.

Next slide, please.

On this slide, I have just listed some of the considerations which go into technical specifications. In general, technical specifications come from safety analyses about the proposed facility or facilities, both the design and operations. I have listed some of the categories: safety limits,

limiting conditions for operations, et cetera.

A key thing is technical specifications can include both what we call technical or engineered attributes, not to exceed a certain temperature, not to exceed a certain pressure, what those might be, how many hours or days the system can run, a part of the facility can run with a certain subset of equipment functioning or with a limited functionality, et cetera.

It can also include the administrative side. Okay. It has the time between calibration of instruments and equipment, for example.

Next slide, please.

And just another last area which we will just mention regarding minimum requirements, this has to do with the training of operators at reprocessing and recycling facilities.

The Atomic Energy Act does require the NRC to establish criteria for operators of production facilities. Again, reprocessing facilities are production facilities.

The Atomic Energy Act requires the NRC to determine what the qualifications of some of the operators, some of the criteria for training them, and so forth, and then to issue licenses.

These are currently codified in another part of the NRC regulations. It is called Part 55.

Right now, those regulations are heavily focused towards nuclear power reactors. And again, the appropriate level, requirements for operators at reprocessing and recycling facilities will need to be determined, either as part of an amended Part 55 or perhaps as a part of a new reprocessing and recycling regulation.

And next slide, please.

Here, I have just listed some potential points of discussion to kick it off, and here's Chip.

MR. CAMERON: Okay. Thank you, Alex.

Alex just walked through the traditional hierarchy of design and operational requirements for NRC facilities. The staff focus is how to develop this for reprocessing facilities. So they are looking to all of you to give them some suggestions on that.

I don't know if anybody would like to start us off on these questions. Alex, in terms of moving through these, does it make sense to start with the first bullet or is there a more appropriate, larger issue to take on, from your point of view?

MR. MURRAY: Several times during the discussion yesterday, there were a number of

statements about some minimum requirements, regardless of what a safety analysis, be it PRA, ISA, or other risk-informing methodology, might do, might be needed. Okay?

One was, well, yes, even though the potential, the probability, or likelihood of a sequence could be reduced, there still should be some requirement to mitigate the consequence. That was mentioned a couple of times, some sort of base level of, for want of a better term, safety equipment, safety controls. That was mentioned a couple of times.

So, you know, I guess my first thing I would throw out there, okay, is there something, are there some things which are universal, you know, yes, ALARA applies, but something beyond that? I don't know, some criteria. I put up there spent nuclear fuel burnup from the overseas facilities does seem to have some, if you will, safety relevance, some top-level applicability.

MR. CAMERON: And these standard criteria would be memorialized in a BDC and/or tech specs or?

MR. MURRAY: It could be either. It could be some breakdown or both, yes.

MR. CAMERON: Okay. John?

DR. FLACK: Yes, you know, going back to how we work with reactors, we usually try to -- well, we start off with design basis accidents. And from there, those are the accidents you want to be prepared to deal with as part of the design. Okay. From there, everything begins to evolve as to what safety-related equipment you might have, and so on.

So my thinking here is there is a similar set of accidents that one can think about for these facilities where you would start from and say, again, deterministically, where that becomes your core. And then, from there, you build around that, and there could be other things.

Now, with reactors, of course, you don't say that's the end in and of itself. You go to the PRA to see whether the accidents might be important for the facility, and so on. But at least you start off somewhere. Whether it is a double-ended guillotine for a reactor, loss of offsite power, there's a certain set of accidents for those types of facilities. Is there a similar kind of set of accidents for these facilities or we just don't know what they are right now? Maybe that is the starting point.

So it kind of pushes everything up a

notch, starting something at that level, and then from there, going down to the kinds of levels you're talking about. Okay, then how much defense-in-depth do we need, and so on and so on?

I don't know; just throwing it out there.

MR. CAMERON: And thanks, John.

I would note that Ed Lyman, one of the points he made yesterday is establishing some design basis accidents deterministically. John is saying you've got to start this whole exercise with looking at design basis accidents and then build around that.

Rod?

MR McCULLUM: Yes, I would agree with John that that's probably a good place to start. I would caution, again, in the spirit of risk-informed, performance-based, trying to say that there is a cookie-cutter list of accidents that would apply to any recycling facility.

I think a risk-informed, performance-based regulation could specify requirements for identifying the design basis accidents. It could specify the level of rigor with which you would want to identify those design basis accidents and the types of things that you would need to show to mitigate them.

One thing I would point to, and I know

there's some people from NRC around the table here who are familiar with this, I think one of the best examples of risk-informed, performance-based regulation we have in that regard is 10 CFR Part 63. I apologize for bringing up Yucca Mountain, but it's something that I know.

It talks about the types of information that DOE has to collect about the geology, but it doesn't say things as specific as, you know, okay, the colloids are going to have to travel at this rate, and so on and so forth.

So I think you could specify in that spirit a set of requirements that give confidence that you will be getting an application that appropriately defines the accidents, analyzes them, and demonstrates they can be mitigated without having to specify here are the 13 accidents you have to worry about in a reprocessing facility.

MR. CAMERON: Okay. Thanks, Rod.

Steve?

MR. SCHILTHELM: Yes, and just kind of building on those two points, nearly all the regulations -- and Alex laid it out -- have some form of design criteria, Baseline Design Criteria or General Design Criteria, or whatever they are called

it in Part 72.

We offered, when we put the White Paper together, that there be some set of design criteria. Those design criteria, in a sense, they help guide you to identifying what those design basis accidents might be.

An example in Part 70, don't have inadvertent criticality accidents or prevent inadvertent criticality accidents. Well, they help guide you to a point of, okay, I need to consider an inadvertent criticality.

So I think, in general, regardless of what the list looks like, people seem to be in line with the need for a set of Baseline or General Design Criteria for these facilities.

MR. CAMERON: Okay, and I guess a question is, where do you start? What comes first on this?

Arjun? And then we will go to Ed.

DR. MAKHIJANI: Well, I think you have to have both design criteria as well as specified accidents because we are revisiting the technology-neutral discussion by other means by saying, one, that we are just going to have performance-based, and so on, and you specify the criteria, and you don't have to have a list. Well, you do have to have a list.

I brought up yesterday the question of tank explosions, which the gentleman from Oak Ridge said was not relevant. But I didn't have a chance to point out that the Norwegian Radiation Protection Authority in 2009 thought it was relevant for PUREX plants and did a study of a release from the British reprocessing plant, and concluded that it could result in cesium contamination of Norway, between 10 percent and 5,000 percent of the contamination that resulted from the Chernobyl accident, which is clearly unacceptable to them. This is the Norwegian Radiation Protection Authority.

Now they didn't specify the mechanisms of the accident, but we can think about what they might be. It is not that hard.

So I think a design criterion might be, you know, that would relate to all aqueous plants, we are going to have liquid high-level waste storage. You've got to limit the worst-case release. Ten percent of Chernobyl is just unacceptable. In my opinion, it is unacceptable, but the NRC and the public have to decide what is unacceptable.

Then, the design criteria for the plant itself, that would be technical, and the defense-in-depth, and so on, come second. But, clearly, it

relates to technologies with aqueous waste and would not be the same for technologies that don't have aqueous waste.

So, even when you have General Design Criteria, a lot of them are going to be technology-specific, at least in the broad sense, and not just general that, you know, we're in reprocessing and this applies to all reprocessing. There will be some like that, but not all.

MR. CAMERON: And is what Arjun just described, is that consistent with other people's thinking on this, that there will be some that are going to apply to any technology, and then you would have specifics for a certain type of technology? Or, Rod, are you saying that, you know, going back to the risk-informed, performance-based, that that could sort of cover the waterfront for anything?

MR McCULLUM: I don't think that what Arjun said, and I am going to continue to try to build common ground because we had some very notable instances of that yesterday, is necessarily inconsistent with what I said or with what Steve said.

I think it really depends on a couple of things. First of all, the level of prescriptiveness or specificity with which you describe the accident.

I mean you can talk about requirements to prevent criticality, and you can talk about the level of rigor with which the applicant will need to demonstrate that they can prevent criticality. And you could actually get into a fairly detailed regulation, but you don't have to go to the point of talking specifically about parameters you need for aqueous systems or parameters you unique to metallic systems.

I think there is a level of detail there where you can appropriately do that, that you can meet Arjun's request to identify accidents, but to do it in a risk-informed and performance-based manner. I'm sorry I keep saying that, but that's my mantra.

And I think the second way is when you get to something that is so unique about a different type of facility, you can bifurcate the regulation. You can have a Section 7x.y that addresses aqueous and 7x.z that addresses pyro processing. And if one of those technologies is not advanced enough when you're writing this initial regulation that we encourage you to stay on your current schedule for, you can leave a placeholder.

In fact, Alex brought up a couple of excellent examples of things. There was a footnote to an appendix that, well, we walked away from

reprocessing back then, so it didn't get written.

But you can do the same thing today. And that proved out to be very good because we are, indeed, coming back to those placeholders. So I think where you can't be completely risk-informed, performance-based, or you don't feel you can, you can at least leave placeholders.

Again, I will cite this. I'm being a little bit redundant to yesterday again, but we do have in Part 50 PWRs and BWRs, and there are aspects of PWR safety and BWR safety that are somewhat different. The NRC is able to deal with that in a consistent manner in its regulations.

MR. CAMERON: Okay. And by placeholder, you mean a section of the regulations that would be reserved for future development?

MR McCULLUM: Yes, a reserved section. The page would say, "Reserved for...," and you would give a title. You know, the title would tell you what you are aiming to do there. You would wait until more of it was known if it was for a less-matured technology before you filled in the specific text.

MR. CAMERON: Okay, yes. Let's go to Ed, Ed Lyman.

DR. LYMAN: Thanks. I would like to push

back on the mantra of risk-informed. I don't believe that at least in the initial stages of this rule that it's possible or appropriate to use risk-informed approaches, because if you can't calculate the probabilities credibly, then you can't actually determine the highest-risk events.

So, I think if you look at the analogy of reactors, initially, there were, based on technical judgment at the time, a list of design basis accidents that was developed. And over time, as operating data accumulated, you were able to modify your perception of the highest-risk events through risk-informed.

But if you are starting with a very small number of facilities with limited or no operating experience, then a better approach would be for the technical judgment of the staff to develop a set of accidents which the licensee or the applicant would have to demonstrate high assurance that they would not occur. And over time, maybe the rule could be risk-informed, but not initially.

The second point I would like to make with regard to design criteria, I would like to throw out one which has bothered me for a long time. That is that there is no requirement for protection of fuel cycle facilities against deliberate air crashes. Now

we have a rule for reactors where there is a requirement that you need to do an assessment of a deliberate air attack and demonstrate some level of performance in that regard, and there's no comparable requirement for fuel cycle facilities. That is a definite gap which needs to be corrected in this rule.

Thanks.

MR. CAMERON: Okay. Thank you. Thank you, Ed.

Arjun, do you want to follow on that?

DR. MAKHIJANI: Just very briefly. I didn't realize Rod was building a record of agreement. I just want to say that, when I agree, I'll say so, and when I disagree, I'll say so. So I don't want the record to reflect Rod's statement about our mutual agreement until I have agreed explicitly.

And I just want to say I agree with what Ed just said.

MR. CAMERON: Okay, but thank you, Rod, in the spirit of trying to build agreement, okay, Rod?

MR McCULLUM: And I will try to be careful. And since we now have framed what is a disagreement, I will try to again search for some common ground or at least put my two cents in, as it were.

I don't think that knowing the problem, and this is the one thing I think was the point of disagreement with what Ed said, knowing the probability is a prerequisite to being risk-informed.

I think what really needs to be risk-informed, to understand the risk, it is really to know and understand the hazards that exist. And then there are multiple ways -- and we talked about some of those yesterday -- that you can address those hazards.

But, really, if you start with an understanding of the hazard, and also, with recycling facilities, you are understanding that they're not reactors, I think that does mean something here. I think that should not be lost.

We start with an understanding of hazard and a commitment that you're going to make a regulation that will require an applicant to put in place sufficient measures between that hazard and the public and the workers to assure safety. I think you can do it on a risk-informed basis.

Probabilistic risk assessment is one tool for risk-informing. It is not necessarily the only way to skin that cat.

MR. CAMERON: Okay. Ed, do you want to follow up?

DR. LYMAN: Yes, just briefly. I don't think you truly understand the hazards unless you understand -- I mean you can't risk-inform unless you have a sense of the relative probabilities of initiating events as well as the probability that they carry through to a particular outcome.

So I just don't see how you can risk-inform. I think, by definition, it means that you are basing your analysis on some sort of a probabilistic risk assessment. So I just don't see how it can be done.

MR. CAMERON: And Sven?

DR. BADER: I think the simple answer is that you would be very conservative on your probabilistic assessment. Unless you're making an event that is not credible, you consider them likely.

MR. CAMERON: Okay. John, you started us off trying to answer a question that Alex put forward. You have heard the discussion on risk-informed, and we don't have enough information about probability to do that. Sven just talked about being very conservative.

Are there any lessons from the White Paper, your thoughts on any of this?

DR. FLACK: Well, building a conservative

PRA is really against the grain of it all because you don't know what you have in the end. I think it comes down to trying to understand what the uncertainties are and having to deal with uncertainty. And risk can go either way. It can show things that you find to be important that you didn't know before, but it also shows things that are not that important.

And it goes beyond just trying to come up with numbers. It becomes a form of awareness by developing a model, understanding what's in the model, and understand the difficulties in quantifying that model, and then having to deal with that.

This is all knowledge and information about the technology, the facilities. You know, unless it's abused some way or somebody has a different agenda on how to use it, it's a search for truth, and that's what it should be.

How far you can go with that depends on things like data, you know, and understanding the model, and understanding the hazards that are intrinsic to it. You know, the likelihood of events, the consequences are very important. Understanding exactly, does this result in a significant consequence or are these things not so significant? I mean it goes either way.

So I think arguing, you have to argue, I think, for realistic analysis, as best you can do, and then know what the limitation of the analysis is, and then put that on the table with other decisions. Some of them may be that we don't know the likelihoods that well. We will need to develop certain accidents in any case, just to be sure as a defense-in-depth.

But now you're off the board. Now you are no longer thinking PRA. You're saying, okay, I took it as far as I can go, these actions make sense because I don't know enough. I have a large degree of uncertainty around them, and we will have to design the plant more conservatively.

But now you're outside the PRA, the designing a plan now. So you really shouldn't mix up the two. I wouldn't like to see us go down a road of saying, you know, we can build conservatisms into the PRA. You do it the best you can and you deal with the uncertainties. I think that is all I could add to the discussion really.

MR. CAMERON: Okay. Let's go to the staff, to Marissa and then Yawar, and then we'll come over to Steve. Marissa?

MS. BAILEY: I just have a question for folks at the table to consider. That's, what role

could guidance play here? There's a certain amount of criteria, a minimum level of criteria that you could specify in the regulations. But if you're looking for a technology-neutral, performance-based, risk-informed set of rules, that would be a limited set and you may not want to get too specific.

So, is there a role for guidance? Could you provide a certain level of specificity in NUREGs or Reg Guides? That is where you sort of get away from the technology-neutral piece and start to address specific technologies.

MR. CAMERON: Okay. Rod, has the Task Force thought about the relationship between the regulations and the guidance aspect?

MR McCULLUM: Not specifically. However, the short answer to Marissa's question of, is there a role for guidance, I would say, absolutely, yes. I mean we have looked at trying to be technology-neutral in the regulation, and I think that is a good first step, recognizing, as I talked about one way is reversed sections. Another way is you could have a different standard review plan for different types of recycling facilities that you would develop in accordance with the regulation later.

So, yes, without going on and on, I think

the short answer is looking at keeping the regulation itself technology-neutral and then bifurcating where you feel you need to be more specific, as you know enough to develop guidance. That might be a workable approach for us. I think that would not be -- and correct me; the authors are sitting around the table; correct me if I'm wrong. I don't think that would be inconsistent with what industry has proposed.

MR. CAMERON: Okay. Thanks, Rod.

Yawar?

MR. FARAZ: Yes, I just wanted to make a point, in addition to what John was mentioning. I mean you can do a fairly good accident analysis. You can analyze the accidents to death. But there's always this unknown.

As you get experience, as you learn more, that unknown gets lower and lower, and this is in addition to the uncertainties with what you have already identified.

So, clearly, you need General Design Criteria. You need operator training, and you need margin to be able to address the unknown.

So I think the analysis that we do is clearly needed, but, in addition to that, we need these additional requirements which some would

consider to be prescriptive to address that unknown.

MR. CAMERON: And those prescriptive requirements could be unrelated to any particular technology. They would be in what would be called Basic Design Criteria or some other term?

MR. FARAZ: Well, many would be technology-specific.

MR. CAMERON: Okay. Steve?

MR. SCHILTHELM: Backing up to what John said, you know, we seem to keep falling into this, there needs to be a PRA to be risk-informed and drawing this alignment between PRA and risk-informed. But I would agree with everything John said.

I think I could almost insert the words ISA everywhere you use PRA because the exercise and the understanding of the hazards and the rigor that you put into understanding what you are trying to accomplish with your safety profile, like you said, is the important piece of the puzzle. It is not coming up with a number or it is not coming with a term called highly unlikely or unlikely. It is the exercise and the rigor.

So I would like to decouple the notion that somehow PRA is risk-informed and ISA is not risk-informed. I think they are both a risk-informed

process that will allow you to understand the risks and hazards at your facility and make good decisions about safety.

And like Yawar said, where you don't understand or you have large uncertainties, that is where you have to apply your conservatism and your judgment. Whether you are doing PRA or ISA, there is an element of judgment where you have either large uncertainties or a lack of full understanding.

So I don't think they are that different. I would like to kind of dispel the notion that PRA and ISA are that different, and they can both be risk-informed.

MR. CAMERON: I think that might be a useful distinction, is that, whether you are talking about using a PRA or an ISA, they are both risk-informed. And maybe we are getting tangled up on what exactly that term "risk-informed" means. Maybe we have to dial it down a little bit, not capital letter "RISK-INFORMED", but risk-informed generally.

Ed, I know you have something to say, but I also would like to ask you a question. When you talk about establishing the design basis accidents deterministically, that would be a starting point for you.

Would you agree that the ISA, for example, would be the way -- in other words, what's the mechanism for that starting point of determining what the design basis accidents are in terms of how the NRC would actually formulate a regulation?

DR. LYMAN: I think the distinction here is that, rather than having the applicants define their own set of accidents, that it would be the staff in the Office of Research that would use a more comprehensive view and an approach which would be fully accessible to the public.

So, again, rather than putting it in the hands of the applicants, I think it is really the judgment of the staff that should take a broad view, look at the historical database, make a reasonably objective determination of where the uncertainties are, and define a reasonable set of accidents. I'm just more comfortable with that being performed by the staff than having it done ad hoc by the applicants.

MR. CAMERON: Let me get some --

DR. LYMAN: And of course, risk, you know, it's going to play some role, you know, qualitative judgments of risk. But the way risk is being used in the agency, putting too much reliance on the absolute values of numbers, like what's going on in the SOARCA

study, for example, that's being too specific with regard to actual risk values.

So, I mean, I think the staff would use some sort of risk-informed judgment, but it wouldn't be based on inappropriately specific numbers.

MR. CAMERON: Okay. We are going to go to Arjun, but I would like to get some reaction from people around the table to Ed's suggestion, including the NRC staff who has to write this, about how they think that might work, Ed's suggestion about the staff should take the initiative in identifying what Ed called a reasonable set of accidents, rather than having the applicant come in with that set of accidents for the staff to look at.

So let's go to Arjun, and then we will go down to Rod.

DR. MAKHIJANI: Well, I just want to say that I agree with what John Flack said earlier in terms of, if you are going to do a probabilistic risk assessment, you can't just put a number and claim it's conservative. Even to do that, you have to understand the mechanisms of the accident. It is much better to be able to define not only your state of knowledge, but, also, your state of ignorance. So then you know what to do.

Secondly, I think to say that PRAs and ISAs are somehow both risk-informed is, to my view, a misunderstanding of how we have used the term "risk" in this business. If you are going to calculate a risk, you need to know ultimately the consequences of an accident and the probability, the two bottom-line numbers in that process.

So, when you are talking about risk, you know, so many cancers, so much radiation dose, so many dollars of damage, there's a bottom-line number that comes out of a product of two other numbers. And it can only come out of one process. I think to attribute other meanings to risk is simply to confuse the issue.

You can have a safety analysis, fine, which is what you were talking about. But to mix up that safety analysis and then you might be able to go back from a safety analysis and say, oh, now that I've looked at 70 different chemical industries, I know more about the probability of this accident which I didn't know before. But, anyhow, you have to go back to calculate that risk.

I would very strongly recommend against mixing up the notion of risk, which is a product of accident consequences and probability, with other

notions of safety, even though both ideas are important in designing something that one might call safe in a regulation.

MR. CAMERON: Okay. Steve? Before we go to Rod, Steve?

MR. SCHILTHELM: Just now I disagree. And clearly, I don't think a number is totally necessary to understand risk, because a number has a large uncertainty bar, and a number stated without that uncertainty bar is no better than a qualitative statement of risk. So I would disagree that a number is the metric.

DR. MAKHIJANI: So there's no misunderstanding here, what I said was that, when you calculate a number, it's obviously your best estimate and there's always an uncertainty around that best estimate. That's why I said, when you do risk, you are not only defining your knowledge, you're also defining your ignorance. And the bigger the uncertainty, of course, the bigger -- and at a certain point, the uncertainties are so big that you are more ignorant than knowledgeable, and the middle number loses its meaning.

So, just so I'm not misunderstood, I am not talking about placing some kind of magical value

on a number. I mean, you know, Ed spoke about that.

It is just that the reason I agreed with what John said was, if you don't know it well enough, then you have to do some supplementary or complementary analysis to be able to understand your problem better.

MR. CAMERON: And that complementary analysis could be the integrated safety assessment, such as was suggested, I think, by Steve.

DR. MAKHIJANI: Yes. All I'm saying is don't mix it up with a very technical notion of risk. At least if there's two notions of risk out there, along with their uncertainty estimate -- the numbers are calculated in particular ways, and if we are mixing up other notions with that set of numbers, at least I would like to know. So, then, I don't think about the way NRC does risk in the way I've always talked about.

Then maybe the NRC staff can comment on that. At least it would benefit me a great deal.

MR. CAMERON: I'm trying to figure out whether you two are on the same wave length here or whether there's still a --

MR. SCHILTHELM: Well, I'm not sure we are because, when the NRC implemented Part 70, they put

forth a risk-informed regulation. And Part 70 in no way tries to calculate a number. So the NRC, through the implementation of Part 70, has at least another paradigm for risk that doesn't have a number.

And while on the reactor side there's PRA that produces a number, on the fuel side there's an ISA that is risk-informed, as stated by the NRC, that doesn't produce a number. So there is more than one paradigm for risk.

MR. CAMERON: Okay. Let's go to Rod, and then go to Alex.

MR. McCULLUM: Yes, and in some ways the discussion has kind of moved past what I wanted to say, but I think I can use what I wanted to say to maybe weigh-in on this quantitative issue here.

I want to start out by agreeing with Ed. I know Arjun doesn't like it when I agree with him -- (laughter) -- but I did want to agree with Ed, in that the overreliance on a very specific number is not what is useful here. I mean it is not important to know whether it is 1.073 times 10 to the minus 7th or 1.074 times 10 to the minus 7th.

I will concede, however, the risk is probability times consequences. Everybody in the room knows that.

The question is we absolutely have to know the consequences. We have to know the hazards. The question is, to what level of specificity do we need to know the probability? That's how you can have a Part 70 being risk-informed, in that I could take the hazard of a facility being the fission product inventory.

I could set the probability equal to one that every single one of those fission products ends up in this glass of water, and then the consequence is I drink it. And obviously, if I was still alive or safe, then there wouldn't be much of a risk there. But, obviously, at some level that becomes untrue.

So the question is, then, how do I make it unlikely that those fission products are going to end up in my bottle of water? What measures do I put in place between the hazard and the consequence so that I may not be able to say it's 1.073 times 10 to the minus 3 or 10 to the minus 7, but I can say that it is sufficiently unlikely that the regulator can make a determination that we have protected safety here. And I think integrated safety analysis allows you to do that.

So, yes, I think there is a way to understand risk and to use risk insights without

necessarily having to do a precise PRA. I think in instances where you have reactor facilities where you have decades of operating history on 104 of these things, you can do PRAs, if not at that level of precision, down to the third decimal point, in ways that give you even higher confidence.

I think, given reactors versus reprocessing facilities, you have the opportunity to do more numerical analysis, and maybe you have a need for numerical analysis. You have high-energy systems. You have systems that are interdependent upon one another to function, which you don't necessarily have in reprocessing facilities.

I guess I wanted to turn back and, given that, ask Ed a question, getting back to another subject he raised. The idea of the confidence you have in NRC specifying the accidents versus the applicant, and I am wondering if this might not be a level-of-detail issue.

I mean if NRC were to specify in the regulations the accidents at some level of detail that an applicant would need to analyze, but not in such a level of detail that they become specific to a technology -- and again, I will take criticality as an example. The NRC could specify, you know, the

criticality accidents without specifying them down to a level of detailed systems that are unique to GE's technology versus AREVA's technology, but specify some pretty rigorous requirements as to requiring the applicant in either case to evaluate a range of criticality accidents.

Do you believe, Ed, that this could be reduced to a level of detail that there could be a comprehensive enough set of accidents specified in a technology-neutral manner?

MR. CAMERON: Okay, Ed, what's your response to that? In other words, when you are thinking about the staff identifying these rather than an applicant bringing them in, is Rod's suggestion about the level of detail here or the generality that the staff might use identifying certain types of accidents, does that match up with what you're thinking?

DR. LYMAN: I just don't think that technology-neutral is an exalted principle that I think would put constraints on what the staff is doing, which may not be necessary or appropriate. I mean it will fall out naturally that some events may be common to a variety of technologies and others are going to be technology-specific.

I don't see the value of trying to ensure that the regulation itself is technology-neutral. So I think it would just fall out naturally, what events were common to different technologies and what weren't. But there's no sense in a priori saying thou shalt not have anything in the rule that is technology-specific.

MR. CAMERON: Any response on that, Rod?

MR. McCULLUM: Well, I would just challenge the staff to think long and hard about, are there accident scenarios where they feel they need to be technology-specific? And I would say, if there are, that they consider bifurcating and that they consider the role that guidance might play. Consider reserving sections for the less-mature technologies.

I mean it may very well be that you have an accident scenario that Eric might say, well, for my facility, that's not applicable, and in his safety analysis, he would have to write an argument for why that scenario is not applicable. The same thing might happen for a different type of scenario for the AREVA folks.

But I think there's room to find the right level of assurance in there and be as technology-neutral as possible. I think it is important to

industry because -- and this is getting back to a very high-level principle that we bring into the room here. It is that recycling regulations are an input to decisionmaking. In order for commercial entities and my friend here from the DOE to make decisions about moving forward with recycling, it helps to know what the regulatory framework is. It is extremely important. I'll give you an example.

I mean regulations on carbon will dictate to the extent to which we are successful in capturing it. And that is even outside the nuclear industry.

So we need to have a regulatory framework we can use to make a basis for decisions, as the commercial entities are trying to advance their technologies and their customers are looking at their technologies. What are the regulatory costs here?

And if you say that you can't be technology-neutral, then you have a real chicken-and-egg problem because you have something that will inform decisions that is dependent upon the results of those decisions.

So, again, to the extent there can be reserved sections, there can be a role for guidance, or there can be bifurcation, allowing us, the industry, the customers of these technologies, and the

Department of Energy to know as much as possible about the regulatory framework before these decisions are being made, which is of critical importance here.

MR. CAMERON: Okay. Thanks, Rod.

Alex, I know you have something to say, but I also wanted to ask you and Marissa, Tom -- John Flack started us off with talking about identifying design basis accidents. We have had a lot of discussion about that.

From this discussion of everybody, are you getting a sense of how you would structure this part of the regulation? And are there other specific issues that you would like to ask the participants to address in terms of what you need to formulate the rule? Since you have them here, let's take advantage of the opportunity.

MR. MURRAY: Well, let me ask the question this way: if we go and look at the General Design Criteria or Baseline Design Criteria that exists out there in different parts of the regulations, I would say probably at least 75 percent of them are technology-neutral right off the bat. And I would say maybe, if one took a very top-level view, maybe the majority, even all of them, could be made technology-neutral in entirety.

Having said that, you know, if you look at some of the General Design Criteria, we are dealing with irradiated materials. Some irradiated materials are self-heated. There's a General Design Criteria in Part 50 that says, you know, you should have a cooling system for -- I think it actually uses the term "the reactor". But for a reprocessing facility, if you substitute, instead of "reactor", you say you should have a cooling system for self-heating materials, and say that's a requirement, a General Design Criteria or Baseline Design Criteria in the regulation, does that not lead to, if you will, applicants to consider evaluating overheating-type accidents?

If you have a requirement, a General Design Criteria or a Baseline Design Criteria for an emergency cooling system for irradiated materials or materials that are self-heating or areas of a reprocessing/recycling facility where materials can self-heat or overheat, does that not lead or direct the applicant towards evaluating accidents that are associated with that? Cannot these specific types of accidents, which might be associated with those areas, say loss of cooling, can they not be fleshed out in some form of guidance, be it a Standard Review Plan or a Reg Guide for specific technologies? I throw that

question out there.

There are requirements for, I should say, I'll use a GDC/BDC for control room areas. Those are essentially technology-neutral. There shall be a control room area or control area, I believe is how it is phrased, and those are fleshed out in guidance, you know, what the staff would envision those areas might have. It might be habitability, specific requirements for operating under accident conditions, et cetera.

And I throw it out as a question. Can some of these minimum requirements be general in the rule and specific in the guidance? You know, there are some things we know. We know, as I say, loss of cooling is an important thing to consider. We know loss of criticality controls are important things to consider.

Is there not a list that the staff can put together with input from everybody here, input from members of the public, comments, and have it revisited at a later date in the rulemaking, and we can go from there?

They will lead towards ultimately consideration of design basis accidents. It can also feed into risk-informing of various types.

Okay, gee, if I have self-heating

materials in this area and I lose the cooling, what are the probabilities of that happening, if you wanted to go down to a PRA rule, for example? Can it be binned using an ISA methodology? Again, I throw these things out.

I do want to comment on one thing that I heard earlier about the focus on numbers and safety analysis. Okay? I think Rod sort of touched on it a little bit.

Whether we're at the numbers 1.073 or 1.079 times 10 to the minus 4 is sort of unimportant. Okay? There's something about, I'll say, relative order of magnitude. Is it 10 to the minus 1 or 10 to the minus 5? Those are fundamentally different. How you approach those are fundamentally different.

When you start getting much beyond, I will say, I will use the term, reliability, which is a little -- we will just call it probability of a system functioning better than, say, 10 to the minus 2 per year. You know that is a pretty darn good system and has to have certain attributes to it. Okay?

So I think take a step back and think in the big picture when you start talking about methodologies. You know, we essentially have quantification in many of these areas. The ISA, Part

70, its development was to some degree quantified or based upon quantification, even though it does not require a quantified methodology.

Enough said. I've spoken enough. Thank you.

MR. CAMERON: Okay. Let's hear from Phil and Yawar, and then go to Steve and over to Ed. Phil?

MR. REED: I just wanted to make a general comment and then respond to what somebody else has said.

With regard to the PRA, now internally when you do PRA, you do get results, and some of these results tell us we don't have to spend time on this or that; we don't have to spend resources on this and that. Let's concentrate on what's the most important.

And one of the beauties of PRA is, if you do get small numbers in these areas, that's the end of the discussion. You just concentrate eventually on what's the most important part.

There was a comment made with regard to aircraft impacts. And indeed, the staff has discussed this extensively for reprocessing plants. And I believe at the last public meeting, I think Alex presented a slide on the GDC, and I believe aircraft was presented there. So the staff discussed this,

essentially.

There is one area of external events that has sort of come up by a number of people, and I think it was mentioned at the RIC conference. That's if we're going to go continually to digital I&C and computerization, the questions come up about cyber security. And I think the issue has been framed around, is cyber security a General Design Criteria? We haven't heard too much about it. Maybe with the folks we have here, maybe we can get a few comments on that.

But it is an external event, like aircraft. It's not the internal events that we're concerned about here. But I just wondered what people thought about that.

MR. CAMERON: Okay. Two specific things, follow-up on Ed's suggestion or comment on aircraft impact, cyber security. We'll go to all of you to see what you have to think about that.

Marissa, go ahead.

MS. BAILEY: Just maybe to broaden Phil's question a little bit, Phil, are you basically asking, then, is intentional, malicious actions something that ought to be considered in the General Design Criteria? Because when you start talking about intentional

aircraft crashes and cyber security, that's kind of what you are getting into.

MR. REED: Yes, I would consider them to be two separate events. The aircraft impacts, strictly analogous to the way we do reactor regulation in the Reg Guide.

And with the other one, it is sort of a little bit nebulous because we aren't too sure how to really deal with it. It's a term that has been used around, but it is hard to get a specific handle on how you do it. But as long as we are going to go to control rooms and functions of the plants that are more computerized today, which we did not have back in the seventies or eighties, these types of questions come up.

With the reprocessing plant, we have to be very careful. You have all the fission products, transuranics going around. So there may be something here that could cause a problem and, if so, should it be considered a Design basis Criteria, is basically what we are asking.

MR. CAMERON: Okay. Thanks, Marissa, for putting that out there. The question is, should category conventional malicious acts be a General Design Criteria for these reprocessing facilities? So

it would be useful to get some comment on that.

Yawar, what's on your mind?

MR. FARAZ: I wanted to go back to what was suggested, that the NRC come up with a list of accidents that need to be analyzed.

For a complex fuel cycle facility, clearly, to come up with a set of accidents representative of that facility, you would need to do a very thorough hazards analysis, go through and identify all the hazards, and then from those hazards, develop the accident sequences. That is something that an applicant or a licensee is more suited to do.

And what the NRC has been doing under the ISA requirements is the NRC looks very closely at the process that the applicant uses or the licensee uses to identify the accident sequences.

The way I see it is, for a fuel cycle facility, the biggest thrust you get in ensuring safety is identifying all potential accidents. The problems that have occurred have not been in the areas or have not been accidents that have been identified. They have been situations that have been overlooked.

So a thorough and a very complete identification of potential accidents needs to be done, and that can only be done by a very thorough

analysis.

So, although I see the benefits of coming up with a list of accidents that need to be analyzed, there's also this danger of the focus shifting from doing a very thorough hazards analysis and starting from the bottom up, to identify accident sequences, which is working your way down by looking at the accidents that have been identified and then working your way down and not paying much attention to the hazards analysis that really needs to be done for any fuel cycle facility.

MR. CAMERON: Okay. I think Rod, in trying to be responsive to Ed's suggestion on the NRC, specifying the type of accidents that should be considered, said that the NRC, it might be useful for the NRC to set general categories, like criticality, whatever. For example, I suppose that conventional malicious actions or intentional -- yes, conventional malicious actions, okay. Intentional malicious actions would be one of those categories perhaps.

Are you suggesting that that might drive whoever is doing the analysis to ignore, to overlook something that would be important?

MR. FARAZ: What I was saying was, I was saying that there might be a lot of reliance given to

the accidents that were identified. For example, if it's overheating of a tank containing liquid high-level waste, the focus might be on that accident sequence itself. For instance, there might be other sequences that might be related to that event where the focus might shift from those areas. So there might be a potential of missing accident sequences that really need to be considered.

MR. CAMERON: Okay. Alex, go ahead.

MR. MURRAY: Yes, I just want to elaborate and agree with the analysis. We seem to be in a little bit of a love fest right now, I think, at the table here.

MR. CAMERON: It's sort of a strange love fest.

MR. MURRAY: A strange love fest, yes.

I do think it is very important for a wide net, so to speak, to be cast for accidents and accident analyses. A very good case in point is what happened at Thorp where they had a leak from a tank. The safety analysis had evaluated and considered the tank being 100 percent full and everything was copasetic when the tank was 100 percent full. The analysis did not consider the tank being half-full.

And for various reasons, the operators

decided, well, we're going to go through some batches and we're only going to fill the tank half-full, and they never put two and two together that this was an unanalyzed situation. And because of that unanalyzed situation, various phenomena occurred which resulted in a leak, and the leak was significant. It's on various websites, various reports are out there, and so forth.

Now there's also a corollary to that, which I think we need to keep in our mind. The plant had, for want of a better term, a General Design Criteria that cells should be lined with stainless steel. Okay, there is no risk-informing basis for that. It is just, hey, this is a good practice; this is something we should do as a minimum criteria.

They did that, and even though 25,000 gallons of highly radioactive materials leaked out, because it went into basically a stainless steel-lined cell, the consequences were essentially nil to the workers and the public.

So you had two parts there. Something where the analysis was incomplete, but where a minimum or General Design Criteria rendered the effect of the incomplete analysis to be essentially moot. And I think we have to keep that in balance as we keep

discussing this.

Thank you.

MR. CAMERON: Okay. Let's go to Steve and Tom and back to Ed, and I think we are getting towards break time here.

Steve?

MR. SCHILTHELM: To go back to what Alex originally said about General Design Criteria or Baseline Design Criteria, whichever you want to call it, I think if you look back in the regulatory history and you look at what we offered, the design criteria can be a broad set of criteria, but it is not a static list. As things are learned, you can add to design criteria. As technologies emerge, you can add to design criteria.

So, if you think of them as a broad set of criteria, not every criteria will apply to every facility. Even in Part 50, I think there are some criteria that don't necessarily apply to both BWRs and PWRs. But if you think of the criteria as your broad set of overarching criteria that is a more living appendix maybe than Part 50 has been, there might be an opportunity there to stay technology-neutral but allow the regulation in the design criteria piece to grow with growing technologies.

If you look at Part 50, technically, design criteria are not requirements; they are criteria to be considered. And you have to describe how they are considered and how they are executed.

And if you keep that concept in mind, there might be an opportunity to have a technology-neutral regulation that has a broad enough set of design criteria that gets you to where you need to be.

MR. CAMERON: Okay. Thank you, Steve.

Tom?

MR. HILTZ: Thanks, Chip.

I just wanted to share some thoughts I had about the conversation this morning and where I know I might benefit from additional discussion, whether it fits in today or at our forum in Albuquerque.

When I read about events or operational occurrences at reprocessing facilities, it seems like almost everything that happens is referred to as an accident. I think it would be helpful to have a common understanding about what an accident is at a reprocessing facility.

My understanding of risk at a reactor is, you know, the accident you are trying to prevent is core damage frequency. Here we may have a series of things that we're trying to prevent or more than one

thing.

But I think it is important to understand that maybe a fire at a reprocessing facility isn't an accident. I mean, you know, a fire at a power plant isn't an accident.

So, as I read the literature and I think as we try to communicate to the public, we probably ought to be very clear about what we mean when we refer to the term "accident". I think we also probably need to have sort of a common understanding of hazards and risks because it seems like we have sort of the discussion, we are still trying to wrestle with, I think, a common understanding of those terms.

I think I'm not sure I see big concerns or big issues with a process that may stipulate certain accidents, whether they are generic in context or, if we're smart enough at the time to write the rule, to be more specific.

I think it is important to understand that we can perhaps develop a regulation that says you have to prevent and mitigate this, these actions, but how you do that might be up to the individual applicant to describe and for the NRC to review and approve.

We have been talking about risk-informed in the context of design. I would encourage us to

think about risk-informed in the concept of operation, too, and once we stipulate something or once we design something, how we are going to use risk to help operate the facility safely.

I certainly would sort of want to understand a little bit more about the stability that I understand I hear from the industry about we need a licensing framework in place. I can't help but wonder whether we need to not broaden that to make sure that it is a regulatory framework in place.

Because if we have such broad generic or general criteria by rule, I think by necessity we are going to have an important place for guidance. Are we sort of mortgaging those discussions so that we can, at a later point in the process, after we get a license, as opposed to providing some overarching regulatory stability, which I think is a bigger subset of the licensing stability?

So those are some of the thoughts that I had as I heard the discussion.

MR. CAMERON: Okay. Thanks. Thanks, Tom.

Let's quickly go to Ed and Rod, and let's take a break.

We want to touch base with the people in the audience, too. But I guess I would ask you to

think about the discussion. We have covered a lot of ground there.

When we come back, eventually we need to get to our scheduled waste agenda item at 11:00. But when we come back, we are going to go to the audience.

I would just ask all of you around the table, what's the most important, salient point that you would like to make on this design operational agenda item? And we will get those on the record and move on from there.

But, Ed, and then Rod, and then we'll take a break.

DR. LYMAN: Thanks.

Just to touch on two points that came up: one, regulations versus guidance, I think we would caution against farming off too many substantive issues to guidance because, first of all, guidance doesn't operate under the same rules of notice and comment as the rule does. And second, most of the guidance these days seems to be written by NEI anyway. Then, by enabling them to write the first draft of every guidance document gives them inappropriate sway over how the outcome of that document turns out. So I would be hesitant about farming off too much to guidance.

Also, guidance documents, there's a bigger chance that they would end up being marked OUO, as in the case with some guidance already. So my concerns about secrecy might be greater in that case.

The second point with regard to cyber security, maybe we should defer this to the safeguards and security discussion, but that does raise the issue of safeguards and security by design. Right now, there is no requirement that safeguards and security issues be considered in the design of fuel cycle facilities. In fact, in the case of the MOX plant, it was the NRC's position that safeguards and security are not designed, should not be taken into account in the design. That was the OGC position.

That's in conflict with the Department of Energy's statements about how safeguards and securities should be fundamentally considered in design. So I would think that cyber security as well as all other potential adversarial tactics need to be considered as General Design Criteria.

Thanks.

MR. McCULLUM: And, Chip, since we do want to get to a break, I will just be very brief here.

The reason I raised my card, I just wanted to compliment Tom on his excellent summary. I think a

lot of what I think are the salient points of this are wrapped up in there.

I agree, I think what we want really is a regulatory framework. I think we want to be as comprehensive as possible because, again, it is in our interest at the front end of decisionmaking to have as much regulatory certainty as we possibly can.

I think we have heard a lot, NRC has gotten a lot of food for thought here. Clearly, there may be a role for guidance, but, as Ed has just said, I think that there needs to be an appropriate balance between what goes in guidance and what goes in regulation. I don't want to see everything mortgaged to some future poor licensee down the road who doesn't know things in the upfront.

And there's a balance between how much we can develop in terms of that regulatory framework without crossing past technology-neutral and how much we can leave in placeholders and things like that.

So I guess my summary, again, I just wanted to compliment Tom for that and say I think balance is the key.

MR. CAMERON: Thank you. Thank you, Rod, Tom.

Let's take a break. Come back around

10:30, have a little bit more discussion on this, including with those of you in the audience. Then, we will move to the waste agenda item at 11:00.

(Whereupon, the foregoing matter went off the record at 10:14 a.m. and went back on the record at 10:37 a.m.)

MR. CAMERON: We're going to try to wrap up here, so we can go on to the waste issue, and Mike Lee is here with us to tee that up for us.

And we're going to go to the audience. But I think Tom, once again, as he did yesterday, sort of gave a nice a summary of what the NRC staff needed. But I would just like to give anybody who wants to volunteer, after listening to that discussion, one perhaps insightful, important to you comment for the NRC staff to consider on this particular area in terms of the technical basis for the rulemaking.

I know that Jim Bresee from DOE has something to say. You don't have to say it now, but you can. Okay, Jim Bresee.

DR. BRESEE: Thank you, Chip.

I wanted to interject a note of optimism with regard to future design criteria. That is that, at the moment, within our research and development program, there's a good deal of active collaboration

between the modeling and simulation staff and the experimental research and development programs that I think offers some real potential for reduced uncertainties in future safety analysis.

I'm, of course, in danger of being overly optimistic, but I think there are tools being developed in the areas of modeling and simulation that, to me, offer some real potential in future systems for a detailed analysis of safety issues.

To the extent that this may provide more incentive for generic standards at the moment, to be modified later by additional criteria coming out of the research area, the one thing that has significantly changed over the past year within the separations areas of DOE has been an extended time table. There is no question that, as between GNEP's ambitious efforts to have commercialization within the next 20 years and the present time table we are discussing, that there has been an extension of our program, and thereby, more opportunity for this type of collaboration I was mentioning to take place, not only on an analytical basis, but on an experimental basis.

We are actively seeking now ways in which improved modeling can be applied to existing plants

allowing us to test their effectiveness, and thereby, provide a basis for pilot plant testing of the same criteria later. I think that this is an area of rather rapid change which could have a significant long-term impact on the NRC regulatory environment.

So I would only offer this note of optimism: that I think our ability to reduce uncertainties in safety analysis has a considerable growth potential in the near-term. I'm saying over the next 10 to 20 years, that this can provide a very effective analytical tool as well as a basis for regulatory design.

MR. CAMERON: Thank you very much, Jim, for that note of optimism and, also, what it means in terms of establishing criteria at this point.

Anybody else want to offer anything, their perspective on the discussion that we had so far?

I'm just remembering Tom's point about we are talking a lot about design, but this is also operational considerations.

Anybody else on this or should we just go to the audience?

Okay, Alex. Okay, go ahead.

MR. MURRAY: Hi, Chip. It's me again.

MR. CAMERON: It's you again, yes. He

sort of pops up out of the box waving his tent. Alex is here. Okay.

(Laughter.)

MR. MURRAY: I will just add one thing that I encourage members at the table, members of the public to keep in mind. Much of the discussion we had this morning did keep coming back to safety and risk analyses, but I think we need to keep in mind and consider that there are minimum requirements for these facilities or there could be minimum requirements for these facilities. I think a very reasonable question is, what are those? What level of detail should be in those minimum requirements, be they General Design Criteria, be they categories of technical specifications, and what have you?

We didn't really get a good discussion of that this morning. So I encourage people to submit written comments on those.

Thank you.

MR. CAMERON: Okay. Thanks, Alex, and perhaps something that we can specifically flag for the Albuquerque discussion, too. Thank you.

Miriam, do we have anybody?

MR. HILL: My name is Richard Hill. I work with ERIN Engineering. We are the largest PRA

firm in the United States and probably in the world.

I thought maybe you would like to hear some comments from a practitioner of PRA. I realize it is not necessarily related to the particular topic, but it has bled over from yesterday.

And I'm letting Miriam hold the microphone because I would like to be able to read my notes, and my Parkinson's will keep me from either shaking the microphone or shaking my notes, and I would prefer to be able to read them.

So PRA is both quantitative and qualitative. That is the definition that is given in the ASME standard for PRAs. It is an ASME/ANS combined standard. We have to realize that it is both qualitative and quantitative.

So ISA really isn't under the umbrella of a PRA. I don't want this PRA to be a big, bad boogie man that scares everybody because it's not.

An ISA is simply a little more qualitative. We used SMAs, Seismic Margin Assessments, for a long time, and still are using Seismic Margin Assessments for seismic events and gaining risk insights out of those. That's a qualitative assessment, more qualitative than a full seismic PRA.

So, just with that concept in mind, risk insights are obviously able to be drawn from an ISA, and that's appropriate. And those insights can be used in design as well as in operation. And those are comments that were made.

PRA capability or ISA capability is going to be dictated by several factors, one of which is the lack of conservatism in the more realism you have. For assessing the capability of a PRA, you have to have it be realistic. The more conservatism you put into it, the less capable it is. This is very clear in the ASME and ANS standards, which the NRC has recognized and endorsed in Reg Guide 1.200.

Also, completeness needs to be in there. The more complete the evaluation and the assessment, the better the capability of it. So the comments that I heard about using conservatisms, that's appropriate in deterministic design. It's not appropriate in a PRA or in an ISA.

In general, the PRAs that are being performed have metrics of core damage frequency and large early release frequency. Those are for reactors. Those do not make any sense. Those are for Light Water Reactors. They do not make sense for gas reactors, and we are in the process of trying to

develop a standard for doing PRAs on gas reactors where there is no core melt, and it will go directly to a release. And you come up with new metrics.

It is very difficult, even though we have a lot of experience with reactors, to try to develop a highly-quantitative approach for a metric of radiation exposure to workers or to the public or chemical exposure to workers or the public. It would be very difficult. It would be difficult to try to just jump right into that.

So my recommendation from a PRA practitioner's standpoint is start with something you already have, you already know, which is the ISA, which is the more qualitative PRA, and then work as you gain more experience and more capability to a more quantitative approach.

So that's my comments. Oh, and one other comment, I guess.

You have been talking about aircraft impact analysis. I am looking forward to that because our firm also developed the methodology for the Bravo Five Bravo evaluations post-9/11 of aircraft and large fires and explosions.

We did evaluation for all of the plants in the United States. We did the methodology and the

application of the RAMCAP evaluation for the Department of Homeland Security that NRC has looked at. We are also doing the evaluation for almost all of the aircraft impact assessments for new plants. So I would like to get into that little subject, if you get there.

Thank you.

MS. JUCKETT: Thank you.

Other public comments?

MR. LYONS: I'm John Lyons. I work at Westinghouse, but I don't represent them. These are all just my views.

As for Alex's comment on minimal requirements, reprocessing, I feel like you guys are leaning toward reactor. I feel like it should be more chemical-based because that's all what reprocessing is.

So we have lots of experience with aqueous reprocessing and non-aqueous, or not reprocessing necessarily, but chemical processes. For example, the Bhopal disaster, that was non-aqueous.

Sorry, I'm a little nervous.

But I feel like we have disasters with leaks and other things that are chemically very hazardous, and you could take from that and use those

minimal requirements to lean towards the nuclear side as well, because this is all chemical. I mean there is coming out of the criticality risk and self-heating, it's all chemical. And even with self-heating, we have exothermal reactions that are also self-heating. So, as for minimal requirements, I feel like we should go towards the chemical side of it.

And that's all I have. Thank you.

MS. JUCKETT: Any other comments?

(No response.)

Okay.

MR. CAMERON: All right, thank you. Thank you, Miriam.

Let's get into our next topic, which is potential waste management issues for reprocessing facilities. We have Mike Lee from the NRC staff or? You can't say the whole thing, either. No one can. We're all challenged on that. Okay, so maybe someday. It's just as well we didn't have that on this transcript.

Mike Lee, go ahead, Mike.

MR. LEE: Thank you, Chip.

Good morning. Thank you for the opportunity to address this group of people here today.

Let me say, from the outset, I'm "the beard". I represent a team, and this team is focused on two of the gaps that many of you may already be familiar with in terms of the reprocessing effort underway related to the definition of what incidental waste might be and then how to classify it.

Part of the team that I participate in is also represented by Phil Reed, who is here today, as well as Wendy Reed. Nishka Devaser, who is also in FSME, isn't here today, but he's also part of the team.

One of the challenges I have been hearing over the last day or so is there is a strong desire to write a technology-neutral rule. But in developing that rule, one of the issues that needs to be addressed is the waste stream that comes out of this, any reprocessing effort.

Historically, the wastes have been defined by exclusion or source. There's histories that have been written on this by Kocher, Croft, Lowenthal. Most recently, Mike Ryan of the former ACNW wrote a history, I think, in NUREG 18.53 which reviews how the waste classification, respective waste classification systems have come about, focusing on high-level waste, spent fuel, TRU, greater-than-Class-C, low-level

waste, and most recently, DOE waste incidental reprocessing.

I think if you look at the old Federal Register notice related to definition of high-level waste or greater-than-Class-C, one of the things the Commission noted is that the regulatory definition implies a manner of disposition. So, if you define waste in a certain way, that implies it is going to be managed in a certain way.

And one of the challenges, like I said before, that the team has is to get its arms around what kind of waste might be coming out of a reprocessing facility. Then, after you have an appreciation for the quantities and concentrations and physical properties and the like, then what's the most appropriate way to manage those wastes?

So I think it has been said repeatedly that the staff is still collecting information. There's no particular view on how incidental wastes are to be disposed of or how they are to be defined.

So I have before you a series of slides that are only intended to promote discussion, and they are only intended to be representative of just an example that we currently have of how a reprocessing facility works and the type of stuff that comes out of

it.

So, if we can go to the next slide, please?

As I mentioned before, the staff is interested in developing a rule that is ideally technology-neutral. But, nevertheless, the only reprocessing process I think that is currently in place or has been demonstrated is the PUREX process.

This slide is just to point out a couple issues or aspects of that process. I would just like to skip to slide 3, which I think is where the action is, which is a mass balance type of arrangement.

And if you look at the lower righthand side of the slide, those are the types of waste streams that currently, I believe, come out of the PUREX process. And if we were to look at those waste streams, the existing regulatory framework is adequate in classifying those waste streams.

So you know that, for example, high-level waste is managed under 10 CFR Part 60 and Part 63. Greater-than-Class-C is currently recognized under 10 CFR Part 61, which is NRC's low-level waste regulation, but defers to DOE to manage those wastes.

And those wastes are to be disposed of, I believe, in a deep geologic repository or in a

facility approved by NRC, or the waste can be low-level wastes, which are currently managed under 10 CFR Part 61.

Just as a footnote, the Commission has directed the staff to identify some ideas or proposals on how it might risk-inform Part 61, if it was to start over again. So, in some ways, the low-level waste regulation, which may be the workhorse, if you will, for the management of reprocessing wastes, may be undergoing some revision or proposed suggestions for revision over the next couple of years. So I think that is just something to kind of keep in mind.

Moving on to slide 4, the waste streams that I alluded to in the previous slide are primarily either high-level waste or low-level waste or non-high-level waste, if you will. And as we have already mentioned, there's a framework in place for managing those wastes.

Currently, that framework, again, just by virtue of its history, low-level waste, for example, is everything that is not high-level waste or not greater-than-Class-C waste or not TRU and not spent fuel. So you have kind of this patchwork of regulations, if you will, that provide management solutions for the various waste streams.

On slide 5, this is just some language from existing NRC regulations that talk about what high-level waste is and what spent fuel is. This information is available on the web and in the Code of Federal Regulations. It's pretty straightforward.

Moving to slide 6, if you look at the PUREX process, there's waste streams -- I'm not a chem engineer; many of you are, I'm sure, and know more about this than I do. But these are the types of wastes and materials that are likely to be subject to some kind of disposition.

So, as the staff gives consideration to what might be included in a reprocessing rule with specific reference to these waste streams, this is fodder, if you will, for consideration.

Moving to slide 7, of course, there's going to be some low-level waste or low-level-like wastes. And this is an example or these are examples, if you will, of the types of products or waste streams or materials that might be managed under a Part 61 type of disposal regulation.

Slide 8 is just a continuation of examples of additional materials that may need disposition paths, and therefore, they will need to be classified in any reprocessing regulation, we believe.

So slide 9, as I said from the outset, is -- and some of these points have been discussed earlier; some of these points are currently under consideration by the staff in other regulatory context.

So, I don't know, Chip, how you want to proceed with this. Start with the roundtable, I guess, or I guess maybe I should ask Wendy or Phil if they have anything else they want to offer before we move along.

MR. CAMERON: Wendy is right back there.

MR. LEE: Raise your hand. There we are.

MR. CAMERON: Hi, Wendy. Phil?

MR. LEE: I would encourage, though, if anyone has any views regarding things that the staff should think about as we give consideration to how to classify these waste streams or waste streams that may come out of a reprocessing rule, I believe there's a docket. We would encourage you, in addition to any verbal comments you give us today, to send us your written comments.

MR. CAMERON: Thanks for that, Mike, and we have some issues there. But what's the biggest challenge facing the NRC staff in terms of what they need to have in a rule in terms of waste management

from reprocessing facilities? Can you tell people a little bit specific about what are you people wrestling with?

MR. LEE: And I would ask Phil and Wendy to pitch in on this as well. But I think one of the biggest challenges is, given that we really don't know which chem engineering process or fuel cycle process the rule is going to be developed around or what it might correspond to generically, it is hard to get a feeling for what types of waste streams specifically would be subject to regulation. I don't know if I put a sharp enough edge on that.

But, Phil?

MR. REED: I think that summarizes the overall picture. I think the practicality is just getting down to the definitions, like a definition of where, you know, high-level waste, but it is not suitable for a repository; therefore, where does it go? If it meets Part 61 requirements, well, fine, you can put it into a shallow-land burial, things like that.

I think the other thing is specifics. What kind of waste comes from the AREVA processes versus the Energy Solution. Now we tried to address this in our first Commission paper. We actually had

the two types of reprocessing, the type that would go for the MOX facility, for example.

But if you go to the type of a detailed reprocessing, such as industry would like us to do and which they mentioned at the last public meeting, then it becomes a little bit more difficult because, then, you go down and you start separating on the cesiums, the strontiums, and the lanthanides, TRUs, and things like that. It gets a little bit more difficult.

We don't have a good feeling of what the specific radiological components would be if we processed waste from, say, an 850-megaton-per-year facility using high burnup of, say, 60,000-megawatt days per metric ton.

When it comes to the pyrochemical processing, there's a little bit more in there because we do have a fairly good idea of the two streams that come out. You know, one is going to be going to ion exchange, and it is going to be solidified, and the other one is going to go to a metallic. We have a little bit of understanding of that.

But it basically comes down to what stream, what specific radionuclides go into that, and then, of course, the regulations and the guidelines that go into it to ensure that we have the stability

and things like that.

MR. CAMERON: Go ahead, Mike.

MR. LEE: If you look at existing Part 61, that regulation was predicated on some assumptions regarding waste streams at the time, which was the early eighties, late seventies, early eighties. The staff looked at 36 waste streams, and from that evaluation, they identified 24 radionuclides that would be of interest. And 12 of the 24 radionuclides actually form the foundation for the waste classification tables and the system that Part 61 is developed under. There's a Class A, B, and C, and then radionuclide C waste.

In this case, though, like Phil said, you are really not sure what kind of waste stream is going to -- it's all technology-specific. So one of the challenges to the staff is to try to hypothesize, you know, given this variety or this collection of technologies, you can hypothesize a series of waste streams. Then you can set up a regulatory definition that is bounding. There's a lot of ways to deal with that.

MR. CAMERON: So you need to know the waste streams, but you also need to figure out, what are the characteristics of those streams that would

put them into one way of disposal versus another way of disposal?

Phil, I'm going to come back to you. Keep your tent up.

But let's go to Rod and Jim and John. Rod, you may be able to put a finer point on all of this from an industry point of view.

MR. McCULLUM: Yes, again, in the vein of technology-neutrality, I guess I want to try to put a challenge to the staff here.

Going back to risk-informed, performance-based, starting with understanding of the hazard, and I think you had one bullet up there that said the scheme we have now is largely origin-based as opposed to hazard-based.

If you go back to that, and the challenge I want to try to bring forward here is, is it possible, without having to know the specifics of the process stream or the specific technology, to develop something useful here that we can provide assurances of public health and safety?

Taking it back to the hazard -- and, remember, you're looking at understanding hazards and understanding what must come between the hazards and the people and the environment you're trying to

protect. That's really the nature of what we're trying to do here.

In this case, the thing that's coming between the people and the environment and the hazard is some form of disposal, be it a geologic repository or a Part 61 type of facility.

So, if you start with understanding of the hazard, is it possible that the staff might be able to define a hazards-based approach that would prescribe a methodology for classifying waste that an applicant could then use to classify the waste in accordance with that methodology? And thereby, you do not have to yourself wait for the knowledge of the process stream.

I guess I would like some feedback on that.

MR. CAMERON: Okay. Thank you, Rod.

Jim?

DR. BRESEE: I am quite sure the NRC staff is looking hard at the issue of changes away from origin-based. Just to cite the famous example, under current regulations if you did a rather complete separations process and were able to isolate, for example, the uranium stream from all others, there are processes that will allow that. The uranium would be,

which from a risk standpoint a relatively low-risk material for handling, would still be classified as high-level waste under its origin, which is from the particular process parameters.

I also wanted to be sure that in the effort to be technology-neutral there are some consistencies which can allow rather specific analysis early on. One doesn't need to wait for the final technology.

Virtually all processes, whether they're pyro or aqueous, will need to deal with gaseous wastes and, in particular, with krypton. Krypton will be an issue essentially technology-independent because of its chemistry.

So the current krypton regulations, which are based upon a reactor-based economy rather than a separations-based, have the opportunity for considerable improvement. You have the advantage, of course, of a fairly short half-life, an 11-year half-life for krypton-85. So that it becomes much less significant if you're dealing with 50-year-old waste, on the one hand, or short-cooled materials, which has been proposed as a way of handling other problems.

A short-cooled, less-than-five-year-cooled process takes advantage of less decay from

plutonium-241, and therefore, reduced hazard associated with americium-241. So there are certain pressures pushing you in the direction of short-cooled processing, but, then, that raises the issue of krypton as a potential hazard.

So, along with krypton, you will need ways of dealing with iodine-129, carbon-14, and tritium. I will just leave those as gaseous issues that will require some special analysis.

MR. CAMERON: And, Jim, all of these, the krypton, the iodine, the carbon-14, the tritium, those are common to all processes. So the staff knows that, no matter what the process is, they are going to have to address those?

DR. BRESEE: Yes, and fortunately, there are some new and rather interesting approaches from the standpoint of actual management of the materials. Those new approaches, metal-organic framework, and so forth, are issues that require a lot of close collaboration between the technology development area and the regulatory area. So we will continue to work closely in that area, too.

MR. CAMERON: Okay. Thank you.

John?

DR. FLACK: Yes, I mean the krypton issue

is a real showstopper. I don't know where EPA is on that right now and whether there's anybody in the room that is from EPA. There is?

And has there been any new developments in that area? Because that is a very important area to deal with, as Jim mentioned. And a lot of it may be right now in EPA's ball park.

So can you speak to that, anyway, on that?

MR. CAMERON: Do you want to speak to that, is the question.

(Laughter.)

EPA is in the process of developing perhaps changes to 40 CFR 190, but whatever you can say. Thank you.

MR. LITTLETON: Brian Littleton with the EPA.

Just a brief statement in this sense: that we are looking at the issue, conducting studies and conducting analyses on it, and we hope to come out with, I guess, some sort of direction in the near future. I think that is the quickest way of addressing it.

MR. CAMERON: Okay. Thank you, Brian. And we may revisit you again this afternoon when we are talking about environmental factors.

So, when you said krypton is a showstopper, what did you mean by that? It was important or it's a showstopper?

DR. FLACK: Well, if the criteria is made such that the technology can't support meeting it, I mean, what do you do? The technology has to be capable of dealing with the issue. If it doesn't, then it's like having a plane that is too heavy to fly, basically. That is the part that we are really trying to come to grips with.

But I understand that EPA is looking at this. So I guess it is in the pipeline.

The other question I had was, how important the last bullet is, and whether or not the staff is actually looking at that with respect to, say, you know, international experience and the need for this classification.

MR. CAMERON: Well, go ahead, Mike.

MR. LEE: Yes, thank you. Oh, I didn't see the red.

A couple of points. One, gaseous releases are covered under EPA's NESHAPs. So I'm not that familiar with them, but they concern radionuclide or gaseous radionuclide effluents. I am not sure the extent to which krypton is addressed in those. So I

speak to ignorance in that regard.

But the point that Rod was making -- I will get to this other bullet in just a second -- is that, under Part 61 right now, you kind of have an implied ceiling on low-level waste. It is 100 nanocuries per gram concentration, I believe, and then there is also an intruder, implied intruder dose limit. So, to a certain extent, you have ceilings, kind of a tiered ceiling, if you will, to the classification of the wastes.

Interestingly, the effluent from a reprocessing facility is not waste until it is actually on its way to some disposal facility. So one of the issues that is going to have to be addressed I believe in the rule, or at least given some consideration, is possibly a pre-processing step. And that pre-processing step in terms of stability and handling and things like that might be necessary in order to make the waste form, whatever it may be, and whatever concentration it might be acceptable to some disposal facility Waste Acceptance Criteria.

DOE facilities, for example, have site-specific Waste Acceptance Criteria, WAC. So you already know in advance what the facility is capable of handling based on some, I don't want to say

performance assessment, but some kind of analysis tells you what the facility can handle, based on a contaminant fade and transport calculation or an intruder dose scenario, or something like that.

So, like I said before, depending on what the waste stream is and how it is processed, it is going to be an integral part of the definition of the waste stream and how it is managed in the context of some disposal scenario. So these are the things that the staff have to come to terms with.

The last point, I am having a senior moment. The caffeine hasn't kicked in.

Oh, yes, I don't want to steal Larry Camper's thunder, who is the Director of FSME, but one of the issues or one of the challenges that the staff has been given by the Commission is to look at how we might risk-inform Part 61 if we were to look at it from a position of tabula rasa, for those Latin students, a clean slate.

If we were to go back and redo the low-level waste regulation, how would we go ahead and recraft it, taking into account a more risk-informed, performance-based approach?

The International Atomic Energy Agency, IAEA, I believe has a geologic Safety Guide 1. And in

that Safety Guide, they have a table that looks not unlike what you might see if you were looking at a pressure temperature diagram, for those of you that might have a thermodynamics background.

But it is broken into areas. High-level waste is one of the areas. They have a de minimis threshold. They have intermediate and low-level wastes, and then they have decay and storage. That certainly is an option that the staff is going to consider as it reports back to the Commission.

But it provides a useful framework, I think, for looking at a reprocessing facility and thinking about ways to not only manage the waste, but, also, how they might be classified.

MR. CAMERON: Do you need these other rulemakings to be final before you develop this regulation and how it is going to treat waste?

MR. LEE: I've got to be careful of how I answer that. I mean this is just --

MR. CAMERON: I think people would probably be curious about what the relationship is, I guess is my question.

MR. LEE: I would defer to Alex. Do we have a timeline for this?

MR. CAMERON: We'll defer to Alex. We'll

go to Alex right here.

MR. LEE: No, he just needs to give me a year, and then I'll answer your question, I think.

MR. CAMERON: Go ahead, Alex, whatever you wanted to say and whatever you want to answer on this one.

MR. LEE: Sure. Okay. I mean I can answer the question. I just need to know what the timeline is because the Commission, the other piece of the information or we've gotten direction we've gotten from the Commission, is that if we were to do a low-level waste revision, that revision isn't to start until fiscal year 2013.

So the potential for amending the regulation in the manner I have just described or suggested, which is just one way of doing it, is a little bit down the road.

Alex?

MR. MURRAY: Yes, I was just going to mention from yesterday's overview presentation, the date for final rule for reprocessing was identified as 2015, assuming resources would be available to do the work.

MR. LEE: The only friendly amendment I would offer is that currently the Part 61 reg, I'm not

saying that all reprocessing waste is going to be managed in a Part 61 shallow-land burial type of disposal scenario. But the current definition of low-level waste is everything that the waste is not.

It's you have high-level waste, which is defined by the Atomic Energy Act, and it's incorporated now by reference in Part 61 with some fine-tuning. You have TRU waste, I mean these other -- if you're going to reshuffle the chairs on the deck, you need a lot of horsepower and a lot of alignment, and I think some help from Congress.

So I think, in our own little way, the existing Part 61 regulation with amendments might be a comfortable way of managing this waste stream or these streams.

MR. CAMERON: Okay. Thank you.

I'm going to go to Ed now, and then come back to Phil and see what he can add to this. Ed?

DR. LYMAN: Yes, I would just like to point out, rather than miss the forest for the trees, I just want to back up a little bit and point out that, according to the information that was presented on the slides, that the total volume of waste, including high-level waste, greater-than-Class-C, low-level waste, and processed uranium, would increase by

about a factor of four over the volume of the initial spent fuel.

What you are doing is exchanging a problem with disposing spent fuel in a geologic repository we don't have with the problem of disposing of high-level waste in cladding holes in a geologic repository that we don't have, disposing of a significantly increased volume greater-than-Class-C waste in a repository that we don't have to disposing of a significantly greater volume of low-level waste in facilities that we don't really have, and a whole bunch of reprocessed uranium that is going to sit around because there isn't any defined disposal pathway for that material.

So, in this context, I would say that it could possibly have an implication for the waste confidence. Frankly, I would think that, if there was a serious push for a reprocessing plant, it would seriously call into question the Commission's ability to say that they have confidence that they are going to be able to dispose of all these multiple waste streams.

MR. CAMERON: Okay. Thank you. It is good to get back to the forest.

Phil?

MR. REED: I just wanted to make two

points. The first point I would like to make is, if you remember Alex's presentation where he talked about a couple of regulations that were published back in the 1970s but were subsequently rescinded, well, in the current Appendix F to Part 50, that's the reprocessing regulation, there was a forerunner to that regulation, which was Appendix D.

Now Appendix D in the last paragraph, I guess the second-to-last paragraph, talked about hull disposal. But the last paragraph essentially talked about what we would consider today to be low-level waste disposal.

And that regulation provided specifics. It talked about ion exchange resins. It talked about DAW-type waste. It talked about the tools, and essentially large volumes that have essentially small amounts of radioactivity, which would supposedly be buried at that time in 20.302, which today was the forerunner of 10 CFR Part 61, but that was removed.

I think by that removal, that made life a little bit more difficult for us. If that regulation or that subsection had remained today, I think that would have clarified a lot of the issues regarding low-level waste, and particularly WIR. And as a result of us not having that, we are having to

struggle to redefine it.

The second point I wanted to make was what Mike had alluded to with regards to 10 CFR Part 61. I think it is becoming clear to the staff after we are doing a few analyses, and admittedly we have to do a lot more, that there may be some radionuclides that are in the reprocessing streams which could conceivably end up in low-level waste that are of large volumes and small amounts of activities.

However, Part 61 does not cover all the radionuclides. So, essentially, if you are disposing radionuclides in Part 61 that may be considered a low-level waste, it would essentially go into Class A. And Class A means that you can put as much as possible in there.

Well, we would like to refine that analysis, and if there are radionuclides that are going into the low-level waste site on Class A, we would like to make sure that maybe they should be Class B or C. They should be stabilized as opposed to just a priori putting them under Class A.

The other thing is that it does look as if an operating reprocessing plant would generate similar radionuclides that are already in Tables 1 and 2 for Part 61. Particularly, they would then be classified

as low-level waste.

It covers the activated metals. Even the transuranics are listed to be disposed in Class A. But a number of radionuclides that we already see over there could easily be disposed of today under Part 61.

MR. CAMERON: Is the Appendix D that you mentioned, you said it would solve a lot of problems. Is there some thought that the new rulemaking would resurrect some of the aspects of Appendix D?

MR. REED: I don't think we have approached it that far. We are just in the initial part of our analysis right now. We have just made the observation. We have not made any recommendations or discussions yet.

MR. CAMERON: Okay. Arjun? Use your microphone, please.

DR. MAKHIJANI: Just a factual question for Mike before I make my comment. I don't see decommissioning waste in there in your streams. Am I right or is it buried in there somewhere that I have not seen?

MR. LEE: I am going to pass the ball to Alex because Alex put this together.

MR. MURRAY: Decommissioning waste is not on that slide. That is strictly operational.

DR. MAKHIJANI: Okay. Because I strongly recommend that you have a decommissioning waste stream there. First of all, you have got to have financial guarantees for your decommissioning waste as part of your licensing process.

I think decommissioning a large, commercial reprocessing plant, which has not happened to my knowledge yet, is going to be a major headache. The only experience we have with that is at West Valley, which was, I would say, more than a major headache, a $32 million plant that cost what, $5 billion to decommission, something? That ratio might change over time, one hopes, with some learning, but you need to add the decommissioning waste.

Now Part 61, my favorite part of the NRC lexicon here, in my reading, actually, of Part 61, if you don't have radionuclides in Table 1 or Table 2, if it was covered in the EIS, then it could be Class A. But this idea that you can stuff everything in the (a)(6), 61.55.(a)(6), and say it's Class A is not right because it needs to be read as English. It may be a mistake, given lawyers' interpretation, and I'm not a lawyer. I was told that it was a mistake to read it as English.

If it has radionuclides that are in Table

1 or Table 2 and radionuclides that are not in Table 1 or Table 2, then 10 CFR 61 is actually pretty sloppily written. In my reading of the rule, a situation like that, would be typical for waste coming from a reprocessing plant, could not be classified as Class A waste under the rule.

The rule is silent on whether it could be classified as Class B or Class C waste because there is no catchall category for Class B or Class C waste. In fact, under the rule, a mixture of radionuclides that are in Tables 1 and 2 and that are not in Tables 1 and 2 is currently not classified, in my opinion.

I revisited this in light of all the controversy that happened after our October Depleted Uranium Workshop, which is a group that Mr. Camper is leading, because depleted uranium is over contaminated with other materials that were shipped from DOE to Utah in a subsequent period, and I got involved in that.

I think if you are going to rewrite the low-level waste rule, it needs to be done before you have the complications of a reprocessing plant, keeping in mind the complications of a reprocessing plant.

For example, if you look at that Table --

I'm sorry, I am going to hold you for a little while on this because I have spent a good bit of time teasing out these questions. I haven't written any official history, but I have certainly written non-government reviews of it more than once.

If you look at the reprocessed uranium column, this is what the Department of Energy was trying to escape from. And I was told, actually, that the Savannah River Site doesn't do reprocessing because it is separating target materials for plutonium production and saying, okay, in my definition, this is reprocessing, what goes on in F-Canyon at Savannah River Site. I was officially told this.

Now if you take that reprocessed uranium today, which is not classified as a waste by DOE, most of it will become a waste, even if you use it, because it will have to be re-enriched, and 85, 87 percent of it will wind up as contaminated depleted uranium.

You are trying to deal with it in that other, you know, stream of regulatory reform, which Mr. Camper is leading, but they haven't even begun to define contaminated depleted uranium and where it fits.

I think in the context of waste, I would

seriously disagree with what -- I can't see the name of the gentleman from the DOE. While uranium may be regarded as not so much of a problem to handle, it is a problem material as a waste because of its long half-life and the buildup of its decay products.

And that is why you get into all of the headaches with large amounts of depleted uranium from enrichment plants. You are going to get into the same headaches with large amounts of depleted uranium or reprocessed uranium for direct disposal.

I think you really need to settle -- and there will be some common questions -- you really need to settle these questions before. I also think this whole idea that it isn't waste until it's on its way to a disposal facility is a legal artifact that has nothing to do with the protection of the public health.

I mean, currently, if you look at the discharges from La Hague or Sellafield, if you take that discharge pipe and put the stuff in a barrel, and take the barrel on a ship and throw it overboard, it would be illegal under the London Dumping Convention. But because it comes out of the pipe and is called a discharge, and it isn't a waste until it's on its way to a disposal -- well, a pipe is a disposal facility.

That is how that liquid waste is disposed of.

And you cannot simply say that effluents are taken care of by existing rules when reactors have three orders of magnitude less emissions than reprocessing plants. You've got three orders of magnitude more, four orders of magnitude more emissions to liquid waste streams from a reprocessing plant as a reactor, and you can't pretend that it is simply not a waste just because it comes out of the end of a discharge pipe.

I think we have to get rid of the legal artifacts and actually focus on the health and environmental issues. And there are just a vast number of them.

I said in the depleted uranium thing, and the Chairman of the NRC had said that in regard to depleted uranium: you've got to revisit the rule and not just stuff under some modification of 10 CFR 61.86. I would strongly advise against that. I think any suggestion that you could hide reprocessing waste under legal artifacts of 10 CFR 61.55 would be really wrong.

First of all, 10 CFR 61.55 doesn't cover many of the waste streams that would come out of a reprocessing plant, in my opinion at least.

MR. CAMERON: Okay, thank you. Thank you, Arjun, for all of that.

Rod, you have heard comments around the table.

And by the way, it is Jim Bresee from the Department of Energy down here.

DR. MAKHIJANI: I couldn't see your name.

MR. CAMERON: There's an introduction going on, for the record, exchange of business cards.

(Laughter.)

Okay, great. Thank you.

MR. McCULLUM: I'm glad this figure got called up. I will thank Ed for bringing that figure back up, although I will not agree with him in this case.

This figure is, to me, an outstanding example as to why technology-neutrality is important here and why it is important not to regulate based on knowledge of a given waste stream from a given technology.

That is a figure that depicts one particular technology at one particular point in time. I notice there it says that this was May 16th, 2007.

And it also depicts that technology based on how much waste you get out for a given amount of

spent fuel that you start with.

The first thing, I want to talk about time and I want to talk about looking at this as a per-energy basis, as opposed to a per-metric-ton-of-spent-fuel-you-start-with basis.

I have heard several presentations from the company that does PUREX over in France about how they have made improvements in their waste stream in recent years, since 2007. They are constantly refining and improving this.

I have heard presentations from that same company about evolutionary technologies, as to how the facility they might build in the United States would be improved yet again.

And there's a gentleman from GE sitting down there at the end of the table looking at this figure who is probably thinking of what his own waste stream looks like, and might at some point make the case that he has an even more improved waste stream in his facility.

So to key a regulation on knowledge of a given waste stream kind of takes away one of the purposes of the regulation, which is to assure safety and to promote safety, in that by putting a methodology that would encourage the classification of

waste, WIR, low-level waste, high-level waste, that would drive continuous improvement in the waste streams, that would seem to be in the best public safety interest of getting us to where we want to go here and helping us make responsible decisions. So, you know, I would not look at this as a snapshot in time.

Another thing, when you make the argument that, well, this proves that there is more waste coming out than going in, remember, this is per a certain amount of spent fuel to start with. You're also getting out a certain amount of MOX from which you will derive more energy. Different processes get things out other than MOX and in different quantities and drive more energy.

Again, if you were to prescribe a methodology for categorizing waste that would encourage the utilization of it -- oops, my figure just went away. I mean you look for terawatt hour of electricity; you see a different story. We are not having to generate as much spent fuel because we are using some of the energy that is already in the other spent fuel.

So I would just discourage using -- this is the reason why I would discourage basing the waste

classification scheme of the regulation. And I'm agreeing with some of the stuff I heard around the table. There are needs for improvements. There are probably things in Part 61 that aren't addressed, and so on and so forth.

And this is an opportunity. We said at the very beginning here that we may be looking at parts of the regulation other than Part 7x, or whatever we're looking at.

I just want to close before I get too long-winded here. Now that I have discussed this, if we could move to that last slide, the one that posed the questions?

Every other discussion we have had we kind of just discuss and we don't really go down the points, but those are some excellent points here. And it gets me to something Arjun just said about taking on this notion of it's not waste until it leaves the disposal facility.

There is something in there, onsite storage to allow decay. The reason it is not waste until -- excuse me -- it leaves the recycling, is on the way to the disposal facility, is because the very nature of this material is radioactive. That means it has radioactive decay. That means it becomes less

radioactive with time.

One aspect of recycling could be to keep it in the facility until some isotopes have decayed, so now they don't have to become waste. So you have an aspect of this regulation here, and this hints at that, where you're talking about onsite storage of four things in the first part.

We would encourage this regulation to very much address when it's integral to the process to store, that's part of your facility that needs to be addressed in this regulation. Then classify what comes out the back end of that in a way that is technology-neutral.

But certainly, integral to a recycling facility, decayed storage could very well be part of it, and the regulations should provide for that.

Thanks.

MR. CAMERON: Mike?

MR. LEE: Three points. One, the earlier comment regarding the waste acceptance or waste confidence decision is in reference to nuclear power reactors. John Garrick's name has been used over the last day or so, and he was always in favor of a waste confidence evaluation in the context of the full fuel cycle.

So one thing that this rule, if and when it goes out for public comment, could be a request for comments on, is it appropriate to ask to implement some kind of provision, if you will, in this regard, making it incumbent on the Commission or the staff or somebody at the NRC? I think that is something that the staff should consider as part of its deliberations in the future.

The second thing is reference was made to depleted uranium and the Waste Classification Tables and how the regulation currently reads. Basically, if you are not one of the 12 radionuclides listed under Table 1 or Table 2 of 61.55, you are default Class A.

That is a decision that came out of the LES adjudication, and the Commission voted on it. So it is not the staff's decision; it's the Commission's decision. So there are certainly many ways to interpret the regulation independent of the LES decisionmaking. But, as of today, the law of the land, if you will, is the LES decisionmaking. So, until that changes, it is what it is.

The staff is currently involved in a limited rulemaking to Part 61 to impose an explicit performance assessment requirement that would be used to evaluate whether DU or any other waste stream

that's not covered under Part 61 explicitly might be acceptable for disposal in a shallow-land disposal scenario. It is not saying it can be.

The rule, which is going to go out for comment, I think, in about a year, asks to be used to evaluate whether or not DU and other, for lack of a better word, unique waste streams might be suitable for disposal under a Part 61 type of paradigm.

The other comment, and I tried to allude to this earlier, is that Part 61 is predicated on 24 radionuclides, based on 36 waste streams, and the regulatory arrangement, if you will, says these radionuclides under these disposal configurations can be managed safely in a shallow-land burial environment.

But the notion that anything that is not high-level waste or not spent fuel or not greater-than-Class-C can be disposed of in that manner I don't believe is appropriate. There are other alternatives to shallow-land burial. There's enhanced engineering facilities. There could be intermediate depth disposal.

If you go back and read the statement considerations for Part 61 and the public comments on both the draft and the final EIS, the staff and the

Commission acknowledged that there are other ways of managing, ways that could be low-level waste, but not consistent with the waste classification scheme under Part 61.

So, I just wanted to get that out on the table. It probably takes more time to explain it, but there are other low-level wastes out there other than Part 61 characteristic low-level wastes, if you follow my meaning.

MR. CAMERON: Okay.

MR. LEE: What the longer-term rulemaking is intended to evaluate is, in addition to shallow-land burial, are there other waste streams out there in the foreseeable future that might be amenable to disposition in other than a shallow-land burial scenario?

MR. CAMERON: Okay. Thank you. I think you piqued Arjun's interest.

Arjun?

DR. MAKHIJANI: A couple of things.

I was referring to the DOE waste that was sent to Utah. It was not covered by the NRC LES license because the NRC LES license proceeding covered depleted uranium from natural uranium feed. It did not cover contaminated depleted uranium.

That is depleted uranium that also contained radionuclides in Table 1 and/or Table 2. That has not been addressed explicitly at least, certainly not in the LES proceeding. I was a part of that for the interveners.

Secondly, I think my understanding of the LES proceeding is not the same as yours. The NRC did say it was low-level waste, and we have acknowledged that.

However, in regard to Class A waste, the NRC said two quite different things. It said, it acknowledged that, when it's not there, when it's not specified in Tables 1 and 2, it is Class A waste. But the NRC also explicitly acknowledged that large amounts of depleted uranium from enrichment plants were not covered under 10 CFR 61 and directed the staff to engage in a special rulemaking for large amounts of depleted uranium.

So it is completely wrong for the NRC to insist, subsequent to the LES decision, that somehow large amounts of depleted uranium are covered under 10 CFR 61 as Class A waste. It is completely wrong.

And in fact, the whole rulemaking and the vote of the NRC Commission, to which the present Chairman dissented, to change 10 CFR 61, however you

want to characterize that change, recognizes that large amounts of depleted uranium are not covered under the existing rule. Now whether they would be classified as Class A, ultimately, or not is a different matter.

But to take a stand currently that large amounts of depleted uranium were classified under the LES process is simply factually incorrect, and I would like a comment on that, just for the record, so it is at least straight as to what the NRC said, as represented by the NRC staff in this room, is not misrepresenting the NRC LES decision.

Thank you.

MR. LEE: I'm the wrong guy to go to. First of all, I'm not the right guy to go to on this particular subject in this level of detail.

DR. MAKHIJANI: But it was your representation about what the NRC said in the LES. So maybe you should withdraw that representation.

MR. LEE: All I said --

MR. CAMERON: I think that perhaps this has been ventilated enough at this point. What you're trying to say, Mike, is that maybe you are not the staff person who has the best knowledge of this.

MR. LEE: Well, the staff has underway a

rulemaking, consistent with Commission direction, right now to introduce a performance assessment requirement to Part 61. That performance assessment requirement would be used to, among other things, establish a baseline requirement for all currently-operating low-level waste disposal facilities.

In the matter of the Clive facility, the imposition of that requirement I believe would be used to evaluate whether or not the Clive facility could receive large quantities of depleted uranium for disposal under Part 61. That's the staff's efforts right now. That's what we're doing.

DR. MAKHIJANI: This is very important and germane to what we are talking about. Because at least my participation in this process, the reason I'm exercising it, my participation on this process is conditioned on the idea that we should respect the facts.

The facts are that the NRC did not say that large amounts of depleted uranium from the LES plant would be Class waste.

The second fact is that the NRC has not yet formally started a rulemaking process. There has been a technical paper and a direction from the NRC Commission to pursue something.

You had a workshop in October here. I participated in that workshop. All of the experts around the table -- in fact, the author of the technical paper himself said it was silliness, and "silliness", if you remember, was a word that was used by the author of the paper, to do a million-year dose assessment from shallow-land burial.

The NRC's invited expert from Notre Dame, I believe it was, Dr. Burns, agreed with that. We all agreed with that.

My conclusion from that outcome is the NRC should go back to the drawing board and redo that whole process. In any case, there has been no notice of rulemaking in regard to that. There's been no EIS. There's been no environmental assessment. So I don't see how you can represent that there's a rulemaking going on.

MR. LEE: Well, there is a technical basis currently undergoing review by the Rulemaking Division within the NRC to implement a performance assessment requirement. So that process is underway.

In approximately a year, that technical basis or the draft rule will be made available for public comment.

MR. CAMERON: So it all depends on how you

define where a rulemaking starts.

MR. LEE: Yes.

MR. CAMERON: But I think that it's important that we had Arjun, one of our participants, on the record, on the transcript, stating his view on what the state of affairs are in regard to depleted uranium, and that he disagreed with your characterization.

MR. LEE: Sure. That's fine.

MR. CAMERON: Okay. Thank you, Arjun. Thank you, Mike.

Ed, do you want to weigh-in on this issue or do you have another one?

DR. LYMAN: No, I had another one.

MR. CAMERON: Okay.

DR. LYMAN: Just getting back to what Rod said, putting aside the question of what the appropriate metric is to account for the relative waste generation of reprocessing once through, I would like to say that, if you are going to wait for AREVA to come up with improved waste management parameters compared to the slide we saw before, I have the presentation from September of 2009 that gives the waste volumes for recycling, the AREVA presentation.

According to those numbers, there would be

about 50 percent greater generation of high-level waste and cladding hole waste than was on that slide. So you are probably going to have to wait a while before you see a significant improvement.

MR. CAMERON: Sven?

DR. BADER: Let me emphasize that the waste streams that you see up there were probably one sequence or one scenario. The benefit of the PUREX process is you can tailor it to optimize your waste stream, and I'll give you an example.

In France, we don't have category A, B, C low-level waste. So the objective there is to reduce, minimize waste, low-level waste that they produce at a facility. Whereas, when we came over here, they didn't take that into consideration, and all those waste streams that you are looking probably got higher classifications, maybe greater-than-Class-C, because they are concentrated.

So we are in the process of going back and looking at this. We have tasks in hand trying to tailor another facility that will meet the U.S. regulations, provided they don't change.

But, again, the problem is this regulatory stability keeps killing us. So we wait and try to optimize it. So what you get a lot of times are dated

numbers, numbers and values that were designed for meeting certain regulations.

Another issue is krypton-85. You said it is a showstopper. It is actually not a showstopper, if you recycle old fuel. We have got plenty of old fuel in this country.

So we can tailor this process to meet existing regulations. And you know, there's clearly going to be balances. Activity in equals activity out minus decay.

So maybe the volume increased a little bit, but the other point about volume is some of these waste forms are a lot more robust when they come out of our facility. You know, the borosilicate glass that this high-level waste is in I would say is probably a lot more robust than spent fuel that has been sitting around for 50 or more years.

The other points, I have been sitting here trying patiently not to say anything, but, you know, the disposal path out at La Hague or the pipe at La Hague, we clearly meet regulations. We're not piping out stuff to contaminate the world. We are meeting regulations, safety standards.

And, then, I guess this goes back to what Rod was saying, that it would be nice to have

regulations that are based on safety and hazards as opposed to origin.

And then, the last point I would like to point out for the PUREX process that we have in France, La Hague, is that we have a fairly integrated waste disposal path for all the waste there. The process in France understands where our disposal is going to be. So we form these wastes to meet those disposal criteria.

Over here, it is kind of, with Yucca Mountain in the current state that it is at, we don't know how to optimize the waste now. You know, do you try to minimize the amount of heat-producing elements in there or do you put something together that's more suitable for salt? These are the types of things that you would have to be aware of when we're talking about a PUREX process.

On that, I'll put a period.

MR. CAMERON: Okay, thank you. Thank you for those clarifications, Sven.

Rod, do you want to say something?

MR. McCULLUM: Yes, I just want to emphasize the importance of one thing that Sven said there, that they are working on trying to tailor their waste stream. You know, the goal here is to achieve

benefits of recycling.

And there are two potential benefits of recycling. One is you get more energy out of the same amount of material that you mine. The other is that you get an improved waste form. And there are different stories out there as to what an improved waste form is.

It is impossible, though, to really figure out how to do that if you don't know what the regulatory framework is, and if the regulatory framework is not technology-neutral.

This goes back to the challenge I put to NRC, and I will admit it is a hard challenge. I will admit I don't have the answer myself.

But it is to come up with a regulation that provides the classification methodology which will support the goal we want to achieve here, which is you want the best possible streams. You want Sven to be able to tailor a waste stream that makes sense, that addresses the hazards, that allows us to move forward with a better disposition path.

So there's a lot to think about here, but I think there are ways to do it. We would encourage, I think, additional dialog in this area because it is a very important aspect of the regulation.

MR. CAMERON: Okay. Thanks, Rod.

Ed, do you want to say anything in regard to Sven and Rod?

DR. LYMAN: Yes, I think, no matter how you tailor it, the total waste volume coming in for reprocessing is going to be significantly increased compared to direct disposal. And the fact is that AREVA is going around making these representations on that point to the Blue Ribbon Commission and Congress and everyone else, and the record has to be clear on that.

With regard to borosilicate glass versus spent fuel, I don't think there's any evidence from leach tests that it retains fission products any better than spent fuel does.

MR. CAMERON: Anything else? Feel free. Okay.

MR. McCULLUM: Chip, I apologize; I'm breaking convention here a little bit, but I did put my card up.

I just want to say for the record that industry does not agree that it is inevitable that recycling will increase waste volumes, and also, that waste volume is not the only criteria here. The amount of radiation, the amount of heat that is in the

waste is also important.

MR. CAMERON: Okay.

MR. McCULLUM: So we do not agree with that.

MR. CAMERON: All right.

And, Alex?

MR. MURRAY: I greatly appreciate that, Chip. I have been patient.

I just wanted to make perhaps three points.

I have heard the discussion here. I have heard different waste forms mentioned, and so forth, different characteristics.

If I put on just my general engineer's/scientist's hat, there seems to be a gradient in the risk, or should I say hazards, if you will, of the different waste forms. There may even be some dependence on process or process efficiencies; I don't know.

But it would seem that something that is more uranium-based, reprocessed uranium, what have you, would seem to have a lower hazard than something that contains a waste or potential waste stream that contains transuranics or contains vitrified high-level waste. There seems to be a difference in the hazards.

And I encourage the members at the table to discuss that and see if there can be some sort of common ground. Yes, we could say uranium is radioactive. That's right, it heats the whole planet up. Okay, the planet is six times 10 to the 24th kilograms. Okay? So there's a lot of uranium. It's naturally radioactive.

But there seems, again, to be some miscommunication here on what these relative hazards might be and how do we, as an informed community at the table and an informed public, how do we address the apparent reality of different hazards from different waste streams?

The second thing which I have heard kicked around here, and I would just like to make it more explicit, is there are different waste rulemaking developments going on. There was an Appendix D for reprocessing waste in a previous, earlier version of Part 50.

A question I throw out to the panel here and to the public here is, if there are wastes specific to reprocessing, how they should be managed and potentially disposed of. Should that be in a rulemaking on reprocessing and recycling or should it be part of a rulemaking on one of the various NRC

regulations relating to waste? Okay?

One last aspect, we're going to discuss, hopefully, if time permits, emissions and effluents later on today. High emissions and effluents waste, too many -- you know, I'm an Englishman, and American is being spoken in this room, not English. Okay?

But I would have to throw the question out for the people who are assembled here, both on the panel and the public in the room, are doses low? Whether from actual or proposed commercial reprocessing plants, are the doses low, to members of the public from effluents, emissions, and what have you?

Because, ultimately, the regulation dose is a measure of risk. So I ask that question to everybody. Are the doses low? Are they low enough, if they are low? I don't know.

Thank you.

MR. CAMERON: Okay. I think we can address that when we get to the environmental part.

We need to break for lunch now because they are setting up a special buffet, although it's not free, but it's special.

But I would like to come back, we have time after we come from lunch, 1:15, to address the

waste issue and some more details before we go to security.

But perhaps we could address Alex's point about, can we find any common ground on the representative hazards from different waste streams? I don't know if we can do that.

And also, I would like to go back to Bob's point about he said the methodology for characterizing waste would encourage minimization. I wondered if you could just tell us, when we come back, what provisions is the industry thinking about in terms of how the rule should address waste? I think it might be useful for everybody to hear that, and then we can discuss that.

So why don't we break? And we will come back at 1:15, talk some more about waste, go to the public, hear their views, and take it from there.

(Whereupon, the foregoing matter went off the record for lunch at 12:03 p.m. and went back on the record at 1:24 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:24 p.m.

MR. CAMERON: Okay. We're going to try to wrap up the waste discussion.

There were two issues that I mentioned before we left, and maybe they can connect up. But I thought it might be useful to get into some specifics and use what the industry has developed as a possible proposal for how you would treat waste, reprocessing waste, in the rulemaking.

Maybe that can segue into these representative hazards from different waste streams that Alex brought up, if, Rod, at the end of describing the industry framework, if you could just say, "And here's how the industry framework would address that particular issue," to the extent that we understand what Alex is getting at there.

MR. McCULLUM: Yes, and I will start out by saying I thought that was an excellent point for Alex to raise, and I'm glad you wrote it down. I think the industry position is really the flip side of the question, if you will, if you turn the question into an answer.

Succinctly, what industry would like to see here in a regulatory context is we would like to see a hazards-based methodology for waste classification be developed. It needs to be technology-neutral. It needs to include a category of waste incidental to the reprocessing, consistent with the way this term has been applied with some of the DOE high-level tank waste, and NRC has been involved in that.

We had in the proposal that industry sent to NRC what we call Part 7x. We had outlined just that position to be developed in Part 7x. This discussion and other things that have occurred since then, I think this discussion is particularly helpful in this regard.

We believe that it is really broader than just the new recycling regulation, that, indeed, in addition to putting out a risk-informed, performance-based -- and I haven't said that in almost an hour, so I had to get that out (laughter) -- a risk-informed, performance-based --

MR. CAMERON: We'll remind if we don't hear it every minute or so.

MR. McCULLUM: -- recycling regulation, in companionship with that, you have to risk-inform Part

61 and assure that Part 61 is comprehensive to address the waste forms of the future. And I think there has been a lot of talk about limitations in the number of radioisotopes.

Industry did submit a White Paper in October 2009 entitled, "High-Level Waste Insights" to the staff on this topic. One of the co-authors of that paper, Jim Lieberman, is in the audience. So, if more detailed discussion is warranted, I would defer to him. I was not one of the co-authors of that paper. So I can't get into any more detail.

But, again, it goes back to -- and I'm glad Alex raised the question because it's about, remember, what we're trying to do here is establish a standard that protects public health, safety, the environment, and workers. We are trying to understand the hazards and assure that we require the appropriate things to be placed between the hazard and the workers and the public, and all that.

And by coming up with a hazards-based classification scheme, and by including WIR as one of the classifications, that enables us to do that. I think if we succeed in doing that both in this regulation and assuring that Part 61 is equally risk-informed and equally comprehensive, then we will go

about accomplishing what I think the question Alex was leading to, and he can correct me if I'm wrong, as well as the overarching point that we're trying to get across here is what you want is a regulatory structure that encourages improvements in waste management, that encourages a safer, safest, whatever, system.

So, you know, as we are making decisions about how, when, where, and pursuing recycling technologies, having that in place in advance so we can make informed decisions and, as Sven said, tailor our waste streams to do the job and meet that regulation, again, it's a big challenge for the staff. But I have heard a lot today that indicates that they certainly recognize this challenge. And I look around the room and it's a crew I think should be up to it.

MR. CAMERON: Okay, and we had this discussion somewhat today about the waste classification in Part 61 and (a), (b), and (d), et cetera, et cetera.

How does 7x deal with that problem? I take it that the methodology for classifying waste streams is that some would be high-level waste, store onsite if no repository or away from facility storage, so to speak. Some would be WIR, and some would be low-level waste.

MR. McCULLUM: Right.

MR. CAMERON: Do you get into what category, what classes of low-level waste it would be or you just followed an existing Part 61 classification?

MR. McCULLUM: I think at this point we just followed existing classification. I think we are looking to go further, and I think this discussion has advanced that.

Jim, do you want to say anything at this point?

MR. CAMERON: Yes, Jim Lieberman.

MR. LIEBERMAN: Jim Lieberman.

Basically, the proposal in Part 7x reflects the concepts which are in the Section 3116, so that the National Defense Authorization Act of 2005, as well as in the Commission's West Valley policy statement on decommissioning, where you are focusing on meeting the performance objectives of Part 61 based on site-specific performance assessment.

There is some discussion of Class C. If it's Class C, then it would meet low-level waste. If it's not Class C, then you have to do the site-specific performance assessment.

MR. CAMERON: Thank you, Jim.

MR. McCULLUM: And, Jim, that would be the WIR category? Yes?

MR. CAMERON: Okay. Thanks, Rod.

Let's see if there's any reaction to that from around the table.

Arjun, what are your thoughts on that approach?

DR. MAKHIJANI: Well, you know, to say that you want a hazards-based approach and then you want to say waste incidental to reprocessing is contradictory because waste incidental to reprocessing is an origin-based approach, not a hazard-based approach. You are saying, well, certain kinds of waste coming out of this particular process will automatically be disposed off in a certain kind of way.

So industry should make up its mind. Do you want special accommodations to reprocessing, so that every particular waste stream will have its own incidental whatever the current lobbying environment might determine it to be? Or are we going to have a hazard-based system?

Secondly, if we are going to have risk-informed, 10 CFR 61 already has a risk/performance standard. It is in subpart C. We have been talking

about 10 CFR 61, Part 55, where the classification is detailed, but subpart C has the dose standard. It is not necessarily as strict as everybody would want, but it's not bad. We have never in the past thought that we should be messing with it.

So I would suggest that the talk of risk-informed should not include subpart C. Subpart C is pretty solid. It is in line with the EPA 40 CFR 190. It is approximately the same or I think the dose limits are actually the same, if I remember correctly, Alex. Thank you, Alex. And so I would suggest strictly hands-off subpart C because then you will have a conflict with the EPA and problems.

So we are going to look at a more rational system of waste classification that is certainly more inclusive because 61.55 is not inclusive. Then we should have, first of all, an agreement that we are not going to mess with subpart C. Then we know what the risk limits are, the dose limits are, and we can talk. And I think then we should abandon ideas about waste incidental to reprocessing.

Thank you.

MR. CAMERON: And, Rod, what do you have to say about Arjun's hazard source claim? And I'll go to Jim, too, after you're done, if he can add

anything.

MR. McCULLUM: I apologize, you know, I thought I was being asked a question. But we definitely intend for waste incident to reprocessing to be a hazards-based category. And that's what Jim was talking about when he mentioned the site-specific performance assessment.

What you have right now is waste that perhaps falls into the high-level waste category simply because of its origin, and that is strictly origin-based. We are taking waste that the reason -- and maybe we need a different title. I think that may be a valid point, but we have already got a precedent with WIR.

It is taking a category of waste that is currently right now categorized based on origin and providing a mechanism, a methodology, to -- and this gets back to what was said at the very beginning. You know, the category of waste drives the disposal path. To determine the disposal path based on its actual hazard, that is, I believe, what Jim is talking about when he says site-specific performance assessment.

MR. CAMERON: And that's a great clarification, I think.

Jim, do you want to add any more?

MR. LIEBERMAN: Many people talk about high-level waste as origin-based, and that's true in part. But the definition of high-level waste is the highly radioactive material resulting from recycling, et cetera. It is not all radioactive material from recycling; it's the highly radioactive.

So you begin with the source is recycling, but is it highly radioactive? And the history of WIR over the years, and WIR started back in the draft Appendix D back in 1969 from the AEC issue that we have talked about before.

The highly radioactive, we would argue, is material that is not sufficient to be disposed of in near-surface disposal and meet the performance objectives of Part 61 in the subpart C that Arjun was talking about. So, if material can be disposed of in near-surface disposal and meet the performance objectives of Part 61, then, by definition, it is not so highly radioactive that it should be considered high-level waste. So that is the hazard part, the risk part defined in WIR.

MR. McCULLUM: And just to complete the clarification, so we are asking the staff to go down that path in Part 7x, and then to look at Part 61, and do they match up? And, you know, I wouldn't say that

I'm automatically saying, oh, you've got to go redo Part 61. I want to make sure that's clear.

But I think you need to look at this broader -- and you know, the EPA is here in the room. So, if it involves EPA regulations, you do need to not just carve out a new regulation that accomplishes this goal of a hazards-based WIR, but make sure that the other parts of two agencies' regulations are all on the same page here. So it is a large challenge, but it is one that feels worth undertaking.

MR. CAMERON: And as Jim pointed out, subpart C, Part 61, is integral to the approach. Okay. Good. I just wanted to make sure that Arjun understood that.

Arjun, go ahead, and then we are going to hear from Phil.

DR. MAKHIJANI: Let me actually agree with part of what Jim said about high-level waste. We understand that it is partly arising out of reprocessing, but we've got high-level waste and spent fuel in the same category for a reason, because they are very hazardous and they contain almost all the fission products. And we understand that radioactivity hazards arise from the fission products.

But the immediate radiological hazard is

not the main thing we're talking about in waste management, other than when you are talking about nuclear waste and tank explosions and leaks and things like that, operational issues.

When you are talking about waste disposal, you are talking about longevity is a very important part of that. So one of the reasons, for instance, that I would oppose any definition of waste incidental to reprocessing, if you've got a lot of iodine-129, the DOE wants to dispose of it in cement. You've got a lot of strontium-90. You've got a lot of cesium-127. We don't think cement is very good for 300 years, let alone 300,000 years.

And the idea that hazard is not a one-dimensional quantity, you've got a water dilution volume that you can use to define hazard, and we do it, and you do it; the National Academy does it.

But you've got a longevity element. And the thing that came up in the Depleted Uranium Workshop that I alluded to earlier in October that was an element of consensus of everybody is that you can't have very long-lived materials in shallow burial because you can't model it.

I mean, otherwise, you could just put high-level waste in Clive, Utah because, if you were

sure the clay cap wasn't going to erode for 1 million years, then why not just put high-level waste? Why have all this aggravation of a deep geologic repository?

So hazard for waste disposal is a multidimensional thing. It is not just the hazard for a worker in a chemical or a radiological facility.

And you can't have waste categories like waste incident to reprocessing that mix long-lived and short-lived radionuclides and say this is okay to dispose of in shallow-land burial because it is not a lot of radioactivity.

The allowable amount of iodine-129 in water is just 1 picocurie per liter. The Savannah River is already contaminated. You have a discharge point of the Savannah River Site not far from 1 picocurie per liter.

And we're asking for tritium to be 400 picocuries per liter, not 20,000 picocuries per liter. And I think it is going to happen one day. California already has a health advisory level, guidance level, of 400 picocuries per liter, and you probably know that.

So we have got a one-dimensional definition of risk today, which is cancers, but it is

not necessarily the most important risk for tritium in water. I don't think it is, actually, the most important risk for tritium in water.

So, if we are going to talk hazard-based, you have got to talk about fetal protection; you have got to talk about pregnant women protection; you have got to talk about multidimensional health endpoints; you have got to talk about longevity; you have got to talk about dose conversion factors. And we will leave the uncertainty about cancer risk coefficients aside because I think it is actually a minor problem in hazard assessment.

So I would support a hazard assessment that were true to the idea of hazard assessment and leave subpart C alone.

And the special categorization that I've got three waste streams coming out of my factory that are automatically waste incidental to reprocessing and pretend that it's hazard is, I think, unscientific from the word go.

MR. CAMERON: Okay.

DR. MAKHIJANI: Industry should give us a new paper.

MR. CAMERON: Thank you, Arjun.

Phil? And then we'll go to Ed Lyman.

MR. REED: I would just like to make two points here.

With regard to standards, the low-level waste standard, the low-level waste regulation, Part 61, has several standards built in.

First of all, the standard for the dose requirement is 500 millirems, which is based on intrusion, and from that, we derive the concentration levels in Tables 1 and 2 of Part 61.

But there is also another standard for Class B and C of Part 61, which is Section 61.56(b), and those are the stability requirements. The regulations specifically state that you have to consider radiation, you have to consider biological effects, and other things, if you decide to solidify. If you want to put them in a high-integrity container, fine, you are allowed to do that.

If you do decide to solidify, there is another standard, and that is the NRC Branch Technical Position. There are standards in there for leaching. There are standards in there for compression. There are standards in there for microbial degradation, and there is a radiation standard in there. I believe it is 10 to the 6 rads per hour. Don't quote me on that, but I think it's fairly close to that. So the low-

level waste essentially does have a lot of standards.

The second question I wanted to address is this concept of WIR. As I understand the industry, they are saying that, if you have an operating reprocessing facility, and let's suppose we had one operating out here today, if you have waste that is coming out of the reprocessed material, the facility, and if that waste is in high volume, and if that waste has concentrations that are less than what you have in 10 CFR Part 60, Tables 1 and 2, you can take that waste and bury it in a commercial land bury facility.

Now you may call the waste low-level waste. You may call it WIR. It really doesn't make any difference.

What is important is that that waste stream happens to meet the concentrations in Tables 1 and 2. Therefore, you can bury it in a commercial low-level waste facility, as I understand it.

For high-level waste, I don't know who sets the standard for high-level waste. I believe those standards are set by DOE, if I'm not mistaken, for the waste that is vitrified. I believe that is the way it -- I'm not sure on that. Maybe perhaps DOE or somebody else can comment on that.

But I don't believe that we have detailed

performance standards for glassified or vitrified waste that would eventually end up in a repository. So I am not sure on that.

MR. CAMERON: Maybe does anybody have a clarification on who sets the standard on that? Yes, sir? And please introduce yourself to us.

MR. HILL: Excuse me. I'm Britt Hill. I'm NRC staff in NMSS.

There is no standard NRC regulations for the activity levels in vitrified waste that would then be placed in a repository. The Department of Energy established some technical specifications based on their views of the performance requirements, but they were internally-generated and not based on NRC regulations. So we don't have any limit, if you will, on the activity levels for high-level waste.

MR. CAMERON: Thanks, Britt.

Arjun, we need to --

DR. MAKHIJANI: I don't believe there is a 500-millirem limit in 10 CFR 61 for intruders. I'm looking at it. It doesn't have a number in it. It may be from somewhere else, but it's not in 10 CFR 61.

MR. LEE: Yes, the 500-millirem is based on this Staff Technical Position on low-level waste performance assessment.

DR. MAKHIJANI: It's not in 10 CFR 61.

MR. LEE: That's correct.

MR. CAMERON: I am glad that Arjun and you are agreeing on your characterization of something now. I think we're making progress here.

MR. LEE: There you go.

MR. CAMERON: Okay.

MR. LEE: I just wanted to follow up with Britt on just a couple of items.

One, at one time, the DOE programs had Waste Acceptance Criteria for each of their glass production facilities, and those Waste Acceptance Criteria were, I guess, developed in concert with the EPA standard and knowledge of how or suggestions of how to dispose of -- how Yucca Mountain might perform or a geologic repository. So that is how you arrived at the mix, if you will, of the glass composition that was used to make the waste.

So I believe, at the end of the day, the EPA standards for spent fuel and high-level waste are kind of driving the bus.

MR. CAMERON: Okay. Thank you, Mike.

Let's go to Ed, check in with Rod, and just see if there are any final cautions for the NRC in terms of this rulemaking and waste.

Ed?

DR. LYMAN: I missed the beginning of this discussion, so I don't know if this came up. But I recall that in the White Paper there was a proposed definition of high-level waste that just mentioned fission products in sufficient concentrations. And it was pointed out at a previous meeting that it doesn't mention transuranics, which may not be covered in the definition of fission products, and that that could be a significant loophole.

Has that been addressed yet here?

MR. CAMERON: No, we haven't, and let me ask Rod or I can go over to Jim Lieberman. Clarification on fission products versus transuranics covered --

MR. McCULLUM: Are you referring to specifically the October 2009 White Paper?

DR. LYMAN: I don't have the White Paper in front of me, but --

MR. McCULLUM: That's an industry presentation.

DR. LYMAN: -- the industry recommendation.

MR. McCULLUM: Okay. Yes. I defer to Jim, who is one of the authors of that.

MR. CAMERON: I think we'll get a clarification here. Jim Lieberman?

MR. LIEBERMAN: Ed is correct. Both the Part 7x as well as the October 2009 White Paper talked about fission products because that's the definition from the Nuclear Waste Policy Act, which is also in the Atomic Energy Act, that says, "in any solid material derived from such nuclear waste that contains fission products in sufficient concentrations."

So the legal definition that we are working under has the fission products. So that is the source of that.

The TRU question is a good question that needs to be considered in the process.

DR. LYMAN: Right, because you could argue that a high actinide waste stream may not be, quote, "highly radioactive", unquote, based on activity, but is significant radiologically.

MR. CAMERON: Okay. Thank you, Ed.

TRU needs to be addressed. Rod?

MR. McCULLUM: Yes, I just wanted to close, and I promise I won't try to get another word in on this, by agreeing with Arjun on the point that the hazard of WIR would have to include the longevity.

And I think that gets to the question that

just arose. You do have to take a holistic look at it. And that's why in proposing a hazards-based categorization scheme, again, alluding to what Jim said, site-specific performance assessments, a performance assessment lets you look at all aspects of the hazard.

There may be a category of waste within WIR above Category C that would require some form of engineered disposal other than a repository, but certainly more than a shallow-land disposal.

And a site-specific performance assessment would allow you to safely design that. So, really, again, what was said before, that the classification drives the disposal path, in fact, that's how we connect all the dots in terms of our goal here, which is protect public health and safety and the environment, and in this case, to do so for a very long period of time.

So I would agree with Arjun that we need to look at all that stuff.

And, Jim, you can correct me if I'm wrong, but that is why our proposal was written the way it was, to rely on that for category of waste, a site-specific performance assessment.

MR. CAMERON: Okay, and Miriam is going to

check in with the public, and, Jim, she can check in with you, if you have something to add there.

MR. LIEBERMAN: Yes, if I could add one more point, Phil mentioned that in the proposed definition we had, if it is a Class C, that it would be low-level waste. Since that paper was written, the Commission has focused on depleted uranium and unique waste streams of blended waste.

And probably we might want to have a modification of this to require the site-specific performance assessment for all waste streams when you are dealing with quantities of waste that wasn't considered in the EIS that supports Part 61. Even if a particular radionuclide was considered in an EIS, a waste stream might be different and, thus, a PA is appropriate.

MS. JUCKETT: Any other comments?

MS. SUPKO: Eileen Supko, Energy Resources International.

Could you go back to the slide with the graphic of material balances? I just have a few comments on this.

It's a little bit inartful, and particularly, Chip, you said that the meeting in Albuquerque may have more members of the general

public. And at least the way it appears to me, I think most people in this room have a technical background.

So you look at it and you see, for example, reprocessed uranium coming out as an outstream. It appears that maybe that is considered to be a waste stream, when REPU is not necessarily going to be waste. It is being recycled today. In Europe, EDF is recycling the REPU. Other countries have recycled REPU.

And I don't necessarily think you should call it a waste stream. It is something to consider because, when you are adding up, gee, comparing a once-through fuel cycle with a single recycle through a Light Water Reactor, and you add up REPU as a waste stream, that is bumping up the waste quantities.

Someone was talking about earlier today, if you are not considering that to be a waste, then you have got a different balance going on. So you need to be really careful about what you are comparing.

Also, you are showing MOX fuel coming out of that box in the middle. And that is true if you are talking about reprocessing and recycling. But you might want to make it a little bit more clear.

What is initially coming out of the reprocessing is plutonium, and maybe that is purposeful because you don't want to use the word "plutonium"; I don't know.

But just be careful about how it is that you are describing what is going to go on, when you are talking to members of the general public. There are different things.

Another comment I heard earlier was that, if you recycle, you are increasing the total volumes of waste. That is not necessarily true. The more we move to advanced fuel cycles, fast reactors, and recycle different materials, total volumes of waste are expected to go down.

In addition, there are other important parameters that we need to consider when we are looking at the fuel cycle. One is uranium utilization. As you go to more advanced fuel cycles, you are using less uranium. That is going to become more and more important as countries around the world start moving toward nuclear energy and increasing the use of uranium supplies.

Something else? Oh, there is also -- I would recommend this, if NRC staff hasn't seen it -- there is a Nuclear Energy Agency OECD study that was

put out, I want to say it was in 2006, which was a comparison of advanced fuel cycles. And in it, they do a comparison of a wide range of parameters: quantities of high-level waste and spent nuclear fuel, quantities of low- and intermediate-level waste, both short-lived and long-lived, in about seven or eight different fuel cycles. They also look at transuranics, uranium utilization, ultimate heat load of the material being disposed of. Those are all important parameters.

And I believe that you can download the document from the NEA's website. I recommend it.

Thank you.

MR. CAMERON: Okay. Thanks, Eileen.

I think Alex, I see him making notes, and if he needs more on that reference, he will ask you.

But I think your main point is that this may be misleading or at least needs to be caveated in some respect.

MS. SUPKO: It is a lot of information for one slide.

MR. CAMERON: Okay. Ed, do you want to say anything on this?

DR. LYMAN: Yes. I agree with the point on plutonium. You should definitely show that would

be producing about 10 tons of plutonium.

With regard to reprocessed uranium, the recycling of reprocessed uranium is extremely low. I think it is about 2 percent in two reactors in France. Most of it is done as re-enrichment in Russian centrifuge plants because URENCO doesn't want to contaminate its centrifuges to a great extent by recycling this contaminated material.

There's absolutely no evidence that it is economic. So it should be considered a waste product for all intents and purposes for the near future.

MR. CAMERON: Thank you, Ed.

Jim?

DR. BRESEE: Yes, just one minor point with regard to recycling uranium. It is a practical process when a country is able to combine, as can China and several other countries, Light Water and Heavy Water Reactors.

And there is an experiment currently underway involving, in cooperation between Canada and China, on the direct recycle without re-enrichment.

It will at some point be a factor in analysis of total fuel cycle cost. So far, we are simply collecting information, but that is one combination where direct recycle without re-enrichment

is technically-feasible.

MR. CAMERON: Okay, thank you. Thank you very much, Jim.

Any final comments on the waste area before we move on to Marshall Kohen and security and safeguards?

Alex?

MR. MURRAY: Hi, Chip. I'm back again.

Can we just scroll to the last slide of this presentation, please? Oops, too far.

I would just like to mention to everybody in this room, you know, we put down some potential points for discussion here. These included some aspects related to storage; what parameters might be appropriate there, if any; any reuse scenarios, be they for reprocessed uranium, what have you; any standards any reused materials might have to meet or should meet or could meet, or what have you.

Please, if you have any thoughts or comments on those, submit them to the NRC for our consideration.

Thank you.

MR. CAMERON: Thank you for that, Alex.

Mike, thank you for teeing it up for us. Okay.

There's a break scheduled in here at 2:15 that we're going to just skip. Okay? Although I know everybody likes to take breaks, but we may get out a little bit early this afternoon. Who knows?

But we have Marshall Kohen with us, who is going to tee-up the next agenda item, which is security and safeguards.

We have a name tent for you, Marshall.

MR. KOHEN: While the presentation is coming up, thanks, Chip. We appreciate the opportunity to tee-up the discussion of issues dealing with safeguards and security as it relates to reprocessing and recycling.

I work in the Office of Nuclear Security and Incident Response in NRC, specifically in the Fuel Cycle and Transportation Security Branch. We have been the branch that has sat as representative of NSIR on the Reprocessing Rulemaking Working Group for the past year or so.

For those of you who do not know, this presentation is about safeguards and security. The safeguards or the MC&A group in NRC is actually in the Office of Nuclear Material Safety and Safeguards. The security policy group is actually in my office, Nuclear Security and Incident Response.

So, by way of introduction, I am going to do the presentation today, but there are, I guess, some aspects of MC&A, and we have Tom Pham here from NMSS who can speak more authoritatively about the MC&A aspects.

I think what I would like to do today by way of kicking the topic off is sort of to give you a snapshot of where we are in terms of physical protection today, what we have in terms of what you are going to see in material categorization, how the material is categorized, and a little bit about the physical protection that evolves from that categorization, but how it would impact reprocessing/recycling, if it were to occur today.

So some of this may be pretty basic, and you all may know it, but I figured I would start with stuff to sort of ramp up to a little bit more specific.

The primary regulations for safeguards and security are in 10 CFR 73. That is the physical protection aspects. 10 CFR 74 is the material control and accounting aspects.

To start by talking about special nuclear material, SNM, what is SNM? Well, SNM comprises plutonium, uranium-235, and uranium-233. We divide

SNM into three categories for purposes of signing requirements for security and MC&A.

Those categories are based on or the categorization scheme is based on the potential for that material to be either directly used in a nuclear fissile explosive or indirectly in the production of materials that would be used for that purpose.

An interesting and very important point here is that the categories that you are going to see in a second are primarily based on the quantity of material that we are talking about as well as for U-235 the enrichment level.

So here you see the table that I am sure many of you are familiar with. I don't want to go into every detail of this, but I think it gives sort of the overall picture of, if you have a type of material at your facility, where would it be placed in terms of categories?

So you see what we would call the formula quantities for plutonium would be 2 kilograms, would put you in Category 1, and for 5 kilograms would you put you in Category 1 for uranium-235 or what we would call HEU, highly-enriched uranium greater than 20 percent.

U-233 is the similar threshold for

Category 1 as plutonium. In NRC terminology, the Category 1 quantity would be termed strategic special nuclear material. Category 2 would be special nuclear material of moderate security significance, strategic significance. And Cat 3 would be material of low strategic significance.

So what is the current categorization and how would it impact reprocessing and recycling? All of the current reactor, nuclear reactor, fuels would be Category 3 materials.

And if we could go back one, if you would, Jose?

The reason is because they are of low enough enrichment that, regardless of the quantity, it would put them in Category 3. If you see the fourth row down, even HEU -- oh, sorry. It would be LEU. Between the 10 percent and natural would put it automatically into Category 3.

Reprocessing and recycling would introduce plutonium, obviously, as well as potentially other transuranics.

Fuels containing greater than 2 kgs of plutonium would be Category 1, and it is based on the table that we just showed, regardless of the isotopics or the form or the presence of other materials. And

here we are talking about the concept of attractiveness, the attractiveness of the material for use in the nuclear device. Other TRUs, for example, americium and neptunium, have SNM-like characteristics in that regard.

The current regulations do not consider the other TRUs. That is the physical protection regulations in NRC parlance do not consider the americium, neptunium, and other TRUs. Plutonium, likewise, is categorized without consideration of the form or the isotopic composition.

As you may know, we have received an SRM from the Commission to proceed with revising the current categorization approach to include the concept of attractiveness as part of our upcoming fuel cycle security rulemaking.

We intend to, and have been charged with, engaging the public in a very widespread way in terms of outreach during that process. That process is beginning. The technical basis is beginning. So that's, again, a long-term rulemaking, but that is something that we will be coming to the public to have discussions about.

In terms of MC&A, 10 CFR 74.51 currently has an exclusion for reprocessing facilities from the

Category 1 MC&A requirements. So what that sets up is the fact that a Category 1 reprocessing facility wouldn't have the same MC&A requirements as other Category 1 facilities or those facilities that have Category 1 materials.

So, as was discussed at length yesterday, it sort of sets up a situation in which we have requirements that aren't necessarily consistent between facilities with similar categories of material.

My understanding -- and Tom can amplify on this -- is that there is a plan within the staff right now to remove the exemption in Part 74, and so to move closer to a more consistent regulatory basis in that regard.

So I think that concludes my sort of formal remarks. I would just, as other speakers have done, let Chip start working from the list of topics for discussion.

MR. CAMERON: Thank you, Marshall. That was very good.

Tom, do you want to add anything before we get started? Okay.

It is interesting, the attractiveness level comment. Maybe that's a good place to start.

Anybody have anything to say on what needs to be done in terms of safeguards and security or safeguards.

Rod?

MR. McCULLUM: Well, I am not going to get into a lot of detail on this topic, but ask my colleague here to weigh-in. He follows this more closely than I do.

But again, consistent with the approach -- and I agree the regulations need to be consistent. We would think they need to be consistent -- here it comes -- in a risk-informed manner, which means to us based on hazard.

You look at things like plutonium is categorized without respect to former isotopic content or composition. I'm sorry. That's problematic for us. I hope Dan will speak a little bit about some of the issues that that could cause for us.

But you should look at plutonium, and plutonium in MOX with other isotopes that are radioactive in low concentrations is not the same thing in terms of attractiveness as weapons pure plutonium. So we would hope that you would take this opportunity to make the regulations consistent and address that.

Dan, will you speak to that?

MR. CAMERON: Go ahead, Dan.

MR. STOUT: Sure. There is interplay between the security aspects and the safeguards aspects that need to be taken in tandem as you look going forward.

And we do encourage you to consider attractiveness in updating the table. MOX assembly is not the kind of thing that someone is going to grab and go run off with.

When we pull the uranium out of the reactor, there is a significant fraction of it that already has plutonium, and it has been created as part of the fission process. So it is not, from a technical perspective, anything that we are not used to.

From a security standpoint, it is the kind of thing that this country can protect, and it is the kind of thing that regulations can be put in place to allow transportation, handling, storage, use very similar to other things that we are used to dealing with.

MR. CAMERON: Okay. Thank you.

Ed?

DR. LYMAN: Yes, let me rephrase what's

going on here. In April of this year, President Obama hosted a Nuclear Security Summit where one of the objectives was to increase security on weapons-usable materials wherever they're found, to lock down all vulnerable materials within four years.

And what is happening here is TVA and NEI have gone to the Commission and said, "We can't afford to transport MOX fuel using SSTs. You have to downgrade the security on these materials."

And you went to the Commission, and we don't know what's in the SRM because it's not public yet, as far as I know. I haven't seen it.

But what is going on here is completely out of line, inconsistent with the risk, the nuclear terrorism and proliferation risk associated with weapons-usable materials.

The National Laboratories conducted a study, an extensive study, and found that plutonium/uranium mixtures are highly attractive until the uranium concentration exceeds about 80 percent, and even then, they are still usable in weapons, although not the most highly-attractive material.

Fast reactor fuel would probably be beyond 20 percent plutonium and would, therefore, still be a highly-attractive material for nuclear weapons use.

There's absolutely no technical basis for downgrading the security on MOX fuel, whether it is Light Water Reactor or fast reactor fuel. And I guess whether the Commission is fully apprised of all the information that the nuclear weapons laboratories have on the improvised nuclear device risk associated with these materials, can I just ask, how many NRC staff have access to Sigma 20 nuclear weapons data?

MR. KOHEN: That's not something that I have complete familiarity with. I imagine it is a relatively low number.

MR. CAMERON: So, Ed, I take it, and I'm not trying to be disingenuous here, but you think this whole idea of risk-informing Part 73 and 74 is a bad idea?

DR. LYMAN: This isn't risk-informing because, as far as I know, it is not based on a well-defined, credible adversary.

Well, first of all, you can't risk-inform security in the strictest sense because risk-informing is a quantitative process, and you can't assign a probability to the threat of a terrorist incident, whether it be a sabotage attack or a diversion or theft of nuclear material. It simply can't be done. So risk-informing is not even appropriate to talk

about when you are talking about deliberate acts.

Second of all, if you are talking about the relative risk of various materials, it has to be based on credible adversaries, looking forward. We are talking about implementing rules that will be around for a very long time.

The capabilities of adversaries only continue to increase, and whatever intrinsic relative attractiveness of the materials themselves can be overcome today -- and as adversary characteristics continue to increase, it will become even easier to overcome.

So there is really no technical basis for any reduction in the current security requirement, based on the so-called material attractiveness, these principles.

MR. CAMERON: Okay. Thank you.

Then Tom? Marshall?

MR. KOHEN: Yes, I guess I would say two things.

First, we haven't completed all of our deliberations, obviously. As I said, we are beginning the process of the development of the technical basis. So I'm not implying today that there is going to be a decrease in physical protection for any particular

type of material. I'm not saying either way. We haven't gotten there yet.

And I guess the second point that I would make would be that we are going to do what we feel is necessary in terms of technical studies, in terms of technical analysis, to be able to back up whatever recommendations we make in terms of revising the categorization table and assigning appropriate physical protection based on those thresholds and based on the attractiveness that we find is appropriate.

So this is not a throw the dart at the problem. We are going to be doing technical analysis to substantiate what our recommendations are going to be.

MR. CAMERON: And do we know what's in the SRM? Is the SRM public?

MR. KOHEN: The SRM was originally labeled OUO/SRI. The Commission, I don't know that there was ever a final decision from the Commission as to whether they wanted to release the SRM and make it publicly releasable.

There is indication that that could happen, and I understand that at least one Commissioner agreed to release his vote sheet on the

topic. But I have not seen that officially, and so I would be a little bit hesitant to discuss the details, not having seen an official response from the Commission saying that they agree to it being publicly-releasable.

MR. CAMERON: Okay, but you characterized the Commission's directive, is it proper to characterize the Commission's directive to the staff as you should look to risk-informing Part 73 and 74?

I'm not trying to put words in your mouth. If you give people sort of a general characterization of what the Commission asked you to do, if not why?

MR. KOHEN: I think it's fair to say that the Commission gave us the go-ahead to go forward to do the rulemaking that we asked to do, that is on the ballot, and that attractiveness was an acceptable aspect of a process to achieve that rulemaking, a part of that rulemaking.

MR. CAMERON: Okay. Thanks, Marshall.

Go ahead.

MR. LOEWEN: This is from the results of a FOIA on materials associated with TVA's interest in the MOX fuel program, which was filed by Tom Clements of Friends of the Earth.

And this is the summary of a TVA meeting

held 22 April 2009, and in attendance were TVA, AREVA, MOX Services, ORNL, and DOE, including Dan Stout is listed both under TVA and DOE here.

I would just like to read this. "Meeting discussion. Much of the work on PWR and BWR MOX is being performed by AREVA and should be completed by August 2009. This includes trying to revise the NRC material classification such that fresh MOX fuel can be more easily transported."

So I just wanted to put that in, if there's any confusion about where this came from.

MR. CAMERON: Okay. Alex, and then we will go to Rod. Alex Murray.

MR. MURRAY: Hi there. Thanks, Chip.

I have just two comments, two points I would like to make. One may actually be a question for both Ed and for Dan here.

Ed, I heard you say something about greater than 80 percent uranium in a fuel. That's when its, quote, "attractiveness" started decreasing. I just wanted to know, I think you were talking from a perspective of fast reactor fuels.

And I guess my question for Dan here is, were you talking about fast reactor fuels for MOX or LWR MOX fuels? Because the LWR MOX fuels are normally

more than 80 percent uranium. So that is my first point, and I would like you guys to clarify that.

And my second, I guess, is more of a question than a point. I have been in public meetings before where members from the National Labs have made a public presentation with a comment where, as I say, the isotopics do make a difference.

And I would like to ask the panel at large their thoughts on that, if any, particularly the presence or absence of other isotopes like plutonium-238, potentially the addition or removal of neptunium, et cetera.

Thank you.

DR. LYMAN: Let me just clarify what I said. The study, which was headed by Charles Bathke at Los Alamos, only looked at the direct usability of materials in nuclear weapons.

When the mixtures of plutonium and uranium were concerned, there is a threshold once the uranium concentration gets above that 80 percent. That is only associated with direct use of the material in a weapon without any processing. It does not take into account the fact that, if the material were stolen, the plutonium could be easily separated, if desired.

Originally, this was characterized by Los

Alamos as the difference between being attractive and being unattractive. They have now changed those designations to impractical and very impractical. So they have actually eased away from using the term unattractive, even with reference to material where the plutonium is diluted below that 20 percent.

But, again, that doesn't have to do with the question of separation. It is only the direct usability of the mixture.

MR. MURRAY: May I just ask, Ed, what is the term they are using now -- I didn't quite catch it -- please?

DR. LYMAN: Impractical and very impractical.

MR. MURRAY: So, if it's greater than 80 percent uranium, it would be very impractical?

DR. LYMAN: Very impractical.

MR. MURRAY: Okay. Thank you very much.

DR. LYMAN: With regard to isotopics, the DOE's formal position is that all, with the exception of almost pure 238, any isotopic mixture can be used in nuclear weapons, but if you are talking about an advanced nuclear weapons state, that there is essentially no -- that an advanced nuclear weapons state can use plutonium of almost any isotopic

composition to build weapons with the same yield and reliability as is currently stockpiled. And if you are talking about terrorist groups, the yield, even the physical yield, is something which would be of great value to a terrorist group. So the question of predetonations is not really relevant. So, in other words, it is not really relevant.

In the most recent study by Los Alamos, their conclusion was, again, that plutonium, other than essentially pure 238, plutonium of any isotopic composition is attractive for use in nuclear weapons.

MR. CAMERON: Dan, do you want to say anything at this point? Go ahead.

MR. STOUT: Yes, I think that was near my last day at DOE and my first day at TVA, and I'm sure the audience was confused.

To answer your question, Alex, it was talking about MOX in Light Water Reactors, not fast reactor fuel. So we are talking about a fuel that is going to contain less than 10 percent fissile component. And consistent with what Ed is saying, from DOE's perspective, that is less attractive for -- I forget the other word -- but impractical.

I mean, you know, yes, Ed's point, if a theft of a MOX fuel assembly were to take place, that

individual or activity would have to do reprocessing to remove and accumulate an attractive quantity that could have direct use in a weapon, and that is not easily done. It is reasonable to be able to put in place requirements that theft could be detected and that recovery of that could be performed with high confidence.

So the NRC needs to consider the threat. You know, the consequence is part of this, the probability. And in that context, detect the threat, recover before something bad happens.

MR. CAMERON: Dan has given the rationale there. Do you want to say anything on that? Then we'll go to Arjun.

And I just want to point out that the SRM is publicly available, okay, at this point. Jim Lieberman just found it, and Marshall confirmed that that is the SRM.

So you can take Jim's BlackBerry home with you.

(Laughter.)

Okay.

DR. LYMAN: That's good.

With regard to separation, you wouldn't have to reprocess the spent fuel assembly. You would

only have to separate uranium and plutonium, which would not require a shielded facility, and would require a much simpler chemistry than actual reprocessing.

So I don't know. There are very few people who would say that that would be a significant technical barrier. The IAEA never considered it a technical barrier and considers MOX fuel to be direct-use material. It requires it to be safeguarded with the same intensity as separated plutonium. So that barrier has never been regarded as significant. Since the characteristics of adversaries are only increasing with time, you can only expect the material would be more vulnerable, not less over time.

MR. CAMERON: So this is a point you made before about you really need to consider what the capabilities of the adversary are on any of these things.

Arjun? Then, I'm sorry, Rod, we'll go to you. Arjun?

DR. MAKHIJANI: Yes, I'm glad Ed brought this up. I mean plutonium in spent fuel, which you alluded to earlier, is very different than plutonium in MOX that's not irradiated. You can handle plutonium in MOX without shielding.

And as Ed said, well, there's nothing more to add in regard to chemistry. It is close, it is a step removed away from weapons-usable material; whereas, spent fuel is regarded as the gold standard of non-proliferation by the National Academy of Sciences, as you know. And the chief author of that report is now the President's Science Advisor, John Holdren.

I personally think that, if you are going to look at this, that the MOX facility as well as transport and storage of unirradiated MOX fuel should have security comparable to military facilities. It's not complicated. It's very straightforward. It corresponds to the facts about what MOX fuel is and the security risks that plutonium poses.

Unirradiated MOX fuel is not a big deal to handle. And just for the record, fissile in a nuclear weapon is 500 tons or a kiloton of explosive power, and the Oklahoma City terrorist bombing was five tons of TNT equivalent, just on the order of magnitude of what we are talking about here.

MR. CAMERON: Thank you, Arjun.

And Rod?

MR. MURRAY: Yes, I just want to clarify that industry is not proposing eliminating or reducing

protections here. We are talking about technologies that potentially make it a safer world, where in plutonium reactors you have less plutonium.

If the United States takes the leadership in these technologies, they are in better hands. Those are points, I know, of dispute.

Plutonium in MOX is less attractive than plutonium not in MOX. It does require work. Now, granted, it is not the same thing as plutonium in spent fuel. I would agree with Arjun there.

So the level of protection, again, I'm not saying less protection, but there needs to be a high level of protection of MOX. It does not have to be the same as SST or pure plutonium, but it needs to be the appropriate level of protection.

With regard to isotopics, they do matter. And I am glad Alex asked that question because that is another piece of this.

Fast reactor fuels, you combine plutonium with things like neptunium and americium. That's also different. Again, it doesn't mean you eliminate protection. It doesn't mean you leave behind inadequate protections. It means you have a consistent level of protection.

So, when something is different, when

something becomes less attractive because you have combined it with something else, you protect it accordingly. Because, ultimately, what you are talking about, again, is regulating technologies that have the potential, if we appropriately manage them, to make this a safer world.

And regulating those technologies in a way that makes it overly difficult to deploy them without lowering, without providing additional protections, that is counterproductive. There are multiple levels of safety here. And what we really want to do is to have a proliferation-resistant reprocessing regime in place, and what that means is the subject of much debate.

I'm not the expert. These guys, a lot of people around the table know more than I do.

But I think that you need a regulatory framework that facilitates getting to that, and that does need to recognize where there are inconsistencies. And I will go back to regulatory consistency. Regulatory predictability is what is important there, and recognizing when things are less attractive, providing appropriate levels of protection for all materials.

MR. CAMERON: Okay. Thank you, Rod.

Ed, do you have something?

DR. LYMAN: Yes. First of all, if you are worried about plutonium and the risk of separating plutonium, then why are you coming here with a proposal to start reprocessing spent fuel in this country, if that's your concern?

Second of all, let me just read the Los Alamos study that also looked at mixtures of plutonium and transuranics. Neptunium as a weapons-usable material comparable to uranium-235 provides no reduction in attractiveness when mixed with plutonium. You know, the transuranics are also weapons-usable and do not, again, significantly affect the material attractiveness of the mixtures. It's all in the Los Alamos study.

In fact, the conclusion of the study is that "We have not identified a silver bullet technology that would eliminate safeguards and security issues. None of the proposed flow sheets examined to date" -- and that includes COEX, all the UREX variants, pyro processing, for example -- "justify reducing international safeguards or physical security protection levels."

MR. CAMERON: Ed, in terms of regulatory framework, I just want to make sure that I understand

that this particular part of the regulatory framework is being done by Marshall and Tom and their colleagues. In other words, it is unlike some of the other issues that are involved in the NMSS staff rulemaking. Is that correct? So it is really Marshall's group is in charge of this rulemaking, and it is just going to apply to the reprocessing?

MR. HILTZ: Yes, I think it is true that NSIR is responsible to lead for this rulemaking, but there are elements of diversion analysis and gaps that are contained within our gap analysis. They were initially identified as a moderate gap, which means that we didn't feel that it was necessary to address that in order to have an effective regulatory framework, but we did get some guidance from the Commission that said go ahead and consider this diversion and attractiveness as part of the reprocessing framework.

MR. CAMERON: Okay, and that's going to all come to you when you do this rulemaking, and you are going to consider Ed's and other people's comments on this.

Do we need to specifically talk about diversion path analysis or is that what we are talking about here? I mean I am displaying my ignorance, and

none of you know.

Yes, Steve?

MR. SCHILTHELM: That's not specifically what we are talking about here, but I'm not sure we need to go into it. It is a technique and a methodology for understanding, and I'm not sure our time would be well-spent by drilling down into that technique.

MR. KOHEN: Yes, I guess I just want to make sure that the context here is understood. The rulemaking that I have talked about, the physical protection, fuel cycle physical protection, security rulemaking is a comprehensive rulemaking for Part 73. It is something that we had planned, obviously, not prior to reprocessing, but I guess a complementary aspect. Reprocessing would be one example of how the Part 73 changes would take place.

It is the first comprehensive security rulemaking that has been done on Part 73 in 25 or 30 years. There's been a lot of piecemeal, patchwork revision to that part. Those of you who are familiar with reactors obviously understand that.

But this is a look at the whole Part to determine that the material that we are talking about, the SNM that we are talking about is not only

characterized properly, that we have done in Rod's words an appropriate assignment of physical protection, appropriate to the consequences, appropriate to the attractiveness and the use of this material.

So I think I like that word "appropriate". We have used the word "right-sizing" as opposed to increasing or decreasing. It's not simply increasing or decreasing. It's simply right-sizing, assigning the protection that is appropriate for that material and that category and that attractiveness level.

So I want to make sure that we understand that this is a rulemaking that's going on in parallel. Part of this rulemaking, in addition to the revision in the categorization scheme, is to make generally applicable the lessons learned of all of the orders that we have put in place, particularly since 9/11.

So that is another major aspect of this rulemaking, is that we have taken a lot of lessons learned over the last several years in terms of the orders that we have given to specific fuel cycle licensees and generally to fuel cycle licensees that we're going to be putting into the regulations.

MR. CAMERON: Okay. Thanks for that clarification.

Jim, you had your tent up.

DR. BRESEE: I think the comments I was going to make would be better made at Albuquerque, when we will have in hand a group of very well-qualified analysts available.

But just as background, there has been some very interesting and useful work done under the Gen IV program, which is being done internationally, under the general category of Proliferation Resistance and Physical Protection, PR&PP.

A good deal of value in terms of analysis can be obtained by recognizing that there's a considerable difference in threats between non-country and a sophisticated adversary. To a considerable extent, the approaches taken are quite different. Attractiveness in the old-fashioned term was aimed more at delay in the process of achieving weapons-attractive material as contrasted with elimination of that type of approach.

Ed is completely correct. In a mixture of uranium and plutonium, it is just a matter of time associated with obtaining access to high enrichment materials. The same thing can be said of a lot of other mixtures.

But I think the details could be better

examined in the Albuquerque meeting.

MR. CAMERON: Thank you, Jim.

Dan?

MR. STOUT: Just a little clarification or background on the paper that Ed was referring to, the Bathke, et al, study that Los Alamos led and the other National Labs participated in.

That was done in the context of evaluating the UREX process. When GNEP first rolled out, there was a hope that a reprocessing technology could be developed that would utilize the transuranic materials by increasing the radioactive composition of the fuel and, therefore, increase the time, as Jim was referring to, and make that material less attractive.

Studies did conclude that elements like neptunium and americium are still fissionable and, therefore, the attractiveness of a plutonium transuranic mixture, for example, is actually more attractive than MOX, which would be like 95 percent uranium and 5 percent plutonium.

MR. CAMERON: Okay. Steve, and let's go to Marshall and then Arjun. Or Steve and then we'll go to Arjun.

Steve?

MR. SCHILTHELM: Just a statement about,

not to debate what Ed said, but my experience as a licensee is that NRC is in a continual threat evaluation mode. And the threat that they are assessing and the requirements that they are placing on licensees is not a static process. It is really quite dynamic. If you are a licensee, you understand just how dynamic it is, and I think Marshall could probably tell you that that's not something that will probably end or change. Post 9/11, we realized some things, and it will remain a dynamic process, I believe.

Kind of circling back to the regulatory framework and the broader question, I think in the last public meeting, and I don't recall exactly when that was, but industry went on record as outlining our priorities. And I don't think those priorities have changed in this timing sequence of those things we think are important from a regulatory framework standpoint.

We talked at length about MOX transportation and plutonium mixtures. We talked about plutonium mixtures in a potential reprocessing plant as being secondary, and then probably tertiary is the more advanced separations. And I don't know that those priorities have changed.

Eric, you may have a slightly different view on the advanced separations of neptunium and americium, but we suggested to NRC that those things could come along later, and by later, we mean years later in the regulatory framework development.

MR. CAMERON: And that was sort of the message you were giving in terms of the importance of this gap being of moderate importance.

And then, we'll see if Eric wants to add something here, but go ahead, Tom.

MR. HILTZ: Yes, I went back and looked, and I apologize if there's some confusion about diversion analysis and characterization.

We do have a gap that is risk-informing Part 73 and Part 74 that is tied into the same Commission direction that came down with the diversion path analysis. That gap is designed and characterized to perceive to reduce unnecessary regulatory burden.

I think the MOX transportation issue is moving separately from the reprocessing framework because there may be a need to implement that prior to we revise our regulatory framework.

So I hope that context is helpful.

MR. CAMERON: And go ahead on a clarification on that, Marshall, and then we will go

to Eric.

MR. KOHEN: Right, and I will just say that what Tom says is exactly right. We are planning to do a relook at the transportation security aspects of Part 73 in conjunction with the revision, the rulemaking that we're doing on fixed sites. So that is exactly right. So the transportation aspects will be considered at the same time as the fixed site for fuel cycle security.

MR. CAMERON: Okay, which is different then this risk-informing. So, when you say the fixed site, is that --

MR. KOHEN: It's part and parcel, at least from the 73 perspective.

MR. CAMERON: Okay. Eric, a comment?

MR. LOEWEN: I disagree with Steve that the advanced separation doesn't need to wait in the regulatory process. So we are behind that technology-neutral. The separation that is being done with the pyro processing is being done today, Idaho National Laboratory, in the treatment of ERB II fuel. There's a record decision by the DOE. There's an EPA decision there, and, also, you have the National Academy of Sciences endorsing that technology.

So what we are trying to do is see that

that technology gets treated equally on the regulatory basis, like we do other sort of technologies as far as enrichment or fuel manufacturing is technology-neutral. You're not picking what needs to be done.

MR. CAMERON: Okay. Thank you.

Arjun?

DR. MAKHIJANI: I really recommend the paper done, published by Brookhaven National Lab, to Alex and Marshall, in 2009, Barry, et al. I will supply you the reference.

But they looked at all the different reprocessing technologies. They binned them in four different groups. They found a number of findings, but even for electrometallurgical processing, they found proliferation advantages were not very significant. And for states with knowledge of PUREX, they were minimal. For non-stated actors, they were modest.

And there were a number of National Lab authors that participated in this, Brookhaven and Los Alamos. Jim probably was referring to this kind of set of studies that is being done by DOE. I think there's been a good effort.

And I think you should really take this particular effort and some other things done in the

academic world in science and global security from Princeton, Frank von Hippel and their associates. I would be happy to supply you with the references.

But the idea that somehow that there's a gradient attractiveness level, once you've gotten rid of the fission products, is not very technically-sound. Once you have separated the fission products, the proliferation resistance is essentially gone, and then we are arguing in the margins of what proliferation resistance is.

And there is absolutely no technical basis for creating some kind of a gradient unless you are talking about a cliff, you know. When you add fission products, it is a cliff. The rest is 2 percent, 3 percent.

MR. CAMERON: Okay. Thank you, Arjun.

And Alex?

MR. MURRAY: Thank you, Chip. You skipped over me twice. I'm taking notes.

(Laughter.)

I heard a couple of things mentioned here which are sort of I'll repeat my computer memory files here. I have heard something about standards, spent fuel standard, a cliff, leaving in some fission products, et cetera.

And I remember from centuries ago there were discussions about spiking the fuel with either 1 percent of the fission products or cobalt-60 or putting a cobalt-60 rod in with a MOX fuel assembly prior to shipment.

And I was wondering, for the parties at the table and in the audience, is that something that should be revisited, reconsidered, reevaluated, or should it just be left to history?

Thank you.

MR. CAMERON: How about MC&A? Do we need to say anything about that? We haven't mentioned MC&A at this point.

But before we go there, Dan, go ahead. I'm sorry.

MR. STOUT: I think the NRC needs to consider the hazards. Having radiation dose is one factor that terrorists would consider. You know, they may be willing to give up their life for their cause of creating a detonation.

Other factors that should be considered are the time delay, and going back to MOX fuel, it is not a snap of the fingers to turn a fresh MOX assembly into an improvised explosive device. You need to assess these factors in the attractiveness of the

material on balance, right-sizing. In a post-9/11 world, you need to consider the factors that cause delay and those that don't.

So I would argue that what you just proposed would not be an effective deterrent. It would certainly increase safety risk at the operational site, and it is not something that we would support.

MR. CAMERON: And Ed?

DR. LYMAN: Actually, if there were a separation process in which the weapons-usable material was never separated from fission products, to the extent that it always met the spent fuel standard, that would be probably the only type of separations that we would think have the potential for being adequate to proliferation resistance.

But as Dan said, you are trading proliferation resistance for significantly-increased occupational risk and possibly public safety risk. And you have to wonder, is that a fruitful way to go?

It certainly doesn't satisfy ALARA to say that you want to have a process which you make as hazardous to everyone involved as possible. So, from a theoretical standpoint, we would say that could be the only way that we would accept reprocessing. But

from a practical standpoint, if you need that kind of an approach to generate electricity, I mean you have to wonder. It is definitely not the softest energy path you can think of.

MR. CAMERON: Anybody want to follow up on that? Eric, do you have anything, any comments?

Okay. How about MC&A?

And I think Arjun has a comment on MC&A.

DR. MAKHIJANI: Well, one thing that I have looked at a fair amount that is a source of concern that I alluded to earlier is MC&A should include tracking of materials, nuclear materials and waste, especially nuclear materials and waste.

I can assure you there's going to be a big issue in the not-too-distant future. There's an upcoming article in Science and Global Security showing that there are considerable discrepancies within the Department of Energy of nuclear weapons materials.

I have myself written a report on discrepancies in nuclear waste of 300 kilograms at Los Alamos National Lab that, in my opinion, are still unresolved. You can find it on our website. There's other discrepancies that the Department of Energy itself has written about in a 1996 memorandum that's

publicly available.

I think this is a very neglected part of nuclear materials accounting and possibly one of the more vulnerable because we are talking about diversion, something you referred to earlier, you know, tracking.

It is relative easy, if you have an inside/outside job, compared to other ways of diversion, hiding things and saying they're in waste. I mean this is potentially a pretty serious problem, and there have been very large waste accounting issues in the United States. I think we don't know of them in other countries because they are not as open, you know, don't have access to as many materials.

But we have certainly advocated much, much more careful materials accounting and waste, especially when processing of large amounts. And we are talking potentially about processing a thousand tons of plutonium here.

MR. CAMERON: Tom, is that the type of issue that you are going to consider in the MC&A?

MR. PHAM: Thanks for your comment.

Regarding an NRC facility, we have pretty strict requirements currently on monitoring and controlling waste. For example, for a Cat 1 facility,

we only allow the facility to process a certain quantity of waste within six months with a limited quantity.

And every type of material, including waste shipped off site, must have a measured value. So we have a good assurance for the facility to maintain strict control of all types of material, including waste.

And also, to elaborate a little bit more, we are considering the diversion path analysis. That is a way, a method, to look at MC&A combined with the physical protection aspect, to look in different diversion scenarios that the facility must face.

Similar in the safety, the facility looks at different accident scenarios. In MC&A, the NRC facility will look at different diversion scenarios, material diversion scenarios, and come up with a different scenario with different mitigating measures, how to protect, deter and protect those scenarios.

That's what my thoughts are to help clarify the issue on waste and the issue on the diversion past analysis.

MR. CAMERON: Okay. Thank you, Tom.

Rod?

MR. McCULLUM: Yes, I just want to say

that I agree that MC&A is a serious issue. I agree that we need to be able to account for these materials at every step of the way. Certainly, the vision that I have for these types of technologies is that if they are things that can make the world a safer place, they need to be able to demonstrate that. They need to be able to know that these are the materials we have and we know where they are all the time, every one of the materials.

And in being comprehensive in being able to say that you are tracking all of the materials every step of the way, I think therein is an opportunity and a responsibility to be technology-neutral, to write the regulations so that whatever processes are to be used, that you can assure an equivalent level of MC&A.

Again, getting to the discussion this morning, you know, you write the regulations overall to assure that. And to the extent more detail on a given process is needed, perhaps guidance or perhaps bifurcating a PWR/BWR sort of seems to be necessary.

But even-handed, technology-neutral, and comprehensive materials control and accountability requirements are what we need.

MR. CAMERON: All right. Ed, do you have

another?

DR. LYMAN: I just thought of something. Actually, this technology-neutral requirement could really backfire on you, if you're not careful. Let's say you had a technology-neutral limit, which you already do have in the regulations, on the limit of error on the inventory difference, as based on your ability to measure the fissile material content in process streams.

Some processes may be harder to meet that than others. That would end up discriminating against certain technologies, if you had a technology-neutral limit.

So you should be careful what you wish for.

MR. McCULLUM: I'll just say I'll go ahead and wish for that because I think that any of these technologies should be able to make the appropriate measurements.

DR. LYMAN: Well, for instance, pyro processing, there are going to be intrinsic difficulties in measuring the fissile material content in process streams. It will probably be harder than it would be with a PUREX plant. So you are actually going to impose a greater burden on one of your

technologies than on the other.

MR. McCULLUM: Well, again, I think the regulations should set the requirements, and it should be up to the respective technologies to demonstrate, to make the case as to how they meet that.

DR. LYMAN: So can we leave the existing limit of their own inventory difference regulation in place, since it's already technology-neutral?

MR. McCULLUM: I don't see why not. You know, I'm looking at my various technologies around the room, and it is a good place to start.

MR. CAMERON: And, Marshall, are you -- well, let's go to Steve first.

MR. SCHILTHELM: When we were working with GNF, we did look at the issue of the existing regulation in relation to IDs, and we were looking at that time at aqueous processing.

There are challenges, and I'm sure Ed didn't ask that question without reason. There are challenges with the existing technologies and meeting the existing IDs.

But, in all honesty, measurement techniques and technology for making measurements are evolving very rapidly. And the ability to measure things is, things are being measured today that I

would have never imagined could be measured five or six years ago. I see Jim nodding over there.

So to conclude that the existing requirements for ID measurement can or can't be accomplished today I think is a little bit premature. I think it is up to NRC to decide what is the appropriate inventory, just IDs to be measured, and then for industry to achieve that, because industry has shown a lot of ability to adapt and come up with ways to do things that need to be done.

MR. CAMERON: Ed?

DR. LYMAN: I would just like to read the opinion -- this is a paper that was presented at the ANS meeting in June. The authors were Lineberry, Bob Benedict, and Zachary Miller from Idaho State University.

So their statement was "The NRC requirement" -- this is on SEID -- "will be impossible to meet for any reprocessing technology and any plant size. The NRC has neither licensed nor regulated reprocessing facility in its 36-year history." Well, that's not true.

"Its requirement for SEID, therefore, must derive from fuel fabrication or enrichment plant operations. When the time approaches for a U.S.

reprocessing facility to be licensed by NRC, the current standard must be revised."

That was their conclusion.

MR. CAMERON: Okay. Marshall, obviously, these are not formal comments on a rulemaking that you are doing, but I am sort of assuming that you are going to take the transcript from this meeting and everything you heard here, and that will at least inform your decisionmaking in terms of putting together a rule. Is that correct?

MR. KOHEN: Yes, sure. I mean, again, we were charged by the Commission with doing extensive public outreach, and I would say that's not just domestic, international as well, because we know that there are aspects of this that will have impact internationally, that there are international groups that are thinking about the types of things that we're thinking about. And that's something the Commission recognizes.

So, certainly, this is one of the first opportunities for us to get some feedback. Obviously, we haven't gone into too much depth about what we are considering at this point, but we will be doing that, certainly, in more detail as we can in the public realm in the coming months.

So the answer is yes, obviously.

MR. CAMERON: Okay, and one issue that came up when we were talking about design basis accidents, and we will get you out of here well in time, but the issue of intentional malicious acts. And one example was cyber security, and we had a little bit of a discussion on that, but we thought that we would save that for now to see if there were any more comments on that.

And, Ed, I'm going to go to you. Do you want to talk about cyber security here in this context?

DR. LYMAN: Well, I'm not an expert in computer engineering, but I did think of that in the context of a more general design criterion that would be essentially a safeguards-by-design rule, where the design of any new facility that processes special nuclear materials should have to go through an iterative process to ensure that the design is compatible with the safeguards and the material control and accounting.

There is no such rule currently. And if there were, certainly, cyber security would be one aspect of that overarching safeguards-by-design rule.

MR. CAMERON: Okay. Ed, it seems that

that could be part of what I am going to call the NMSS rulemaking in terms of a Design Basic Criteria.

And I don't know, Marshall, if you have anything you want to say about this, if you understand the context that we are bringing up. Is that something that is going to be addressed in any of the risk-informing? I mean, how does your group get involved in the cyber security as a design basis event for any type of facility?

MR. KOHEN: To my knowledge, the only cyber security regulations right now are for power reactors. I don't know of any move to develop similar regulations for fuel cycle facilities. I'm just not aware of any. And thus, it would be sort of premature for me to talk about what our role would be versus anyone else's role in doing such a thing. So that is pretty much where I can leave it.

MR. CAMERON: Okay, and the cyber security for a reactor, those regulations may be much more detailed than just the statement that this is a design basis criterion that the license applicant has to take account for. I don't know if that's true.

Alex?

MR. MURRAY: Thank you. I'm glad you remembered I am here. I was getting worried there,

Chip.

Just as a follow-up, Marshall, myself, and others were just starting to look at an old proposed Appendix Q to Part 50, which did discuss some General Design Criteria for MC&A and safeguards. We are just at a very preliminary level. There's some potential attributes to it which would seem to still have some relevance today.

As with all General Design Criteria, they are at a top level. You know, the design shall consider, the design shall have certain features for physical protection, what have you, and guidance is used to, if you will, expand upon what that means in practical terms.

In the presentation this morning, there was actually a reference, a Federal Register notice reference to that proposed Appendix Q. Okay?

MR. CAMERON: Okay. Anybody have any questions about this proposed Appendix Q? I mean, did that sort of fly under the radar from the tee-up this morning? Do people know what that is?

MR. McCULLUM: We were talking about it at lunch, some of us. It is refocus. You alluded to an Appendix P and an Appendix Q this morning. Are those available on the web somewhere or are they on

somebody's dusty shelf?

MR. MURRAY: The answer is, yes, they are available on the web. You have to go into The Federal Register notice files. We are going to see if we can actually put some of these materials, including those Federal Register notices, in a more direct link on the NMSS web page.

MR. CAMERON: So it sounds like there is an interest in this and the information should be more accessible perhaps.

I think we are done with safety and security, except that, as always, I would ask Miriam to see if there's anybody who might have something to say on this before we move on.

MR. PHAM: I would like to add some more, based on the handout you have outside.

One of the other considerations of the NRC to look into that is, in MC&A, to improve the material accounting management for a reprocessing facility. And of course, we already anticipate that a reprocessing facility likely will have a very large throughput and inventory. So we looked at that.

Last year many of our NRC staff present in this room, we went to Japan and we visited Rokkasho reprocessing. And there were some lessons learned,

and we also exchanged some technical discussion with the Japanese.

Actually, they have the facility running. If they have trouble, they restart it, things like that.

So, the MC&A part, we have a really good discussion with them, and we learn about how they come up with different new technologies, how to come up with more real-time material management.

Right now, under our current Cat 1 facility, how we define, limit quantity for inventory or for the SEID or things like that, we have a number, and that number is pretty stringent. It's too strict.

And the Japanese shared their experience with us, and they have actually a practical thing they already completed and they already run it. And they have a number to share with us.

So we consider all those things to make sure that, if we need to license a reprocessing facility, the nuclear material should be under a good management program.

MS. JUCKETT: Any other comments?

(No response.)

Okay.

MR. CAMERON: Thanks, Miriam.

We have been at it for about two hours. Why don't we take a 15-minute-or-so break?

When we come back, we have a discussion of environmental protection issues, effluent limits, 40 CFR 190, and other subjects that you might want to weigh-in on, including perhaps what we might give more attention to when we go out to the second workshop in Albuquerque.

So it can be a pretty free-ranging discussion, and I would anticipate that we would probably wrap up around 4:30 at the latest, unless there is a real burning discussion going on.

Okay. Thank you.

(Whereupon, the foregoing matter went off the record at 3:13 p.m. and went back on the record at 3:39 p.m.)

MR. CAMERON: Okay, we have a topic which is environmental protection. Originally, we were thinking about effluents, effluent control and monitoring.

We know, you all know probably, there's a rulemaking that hasn't really started yet, except it's in the information-gathering stage, to change the basic radiation protection standards in Part 20. And whatever comes out of that is going to apply to these

types of facilities, I assume, or may apply.

There's the whole issue here of 40 CFR Part 190, and we heard from Brian from EPA about they are at very early stages. We are going to see if we can get Brian and his colleagues to Albuquerque to be at the table.

I'm looking for what else. Available technologies for control of reprocessing effluents. So this is the time to have some discussion of these environmental issues.

Do we have a tee-up? We don't have a tee-up? Oh, we do have a tee-up? It's not Alex again, is it? Oh, my God.

(Laughter.)

MR. MURRAY: No, it is actually Alex's twin brother Skippy.

MR. CAMERON: Skippy Murray? Okay.

MR. MURRAY: Yes.

MR. CAMERON: Okay. We're going to have a tee-up by Skippy Murray, and he's the only one who will be employed here after this.

(Laughter.)

MR. MURRAY: Okay. Let me just go straight into it.

Next slide, please.

Environmental protection has several aspects involved. In this short presentation, we are going to primarily focus on effluents and emissions, which has been the main discussion of the Working Group at the NRC.

Next slide, please.

Okay. A little bit about effluents and emissions. These limits are actually established by the EPA. The actual limits are 40 CFR 190. It is an EPA regulation, for those not familiar with federal regulations.

The NRC regulates to the EPA limits, and we do that via 10 CFR Part 20, which basically are the standards for radiological protection. They have dose requirements, and so forth, in there.

Now 40 CFR 190 for emissions and effluents has two aspects to it. It has dose limits and it has quantitative limits. The dose limits are relatively low. They are based upon individual health impacts. Sometimes the determinant that is used is the MEI, the Maximally-Exposed Individual. And I have shown the limits there. They are essentially 25 millirem for whole body TEDE dose. Okay?

I have just put in for comparison, for members of the public, I put in there what some

typical experiences with ionizing radiation exposure correspond to. A typical chest x-ray is approximately 10 millirem. If one moves from the Washington, D.C. area to the Denver area, and you live there for about a year, the difference is about 200 millirem. So that puts it in perspective. Again, these dose limits are very, very low compared to natural variations in background radiation.

The modern reprocessing facilities overseas, based upon the reports the staff has seen, some of the public meetings we have been in, presentation to the Advisory Committees, have all shown that these dose limits are easily met by modern commercial reprocessing facilities.

Now the other attribute to this has to do with quantity limits. And when I say quantity, quantity when you deal with radiation, usually you talk curie quantity. It is directly analogous to mass. Okay?

These limits are a little more difficult to understand, to ascertain, to meet. They are based, instead of being based upon individual doses, they are based upon collective doses, essentially, the whole dose, the whole population of the world, and this brings in this whole concept of micro-doses to macro-

populations. Okay?

This may overstate the impacts. You know, again, natural variations in background radioactivity far exceed what we see here.

Next slide, please.

Okay. These are the actual limits. I put the limit down -- the dose limits are in the table on the lefthand side of the slide. The quantity limits are on the righthand side.

The way the regulation is currently written, the limits are in curies per, if you will, electrical output, and it is phrased in gigawatt electrical years. Okay? That is an output of electrical energy, a big one, I might add.

Okay. In the last column of that table on the right there, I have put in some of the values of krypton, and I probably should say for the radionuclides which were present when you have fuel discharged at approximately, I think it's 52,000-megawatt-days-per-ton burnup. So, roughly comparable to what you have discharged from power reactors. They may be just a smidge on the low side, but definitely in the range.

And as you can see, for krypton and iodine, there are some significant differences.

In the case of the plutonium and other alpha-emitting TRUs, the limit would appear to be easily met by current filtration technologies.

Next slide, please.

Just a very quick discussion about the basis for the EPA limits. As I said a moment ago, these quantity limits are based upon collective dose, population dose. In essence, the dose is spread over the entire world's population.

It was based upon 1,000-gigawatt electrical capacity of nuclear power. Let me just put that in perspective. For those who are not familiar with some of the terms, that is about 10 times what actually exists today in the United States.

It was also predicated upon having a reprocessing facility for, I think it was, every 14 nuclear power plants. And when you crunch the numbers, that was about 25 reprocessing plants in the United States alone. As I have noted on this slide, the actual number today is zero.

It also was based upon short or relatively short cooling times; i.e., reprocessing a short time after discharge of the fuel from the reactor, somewhat less than the current practice at La Hague and Thorp at Sellafield, about four to five years of cooling.

It was also based upon a generic site in the middle of the United States. It would be a land-locked site. And one of the differences with current practice, that I should say Sellafield, La Hague, and Rokkasho are actually on the coast of their respective countries.

Next slide, please.

Now I should add this is sort of like one of the laws of thermodynamics. Nothing comes easy. There are control technologies available to capture and reduce the emissions of some of the gases, such as, I should say, krypton-85 and also iodine.

However, these control technologies do introduce potential hazards. One of the things I put up there is voloxidation. That is a process which has been tested at the laboratory in a pilot plant stage at Oak Ridge, if my memory is correct, which involves heating up basically fuel, PWR fuel, that has been chopped up in an oxygen environment. This forces the release of materials. However, it does involve heating potentially pyrophoric -- that means burning or combustible materials -- up in an oxygen atmosphere.

When you capture krypton and iodine and tritium, what do you do with them? You have to store

them and you have to dispose of them. Krypton, they would have to capture as a compressed gas. Iodine would be on some form of absorbents. These introduce potential hazards. Do the benefits of capture outweigh the risks of release?

Another interesting thing we found from analysis, if one uses old-age spent nuclear fuel, krypton and tritium decay considerably. They both have half-lives of approximately 11 years. There's a significant quantity of spent nuclear fuel older than 30 years. If you only reprocess 30-year-old fuel or fuel older than 30 years, there's an automatic 90 percent reduction in your emissions or potential emissions without even considering any capture technology.

Having said that, I think it was Jim from DOE who brought it up a little earlier on, you also have a tradeoff. Okay? Yes, you can use aged fuel, but then you lose some fuel value, the decay of the plutonium-241. You also have some americium buildup which can potentially impact recycle or disposal considerations.

Again, nothing is easy. Whatever is decided upon has to be based upon a very thoughtful and thorough analysis.

And one last result from our current preliminary analyses that have been performed by the staff is there are many assumptions, including assumptions in the iodine analysis. Some of those assumptions may not be valid today.

Next slide, please.

And again, just on this slide, are there any specific requirements for reducing or addressing emissions and effluents or protecting the environment from potential reprocessing and recycling facilities in the future? Some things are mentioned here.

Next slide, please.

And I have just put up some points here for discussion in the short time that we have.

You know, again, I think that there could be some very interesting discussions about age of the fuel, any specific performance requirements, minimum decontamination factors on effluents, et cetera.

I'm done.

MR. CAMERON: Thank you very much, Alex.

What's the controversy here? I mean, what's the controversy for discussion in terms of effluent limitations?

One statement you made is that it is going to be fairly simple for reprocessing facilities to

meet the NRC's effluent limits. Is that --

MR. MURRAY: I would characterize it this way: the dose limits appear to be easily met. The quantity limits would not likely be met using current practices, not necessarily current technologies, but using current practices.

So, for example, taking a La Hague facility or a Sellafield Thorp facility or a Rokkasho facility, and placing the equivalent in the United States of America, it most likely would not meet the quantity release limits, as with current practice.

MR. CAMERON: So we would have to use different practices? And by practices, you mean -- some examples of a practice, for example?

MR. MURRAY: Some examples of potential practices would be use of captured technologies. Say for krypton, it could be some form of carbon or cryogenic separation and absorption. In the case of iodine, it could be improved silver impregnated zeolites. In the case of tritium, it could be the use of some form of noble metal catalysis or hydrating materials, et cetera.

But the key thing is not currently practiced. It's a delta.

MR. CAMERON: Okay. Good.

Rod, go ahead.

MR. McCULLUM: Yes, I want to, first of all, correct something Alex said. I don't think our licensees ever consider meeting NRC's requirements easy.

(Laughter.)

But I do agree that recycling facilities should be able to rigorously demonstrate compliance with those effluent limits. Nor should it be easy, I would point out.

I think this was a good presentation in that it demonstrates you are looking at all the right things. We would certainly want to make sure that your requirements are up-to-date with the latest radiation protection science.

We understand that EPA is looking at 40 CFR 190 consistent with the 10 CFR Part 20. And in that context, I don't know that there is a lot specifically to be said here for the recycling regulation, other than that we would hope these things would all be harmonized and that you folks would come into line with that.

There's a couple of things on that slide or were mentioned in your presentation. They are in the penultimate bullet. Spent nuclear fuel time,

aging, or other requirements, I mean recognizing that you do lose some of the bad actors if you age it, and then, of course, you also take on the challenges of americium. That is not something, I don't think, our licensees or applicants would want to see specified by regulation in terms of seeing a regulatory requirement that you could only reprocess fuel of a certain age or not of a certain age.

I think that's something that, if an applicant determined in their process to meet a limit they had to have fuel of a certain age, they would commit to that as a license condition or a technical specification, but that would really be up to the licensee to propose those kinds of limits. Those are not in a -- sorry -- risk-informed, performance-based, technology-neutral regulation. That is not the kind of thing you would specify; it would not be productive to specify it by regulation.

And similarly on siting attributes, I would not want to see, you know, us having to take credit for being on the coast to site one of these facilities. You may very well site one in an arid or a humid part of the United States far away from the coast. So, again, it would be up to the licensee to demonstrate how they comply with the environment in

which they choose to site themselves.

But, really, looking at this presentation, you have got the right things on your plate. And we encourage all the agencies looking at these things to harmonize these regulations and to come up with a workable approach.

MR. CAMERON: Thanks, Rod.

Steve?

MR. SCHILTHELM: If you could scroll back to the slide that shows the actual limits? One more. I'm sorry, go forward. Yes.

If you just look at the limit and imagine trying to comply with a limit that says I can release 50,000 curies, I believe that is, per gigawatt electric year, in typical regulation you would have a dose-based standard. Well, you know, not to pick on EPA, they came up with a criteria based on the expected technology, the expected number of reprocessing plants, the expected number of nuclear power plants, and the expected ability to either capture or not capture some of those radionuclides.

But that particular value doesn't really correspond to a dose or a risk or a detriment to the public. I think that is where the difficulty lies.

The denominator changes over time. We

have even had debates about, what is the denominator? Is it the gigawatts electric produced from the MOX fuel that you create or is it the total gigawatts electric produced in the United States? Different people choose what the denominator should be based upon their understanding of the background.

So I think the difficulty is, one, the way the metric is written, and then, two, the science behind the metric. Radiation protection regulations and dose modeling have evolved, I believe, three times since this regulation was written. So, to state it in terms of curies released rather than a dose metric, this is very problematic.

I have no preconceived notion of what that would mean if you applied today's technology and today's dose models and today's attributes, but I would suggest that a standard should be dose-based, not curie-released-based per gigawatt electric.

MR. CAMERON: Okay. Thanks, Steve.

You know, both you and Rod have expressed some concerns, that, for example, don't establish generic limits on things like fuel age or siting. Where's the playing field for effluent limits and application of existing effluent limits to reprocessing facilities? The playing field for that

is existing Part 20, existing 40 CFR 190, or any changes that the NRC proposes as part of this Part 20 rulemaking or what EPA might propose as part of CFR 190? I mean, is that where this discussion is really going to center, as opposed to this rulemaking --

MR. McCULLUM: Yes, that is why I said there is -- and I am glad Steve brought it back to the point because, in visiting that playing field, that certainly is an issue. I agree wholeheartedly, I think everybody in the industry agrees that dose-based is the way to go.

But that is a much broader subject than recycling regulations. It is a subject that needs to be addressed, and I am encouraged to hear from EPA that they are working on it, and NRC is also working on it on a broader level.

And we would just hope that that whole playing field would be harmonized and conform to the latest technical understanding of what the appropriate radiation protection standard should be. Then we will, in our usual, rigorous way, we will look at those standards.

MR. CAMERON: Tom?

MR. HILTZ: I think our understanding of 40 CFR 190, in our communications with the Commission,

we have indicated that we recognize that 40 CFR Part 190 is a potential challenge for a reprocessing facility to meet. But we have not identified that as one of our regulatory gaps.

It is my understanding that our regulations in Part 20 embed compliance with 40 CFR 190. But the staff, up until now, has taken a position where we will work collaboratively with the stakeholders, including EPA, to understand, help understand their concerns, be a resource, if the decision is made to revise 40 CFR Part 190, and progress the discussion appropriately. But we are not the lead for 40 CFR Part 190.

MR. CAMERON: Would it be helpful in Albuquerque at least to have further discussion, if we had Don Cool or someone like that or EPA at the table, to have a discussion of this? I'm just trying to get an idea of where the productive discussion on this issue could be.

Let's go to Rod and then Phil.

MR. McCULLUM: I would just say we would certainly welcome that. If the parties that are involved in those areas are at the table, the opportunity to discuss the issue would be valuable.

MR. CAMERON: Okay. So not just EPA, but

maybe the people who are working on the radiation protection standards, I guess.

MR. HILTZ: Yes, I think we will need to look at that --

MR. CAMERON: Okay.

MR. HILTZ: -- and figure out what we want to accomplish in Albuquerque. And I certainly, you know, want to make sure that our workshop is focused on the gaps that we need to resolve.

MR. CAMERON: Right.

MR. HILTZ: And if EPA is willing to come to the table and sit, we would certainly invite them to do that and participate in the discussion.

MR. CAMERON: Okay. Phil?

MR. REED: Yes, I would just like to follow up with what Tom says. Both of the EPA regulations are enforced through our Part 20, which requires both the NRC Part 20 regulations to be met as well as 40 CFR 190. They are essentially enforced through the ALARA concept, which is coming into the tech specs under Appendix I of Part 50.

Now when you apply the ALARA concept, it just simply means that, based on $1,000 per person rem, you just have a technology. You apply the technology, and eventually you bring down the

limitations.

But, as Alex had mentioned, sometimes a technology may not be appropriate or it may not work in these cases. But, then, you have going for it, you have krypton-85 and tritium. Of course, you have about 10-year half-lifes.

And I'm not sure whether they are mentioned in the low-level waste Part 61 or not, but if they aren't, you can classify them as Class A, put them under Class A, let them decay for 10 years.

But the basic concept here is, under the ALARA, the industry is required to fulfill the ALARA requirements simply by adding more technology in order to reduce the effluents to the lowest limit that is reasonably achievable.

MR. CAMERON: Thanks, Phil.

And Ed?

DR. LYMAN: Yes, that's a useful way to look at it. I just wanted to point out, what is the logic? The underlying logic here is that you are taking spent fuel and you are processing it, and you are releasing fission products in the process.

So it is incumbent upon anyone who is operating such a facility to ensure that you do not have a significant impact on the public. And for that

reason, it is reasonable to impose the limits on certain radionuclides, even if the individual doses are shown to be low, because they do have collective impacts.

Krypton-85 is unusual in that it does disperse uniformly in the atmosphere. I think it will eventually disperse throughout the entire hemisphere. So it does actually impose a global burden.

And there are methods -- I think UNSCEAR evaluated the collective dose impacts from reprocessing using a model, and I don't think modeling something like krypton, I don't think there's been any real improvement because of the way it behaves. So I am not sure there would be much benefit to be gained from trying to look at that again.

But we do strongly support that, if there is going to be reprocessing, that there needs to be assurance that you do not release quantities of radioactive materials into the atmosphere.

There are also other isotopes. As mentioned before, carbon-14, I think one thing that UNSCEAR found was that carbon-14 emissions actually are significant contributors to the collective dose.

And Thorp actually did apply controls to capture carbon-14. La Hague doesn't. But certainly

in any revision of EPA regulations we need to take a look at carbon-14 as well as any other isotopes which in the intervening time have been shown to be significant.

MR. CAMERON: Okay. Thank you, Ed.

And Arjun?

DR. MAKHIJANI: Yes, I think tritium and carbon-14 were discussed earlier. I think the thing that is different about reprocessing, as Ed said, you are deliberately releasing fission products and activation products. In a reactor, you try not to release anything. And here, by the inherent nature of a process, you are taking stuff that you would otherwise be containing and releasing it.

So I think it is important to keep a population dose concept in here. I mean, when we calculate doses from atmospheric testing, we know that carbon-14 is the most important component.

And I would just like to suggest to Alex that a comparison with natural background and radiation natural background for involuntary dose imposition is not appropriate.

And the other thing that is not generally taken into account -- and I have asked the National Academy and repeatedly other agencies to think about

this, EPA -- is very often you say, well, there's a de minimis dose. You know, if it is a microrem or a millirem, it's very small and you don't know its effects.

But this is not correct because, if you think about the idea that the linear threshold we don't know; there may be a threshold of 1 millirem or 1 microrem. However, we get natural background of 7 rem per year, even if you live at sea level.

So, when you are imposing a dose on somebody, it's not the dose, the millirem above zero. It is the millirem above a level that we know that Mother Nature is already doing to us. And we allow Mother Nature and our dentist to do things to us that we wouldn't allow our neighbor to do to us.

And so I think you cannot disregard when you know that population doses are going to be very large, which is a different situation from reactors, actually. Reactors, you are not releasing large amounts of materials, and in reprocessing plants you are going to be releasing a million curies of tritium every year whose dilution volume, to my back-of-the-envelope calculation, to the existing drinking water standards is 50 trillion liters per year.

That is a very large dilution model, and

you don't want to approach 20,000 picocuries per year. So, actually, the coastal versus inland is very important in how you are going to consider your siting and whether you can actually meet some environmental limits.

My final point is that, you know, it is very difficult maybe to think about gaseous emissions in this way, but effluent discharges via pipes that are comparable in concentration to Class A waste should be considered similar to Class A waste. And the legalistic idea that it is not waste until it is on the way to the disposal facility should be discarded.

Anyway, I would also look prospectively ahead. If you want certainty that you won't be disrupted by changes in regulations, I think some of us have said that plutonium limits should be .15 picocuries per liter; tritium should be 400 picocuries per liter.

And it's not just us on the outside. The Department of Energy agreed in the cleanup of Rocky Flats that plutonium should be .15 picocuries during the decommissioning in surface water, not even drinking water, surface water; that in licensing there should be some kind of, at least the industry should

consider some kind of proactive idea as part of ALARA. Even if you are dealing with drinking water limits the way they are today, maybe we should look to some kind of guidance beyond drinking water limits for thinking about ALARA.

I like the concept of ALARA, but I'm not very happy in the way that it is applied to reactors currently. And you wouldn't have as many scandals if you were looking at, for instance, the individual radionuclides that were being released. I'm referring to the tritium scandals.

And we have not met with any success with asking the NRC to think about individual radionuclide releases from reactors. This problem is going to become very magnified with reprocessing plants.

And I think when facilities are built, I don't want a reprocessing plant to be built mainly for non-proliferation reasons. But if they're built, I think you want to avoid just discharging scandals to the extent possible.

MR. CAMERON: Thank you, Arjun.

Rod and then Jim.

MR. McCULLUM: Yes. Again, getting back to the spirit -- and I hope I can do this -- of our earlier discussion, I want to agree with Arjun that we

absolutely believe that we should protect the public from the effects of the isotopes listed up there. So we're in agreement there.

And we believe that we should protect them in the accordance with the most up-to-date radiation science information available.

And looking at what's under the middle column limit there, it is simply our position that does not represent the latest radiation science information available. This is broader than -- again, it would be useful to hear from the broader community here because that is where we would like this to go.

And in that context, absolutely, we should limit these releases with the most appropriate standards, and we should apply ALARA. I don't think any prospective applicant would see whatever dose limits, if those are the most appropriate limits, as we believe, as, okay, well, we'll release that much. They would, then, look at the cost/benefits of going below that, in accordance with ALARA requirements.

So we are in agreement of the need to protect, and we want to do it with the most up-to-date and informed radiation science.

MR. CAMERON: All right. Then Jim?

DR. BRESEE: Yes, let me just add a few

comments with regard to krypton-85. I said some things about it earlier today.

I think it is a little misleading to speak of reprocessing automatically in some sense releasing large quantities of krypton-85. There may be business reasons not to, quite independent of the requirements of whatever revised provisions may come from EPA or NRC.

It turns out that more than 10 times the quantity of xenon is accompanying the krypton in used fuel. And xenon is a very valuable commodity. It is non-radioactive. It sells for $10 a liter, standard temperature and pressure today. You might want to recover krypton and xenon quantitatively simply to balance the cost of reprocessing.

So, in addition to the need to meet standards, one needs to look very broadly at future fuel cycles. We have an opportunity, because of delayed implementation in this country, to use our quite advanced technology. Technology is evolving rapidly.

And I'm personally quite optimistic that we will be able to meet whatever standards are finally established and not just say that, in some sense, there's an automatic release associated with fuel

reprocessing. Fuel reprocessing can be done very cleanly. There will be ways in which it may ultimately be seen as a way to reduce the threat of proliferation rather than to expand it.

MR. CAMERON: Thank you very much, Jim.

Ed?

DR. LYMAN: Just looking at experience, no reprocessing plant in the world actually captures krypton. I know I looked at the original Thorp assessment, and they decided that the cost wasn't worth the benefit. And these are the same vendors in some cases that are trying to build a plant here.

So the question is, how do we ensure that the practices actually do improve if a plant is built in this country? And if there is an effort to weaken the EPA requirements because of the fact that plants would have to do something different in the United States than they currently do overseas, then that's a problem.

MR. CAMERON: And Rod?

MR. McCULLUM: Yes, and I think I would in part agree with that. I think there will be an expectation that plants here do something different than what they do overseas.

I think that, again, the limits we are

looking at there are not necessarily the appropriate driver for that expectation, but, clearly, we are not talking about weakening regulations here. We are talking about making the appropriate regulations consistent with the latest available radiation science.

MR. CAMERON: Okay. Anybody have a comment on that? I think that was an important point, if it wasn't understood before, that from the perspective of the industry, you are not thinking about trying to see that regulations in this country are going to be weakened to correspond to regulations elsewhere.

MR. McCULLUM: Yes, to put it more succinctly, we are not just simply going to Xerox the blueprints of La Hague and Thorp and bring them over here.

MR. CAMERON: Okay. An important point.

Yes, John?

DR. FLACK: I think the issue is going to come down to, unfortunately, collective dose. That is where folks are going to have to come to grips with this, you know, how one perceives that issue.

Now it may be on the EPA's plate right now, and that may be how they decide on what

quantities are acceptable, and then we will have to enforce it. But this still has to be determined, and there should be a technical basis for it.

You know, ALARA would say that, if we are talking about a collective dose, what's acceptable? I mean you just keep pushing the technology until it's no longer available.

There has to be some tradeoff there with that, but I don't think this whole issue has played out yet. And I think this is going to be something that is going to be a concern on everybody's mind going into this, as to how we deal with that gorilla in the room kind of thing.

Maybe things have changed since I have looked at this last, but if it hasn't, it looks like there is still a gorilla in the room on this one.

MR. McCULLUM: Yes, Chip, I want to agree with that. And again, I stress that's why we think the broader dialog is necessary here.

MR. CAMERON: Okay. Sven?

DR. BADER: Yes, we're not skirting the issue. We're not trying to suggest levels need to come down.

I think there's been points here that tritium is missing, carbon-14 is missing. What we are

really emphasizing is we are looking for a sound technical basis for an updated regulation, so that we have something to design to.

MR. CAMERON: Okay. And I think if there's one point that is important that is coming out of this discussion, it is that, what you said, what Sven said.

Do people agree with John that there is a gorilla in the room? Is that the right characterization?

MR. McCULLUM: Various forms of primates, I think, yes.

(Laughter.)

MR. CAMERON: Various forms of primates, okay.

All right. Steve?

MR. SCHILTHELM: To John's point about a gorilla in the room, there is. ICRP has written differently about collective dose than they did in the past, if you look at their new recommendations. Some agree; some disagree.

So I think there is a debate that will occur, as Rod said, in a different forum, and NRC and EPA are going to have to come through that debate and put forth regulations.

So, yes, you're exactly right.

MR. CAMERON: Okay. Yes, Arjun?

DR. MAKHIJANI: One brief thing that hasn't come up, you know, in the last century, the idea of regulation or protection of health and environment was around human beings, various primates. But in recent times, the ICRP and in the United States various bodies have taken up the question of ecosystem risk, and it is no longer accepted.

DOE has begun to grapple with this. We don't agree with the details of what the DOE is doing, but we agree that the topic is very important.

At my little institute, we have begun to kind of think through this problem as systematically as we can.

And I think when you look at these discharge levels, population dose is not the only consideration in mind. And I do think, you know, we are going to do something, and I do agree with the idea that there should be some -- that business should have some environment in which they can make an investment. It is not an investment that I support, but if you are going to do it, there shouldn't be turbulence.

Okay. To accomplish that right, I think

you need to be stringent and prospective in what the public might want in terms of health and environmental protection. I don't have any specifics to suggest at this time. I probably will a few months down the line. But we are looking at this in relation to Hanford, for instance.

And I think it would be good to put ecosystem risk on your plate in this regard, especially in regard to putting limits on total discharges.

MR. CAMERON: Sven?

DR. BADER: I just want to point out that Sandia just issued a report on providing a technical basis for 40 CFR 190, and it's worth looking at that. They looked at the cow uptake, and so forth, yes.

MR. CAMERON: Okay. Jim, do you have a tent up from before or do you have something to add now? Okay. All right, I just wanted to make sure.

But are there any other environmental issues someone wants to bring up? Are there any other issues that we haven't touched on at all today that are important?

(No response.)

Any suggestions for Albuquerque? I mean we have already discussed among the NRC staff what we

might do differently, more focus on certain things. But this is the time to address anything like that.

Rod?

MR. McCULLUM: Yes, just very simply, I think the NRC staff has heard a number of challenges put to it, both from the industry side and from some of the other stakeholders here.

The tee-up presentations are a great idea. Maybe if we could see in a month from now some reaction to some of the challenges that you heard here, which I think if you tee that up, might further the dialog.

MR. CAMERON: So tee-up some of the challenges that we have heard?

MR. McCULLUM: Yes. I think you heard a lot from industry as to some of the things we would like to say. And if you didn't, I will say it again: risk-informed, performance-based, technology-neutral. And I think, also, from our stakeholders here you heard some of their concerns.

I think to the extent that in your process so far you have been thinking about these things, something that illuminates what you have been thinking so far. A slide that says, hey, here's what we heard from you guys, and here's where we're looking at

addressing it. And that might stimulate some additional dialog.

MR. CAMERON: Now that's a good suggestion. I'm not sure where the staff will want to go at that point in terms of how their thinking has changed or not changed.

But, you know, it is always difficult when you do two or more of these workshops. We want to give the people who are around the table in Albuquerque a chance to talk about this as if it is fresh and new, but there is still a value, as you point out, to teeing-up, well, here's some of the challenges that we heard.

Different people around the table, or even the same people from reflecting on things, might have a different take on it then. But I think that is a good idea.

MR. McCULLUM: Yes, and for our part, I think our thinking has evolved through this day and a half. And we really appreciate that. We have been talking amongst ourselves.

I am not expecting you will have all the answers. When I say tee-up, here's what you heard and here's where you think you're going with it; it might be you plan to address it, not that in a month from

now you will have the regulation ready.

MR. CAMERON: Okay. Thank you. Good comment.

And I think we have already talked a little bit on the staff level about, well, first of all, we are going to make the tee-ups available beforehand, so that people have those.

And also, perhaps take a look at the discussion points and make them more focused perhaps on one or two points, so that we can really zero-in on what we have found to be the most valuable here.

But that is a good suggestion. Thank you.

Sven?

DR. BADER: I actually have a question for Alex. He quoted something that said there are some iodine-129 assumptions that are not valid today. Could you elaborate on that?

MR. MURRAY: Oh, yes. This is in the analysis which the staff has been looking at and considering. Some of the iodine, the assumptions for the iodine doses were based on, first, some different versions of the ICRP, different dose assessment methodology, but also some assumptions about where, if you will, where the points for ingestion would be. Okay? What population would be impacted? Basically,

a 50-mile population initially, then national dose, and then, basically, a world dose, et cetera.

So some of it is locative and origin, and some of it is basically the population assumptions in growth. Some of those don't appear to be fully valid. Okay?

I should on that, if those effects were included, they would decrease -- iodine capture would still be required, but the required amount of capture, the decontamination factor, if you will, necessary to meet the regulation would be reduced.

MR. CAMERON: Okay. Thanks, Alex.

Apropos of Rod's remark about this has stimulated some of their thinking, I think everyone is going to look forward to some of your developing thoughts on the issue of risk that we talked about yesterday and that document that you are coming forward with, and perhaps having a discussion of that at some point.

But I think Tom and others would be looking forward to how your thinking has developed on a lot of these issues by the time we get to Albuquerque.

MR. McCULLUM: Yes, I am hoping we will have our risk White Paper out and to that workshop.

We would certainly be happy to discuss our thinking. Either we will have it out or we will have evolved our thinking to the point where we just have a few more questions to address, and it might be useful to discuss those. So, yes.

MR. CAMERON: Good. Good. That will be great to have on the agenda.

And, Tom, did you want to say anything else on these issues in terms of what the industry is thinking?

MR. HILTZ: Well, I think it is helpful to understand just what you indicated, that maybe we could have some further evolution of the NRC thinking.

I think we heard from several stakeholders. And if there are some important points that we need to consider that you have gathered from this, I think we would certainly like to hear those and see those shared, if you want to provide them in writing or be prepared in Albuquerque. I think that would be very helpful.

MR. CAMERON: Okay. Great. So I think that this meeting discussion will move us forward to a different level in Albuquerque while still allowing the same foundation issues to be addressed.

Go ahead, Dan.

MR. STOUT: I just want to compliment you. I think this process has been valuable. I think it resulted in a lot of tough issues getting conversed and getting views on the table that I haven't seen in other formats.

You know, industry needs regulatory predictability. From our perspective, it would be great to have regulations done before we start design. That isn't going to happen.

The NRC would love to have all kinds of designs to look at and to make sure that the regulations they put in place cover everything. And that is not going to happen.

It is going to be an iterative process. Like Marissa mentioned, you know, there's going to be Reg Guides. I just think that collectively we need to look at this whole thing as an iterative process, and I implore you to continue to push forward.

It's the right thing to do from all angles, for the NRC to strive to put in place regulations, to get what you can from us, the industry, and from stakeholders. And we encourage you to just keep going.

Despite what's going on in the political world, despite what's going on technically, this is

the right thing to do, to enable a sustainable nuclear industry long-term.

MR. CAMERON: And that's Dan with TVA, no longer with DOE.

Okay. Marissa?

MS. BAILEY: Just to respond to what you said, Dan, and to add onto Tom's comments.

First of all, I would like to emphasize that the NRC doesn't take a position pro or con, either for or against reprocessing. That is going to be decided in the national dialog on how we eventually manage our spent fuel.

Our role is basically to ensure that there is a stable regulatory framework for us to be able to license a reprocessing facility safely and securely if an application comes in.

Having said that, our goal in this meeting and in further interactions really is to about a year from now produce a regulatory basis for rulemaking for reprocessing, at least a draft regulatory basis. And I think that that's what we are trying to drive towards, is that in about a year we have a draft technical basis or regulatory basis for reprocessing.

And so what we are trying to do here and in Albuquerque, and maybe in other subsequent

interactions, is to inform our decisionmaking. So I do appreciate the comments and the feedback that we have gotten from the various stakeholders.

I would encourage you to let us know if there are some points that we aren't considering, but, again, it's the regulatory basis for reprocessing that we are trying to produce a year from now that addresses at least the high-priority gaps and maybe some of the medium-priority gaps.

MR. CAMERON: Okay. Thanks, Marissa.

And I always like to ask Miriam to go out to the public because I don't really like to deal with all the angry people out there. So I dish that off to her.

MS. JUCKETT: There has not been enough anger. Anyone have any comment? You have a captive audience.

Cathy's angry.

(Laughter.)

MS. HANEY: No, Cathy is not angry. I just thought, as long as you are offering the microphone, I just wanted to echo Marissa's last statements. I have found this very valuable. I have been able to sit through maybe half of the meeting, but I really think that I have benefitted as well as

the staff from the open dialog, getting some of the issues on the table.

So I appreciate you all taking the time and effort to come to this meeting and contribute, and we look forward to just future dialogs with you.

So, I'm sorry, Miriam, it wasn't angry, but there you go.

MS. JUCKETT: Any other comments?

(No response.)

Sorry, Chip.

MR. CAMERON: Thank you, Miriam.

Tom, did you want to say any last things to us?

MR. HILTZ: Yes. Thanks, Chip.

I want to associate myself with Cathy and Marissa in thanking you all for participating. It has been very helpful for us.

You know, we went into the workshop not sure what to expect. And I think after two days, we are very appreciative and we found it very, very productive.

So thank you all for your participation.

I also want to thank the Working Group members. Many of those are here, the NRC Working Group who have provided support for this workshop, and

I particularly recognize Jose and Jeannette for their coordination efforts and support, and Alex who stepped in the past couple of months to help pull some of the presentations together. So thank you very much.

And finally, Chip, I would like to thank you and Miriam for your outstanding support of the workshop. It is a success because of you all in principle. So thank you very much.

MR. CAMERON: Thank you all.

We are adjourned.

(Whereupon, at 4:39 p.m., the proceedings in the above-entitled matter were adjourned.)