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UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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REACTOR PROTECTION AND NUCLEAR MATERIALS SUBCOMMITTEE

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THURSDAY

JUNE 23, 2011

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Michael Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman

JOHN D. SIEBER

JOHN W. STETKAR

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

DEBORAH JACKSON

PRIYA YADAV

CHRIS McKENNEY

ANDREW CARRERA

DAVID ESH

DREW PERSINKO

LISA LONDON

ALSO PRESENT:

JIM LIEBERMAN, Talisman International *

JOHN GREEVES

* Present via telephone bridgeline

T-A-B-L-E O-F C-O-N-T-E-N-T-S

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

8:29 a.m.

CHAIR RYAN: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Radiation Protection and Nuclear Materials. I'm Michael Ryan, Chairman of the Subcommittee.

ACRS members in attendance are John Stetkar and Jack Sieber at the moment. I think we will be joined shortly by Dennis Bley and/or Howard Ray.

The purpose of this meeting is to hold discussions with the NRC staff on proposed rulemaking language to amend 10 CFR 61 to add site-specific analyses for LLW disposal. The technical basis for the rulemaking language will also be discussed.

The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and facts as appropriate. The subcommittee plans on proposing a letter report on this matter for consideration for the full committee at the July full committee

meeting.

Derek Widmayer is the designated federal official for this meeting.

A transcript of the meeting is being kept and will be made available on the web. It's requested that speakers first identify themselves and speak with sufficient clarity and volume so they can be readily heard.

We have not received any requests for members of the public to provide comments. However, I understand there are several folks on the bridgeline who will be listening in on today's proceedings.

Would the folks on the bridgeline please introduce yourselves.

(No Response.)

CHAIR RYAN: Nobody is there yet. Thank you.

MR. LIEBERMAN: Jim Lieberman.

CHAIR RYAN: Good morning, Jim. And you're with?

MR. LIEBERMAN: I'm with Talisman International.

CHAIR RYAN: All right. Thank you.

Anybody else?

We will now proceed with the meeting and I call upon Debbie Jackson, Deputy Director of the Division of Intergovernmental Liaison Rulemaking in FSME to open the proceedings.

Welcome.

MS. JACKSON: Good morning. Thank you, Dr. Ryan. I'll be opening the staff's presentation today on the Part 61. We are here today to provide an update of the progress that the staff has done on Part 61, solicit the subcommittee's feedback, and input on technical issues that have arisen during the rulemaking process.

We are also going to tell you what we heard at the May 18th public meeting and summarize at a high level the public comments that were received from the public comment period that closed on June 18th.

The FSME staff previously discussed Part 61 rulemaking with you, the ACRS Subcommittee, on December 16, 2009, and most recently with the ACRS full committee on March 4th through the 6th of 2010.

We received Commission direction. The

staff has submitted several Commission papers on regulatory issues pertaining to Part 61 and has received direction from the Commission to proceed forward with a rulemaking to require site-specific performance assessment prior to disposal of significant quantities of DU and blended waste.

Why are we doing a rulemaking? To address emerging regulatory issues with low-level waste disposal. When the original Part 61 regulations were developed, there was a set of conditions that were analyzed by the staff at that particular time. These included certain existing defined volumes and concentrations of radioactive waste.

However, those conditions are changing and low-level waste disposal facilities are currently faced with disposing waste of types that were not considered in the original rule.

One significant parameter that was considered put ultimately did not make the way into Part 61 at that time was uranium, particularly large quantities of depleted uranium. There has also been significant changes in the ways in which nuclear power industry has managed its waste in the

emergence of a concept known as blending.

Today we have four staff presenters. Priya will discuss the background of Commission direction, 2009 DU workshops. Andrew will discuss the draft proposed rule and the summary of the proposed rule language. David Esh will discuss the intruder analysis requirement and period of performance proposal. Last we'll have Drew Persinko who will discuss the public meeting for May 18th and a summary of the public comments.

With that, Priya.

MS. YADAV: My name is Priya Yadav. I'm a project manager in the Division of Waste Management and Environmental Protection. I'm going to give you sort of a background presentation today describing kind of how we got to where we are today. Then Andy will go info specifics on the rule language. Then Dave will go into specifics on the intruder assessment, period of performance, and also some specifics on the guidance document that we're working on in conjunction with this rulemaking.

This is an overview of my presentation. I just plan to give a little bit of background, talk about some recent activities, go a little bit

into the comments that we got from the 2009 workshops that we had, and also the comments we received from you from your letter received in March 2010, and just describe how those comments kind of fed into the approach that our rulemaking working group has taken thus far.

As Debbie touched on, the two emerging issues that we've been handling are both large quantities of depleted uranium that were not previously envisioned. Then also industry is contemplating large-scale blending of waste so blended-waste streams. Both of these emerging issues are incorporated kind of into the discussion we are going to talk about today.

We wrote two SECY papers on these topics. This is a summary of the SRMs that we received on the topic. For depleted uranium we were directed to complete a limited rulemaking that requires a site-specific analysis for large quantities of DU. This analysis will have to demonstrate meeting performance objectives prior to disposal of large quantities of DU. We were directed to specify criteria needed for this analysis and then also develop supporting guidance.

On the blending front we were directed to incorporate the blending issue into this rulemaking for DU. This rulemaking that we're talking about today is sort of an umbrella to cover both of these emerging issues.

Just a summary of our recent activities to implement these two SRMs. In 2009 we had the Unique Waste Streams workshops. We had one in Bethesda and one in Salt Lake City, Utah. We had round tables at each of these locations where we had a broad range of stakeholders. We had representatives. We had generators like DOE and LES. We had representatives from industry like Energy Solutions and WCS.

We had academics. Dr. Ryan was there. We had professors from various universities. We had public interest groups like HEAL and IEER were in attendance, and then also Agreement State regulators, South Carolina, Utah, Texas, and Washington were all there.

Over two days we covered a variety of technical topics, some of which we'll talk about today. It was very useful for us to get kind of a broad range of viewpoints that informed our

rulemaking approach. After those meetings we came to brief you in December and March and we received your letter that I'll kind of summarize a little bit later.

We got two requests at the public workshop which directed our next two activities here. We got a request to issue some guidance before we were able to share draft guidance along with the proposed rule so we issued inner guidance. We issued a letter to Agreement States, basically a summary of existing guidance relevant to reviewing performance assessment.

We also had a request to get more details on the screening model that was developed for the DU SECY paper so Dave led a public workshop in June where he demonstrated our GoldSim model and stateholders got to ask questions about details of the model.

All of those activities informed our regulatory basis document and this document is basically our rationale for why we think Part 61 has to be changed, changes we want to make to Part 61. It described the existing regulatory framework, talks about issues, describes the interactions I

just talked about and then also considers alternatives.

Most recently we had a public meeting on May 18th where stakeholders were invited to comment on the regulatory basis document on the proposed rule language which you'll hear about from Andy. Then also the Period of Performance Technical Analysis Paper.

We had approximately 50 people attend and we had a good representation from industry. We had Energy Solutions, WCS, EPRI. We had a couple regulators on the phone. We had Utah and South Carolina were in the phone. We had one public interest group, at least; State Broker Alliance was on the phone.

There was a lot of time for public comment. Then we also had a written comment period that just completed June 18th. So far we've seen 13 sets of comments and Drew will go into more detail and kind of give a summary of some of the comments we've received.

All of this is available on the site-specific analysis website if you want specific details from the transcript and meeting summary, the

slides that were presented. Also the proposed rule language in the Technical Analysis Paper.

I just wanted to go over kind of the key points that we took from the workshop that helped informed our approach. First, we heard from most stakeholders at the workshop that it was important to them that we identify a period of performance in the rule.

They felt like without something identified in the rule, agreement state regulators were adopting various approaches and holding their licensees to different approaches. Most stakeholders wanted to be held to kind of the same standard so they were looking for us to identify more details in the rule that they could be judged against, that their analyses could be judged against.

Similarly, they asked to include a dose limit for intruder protection in 61.42, again, so that their intruder analyses are judged to the same dose limit.

Also, another major theme that we heard was that there was no need to define waste streams in particular, or to specify different requirements

for so-called unique waste streams like large quantities of DU, but rather to require that a performance assessment be conducted for all radionuclides disposed of at the facility.

This performance assessment would identify specific requirements for specific waste streams. There is no need to separate out something that is "unique" that wasn't necessarily captured in the Part 61 to EIS because you have one method to kind of treat all waste streams.

On the creative performance issue we basically heard opinions from the whole gambit. Stakeholders think that 10,000 years was too long basically because uncertainties increased at the longer time frame so modeling became a little more difficult. Then we had stakeholders that thought the uncertainties were manageable and that 10,000 years was a sufficient time frame.

We had some stakeholders that believed we had to go further than 10,000 years basically because activity for DU has not peaked yet and activity is still increasing after 10,000 years, so some stakeholders thought somewhere between 10,000 and peak might be the right answer. Then there were

stakeholders that thought how could you evaluate anything less than peak dose.

If the dose keeps increasing, you need to evaluate out to peak dose. Basically out of the room of individuals involved we had kind of the whole range of opinions so we knew this wasn't going to be an easy solution for us to come up with.

CHAIR RYAN: I think I recall one was even less than 10,000.

MS. YADAV: Yes. 10,000 years was too long. Right.

CHAIR RYAN: So it was all of that.

MS. YADAV: Exactly.

CHAIR RYAN: Not just 10,000 and up but less.

MS. YADAV: Exactly.

Then we received your letter from ACRS after we briefed you in March. Hopefully after we go through kind of our presentations today you'll see how we tried to incorporate as many recommendations as we could into either our rulemaking language or the guidance document.

Specifically you recommended that we require risk-informed site-specific, realistic

performance assessments that we clearly articulate the standards that applications will be reviewed against. Give some guidance on uncertainties and base scenarios on realistic assumptions for release from transport. And then treat the proximity of members of the public, their location in a probabalistic and risk-informed fashion.

Also you recommended to terminate doses over a period of performance determined on a case-by-case site-specific basis rather than including a specific number in the regulations. Then you recommended also that our guidance include a variety of topics here, climatic conditions, depth of disposal, talk about cover technologies, limited water infiltration and human intrusion.

We tried to take kind of a range of all the opinions we got at the workshop, looked at your letter and tried to fashion an approach. This is kind of to give you context for what you're hear in Andy's presentation which is the specifics of the Gold language. This is the approach that we started with trying to take into account all the comments that we got from all our stakeholder interactions.

Our approach is to require a performance

assessment for radionuclides and then discuss the site-specific scenarios to use, reasonably foreseeable scenarios, all that in guidance. Talk about uncertainties, talk about the mechanisms for release and transport, all of that in guidance.

We decided to require an intruder assessment for all radionuclides basically to ensure that the same analysis is done for, for example, large quantities of DU as was done for the waste classification tables in Part 61 DESI. By requiring intruder assessment, that basically ensures the same analysis is done for all radionuclides.

We decided to include the dose limit of 500 millirem in the rule language in the performance objective for the intruder. The increased dose limit kind of compared to the 25 millirem dose limit for the general public takes into the account the decreased NRC's belief that there is a decreased likelihood of intrusion and that it's unlikely although possible so there's an increased dose limit that we are recommending of 500 millirem. Then similar to the performance assessment we plan to discuss the use of site-specific scenarios and guidance.

For the period of performance we decided to define a specific period of performance in the regulation but try to allow for some flexibility through the compatibility category. We hope to recommend a compatibility category that Agreement States can be more stringent than what we are recommending so they can be more stringent than 20,000 years for example. That allows some flexibility on a case-by-case basis.

Also for period of performance we plan to clarify in the guidance kind of a risk-informed performance base implementation of this 20,000 years and say for less complex sites with shorter lived and predominance of shorter-lived radionuclides that a lower level of effort is expected in your analysis than the site that, for example, 80 percent large quantities of DU. In our guidance we have kind of a graded level of effort and try to go into detail about what level of detail is expected for this period of performance.

That kind of just gives you context of --

CHAIR RYAN: Just a quick question on the 20,000 years. If I understood you right, you

said it has to be a minimum of 20 but somebody else could pick a bigger number.

MS. YADAV: Yeah. That is the compatibility we are recommending. That has not yet been assigned. I still has to go to the Compatibility Board and all that. Our preliminary recommendation is also based on feedback we got from Agreement States is to allow some flexibility in 20,000.

CHAIR RYAN: Some flexibility and pick any number you want are two different things.

MS. YADAV: No. It can be more stringent than 20,000 years.

CHAIR RYAN: Up to the sky's the limit?

MS. YADAV: Yes.

MR. WIDMAYER: Would you introduce yourself, please?

MR. McKENNEY: Chris McKenney, Performance Assessment Branch Chief. Our working group member for the session, which Andy will list in the next slides, is the State of Texas. Of course, they have a peak dose currently in the regulation so they wanted to reinforce the fact that they didn't want to change the regulations and have

the flexibility to still require a peak analysis for their disposal sites.

CHAIR RYAN: Okay. So I guess that seems to be your potential friction point where there is a requirement with the NRC. It may or may not apply based on whether people have it apply or not.

MR. McKENNEY: That's the standard issue with compatibility.

CHAIR RYAN: Okay, but that's a complicated one.

MS. YADAV: That is, and we have actually received comments on both sides of that. Industry wants it to be Compatibility A so that everybody has to do 20,000, but the Agreement State feedback is that they want flexibility.

CHAIR RYAN: Okay. That's something to think about. Thank you. We'll learn more about that later.

MR. CARRERA: Thank you, Dr. Ryan. Thank you staffing members of the ACRS, as well as the participants. My name is Andrew Carrera and I work in the Division of Intergovernmental Liaison and Rulemaking. I'm also the Part 61 rulemaking

project manager. Today I will be providing you with a brief high-level summary of the Part 61 preliminary proposed ruling.

Next slide, please. With the Commission's directions to proceed forward with the Part 61 rulemaking as you previously heard from the previous presentation, the staff completed a regulatory basis document that outlined the objectives of the proposed rulemaking. The rulemaking process began in October of 2010.

Interdisciplinary rulemaking team working group representing different offices across the NRC was formed. This rulemaking team also included an individual representing both the Organization of the Agreement States as well as the Conference of Radiation Control Program Directors. That is what Chris McKenney has previously referred to as an Agreement Statement member on the team.

Next slide, please. The rulemaking team developed the objective and purpose of the rule, and that is to specify site-specific analysis requirements to demonstrate compliance with performance objectives in 10 CFR Part 61. And to strengthen and clarify system regulation to reduce

ambiguity and facilitate implementation and align requirements with the current health and safety standards of Part 20.

Next slide, please. To achieve the objectives and purpose of the rulemaking, the rulemaking team proposed the following approaches to the Part 61 rulemaking, and that is the rulemaking should be waste-stream neutral as Priya mentioned earlier. It should contain site-specific analysis requirements, and it should include other changes to support the implementation of the site-specific analysis requirement.

Now talking to the waste-stream neutral approach as was mentioned before. As you know, recently large quantities of depleted uranium, blended waste came into consideration for disposal at commercial low-level waste disposal facilities.

CHAIR RYAN: Just so everybody is clear, tell everybody what DU blended waste means. It means blended with what and how much? Give us some --

MR. CARRERA: These are mostly waste from reactor, resins, Class A waste.

MR. ESH: This is Dave Esh. It's

basically when you take some higher-class waste blended with a lower-class waste make the combination down to a lower class in waste.

CHAIR RYAN: All right. So and --

MR. ESH: Maybe it takes some amount of Class B waste and you combine it with a Class A waste at low concentrations and bring the total concentration down below the A limit.

CHAIR RYAN: With the idea being the final product material, whatever that is, is what you classify for disposal.

MR. ESH: Yes, with the idea being that the performance of your facility is going to be defined by, of course, the quantities and concentrations of the material you dispose of but it's not going -- the overall performance is not going to be that smart to know, okay, I have difference performance. If you mix these two quantities together as opposed to you put them in there and you haven't mixed them.

CHAIR RYAN: Again, that gets to, I think, a key point that concentration is a convenient metric for transportation, health physics calculations and so forth, but it really isn't as

convenient for the real metric extractional release from inventory for low-level waste disposal.

MR. ESH: Yeah.

CHAIR RYAN: So fractional release from inventory is kind of the right metric in my mind for assessing disposal site performance but how you get to that fractional release from inventory this is part of this conversation.

MR. ESH: And we can discuss that further. There are definitely areas -- there are definitely parts of the analysis where I agree completely with you, and then there's some others where concentration does come into play and we can talk about that.

CHAIR RYAN: Okay, great.

MEMBER SIEBER: How do you deal with heterogeneity of the mixture?

MR. ESH: I think maybe we can talk about that maybe after my presentation and cover the intruder assessment, but it's a very good question. The heterogeneity is a hard problem. I can talk about how it's handled now but then with this new requirement, it introduces -- the new requirement for the intruder assessment could introduce some

issues associated with heterogeneity.

MEMBER SIEBER: Okay. Thanks. Thank you very much.

CHAIR RYAN: Sorry. Go ahead.

MR. CARRERA: Thank you, Dr. Ryan. That is also ensuring that in the future all the previously unanalyzed new waste streams coming into consideration for disposal for these types of facilities. To better address these waste streams and any other potential new waste streams the working group determined that the proposed rule should use a waste stream neutral approach rather than trying to address each of these new waste streams in a separate rulemaking.

This approach is meant to reduce the need for future rulemaking that would be necessary to address any new and unanalyzed waste streams. With that in mind, the staff is proposing to amend Part 61 to require low-level waste disposal facility to conduct site-specific analysis. The purpose of the site-specific analysis will be to demonstrate compliance with the performance objectives for Part 61 and to enhance the safe disposal of low-level waste.

As you can see, the site-specific analysis on the slide includes performance assessment using newly defined period of performance to demonstrate protection of members of the public from releases of radioactivity. It also includes intruder assessment using newly defined period of performance as well as the dose limit, as Priya mentioned previously, to demonstrate protection of inadvertent intruder.

Also, it includes a long-term analysis. That is determine whether additional limitation and disposal of some long-lived waste at existing facilities -- I'm sorry -- determines whether additional limitation of disposal of some long-lived waste stream disposal facilities may be needed.

Also it include site-specific analysis that would be required to be updated for any waste to be disposed of that do not fall within the bounds of the existing site-specific analysis and would be required to be updated and included with any application to amend the license for closure.

I will go into great detail in the site-specific analysis in the rest of the presentation. The staff also proposed other supporting changes as

part of the programs to facilitate the implementation of the proposed rule.

Next slide, please. Performance Assessment Part 61 currently requires licensees to prepare analysis to demonstrate that the low-level waste disposal facility meets the requirements and objectives of Section 61.41 which ensures protection of the general population from releases of radioactivity.

This analysis is currently called a technical analysis instead of a performance assessment. It does not contain a period of performance associated with the analysis.

The proposed rule that the staff came up with would split the current section 61.41 into two subparagraphs. Specific requirement for performance assessment and revision to include the use of TEDE dose methodology would be added to Subparagraph (a). The specification for period of performance to estimate peak annual dose up to 20,000 years would be added to Subparagraph (b).

CHAIR RYAN: One of the questions on the 20,000 years that I would like to get to, maybe later David when you're up, I struggle with what

radionuclides are in the inventory at 10,000 years versus 20,000 years that really factor in a performance assessment. Why this different period is necessary. Hopefully we can cover that.

MR. ESH: We will.

MR. CARRERA: And Dave will talk about that.

CHAIR RYAN: I just wanted to put a place holder there for that.

MR. CARRERA: Thank you.

Next slide, please. Intruder assessment. Part 61 currently does not require a licensee to perform an intruder dose assessment to demonstrate compliance with Section 61.42 performance objectives for protection of inadvertent intruder.

Unlike requirements of Section 61.41 no dose limit is currently associated with the requirements for protection of inadvertent intruder. Instead, the safety of an inadvertent intruder is ensured by the waste classification system and dispose of requirements imposed for each class of waste.

The proposed rule was split, Section

61.42, into two subparagraphs (a) and (b). Specific requirement for licensees to prepare intruder assessment as well as an annual dose limit of 500 millirem TEDE would be added to Subparagraph (a). The 500 millirem TEDE dose limit can actually count from the technical basis that the staff used during the original development of Table 1 and 2 of Section 61.55 which is the driver of the waste classification system.

The specifications for period of performance to estimate peak annual dose up to 20,000 years will also be added to Subparagraph (b). Dave will also talk to staff's technical basis for recommending the intruder assessment as well as 20,000 period performance in his slides.

Next slide, please. Long-term analysis. The staff determined that there should be a requirement to consider uncertainties associated with disposal long-lived waste streams and it's necessary to ensure the protection of the general population and intruder from these toxic wastes.

Long-term analysis would also help to determine whether limitations on the disposal of some low-level waste at certain sites are needed.

The proposed long-term analysis, which would be added to a new Section 61.13(e), and low-dose limit will apply to the results of the analysis but the analysis would need to be included as an indication of the long-term performance of the disposal facility.

CHAIR RYAN: Just a couple of quick questions that we'll follow up on. Peak annual dose. Do you really mean exactly that, peak annual dose, or peak annual dose committed in a year of intake? We're using committed doses. Right?

MR. ESH: Yes.

CHAIR RYAN: Okay. So I just wanted to make sure I'm not going back to annual doses. That's really a little different. A dose in a given year wouldn't necessarily be whatever number you calculated. That's the 50-year committed dose from that particular year of intakes. Is that right?

MR. McKENNEY: This is Chris McKenney. Yes, it is. It could also be read as peak dose per year because of the way you use TEDE peak. TEDE dose per year because of the fact --

CHAIR RYAN: Total effective dose equivalent calculated for a year of exposure.

MR. McKENNEY: Right.

CHAIR RYAN: I would just offer the comment that clarity of language is probably necessary to ensure it doesn't miscommunicate. Anyway, thanks.

MR. CARRERA: Thank you, Dr. Ryan.

MEMBER SIEBER: Somewhere back in ancient memory I had the recollection that some waste streams like depleted uranium increase specific activity as time goes on. Is that correct?

MR. ESH: Yes. Basically the depleted uranium through the process of its production most of the progeny, the daughter radionuclides, are removed. You end up with kind of almost pure uranium waste form, primarily U-238, more than 99.7 percent, something like that. Then small percentages of uranium 235 and uranium 234.

MEMBER SIEBER: A scattering of fission products because there is spontaneous fission going on.

MR. ESH: You would have --

MEMBER SIEBER: That increases as you go out.

MR. ESH: Primarily how it works is as

you go out in time, then Mother Nature says, "I'm going to put all those daughters back again."

MEMBER SIEBER: Oy vey.

MR. ESH: Come building in. Uranium is very, very long-lived so they don't build in for a very long time but they eventually come back in.

MEMBER SIEBER: My question is if you go back 20,000 years, well back past cavemen, if you go out 20,000 years was that number chosen because of the building of specific activity? For example, if I do a little math in my head, if I go out 50,000 years, that could be maybe double what it was at 20,000.

MR. ESH: Yeah. I'll talk about it.

MEMBER SIEBER: So what is the basis for the 20,000 and how does it relate to the fact that specific activity is increasing in some waste streams.

MR. ESH: It's a good comment. I'll talk about it in detail. The in-growth characteristics associated with the depleted uranium waste stream was one of the considerations that we used in recommending that number. We'll talk about it in detail.

MEMBER SIEBER: It seems to me the curve flattens off somewhere.

MR. ESH: It does around 2 million or so. It's around 2 million that it flattens out. It's more complicated than just the pure radiological characteristics because in performance assessment was have to take into account how the progeny that come in how they are released and transported and their propensity to cause dose. Hazard and risk are two different things in this context.

MEMBER SIEBER: Transport is different.

MR. ESH: Transport is different from progeny.

MEMBER SIEBER: The tails and the daughters of -- the fission-product daughters.

MR. ESH: Exactly, yes.

MEMBER SIEBER: And they come out at different rates and go different distances in the environment.

MR. ESH: Yes.

MEMBER SIEBER: I hate to say it but this is a pretty complicated proposition.

MR. ESH: It is probably much more

complicated. Hopefully people will understand after we're done today. It's more complicated than they anticipated when they sat down this morning.

MEMBER SIEBER: Yeah, and there is a fair amount of chemistry involved in addition to radiochemistry.

MR. ESH: Yes. Definitely.

MEMBER SIEBER: And that has to do with soil characteristics ground water, water table flows, all the chemistry that is involved in that. Anyway, I've gotten interested in seeing how you addressed all those things. It appears that you've addressed them one way or another. The question is --

MR. ESH: We tried to. Whether you believe we did appropriate we'll find out but we tried to take into account those things.

MEMBER SIEBER: You have to make a lot of approximations and assumptions because you have to write a rule. If you write a bounding rule, you can't do anything.

MR. ESH: Yes, exactly. We recognize that.

MEMBER SIEBER: Well, I do too. We'll

see as we go on. Thank you.

CHAIR RYAN: Thank you.

MR. CARRERA: Next slide, please. Site-specific update analysis. Currently Section 61.28 and 52 do not have requirements for updated site-specific analysis. An updated site-specific analysis requirement is needed to provide greater assurance of compliance with performance of chapters in Part 61 and to enhance the safe disposal of low-level waste.

Next slide, please.

CHAIR RYAN: So just in practical terms, that really is an update for any new site performance assessment that is done up-front has to be maintained and finalized at the period of closure so that any learning that has gone on during the period of operation is included in the long term analysis.

MR. CARRERA: Yes, exactly.

CHAIR RYAN: Okay. Great.

Next slide, please. The staff also proposed an amendment to Part 61. That would include additional new definition in Section 61.2 and concepts in Section 61.7 to facilitate the

implementation of the site-specific requirements.

CHAIR RYAN: Definitions are great but I could probably suggest that -- I'm going to guess you could write a NUREG guidance document on every one of those. Is there any thought to how you are going to do that?

MR. ESH: Yes. In parallel with the rulemaking I'll talk about that we are developing a guidance document. It's pretty extensive. We talk about these topics in a decent amount of detail. At some point in the future it would probably be useful for you to see and for us to get your feedback on.

CHAIR RYAN: That would be great. Getting that into guidance, I think, with real clarity is what you expect will be very helpful. Thank you.

MR. CARRERA: That's all I have today. Thank you for your time. I would like to reserve the rest of my time for the main attraction.

CHAIR RYAN: Any other questions from members for Andy? John?

MEMBER SIEBER: Not yet.

CHAIR RYAN: Not yet. Okay.

Dave, I noticed yours is the thickest

package.

MR. ESH: Yes. Everybody has had their coffee already. I have a lot of ground to cover. I'm going to talk about some of the technical issues that we faced in this rulemaking. A little bit of background on me. I've worked in Performance Assessment at NRC for, I think, about 12 years now on low-level waste performance assessments, complex decommissioning sites, waste incidental to reprocessing, and high-level waste.

I have a bachelor's degree in physics and nuclear engineering, a masters degree in nuclear engineering with minors in geoscience and civil engineering. I Ph.D.'ed in environmental engineering. My primary interest area, at least prior to coming to NRC, and still at NRC is in the materials area, especially the durability of materials. I'm going to talk about some difficult issues. It would be great if we could get your feedback and maybe some clarity on some of the topics.

These are the non-controversial topics that I will cover today; intruder assessment, period of performance, and our guidance document, as I

mentioned. Let's start off with one of Dr. Ryan's favorites, the intruder assessment.

This intruder assessment -- I should be clear on this first bullet here. It's a new requirement for intruder dose assessment. The existing regulation 61.42 has requirements to meet waste classification and segregation requirements and intruder barriers. That's the mechanism that NRC chose to try to protect an intruder.

Whenever the regulation was developed in the '80s they said, "We can take two approaches. We can either have licensees do some sort of intruder calculation of concentrations they could take at a site. That would be a site specific process. Or NRC could do that sort of calculation and define the concentrations that they would apply to sites.

At that time they said, "We think there is going to be a whole lot of low-level waste sites so maybe NRC should do those calculations and then impose the resulting concentrations on all licensees." In order to do that they had to select a site to do that calculation from and they selected a human site which I think is protective but I could also is not risk informed. Does it make sense to

apply the concentrations that limit your risk to the intruder for a humid site to a more arid site? I would say probably not.

In fact, in an arid site you worry about different pathways than you worry about for a human site. You are much more concerned about some of the airborne pathways than you are the water pathways. Anyway, NRC went through this process and they did inverse calculations that we referred to.

They took a unit concentration of waste, they calculated the dose that they get from that for some different intruder scenarios, and then they said, "We are going to assign a limit to protect intruders. Nominally we'll pick 500 millirem." Then they calculated the concentration that would produce 500 millirem.

After some modification those are the concentrations that ended up in the tables but that is the general process of what NRC was doing with intruder protection.

MEMBER STETKAR: Dave, just because I don't have a lot of historical background sitting in on this subcommittee, is there any basis for the 500 millirem or --

MR. ESH: The 500 millirem was picked at the time for two reasons. It was picked because that was the public dose limit. Also they thought about this problem and they said, "We have institutional controls that we impose for a period of up to 100 years.

Then after that our strategy could be perpetual control and maintenance and somebody is hanging around the site. A fence is up and they repair the fences and they take that whole approach. Or it could be that we develop requirements to allow people to then leave the site and that the site no longer poses risk to people.

They chose the alternate path in the framework. They said, "Okay, we don't believe that people are going to use these sites in the future but we can't guarantee you so we'll impose this intruder requirement to handle that part of the problem." That philosophy that Priya expressed about it's unlikely but possible is reflected in that dose limit of 500 millirem. The public dose limit is 25. The intruder dose limit is 500.

If you were trying to say this is a probably of 1 and I think it's going to happen, I

think you would imply the same dose limit to either of those receptors. Just because the definition of a site boundary on one side or the other to impose a different limit.

MEMBER STETKAR: That's what I'm just trying to understand. It's some sort of ad hoc. pseudo risk informed.

MR. ESH: Yeah. I mean, the argument at the highest level is does that whole scenarios even make sense. In the course of this rulemaking it was a limited scope rulemaking. We felt like that would be a policy change to say do you even need that requirement because not all waste management programs have a requirement like that. EPA does not do intruder analyses for their hazardous waste disposal.

MR. WIDMAYER: Okay, Dave. I have to interrupt for a second. The philosophy that you just explained as far as the intruder protection lasting X number of years and the fact that NRC didn't want to protect the facility for a real long period of time was because the waste was going to decay. That's a big different that we have in this particular case.

MR. ESH: I agree with that. This is where the issue of long-lived waste comes in because it doesn't have the characteristics of the waste that does decay.

MR. WIDMAYER: Is that the reason they felt that the site didn't need to be protected for X number of years. It was part of the justification for why --

MR. ESH: That's a good justification. I mean, if you're only trying to protect it for some period of time and the waste has characteristics that you're losing that activity, then you don't need to worry about what happens after that material is decayed. There are a lot of things like that I mean to say and hopefully I don't miss too many of them.

MR. McKENNEY: Dave, one other question. This is Mr. McKenney. We did go out on a DEIS and ask about different limits for the intruder analysis. It wasn't just -- we picked a public dose and then just went with it. We asked about larger ones like 5,000. Then after Part 20 changed and the dose limits changed for the public dose after a request for rulemaking change on Part 51 and said

that 500 is still good and we did not need to revise the waste classification table down to 100.

MEMBER STETKAR: Okay. Thanks.

MR. ESH: So moving on with intruder assessment, it is a regulatory construct. I think you described it well. I explained the reason why it's there.

MEMBER STETKAR: I just wanted a little background.

MR. ESH: It's used in a lot of different programs. When you look internationally a lot of programs use something like it and they may define it somewhat differently but the concept is usually there.

I think I've covered most of these things already or we have covered in the presentations.

The last bullet is probably something I need to talk about, though. What we are recommending is reasonably foreseeable land use scenarios impacted by the time frame and the change in the natural site conditions. What does that mean? Well, Chris Grossman developed our chapter and our guidance document on intruder assessment.

I think he did a very good job outlining how you go about defining some intruder scenarios. The things that he talks about in there is that it is practical to consider local practices, and I think he calls them cultural practices, but it's more like what is your current land use there.

If your facility is sited in an industrial area and it all industrial activity around it, it's probably a good assumption that some sort of activity in the immediate future after your control period is likely going to be some form of industrial activity too.

As you go out in time, though -- that's the problem here and in the period of performance. As you go out in time, though, you have issues about how likely is it that that activity is persisting. That is an issue that comes up.

We also talk about considering the state of the waste. I know this is an issue that you've talked about before, Dr. Ryan. Is it reasonable to assume all your waste is unrecognizable and, therefore, somebody puts a garden in and does gardening activity.

If you can provide a basis that your

waste is recognizable and you can condition your scenario appropriately, then we think that's appropriate but you can't do it without basis. You need basis for it but if you want in an activated metal, activated stainless steel and you argue that the stainless steel is going to remain stainless steel for a significant period of time, yeah, but it seemed pretty unreasonable to do a gardening scenario for that material. That's reflected in there, too. Then this issue of site conditions. All sites are not created equal. Some sites current practices may differ considerably from other sites.

We think it is appropriate to consider site conditions but you have to be cautious about that because site conditions -- if that is allowing you to use or causing you to use a scenario that results in much lower dose than some of these default type scenarios that have been used in the past, you want to ensure that those conditions are durable and persistent as the conditions can change over time pretty significantly as the environment changes.

MEMBER SIEBER: What about mining

activities and things like that?

MR. ESH: There is a siting criteria that you try to avoid siting a facility in an area with natural resources that are exploitable but you can't necessarily total avoid that because that is partly based on what are the economics of recovery today which may differ considerably sometime in the future.

In our scenarios when we are looking at default scenarios, we tend to look at some sort of residential construction scenario because even as you go out long periods of time we expect people are still going to be living in houses and they are still going to be building houses.

They are also still going to need water. Most of us are on public water systems, I'm sure, but some people still use wells. Wells are kind of getting phased out as we go and more people get on public water systems but, you know, it's probably reasonable somebody could put in a well somewhere inadvertently.

In terms of resource exploration we kind of ask people to look at are resources being actively exploited in that region today, then that

is probably a scenario you might want to consider in your analysis for your facility.

If your facility is in the area where you have shale resources and there is natural gas exploration today, then somebody could put a natural gas well for your facility. You should understand what the risk is if that would happen. That's kind of how we are recommending this intruder assessment is done.

We did hear about on May 18th from some of our stakeholders, primarily representing industry. I think part of what caused the problem was in our definition where we said occupies in that first bullet up there. When I looked at that I could see how it could be misinterpreted. They were interpreting that as you have to build a house on the facility and analyze that somebody has built a house.

What we're saying is no, you don't have to analyze that somebody has built a house. This is more accesses the disposal site. The future land use is going to be determined by things like records and markers and government workers not making errors and all those sorts of things that are fairly

complex and a whole different field of study.

You can't ensure that somebody isn't going to -- you have to probably look at it that somebody can possibly use the site but they don't have to use it necessarily, especially in the near-term, in the most disruptive way possible.

As you go out in time it becomes a much harder problem because then you are looking at population growth and economics and all sorts of things to determine whether cities come and go and the problem becomes much more challenging. Probably need to be a little more conservative in your scenario selection.

CHAIR RYAN: Dave, how much influence do you think depth of burial would have on the intruder scenario?

MR. ESH: The depth of burial can have a big influence primarily -- if you're analyzing, say, resident scenario, the way that is usually done is we assume a foundation is put in to a depth of nominally three meters. If you put your waste with a one-meter cover, then you potentially dig up two meters of waste by the area of your foundation and put that into the environment. It's a lot more

material you put into the environment.

If you put it deeper than that and, say, you're looking at a driller, installing a drill, a water well of eight inches, 12 inches, that's a lot less material that you are going to be potentially disturbing and extracting.

We do feel that disposal depth is one way to mitigate impacts to intruders. That concept is throughout the waste management program and that is the reason why high-level waste goes deep in the ground and low-level waste is more shallow in the ground.

CHAIR RYAN: But even in a low-level waste case you could do other things like has been done like intruder barriers and other things that cause a return on a drill bit that says there is something wrong here.

MR. ESH: And we cover that in the guidance, too. We believe if you can develop intruder barriers and demonstrate that they are going to prevent some sort of activity or disturbance, sure, go ahead and do that.

CHAIR RYAN: I think the other part of the intruder is the inadvertent intruder. At some

point an intruder becomes advertent which is doing it on purpose and he knows what he's doing. I think the whole idea of ought to be exploring and thinking what exactly is an inadvertent intruder from an explorer who has an intention to look for something a little different and unique and them, I guess in my mind anyway, takes on an obligation to be responsible for that intrusion.

MR. ESH: Yeah. At some point that person would be accepting the responsibility of the risk that they are undertaking. It's like today whenever people go and try to steel copper wires and they get electrocuted, well, you probably shouldn't have been trying to steel a copper wire.

The NRC took a similar approach regarding advertent intrusion. Back in the development of the regulation they said, "Look, we aren't providing criteria to protect from advertent intrusion." And we're taking that same approach here.

CHAIR RYAN: I think it would be helpful if that was explicitly brought forward in the new language.

MR. WIDMAYER: Is there a requirement

for intruder barrier now?

MR. ESH: There are requirements for intruder barrier, either intruder barrier or adapt for a Class C waste.

MR. WIDMAYER: Okay. And how long are the intruder barriers suppose to last now?

MR. ESH: You have to demonstrate that it last for 500 years for Class C waste or have deep enough disposal.

MR. WIDMAYER: Okay. So how -- what does the demonstration in your change -- how long do you have to demonstrate performance for the new intruder barrier?

MR. ESH: We don't specify a period you have to demonstrate the barrier performance for but we provide guidance on the things you need to supply to demonstrate how long you want to demonstrate it for.

MR. WIDMAYER: I'm assuming it's longer than 500 years.

MR. ESH: If somebody chooses to try to use an intruder barrier to mitigate the intruder risk, yes. The problem is whenever we do -- whenever we say we want to do risk-informed

regulation it's like you have to provide some flexibility. You have to balance the flexibility with the requirements and I think that's what we are trying to do here.

Let's more on to the period of performance. This is going to be a little bit long and I'll try not to race through it too much. A little bit of background. The period of performance is one of the many important elements in the safety evaluation of low-level waste. It's not the only one. There are all sorts of things that go into determining the safety of a waste disposal facility but it is important. I would argue it's especially important for long-live waste.

What we found is that different approaches are used in the U.S. and internationally for low-level waste. It's interesting that the European communities are much more comfortable going out to longer time frames than it seems in the U.S. I don't know if that's a cultural thing because they've been around a lot longer or what but it seems like that is probably the case.

We have diverse views among stakeholders. That's probably the world's largest

understatement. As Priya covered they range from a thousand years to peak which for something like depleted uranium could be out at 2 million so it's a very broad range.

As she indicated, the stakeholders were very clear in 2009. They said, "Put this in the regulation. Give a common playing field for all of us." We heard that feedback and that's greatly factored into our decision of the approach that we took.

Some background from NRC. This issue has been talked about for almost 20 years, a long time. There's a lot of ACNW letters on the topic saying all sorts of things. I put some excerpts in the backup slides so you didn't have to dig them up but feel free to dig up the letters and put them all together and see what you think of them.

One important thing is the ACNW communicated some basic principles to us in '97 and I think there is a 1997 letter and I'm going to talk about those on the next two slides.

We do have very little Commission direction in this area. We have one SRM in '96 where they said provide a basis for truncating the

period of performance at 10,000 years. That's the only real guidance we got from the Commission on this topic as far as I could find. If somebody else knows of something else, great. Send it my way.

During this time the period of performance was being discussed for both high-level waste and low-level waste we had this performance assessment working group which was looking at all sorts of issues around low-level waste performance assessment. At the end of that process in 2000 it originally started off as a Branch Technical Position.

In the end it got issued as a NUREG. They recommended 10,000 years with longer-term impacts and a site environment assessment. What we refer to this is a two-tiered approach and that two-tiered approach is exactly what you see the ACNW recommended in 1997. I think the staff recommendation in 2000 and the ACNW principles that they discussed in '97, they were both using this kind of common approach.

So what do these two tiers look like? Well, first of all, it says consider the site-specific characteristics. Site-specific

characteristics that's easier said than done. Hopefully I'll shed some light on that to you. I have provided the full text on the backup slides of the 1997 letter just so you don't have to dig it up and you can tell me if I misinterpreted or mischaracterized something.

The main elements of Tier 1 are shown here on the slide. The first is no less than the time for the more mobile radionuclides to produce peak dose. All right. That sounds great. Great principle. I think I can understand it. When you take that and try to convert that principal to practice, it gets very difficult. I have a complicated table towards the back of the presentation where I'll talk about that in detail.

The problem is even mobile radionuclides when you move from a shallow humid site to a deep arid site you can have travel times that change between hundreds of years and tens of thousands of years. Then you throw in geochemistry on top of it. You have things that move very, very slowly in the environment and things that move very quickly.

You throw those two things together. If I was trying to say how do I convert this no less

time for the more-mobile radionuclides to produce peak dose, that's going to be a very broad range of values as I look at it across the country which is what this regulation has to apply to.

MEMBER SIEBER: Do you take into account the radionuclide composition?

MR. ESH: In what way? What do you mean?

MEMBER SIEBER: Well, different decay rates for different nuclides.

MR. ESH: Oh, yes. Of course.

The second element that was mentioned here was no longer than the time period over which scientific extrapolations can be convincingly made. Everybody interprets that one differently. What does that mean? Some people will say a thousand years you failed this, that you can't convincingly make it a thousand years. Other people are more comfortable out at much longer times. With this advice they are good principles and then when you try to convert them it becomes tough.

The last element here really isn't a principal about how you pick the period of performance but it's more about, okay, you have to

recognize that performance assessment is providing information but at some point you have to say does that information support my case or my decision that I'm trying to make and those can be two different things. You may need to recognize sometimes your facility isn't meeting the criteria that you're trying to meet. That's well expressed, I think, in the approach that we took.

Then the second tier has elements about the robustness of the facility.

CHAIR RYAN: I'm sorry. Just back on that last one, doesn't that really kind of get -- I'm interpreting old language from my predecessors but it seems to me that when you have now sophisticated computer modeling for science and monitoring and you are trying to figure out does the monitoring and the modeling jive and make sense and does it tell me that we're okay or really okay or not so okay, that's what that really kind of addresses to me. Do you think that's a fair --

MR. ESH: I think that is a fair characterization, yes.

CHAIR RYAN: Back when some of these items were written when 61 was promulgated, modeling

a site was a very simplistic pencil-and-paper exercise as opposed to a sophisticated groundwater model that we use today.

MR. ESH: We have to be cautious that just because we can do sophisticated calculations doesn't mean that they have value or doesn't mean that they represent reality. In some cases you can learn a lot more from doing something very simple than you probably can from the complex evaluation.

The other principals expressed were about what do you do for the second part of the calculation. This is a very long turn. They said look at the robustness of the facility over the range of external processes and events that may affect the performance of the facility. We agree with that completely. That's a great thing to do. How is the facility and site going to perform over the long term.

Then the middle tier, this evaluation will ensure that no significant changes in the dose from the disposal site will occur. I think that's good. You want to understand that, okay, it isn't just a matter of I'm meeting the criteria because of the criteria, but I'm meeting the criteria and I

have a good decision that I'm making here.

The problem is if we went to apply something like this is how do we define significance. Is it a factor of two change? A five change? A hundred or a thousand? Is it relative? Is it absolute? I think that is a difficult question to answer so I'm going to talk about the approach that we took to try to avoid this defining significance at these very long times.

Then also the estimates of the peak dose beyond the time of compliance qualitatively compared to the dose standard. It's along the same lines as the point above.

So the general objectives when we went through this process is we said these are things that we want to accomplish. We want to provide protection to the present and future generations. The difficulty is how do you define that protection to the future generations when you consider soci-economics and uncertainty that becomes a very hard problem, I think, as you were talking about earlier.

Consider uncertainties in the process. At a minimum we want to communicate long-term impacts. Regardless of what the regulatory boundary

could be for the compliance period, we think you should be transparent with your stakeholders. What's happening at those longer times? What is the best you can say about it now? They deserve to get that information and they can then voice their opinion about it.

It doesn't mean that you have to take drastic actions because of it but at a minimum they deserve that information. Many stakeholders that we talked with they can have some very good insights and some very good value even on these long-term hard things. Then we also want to facilitate decision making. If we can't make decisions, then what's the point of the whole exercise.

So the period of performance selection process we did a literature review. We looked at what people consider when they are trying to address this problem. They generally look at the characteristics of the waste. They will look at the analysis frameworks and what are all the requirements that you are imposing on the problem, not just, say, a period of performance.

They talk about uncertainties. In the performance assessment process we generally focus on

the middle two; natural and engineering. We try to limit too much speculation about the societal uncertainties. We do that by constraining some areas and being reasonably conservative with the scenarios we pick.

We generally ignore technology and I'll show you on a conceptual figure coming up why I think we really can't factor the technology in the regulatory decisions that we make but it's another level of confidence that I think we should gain from the risk that people may be exposed to some time in the future.

Then the really hard part that is likely to give you the technical equivalent of an ice cream headache is the socio-economic considerations. That's how you factor in transgenerational equity and discounting. It's a really hard problem and I would save it's a really hard coupled problem. It's not linear. There's feedback mechanisms. It's really challenging.

Dr. Sieber.

MEMBER SIEBER: Could you just expand what you're talking about a little bit for me?

MR. ESH: Yes. I have a slide from the

group NAPA.

MEMBER SIEBER: That talks about it?

MR. ESH: Yes, that talks about it. You'll see from the principals or elements that they list what that means.

MEMBER SIEBER: Right. Thanks.

MR. ESH: So waste characteristics. If I had one thing to do over from when we started this process is I wouldn't have made the figure on the left because I think it's caused a lot of problems. The figure on the left was designed to show depleted uranium is somewhat or a lot different than some of the characteristics of typical commercial low-level waste. The depleted uranium is kind of flat. It does nothing and then you get this ingrowth of the daughters we talked about.

The commercial low-level waste has a rapid drop-off in activity and you're down to a percent or fractions of percent by hundreds of years type of thing. The problem with this is that 99 percent of the waste that drops off real rapidly is not causing you any risk in your performance assessment. Those are all decaying in place.

It's the cobalt-60s of the world and the

other short-lived things. You get this rapid drop-off in the total activity in the facility, but the performance assessment is about looking at what is the risk from what is remaining after things have decayed. Yes, you want to ensure that the risk is lower from the short-lived things that decay in place, but the performance assessment then has to characterize what's the risk from what's remaining. So when you are selecting a period of performance, it has to consider how am I going to distinguish when the risk from what is remaining is okay and when it's not okay. It needs to allow you to do that.

If we look at this previous figure here, you see the low-level waste drops off pretty rapidly. High-level waste drops off pretty rapidly, too. At 1,000 years you may have 1 percent of that total activity high-level waste left. Does that mean you should select a thousand-year performance period for high-level waste? No. The performance assessment is based on analyzing what is left, not necessarily what you started with.

CHAIR RYAN: David, one area that maybe you'll cover and maybe it's a new question but I

keep struggling with mill tailings. You put that on the surface and cover it up.

MR. ESH: Yeah.

CHAIR RYAN: There's a lot of uranium in mill tailings.

MR. ESH: The difference is mill tailings -- most of the ore in the U.S., for instance, is low-grade so it's a fraction of a weight percent uranium that they are dealing with. Those tailings are also at very low concentrations of uranium but they do have the daughters present right now. You're talking about, say, radium-226 in the hundreds to a thousand picocuries type concentrations of those daughters present in the tailings right now.

For the depleted uranium you may be talking about 80 weight percent uranium. It's a vastly different concentration of materials you're talking about. The quantities are large of mill tailings, the concentration is low. Depleted uranium potentially the quantity is large and concentration is high so they are a little bit different, or a lot different I would say. A lot different technically. One is a lot harder to

analyze.,

CHAIR RYAN: But, by the same token, on the surface of the ground and buried in the ground is really different, too.

MR. ESH: On the surface of the ground but we do protect them with engineered covers that are designed using Reg. Guide 3.64 to mitigate the flux, the radon flux from the tailings. Groundwater protection is included in that. I try to minimize infiltration. I think the technology has been evolving to try to achieve the protection from mill tailings. Early practices were pretty poor. I think current practices are much better.

MR. WIDMAYER: Can you go back to the cracked-egg diagram?

MR. ESH: Yeah.

MR. WIDMAYER: You were talking about -- this is helping me figure out what your period of performance needs to be and you said performance assessment. Is it both of them, performance and intruder assessment, or are you just talking about the performance assessment right now?

MR. ESH: Well, in the proposed rulemaking we applied the period of performance to

both criteria. We talked about that and we said does it make sense to apply it to only one and not the other. We ended up with we think it makes more sense to apply it to both. The challenge is in the intruder assessment it's more conditioned by the human behavior aspect of it.

Both of them are going to be determined by human behaviors but the performance assessment is conditioned by how much are people eating, growing, drinking, how long are they living in their house, etc. The intruder assessment depending on what the intruders are doing you have to factor in their actual disturbance activity which I think is more uncertain than how much food people are eating and how much water they're drinking and those type of things.

MR. WIDMAYER: There might be some legitimacy in rethinking whether you want to apply the 20,000 years to both of the assessments.

MR. ESH: Yes. It's a good comment. It's something we thought about. This is where we ended up but it may be a good argument to be made to reconsider that.

CHAIR RYAN: Now known as the Egg

Diagram

MR. WIDMAYER: Cracked-Egg Diagram.

CHAIR RYAN: Cracked-Egg Diagram.

MR. ESH: The Esh Cracked-Egg Diagram.

(Laughter.)

CHAIR RYAN: Ten and 20,000 years doesn't seem to be a big difference on that diagram.

MR. ESH: If you look at just purely the waste characteristics on either the left or the right, I can see where you come from with that opinion. Waste characteristics is -- if you were purely basing this on waste characteristics, then I would say you need to go out probably much longer for this type of material. You can look at the curve on the right and see when you're talking 10 or 20 you still have a long way to go on the waste characteristics.

The interesting thing, though, is because the depleted uranium has most of the daughter products removed, say in 1,000 years you're off by three orders of magnitude between where you are at 1,000 and where you end up at the end. At 20,000 years you are pretty close to an order of magnitude, a factor of 10.

I think I can get in front of a stakeholder and explain uncertainty and argue that I'm not doing something that is unproductive to them by being within a order of magnitude but I have a hard time doing that when I'm off by three orders of magnitude. There is a lot of uncertainties in these problems. The waste characteristics, decay and in-growth, is something we know pretty well. That should be --

CHAIR RYAN: So 10,000 to 20,000 is really the attempt to reduce uncertainty by accounting for in-growth of daughter products?

MR. ESH: It accounts for some in-growth. There's multiple elements to it and hopefully I'll explain those to you.

CHAIR RYAN: Okay. Very good. Let's go on. In addition to looking at the decay of low-level waste and high-level waste, we also looked at it another way. We looked at the inventories that have actually been disposed of. We did this using the DOE MIMS database which they keep track of the actual disposals at four different sites starting in like basically the '80s, different times in the '80s.

You can look up specific isotopes or total volume and curies. It's a useful tool. It does have some limitations because in some sites like in Richland there are large quantities of activity and some isotopes that occurred prior to the MIMS database so you need to use it with caution.

In addition we got information on uranium disposals from Agreement State regulators in 2009 and those don't necessarily match the MIMS database. In most cases the MIMS database is lower than what the Agreement State regulators provided to us.

What did we do in this analysis? We estimated the reduction factor that is needed to reduce the waste concentration to a groundwater concentration that would produce 25 millirem TEDE to try to do an apples-to-apples comparison of isotopes and see what's been disposed of and how far do you need to have things happen in the performance assessment to get it down to where you need to.

The performance assessment is that process to verify that you are going to achieve those reductions through sorption, solubility,

dispersion, dilution, all the processes that happen from waste disposal to a person being exposed to concentrations of that waste.

MEMBER SIEBER: How do you deal with the changes in groundwater chemistry?

MR. ESH: Yeah. Well, I'll talk about that. Let's talk about this slide first and the next slide. Remind me to come back to it if I forget.

MEMBER SIEBER: All right.

MR. ESH: So what does this look like? This is a slide of what has actually been disposed of at four sites; Barnwell, Clive, Richland, and Beatty, doing that calculation of what's in the waste compared to what ends up in the water.

What I want to highlight on here is a number of things. First, some of the waste actually disposed of is already below what you wanted to get to in the water just doing this simple calculation. That's a good thing. You say, okay, the risk is minimal for those isotopes.

What you also see is that you have some higher concentrations of short-lived waste. I didn't put all the short-lived radionuclides on here

because it wasn't necessary. I just put a few examples. I put strontium-90, I put americium-241. This is part of the reduction factor versus half-life. This is a line of strontium-90 disposals of the four sites. This is a line of americium-241 disposals at the four sites, so on and so forth.

Well, you have this kind of behavior where the reduction factor that you need is lower for the long-lived waste than it is for the short-lived waste. That's good because you have increasing technical challenges you move this way. If you need big reductions and you have long-lived waste, that is a much harder problem than if you need small reduction of long-lived waste or big reduction of short-lived waste.

Big reduction of short-lived waste you can achieve with engineer barriers, intruder barriers, confidence in the properties of concrete over hundreds of years. There's lots of things you can do to mitigate these short-lived radionuclides. The long-lived ones become much harder.

What was interesting is that uranium-238 and thorium-232 kind of stand out that there already are thousands of curies of each of these in all four

of these disposal facilities. It's not anywhere near large quantities of depleted uranium. Large quantities of depleted uranium you are moving up another couple orders or magnitude beyond where you are here.

But our rulemaking has to cover blended waste which is stretching you in the direction in the short-lived radionuclides and has to cover large quantities of depleted uranium which is stretching you out in this direction on the long-lived waste. So my argument is we need to make sure that the technical requirements in the regulation allow us to distinguish when this is okay and when it's not okay for a particular site.

They need to be able to distinguish between when the action is okay and when it's not. The period of performance is one thing that can influence that. If you picked a very short period of performance just from the engineering in the facility, you may have 500 years of performance of a concrete vault and nothing gets out. Then your concrete vault fails and your radionuclides start leeching into the environment and transported through your aquifer and they shut off at year 1300.

Well, if you had a thousand-year period of performance, you just never show that. If there is no requirement to show it, people won't, and if there is no requirement to have some transparency in those longer-term impacts. Our argument is that these regulatory requirements that we are specifying are necessary given the direction the Commission gave us.

Now, it's more complicated than this. This is just waste concentration water concentration. These are only parent radionuclides, not the whole decay chain. It's only a water pathway. We have lots of pathways in performance assessment. We have decay chains.

The next slide was an attempt to consider geochemistry. Okay? What we did is we took the ratios in that base calculation on the previous slide for one site, and we modified them by the geochemistry. We said let's take a geometric mean distribution coefficient for each element and we'll use that as a proxy for some sort of geochemical effect that is going to reduce your impacts.

What you see is something like thorium which has a much lower solubility limit and higher Kd drops quite a bit and it's kind of more in line with everything else then. Uranium drops less.

Uranium compared to thorium is more soluble, lower distribution coefficient, more mobile in their environment, especially under oxidizing conditions. The challenge comes, 1) in reducing conditions. Uranium can be practically immobile and insoluble. Most of our disposal sites, though, are in oxidizing environments is the issue.

MEMBER SIEBER: It's a good thing. Otherwise the mining industry would be out of business.

MR. ESH: Yes. They couldn't recover their uranium.

I've bonded on here this impact of the geochemistry and then you still have this idea that large quantities of depleted uranium are really standing out here so with different types of blended waste forms that would be standing out,

One of my colleagues said since I went to Penn State I should draw the Esh hockey stick on here since Penn State is known for hockey sticks.

MR. WIDMAYER: To go along with the cracked egg.

MR. ESH: So we talked about uncertainty. This is a conceptual figure. I don't want to spend a lot of time on it because there are some important things surrounding our recommendation for 20,000 years I need to cover. One of the important things I want to recognize that I mentioned earlier is this idea of -- well, two things.

Technology. In our assessments we don't include what happens with technology. Technology changes more rapid than anything else in the problem. If you think about like radon and the risk from radon, radon wasn't even known over 100 years ago.

It was identified. Today for radon in your house when you buy a new house, some places require you to have it tested. It's always an option and you can put conditions on your contract that put a mitigation system in to prevent your exposure from radon.

Maybe it's my scientist and engineer coming out in me but this gives me a lot of

confidence that all things said and done, I think technology can give you an extra level of protection that you can't convert that into a regulatory requirement per se. If we want to sorry about defense in depth, that gives me some confidence.

Then this issue of, okay, waste characteristics and depleted uranium and what happens out at very long times, well, very long times you have to start thinking about extreme national events; super volcano, meteorite impact, all the things that are going to really mess up the world. Are those people going to be worried about waste disposal when those events are happening?

Even on a shorter time frame I would say think about 1918 and the flu pandemic. Three percent of the world's population died in 1918 so if you are calculating a risk, .03. We are way, way down there at 25 millirem on risk to people, so does it make sense to extend an analysis approach of like a 25 millirem limit out to those very long times?

During the little ice age, especially in some of the European countries, 10 to 30 percent of the population died in some years from famine and disease and everything that went on. This issue

that Dr. Sieber mentioned about the complexity of the problem, I say that's totally there. The problem is much more complex as you start thinking out over these long time frames and really what you're doing to try to do a risk calculation.

So socio-economic. What does that mean? Well, the National Academy of Public Administration recognized these intergenerational decision making. They said it involves a number of variables. While we haven't formally adopted these variables, we think they are pretty good. They are pretty much in alignment with what we would use for a waste disposal decision.

Some of the things they recognize here is, "Every generation has obligations of the trustee to protect the interest of the future generation." Okay. "No generation should deprive future generations of an opportunity of a quality of life comparable to its own." I think that is a very good element or consideration to have but what does that mean? Right? I mean, when are you depriving a future generation of the quality of life comparable to what you have? Does that mean if you don't set a dose limit of 25 millirem out for all

time that you are violating this principal? I would argue because of the risk associated with the 25 millirem you have a ways to go before you would violate this criteria.

The approach that we came up with for period of performance we think is in alignment with these principals. Something like the last bullet is really important. Of course you wouldn't want to do something that adds irreversible harm or catastrophic consequences. We have enough requirements in place that I think we could achieve that.

The other really challenging thing is in this third bullet, this, "Near-term concrete hazards have priority over long-term hypothetical hazards." What does that mean in a performance assessment when you have these uncertainties increasing over time? You have to spend a lot more of today's resources to manage those uncertainties of the long time than you do to protect the near-term which is more concrete an objective.

Is that in alignment with this number 3 if I have to devote a whole bunch of resources to those uncertainties in the long-time? I don't know.

We've thought about all this and went through it in detail and our recommendation is based on some of these considerations.

So we considered five options. We had a no change. That is basically what's done now. The regulation doesn't specify a period of performance. We just let people interpret it and go through all this complicated stuff themselves and come up with what they believe.

We considered a peak-dose approach. The Committee in 2000 when they wrote a letter on NUREG 1573 that was one thing they mentioned at the end is consider a previous recommendation about peak dose because at that time there was a lot of argument about the staff recommending 10,000 and a number of licensees or Agreement States wanted 500 and there was a big debate and brouhaha over it.

The Committee said, "Just get out of that. Just do peak dose and be done with it." The problem is do you really want to do peak dose given the uncertainty as I talked about there? I don't know.

Option No. 3 was regulatory precedent so that's the two tiers and that's pretty much what the

ACNW recommended to us and the Performance Assessment Working Group came up with. Then we came up with maybe a new approach which would be three tiers.

What that would allow us to do is to have a shorter compliance period that is quantitative where you can be more confident about the results. An intermediate period that is more uncertain but you still apply a limit to and you're talking about semi-quantitative type of evaluations there, and then a very long-term period where maybe you don't have a dose limit or you have some high metric and it's more a qualitative evaluation.

The problem we saw with this option No. 4 is then we'd have to get agreement between two boundaries and three limits. Even with the two-tier approach we have to get agreement with one boundary and two limits. It's a much bigger change from what is done now. Maybe in the long run that is something to consider.

We also looked at what is done with industrial metals because industrial metals are handled a lot differently than things that are radioactive so it doesn't make sense to do

radioactive things different than industrial metals.

MEMBER STETKAR: Dave, are you going to -- my background is risk assessment. Are you going to talk about some of the stakeholder feedback you got on Option 4?

MR. ESH: I don't know if we've heard much feedback from stakeholders on Option 4. They all got wrapped around the axle and I was hearing about the number on Option 3. I don't know that they looked at it in much detail. I thought Option 4 was the most eloquent and that's because I developed it.

(Laughter.)

MR. WIDMAYER: It seemed like the background document the staff maybe was thinking they preferred Option 4. Maybe that's just because you wrote the background document or --

MR. ESH: I think technically Option 4 has a good basis for it, but from a practical standpoint we realized in a limited rulemaking that's a big jump.

MEMBER STETKAR: I am interested if you got that kind of kickback from the stakeholders. I don't think we heard virtually anything from the

stakeholders.

MR. WIDMAYER: The jump you're taking is big enough. I don't know what would be --

MR. ESH: Maybe the point is if it's big then who cares if it's very big.

CHAIR RYAN: Just to recall, the 10,000 and 20,000 difference is really that extra decay in that period. It really reduces the --

MR. ESH: There are three elements to it. One is that, yes.

So we did develop some rating factors. Those are discussed in the paper. I'm not going to go over them. We tried to be more quantitative about it than just a guy sitting in a room and picking a number. We assign some relative high, medium, and low values for those rating factors and the paper discusses this, what assigned to them and why.

Then ultimately, as I alluded to, we ended up on Option 3 we said this regulatory precedent and the two-tiered approach we think makes a lot of sense. It gives us kind of the best balance between all these factors and the stakeholder views that we've heard. Maybe given

some more time and some more discussions and interaction with stakeholders we could do something a little more eloquent.

So what did our recommendation look like? It has two tiers just like we talked about, a compliance period of no less than 20,000. This language is in the period of performance paper. It's not necessarily the language in the draft text of the regulation.

A compliance period of no less than 20,000 years with a peak annual dose limit of 25 millirem TEDE. And then a requirement to calculate the peak annual dose that occurs after 20,000 years with no dose limit applied to that.

A requirement to provide analyses that demonstrate how the facility was designed to mitigate long-term impacts. We also put in language associated with uncertainties and long-live waste and inventory limits they may need to set to manage the uncertainties.

We thought that was important because in the SRM that the Commission gave to us that was one thing they were clear on, "You shouldn't be developing requirements for kindergarten that

everybody passes. These requirements are first year MIT that some people, or sites, aren't going to make it for this problem. You need to make sure the requirements are equivalent of the first year of MIT and not the equivalent of kindergarten."

So our basis for the 20,000 years, as we've talked about, the first thing is that the near-surface disposal is not geologic disposal. That was one concerned that came up early in our working group process is that people are going to look at this and say, "Why do you have 20,000 years for low-level waste? It's less dangerous than high-level waste and you have 10,000 years for high-level waste."

That's a good comment. We didn't end up with 10,000 years for high-level waste. We started there and we ended up at effectively a million year compliance period for high-level waste and that's in the U.S. Internationally they tend to all be pretty far out there on their periods of performance much more so than what we're talking about here.

The key point is that the stability issues are different for near-surface disposal and geologic disposal. That's part of why you go to

geologic disposal because of the stability issues. In near surface we have natural cycling of the climate. Right now we are in an interglacial period. It's been warm for about 10,000 years plus or minus a few thousand. Past interglacial periods have lasted anywhere from 5,000 to 25,000 years. It's going to get colder sometime in the future and you're going to have the affects associated with the climate change.

MEMBER SIEBER: It's been 21 so far in this geologic period.

MR. ESH: Twenty-one of those cycles. It's not like this is not known that we are going to have these cycles. If we pick 10,000 years, the problem with that is it's right in the middle possibly of this transition. The technical staff's argument is either try to get before it or get after it.

The reason why we said let's go out and get after it is because that would give you an incentive to dispose of your long-lived waste in more stable sites. The regulation says a corner stone of disposal is stability so why wouldn't we want to set criteria that allow us to try to

distinguish between more stable sites and less stable sites.

It was interesting the feedback that we got on our proposal from the stakeholders. Generally the people that were presenting the northern states hated the proposal and the people that represented the southern states were okay with it. That tells me it's probably pretty good but this is my interpretation.

So that's one aspect, what's going on with stability of your system and how you are going to distinguish when you have a good site and a not-so-good site from the stability standpoint.

The second one was the radiological characteristics that we talked about. At 20,000 years you're not capturing the peak of where this material goes to, but certainly you can make the argument better than the shorter values, At 10,000 you're off by roughly a factor of 30. At 20,000 you're close to an order of magnitude.

Like I said, it's more complicated than just looking at the decay in ingrowth curves. You have to look at the dose impact and the transportability, etc., of the daughter species.

It's more complicated than just looking at the ingrowth. This 20,000 value better captures both the decay in ingrowth and the transport characteristics. I have a complicated slide that I'm going to walk you through on that.

When you go out to very long times you are running this battle of what does this mean in the context of the uncertainties you're dealing with. Not just the uncertainties from this waste disposal but this is in a much more bigger global problem of uncertainties that you are going to be dealing with, many of which I would argue are much more significant than the uncertainties from waste disposal.

But I think you have to be able to make that argument to stakeholders is, "Look, I have a way to distinguish between a good and a bad site. I have requirements that are going to allow me to determine when I need to put limitations on long-live waste, and I have transparency of the information that I'm going to provide to you in this process."

So this is probably the first time you've had a derivative and a title I'm sure. What

I'm going to try to convey here is this issue of the transport characteristics. When the Performance Assessment Working Group in NUREG 1573 recommended 10,000 years, they were analyzing just this box down here in the corner. Their analyses were based on human conditions and what I would call a shallow site.

What they said is if we look at 10,000 years, everything that is above heading to the northeast on the diagonal here, everything on this side of the diagonal it's going to show up in our performance assessment calculations generally.

This table is showing the impact of changing the performance period from 10,000 to 20,000 or 50,000. It's time to answer this question of is there an improvement to switching from 10,000 to longer values when I look at radionuclide transport.

The problem becomes complicated when you consider that you can have a range of possible disposal -- I mean, this is the depth of the unsaturated zone. You can have a very broad range of depths of the unsaturated zone which can result in very long transport times. And you can have

variability in the climate conditions ranging from arid sites to humid sites.

I would argue that 20,000 years starts capturing more of the things that are going to arrive, especially uranium which was the direction the Commission gave us in this rulemaking and some other things like neptunium, iodine, technetium, tritium, chlorine in these deep arid condition.

Our regulatory criteria have to apply to all the sites. To me this says, okay, it makes more sense to push out longer. The interesting thing was when you went out to, say, 50,000 you weren't necessarily capturing a lot more. There were some things that move so slow that they don't even show up at 50,000 years.

The other challenge with both this and the stability issue is if you say, "Let's just define it on a site-specific basis. Dave, you're telling me there's all this variability here so why does it make sense to try to apply a number for all these different sites?"

No. 1, we have to have something that is legally enforceable for us and we get into this issue of it has to be in the regulation or policy

statement or otherwise people can pick and choose what they want to do or interpret it differently.

CHAIR RYAN: Just on that point, Dave -- sorry to interrupt but couldn't you have both? Couldn't you have a period of performance unless otherwise demonstrated by the applicant?

MR. ESH: Yeah, I think you could do that. Yeah. I would have to think about it.

CHAIR RYAN: That might be a way to think about the fact that there are unique things. You've explained it very, very well all morning but this really kind of nails it down that, you know, we've got arid, semi-arid, humid, shallow, moderate, deep and that covers, as you well know better than I do, a very broad range of potential sites.

MR. ESH: Yeah.

CHAIR RYAN: If you could say, "Here's a period unless otherwise proven," you have the alternative to say, "I can prove a different performance period."

MR. ESH: Yeah.

CHAIR RYAN: Or, "I'm going to take credit for the longer performance period," perhaps at some other particular site. That might be a way

to recognize the flexibility here and the variability.

MR. ESH: The Law of Unintended Consequences runs rampant in this.

CHAIR RYAN: Back to that ice cream headache.

MR. ESH: Yes. So if I said, okay, I'm going to set a period and I'm going to allow just a site-specific determination, a period of performance based on my transport characteristics, well then this deep arid site may say, "I need 50,000 years before these things show up."

If I pick a shallow humid site, then maybe I need 300 years before these things show up. Well, why would you want to essentially encourage people to be choosing sites with lesser performance over sites with more performance because of this requirement. I think you could have that happen.

You could have the same thing happen based on how you interpret site stability and the requirements for site stability. We want to enhance disposal in sites that are stable and do have long transport times, not in sites that are unstable and have sort transport times.

CHAIR RYAN: I think it can lead that flexibility so people could address that. Here's a minimum requirement and there is an alternative to this minimum requirement and lay out some technical regulatory language that allows them to get to that. That would an extremely valuable addition.

MR. ESH: Yeah. You know, this writing regulatory language or guidance is much more challenging than people -- people that haven't done it don't recognize how challenging it is. It's a bit like fusion. You're trying to confine Jello with strings and that's a hard problem.

Our second tier after we get through the point of the first tier and the boundary that we select for it, as we say, in the second tier we're not putting a dose limit to that. We that that's in agreement with what ACNW had recommended to us in the past. But we are ensuring that, 1) you communicate those results and that you give them to your decision makers and your decision makers can factor them into how they make their decisions.

We think that allows them to be placed in the proper context. They can talk about some of these things, about uncertainty and other impacts

and net benefits and all those sorts of things that you don't necessarily get into in a radiological licensing decision within the actual framework.

We think it's better aligns with the long-term decision making and other programs such as disposal of industrial metals and better aligns those impacts with the uncertainties. Not this argument of the uncertainties of waste disposal are so large and, therefore, you should allow it, but the uncertainties associated with waste disposal are swamped by the uncertainties -- other uncertainties that affect how people live and the risks they are exposed to.

When people make this argument to me that the numbers are meaningless at long time, I just stop listening. In performance assessment you have to be able to demonstrate that this action that you want to take doesn't result in a risk to somebody. Just to throw up your hands and say, "I don't know what the impact is," well, then maybe you shouldn't be taking the action.

You better have some basis and there better be some meaning for those numbers you produced. I would say what this usually comes from

is not enough data and not enough model support for the calculations. There are some good PAs out there, especially some that I've seen internationally that have a lot of model support and a lot of data and I can guarantee you that those numbers, even at long times, have some meaning to them. It's when you don't have much information to support your calculations is where you're in trouble.

Priya talked about this. We recognize that the ACRS had said to us, "Don't put it in the regulation." All our other stakeholders said, "Do put it in the regulation." We said, "How do we manage this? Can we make something that works?" What we decided on is we needed to put some minimum standard in the regulation that would apply to everybody, would allow for some flexibility and be smart about it.

So the guidance document has a section that talks about if you don't have short-lived waste, run the crank out on your numbers but make the argument if I only have short-lived waste. It poses no impact as I go out in time.

If you don't have low concentrations of

long-live waste, do some sort of simple calculation like what I presented back on the inventory analysis for something else and say, "This material doesn't pose a risk regardless of what happens to it out at those longer times." So we allow for people to be smart about their problem. Whether they choose to or not, that's their choice. But we do also allow for going longer for high concentrations of long-live waste.

We talked about this and you had some comments on it, Dr. Ryan. Our Agreement State regulators said they wanted that flexibility. Whether that's the right thing to do or not I guess that will come out in the process. The other thing we communicate is our expectations for the long-term analysis.

Now, guidance I'll go through very quickly before I over-time.

MEMBER SIEBER: Let me ask a question on two slides, the last one slide 29. You made a comparison with disposal of industrial metals. What characteristics are you talking about here?

MR. ESH: Well, basically in the disposal of industrial metals they use a

prescriptive design process and say put it in this type of facility. Then they have control for a certain period of time. Then they have a re-evaluation of whether they need to do something more at the end of the control period but they aren't projecting out to very long times what may happen with that material, what if somebody lives on the site.

I've seen some analyses in the literature that various researchers have done of the risk if you did an intruder analysis of some of these types of facilities. They are talking about risk of like .3 to 1, basically much higher levels than what we are expressing here in our regulatory framework so we have to take that into account. There's a lot more of those, too.

MEMBER SIEBER: You're talking about things like mercury?

MR. ESH: Yeah. Heavy metals, mercury.

MEMBER SIEBER: Okay.

MR. ESH: You know, people will describe those infinitely persist. Well, some of them kind of infinitely persist but many of them are affected by biological processes that they don't necessarily

infinitely persist. They have effective like chemical half-lives of tens to hundreds of thousands of years.

MEMBER SIEBER: Okay. Thank you.

MR. ESH: Yes. Guidance. Guidance is being developed. We'll issue it in parallel with the proposed rule for public comment. The approach we took is to supplement existing guidance. There is a lot of guidance out there. What we would love to do is consolidate it all and make one big set of volumes and guidance on all the topics associated with.

You can go to one place and get everything you need. We would love to do that in a future rulemaking. That will be a very big effort. We have Priya, Chris Grossman, and myself working part-time on guidance. That is a little bit more than a three-person part-time effort.

MR. WIDMAYER: And the working groups and meetings and stuff that you talk about, these people that were reacting to your rulemaking language they did not have this guidance?

MR. ESH: They do not have the guidance, no. It's in draft form right now. It's about 150

pages or so. I don't think we have it in a form that is ready to be publicly distributed.

CHAIR RYAN: This is general guidance on all five of those, six of those?

MR. ESH: It's the guidance on all six of these. In the backup slides I broke it down further to have all the subtopics under these main topics that we're covering in the guidance. We covered many of the things that you expressed in the letter to us on March 18th that provide guidance on. A few of them we didn't, though.

Like in the area of waste packaging and disposal technology, we have guidance on engineer barriers generally but we didn't provide guidance on waste packaging and disposal technology because we haven't received necessary proposals of different things that people wanted to do in that area.

We felt like we would kind of be shooting in the dark as to what people want to do or what they want to propose in that area for low-level waste disposal. Generally low-level waste disposal facilities don't use an awful lot of engineering. The engineering is used to control the short-lived radionuclides. The site is suppose to control the

risk from the long-lived radionuclides.

I think that's all I have.

MR. McKENNEY: Derek and Dave, the guidance is expected to be published along with proposed rule for public comment. That's the current way of rulemaking. Much like the fact that we didn't have a Statements of Consideration nor the rest of the regulatory analysis or anything else published as part of the draft text that we put out on May 6, the guidance will be also be available at the time of

the proposed rule.

MR. WIDMAYER: I understand. It would certainly be helpful to the stakeholders to have the guidance.

MR. McKENNEY: But that is exactly why it's going to be published with the proposed rule when the formal comment period is actually occurring.

MR. ESH: The rule text is -- it's a big effort but it's an effort involving a lot more people than the guidance document. The guidance document is a longer effort and a bigger task. We couldn't get the guidance document out in the same

period for this extra discussion and interaction on the rule text.

I do want to recognize the working group. I think we've had very good interactions in our working group. Everybody gets along great and we've had lots of productive discussions. We've had very little swearing, primarily me. Some blows have been thrown, primarily by OGC, but none have been landed.

CHAIR RYAN: Very good. We're scheduled for a 15-minute break at this point which we'll take and we'll reconvene at 10:35. Thank you.

(Whereupon, at 10:18 a.m. off the record until 10:34 a.m.)

CHAIR RYAN: We will go ahead and get started. Without further ado, Drew, you're next.

MR. PERSINKO: My name is Drew Persinko. I'm the Deputy Director in the Division of Waste Management and Environmental Protection. Early this morning Priya talked about the comments we received back in 2009 before the draft proposed rule language was written.

What I'm going to talk about now briefly is I'm going to talk about recent comments we

received on the draft proposed rule language and the technical analysis supporting the 20,000 year period of performance, the comments that were received at a public meeting held on May 18th. Also we received subsequent written comments.

I would like you to keep in mind that this is really only a preliminary review of the comments. Although the transcript has been available for a few weeks, the written comments were received basically the period of performance -- I mean, the comment period closed on the 18th but we didn't receive the comments until probably Monday close of business roughly.

We gave it a cursory review as to the kind of comments we received. I'm going to try to present that to you to give you a flavor of the comments we received. As you'll see, to no surprise, I guess, there is a wide spectrum of opinions.

We had a public meeting on May 18th and it was an opportunity to discuss the draft proposed rule text and the technical analysis supporting the period of performance. We were seeking the documents that I mentioned. The proposed rule text,

and the technical analysis were made publicly available. They are publicly available in ADAMS and on our website.

We were seeking early initial public reaction to these documents. The rule has not yet gone to the Commission. The rule has not been published as a proposed rule. We were just getting early, early comments on it. Following the meeting we accepted written comments. As I said, the process closed on June 18th. The regulations can be reviewed at the regulations.gov website.

When you look at the comments we received, both the ones that we discussed on the 18th and the cursory review of our written documents -- the written comments rather. If you look at them, I think they can be roughly categorized into six bins right now.

As we get into the documents and we analyze the comments further maybe we'll find more bins, but right now I think they'll fall into about six bins. The first bin has to do basically with Part 61 framework that we used. We received some comments along the lines basically saying maybe this isn't the correct approach to DU disposal.

Several stakeholders questioned whether we should be developing a separate regulatory requirement and criteria just for DU because of the uniqueness of DU. Other commentors recommended that the staff should not even consider near-surface disposal for uranium. Another comment said staff should require a minimum depth of disposal.

Second grouping of comments had to do with the 20,000 year period of performance. This mirrored the 2009 comments. Basically we received comments that were in favor of shorter PoP's such as 1,000 years or maybe 10,000 years. And we received comments that suggested longer PoP's up to peak dose. One comment we received thought that the 20,000 PoP was a good number.

(Laughter.)

Third major comment grouping had to do with how we treated future system states. What I mean by that, that included looking into the future to project what's going to happen down the road in the future and that had to do with topics such as climate change, changing in lake levels.

Most stakeholders agreed that it's important to account for future system states and

account for that in the modeling parameters, but they cautioned us that this is an area having a lot of uncertainty. They wanted to make sure that staff was mindful to avoid unnecessary speculation and to limit the future system states to those that are reasonably foreseeable. We are working, as Dave said, in our guidance document.

Another grouping had to do with the intruder assessment requirement that Dave spoke about. We received comments along the lines that the changes we made are unnecessarily restrictive and they impose significant new requirements.

Some stakeholders suggested that we employ a risk-informed performance-based philosophy such that the intrusion scenario really cannot be -- you shouldn't assume a probability of 1 to occur and assume that the intruder would strike the hottest radiological area in the disposal cell.

Yet, we had other stakeholders suggesting that, yes, a probably of 1 is the right number for such a scenario. Some stakeholders took issue with the 500 millirem exposure. We had some stakeholders suggesting that the lower limit should be used such as 100 millirem or 25 millirem.

MR. WIDMAYER: Nobody suggested a higher number?

MR. PERSINKO: I don't remember seeing a higher number but they took issue with the uncertainty and the risk-informness of it but at this point I don't remember seeing a higher number.

We received a number of comments, as mentioned earlier, on the compatibility designations for the proposed rule. I think we proposed C. I think we had one comment that said B, there would be a B category. There was a discussion on this at the May 18th meeting.

I would just like to note that we will make a recommendation as to what it should be but it gets reviewed by a compatibility panel here at the NRC involving Agreement State people at the NRC and they make the final decision as to what it should be.

CHAIR RYAN: With a range of recommendations?

MR. PERSINKO: The one I recall, I remember one of the comments said it should be a B recommendation rather than a C. I think B captures the -- it's not verbatim. C is it should be at

least as restrictive, I believe. B is it captures the concepts but it doesn't have to have exactly the same language I believe. I remember that comment. That's the ones I remember.

CHAIR RYAN: The panel will make the determination for the benefit of all.

MR. PERSINKO: Correct. We make a recommendation but it's the compatibility panel that makes the final decision.

CHAIR RYAN: Do they have the benefit of all the input you receive?

MR. PERSINKO: I believe they will.

CHAIR RYAN: Okay. I just wanted to understand that

MS. YADAV: Lisa, if you want to clarify that.

MS. LONDON: I'm sorry. This is Lisa London. I'm from Office of General Counsel. Just to clarify, on B it's actually and essentially identical and it's to encompass transboundary edification. C is to meet the essential objectives of a program and to ensure that there aren't implications, conflicts, or gaps in a program.

CHAIR RYAN: Okay. That's helpful.

Thank you. The other question I had does the panel that makes the decision have the benefit of the comments that have been received?

MS. LONDON: I believe they do, yes.

CHAIR RYAN: Okay. Thank you.

MR. PERSINKO: Okay. Of course, the last category "other." There are a lot of comments that really didn't fit into one of the above categories. They sort of made these stand-alone comments. Just to give you a little bit of flavor of that, there was some discussion about NRC harmonizing its low-level waste regulations with other government agencies such as DOE.

There was one comment suggesting we should be using organ dose instead of TEDE as our limits. There was a comment that DU should not be Class A waste. Then there was comments along the lines that the definition of long-lived waste was not what it should be so they just didn't fall into any category and there are a number of those. Like I said, we just really got the written comments and some of them are quite long.

What I would like to do now is I have some concluding remarks and then path forward. I

would like to say that we believe that the staff followed the direction that it was given by the Commission. The Commission in its SRM 08-017 told us to do a limited scope rulemaking, to revise Part 61, to specify a requirement for the disposal of large quantities of DU, and the technical requirements for such an analysis.

In that SRM the staff also directed the staff not to alter the waste classification of DU and to conduct a public workshop for all effective stakeholders which we did in 2009 that Priya spoke about earlier. They were told to conduct the public workshop and from that, as Dave spoke about, we also heard at that workshop that we should have a PoP.

As far as the path forward, we'll spend the next several weeks looking over the comments and trying to dissect the comments and try to review them further. What we would like to do is after we meet with the full committee and hear the comments from the subcommittee and what the full committee has to say, we would like to review the recommendations from the committees and the stakeholder comments that we receive, and then we would decide what path forward we should take, do we

need to adjust the rule in any way before we go forward with it. We still are going to access what we need to do to the rule before we send it out.

CHAIR RYAN: I really don't anticipate during the full committee meeting session that we would have a draft letter for consideration by the full committee and hopefully would finish that full committee letter during that meeting. Just as a planning item that's how we hope it will be.

MR. WIDMAYER: What kind of time frame are you working to try to get all this done?

MR. CARRERA: We are anticipating to send up a proposed rule package to the Commission October 14.

MR. PERSINKO: So, anyway, that concludes the brief review of the comments we received. As I said, we received them fairly recently, as of Monday, and we are still looking through them but it gives you a flavor of --

CHAIR RYAN: What total number of comments did you receive?

MR. PERSINKO: We had 15 sets of comments.

CHAIR RYAN: Fifteen sets.

MR. PERSINKO: I think it was 15, 14, something like that.

CHAIR RYAN: Okay.

MR. PERSINKO: Individual comments, few, I don't know. Some had four or five comments in there. Others had maybe more.

MS. YADAV: Energy Solutions and DOE each had 23 pages of comments.

MR. CARRERA: And Dr. Ryan, I just sent you the sets of comments we received yesterday.

CHAIR RYAN: That will be great.

MEMBER SIEBER: That will be good.

MR. PERSINKO: With that I would just like to basically open it up and hear the subcommittees thoughts on what we presented today and about the staff's work, answer any questions you may have.

CHAIR RYAN: I think we've had one other request for a member of the public to make comment and we'll now have a few minutes allowed for that.

MR. GREEVES: I thank the subcommittee for allowing me to speak. My name is John Greeves.

CHAIR RYAN: Who do you represent?

MR. GREEVES: I represent myself. Not

to say I haven't given advice to others but today I'm representing myself. Dr. Ryan, as you are aware, we have a long history on the subject. I'll be brief and I look forward to the comments that the subcommittee has and the full committee.

I just want to emphasize that many significant improvements -- the proposed language does include many significant improvements and the proposed Part 61 provides clarifications which have been long needed. This has been around a long time. The site-specific performance assessment frankly had been doing that and it just needs to be in the regulation, modern dose assessments, specifying limits. These are all things I've agreed with and I'm on record with letters to the Commission and others.

I especially support the two-tier concept for a compliance period and an evaluation period. All these things are included in the proposed language all to the good. There are some areas that I have some concerns with. In the space of time I'm going to just identify those.

There are a few significant staff proposals that I think are problematic. The most

glaring of which is the 20,000-year compliance period. There is no precedent for a 20,000-year compliance period. The high-level waste standard for all sites are 10,000 years. Trying to get both the applicant and the regulator to focus on a 20,000-year period to do an assessment leads to ambiguity.

The results are going to be difficult for any regulator to implement. We've got multiple regulators that are going to have to touch this thing. It's going to be a problem for both of them. I think 20,000 years is a wrong number. I admit there's some right numbers but it certainly isn't 20,000. It's less than that. I know I have some precedence, either 1,000 or 10,000 or less than that.

A second problem area, and it's been mentioned here today. The staff noted it on their slides. They had comments from others on it, this language. Once you write it in a language it becomes the Bible. Guidance is difference but this notion for the intruder to occupy the site, the language literally says the intruder occupies the site.

It goes further. In the proposed rule it articulates agriculture, dwellings, resource exploration. When you put that language right into the rule, it's also incumbent upon some regulator to require that to happen. Even if you look at it and recognize it, nobody is going to do agriculture here. There are no resources.

Anyhow, I think that language is problematic. The staff targeted it on their slides. I would propose replacing that in several places in the rule with "have access to." "Access to" hopefully allows a regulator and an applicant to demonstrate what that access is and how to either defend it or not read it.

Elsewhere related to that in the proposed language it says, "The intruder engages in activities on site." I think an insertion of language of "reasonably foreseeable." You'll find this language "reasonably foreseeable." It's strewn throughout staff guidance everywhere. It needs to be in the rule "reasonably foreseeable activities" to just make sure that is the standard. So those are the two problematic areas.

Sort of a different topic but it's on the list is the compatibility level. The public learned on May 18th the staff at least had in mind to propose the flexibility on compatibility for the performance objectives. Frankly, I've worked in this business for decades.

I was shocked to see them consider having the performance objectives flexible. Those performance objectives are the backdrop of all the rest of the rule. The language, the history, all indicates that the Commission itself strongly recommends strict compatibility for those performance objectives. They should be identical. There is so much opportunity for other people who will implement this regulation. To create and invent ways to not honor those performance objectives I think would be a bad approach.

Also, those performance objectives are targeted within legislation. The Commission, the staff is obligated to implement those performance objectives. I don't see how you can make them flexible. I think that would be a strong point to keeping the performance objectives whatever the identical compatibility is. Frankly, people do not

understand the Bs, the Cs, the Ds but they know what identical is.

Another point the staff mentioned this morning, they got comments about harmony within the federal government. Apparently I read them but you've got comments from the Department of Energy. I heard their comments on May 18th as an observer. Since I retired from NRC seven, eight years ago I've had a chance to work with the Department of Energy on their responsibilities for low-level waste disposal.

It's been difficult to work with one standard for DOE and another standard for NRC, and it's going to be even worse when DOE standard is 1,000 years for compliance if there were to be a 20,000 year NRC period of compliance. I highly recommend harmony within the federal government on a number. Not 20,000, but maybe it's not a 1,000 either. Whatever it is harmony would be a high recommendation.

Also, having worked with the Department on a number of low-level waste sites, I've come to understand the benefit of having a waste acceptance criteria that is derived from a site-specific

performance assessment. This rule clearly is going to require a site-specific performance assessment.

I would recommend that the rule be clued language allowing use of a waste-acceptance criteria based on that site-specific performance assessment and use that as a way to address waste streams coming into the site and take advantage of this notion of having a site-specific performance assessment and not relying on generic tables that were done for humid sites 30 plus years ago. I just emphasized the high points. I would be happy to answer any questions about these and thank you for your time.

CHAIR RYAN: Thank you very much. Thank you.

MEMBER SIEBER: Appreciate it.

CHAIR RYAN: Let's see, John. Is there anybody else on the bridgeline?

MR. LIEBERMAN: Can I make a comment?

CHAIR RYAN: Yes. Let us who you are, please?

MR. LIEBERMAN: So --

CHAIR RYAN: What is your name, please?

MR. LIEBERMAN: Say again?

CHAIR RYAN: We need to know who you are. What is your name?

MR. LIEBERMAN: Oh, Jim Lieberman and I'm with Talisman. I worked with Jack Greeves on a number of issues that I agree with and comments that John made. I would also add the site-specific analyses should be updated periodically to make it more of a living document because things change over time and that is the only addition I would make to John's comment.

CHAIR RYAN: Okay. Just to be sure we got your comment, Jim, the phone connection is not exactly perfect. Would you mind repeating what you want to make updatable over time?

MR. LIEBERMAN: I would suggest that the forms assessment and the intruder assessment be updated for a period of, say, five years to reflect changes in waste stream and performance estimates technology.

CHAIR RYAN: So the performance assessment and intruder assessment should be set up such that they are updatable as a function of time. That's your comment.

MR. LIEBERMAN: Exactly. Thank you.

CHAIR RYAN: Thank you. Anything else, Jim?

MR. LIEBERMAN: No, that's it.

CHAIR RYAN: All right. Are there any other individuals on the bridgeline who want to make a comment?

Okay. We'll go around to others. Jack.

MEMBER SIEBER: Well, I would like to state right off the bat that it's a very complex subject. It doesn't limit itself to a tremendous amount of scientific rigor. On the other hand, I think the staff did a tremendous job of taking a complex subject that Doug Mott had, specific boundaries, and making it understandable in this session. I think they have done an excellent job and I congratulate them for the work they have done.

As I go through it I note that the staff has chosen the two-tier approach. If I were to give myself technical permitting, I would go for the uncertainty-informed approach which is a three-tier approach. Then what I think about if I got assigned to the job of doing it that I would have a tough time doing that.

I consider going to a two-tier approach

compromise between perhaps the better method that would be impossible to perform to a method that I don't like quite as much but is a practical method that can be used. I'm sort of up in the air about where we ought to be but right now my tendency is to agree with the staff that if you want a practical rule you probably have to go with the two-tier approach.

I think the issue of the 20,000 years is a little on the arbitrary side. I see the basis for why the staff has chosen that number. Personally if in the review of public comments for further thinking on the part of the staff, or direction from on high or, perhaps, in the next building some additional or some change would be made to that, I would be amenable to considering what that change is.

Right now 20,000 years from the layout of all the factors does not seem unreasonable to me. On the other hand, I could probably make a judgment on those same factors that come up with a shorter period of time. That remains an open issue as far as I'm concerned.

I think from the intruder standpoint and

the activities that they undertake and the motivation, I think we are probably better off not trying to guess what the intruder is going to do and stick with what the staff proposes in that area. Basically those are the three big points that I have.

I do have a question. I did not see any place where you talked about a minimum depth of disposal. Is that correct?

MR. ESH: Yeah, that's correct. I appreciate your comments. I think you have pretty much summarized the technical staff's thinking as we went through this process in trying to derive what we thought should be the requirement. I think we are in great agreement there.

We don't have a minimum depth requirement proposed right now. We did have a public comment along those lines that maybe you should have one. The thinking is when you did the regulation in the early '80s you put a depth requirement in there for a certain type of waste or an intruder barrier, one or the other.

So if you have a material now like uranium that causes trouble with radon, in

particular, why wouldn't you do a depth requirement for that? That was a good comment. I hadn't even like thought -- I hadn't even pulled the string on that one. That was a good comment that I saw.

MEMBER SIEBER: That is basically my same comment. It seems to me that if I were a citizen with just basic knowledge of radiation and environmental factors, it would seem to me that I would want some new depth. The more difficult question is trying to decide what that new depth should be and what it's based on because I think it depends on the nuclides in the waste.

It depends on groundwater transport. It depends on the amount of moisture that hits the ground. You are going to need -- if you decide that you need a minimum depth, it's going to have to be a performance-based definition as to what that depth should be. That's going to be individual and specific to each site. If I were to find the best-of-all rules, that is something I would consider.

MR. ESH: Part of the reason why we didn't have a depth requirement is because we are also operating in this spectrum of quantity and concentration. You may not need a certain depth of

cover if you have limited concentrations of uranium, for instance. Your normal cover that you use for your facility may be sufficient.

MEMBER SIEBER: For example, mill tailings.

MR. ESH: Exactly. And you can achieve it through two different methods. You can achieve protection of that material, say, if you're trying to mitigate radon through increased depth and especially ensuring the moisture content or the liquid saturation of that cover above the material. Or you can use a material such as a clay radon barrier or other type of radon barrier.

The problem becomes when you go out in time, you know, we've sponsored -- NRC has sponsored some research by Craig Benson at the University of Wisconsin on the performance of engineering systems over time, especially covers. He does a fantastic job analyzing systems and understanding how they work.

I think if people want to get pointed in someone's direction about how to analyze an engineering problem, I would point them in that direction. When he's done analysis of how covers

perform over time, when they're shallow the performance can change pretty rapidly.

Mother Nature says, "I don't like it that you've tried to put in these materials that I didn't have originally and they are dissimilar from my natural environment," and just starts beating on them with all sorts of processes and the properties of those materials changed. For a clay radon barrier you have to ensure you have sufficient depth of it by itself so that the properties of that barrier doesn't change.

MEMBER SIEBER: The interesting thing is you talked about the ice age. I suspect we are due for one if you ignore some other climate change theories along the way. Where I live you can actually count shorelines on the mountainsides. I've been able to count 19 but somebody told me there's 21.

There is a tremendous topographical change when these ice flows go past and they can carve out a channel. For example, where I live that channel runs 175 miles to the north. It goes up into Canada and comes back down and forms the Columbia River. You can actually walk a pathway out

to the Pacific Ocean. It's pretty far inland. It's 500 miles inland. A lot of things can happen during these glacial stages. They occur in a periodicity in this eon of about 20,000 years. Putting something 10 feet under the surface, to me that can disappear in two weeks.

MR. ESH: I think we recognize that. The issue we struggled with is that in some more northern states the impacts are likely to be pretty severe. Whereas in some more southern states they might be more moderate.

MEMBER SIEBER: But the rule has got to recognize that you've got to use different approaches depending on where you are.

MR. ESH: We get into this issue, though, of do you want to -- does your requirement want to enhance putting material into the more stable sites versus the less stable sites when you analyze those changes.

One comment that you had made earlier I don't know if you want to go back to was regarding heterogeneity, waste heterogeneity. I don't think I came back to that.

MEMBER SIEBER: No, you didn't. It's

still a question in my mind.

MR. ESH: Okay. So the issue is right now if you do a residential intruder scenario, for instance, what is generally assumed is they put in an excavation for a foundation and they exhume material. The activity is dispersed throughout that volume that is exhumed with the assumption of it's unrecognizable at the time that event happens.

You say it's uniformly distributed. You take that material out. You dilute it with maybe clean materials or covered materials that were on top. Then you calculate the risk associated with that scenario.

That works okay. Then you develop the waste classification tables that have single concentrations in them basically embedding these assumptions about waste distribution in the calculation and in those single numbers that are in the table.

With a move to site-specific intruder analysis the issue you can get wrapped around is what is the distribution of activity within my waste. If I say I'm interested in -- I put the waste deeper and I might have a drilling scenario.

The drilling scenario is going to be -- the results are going to be more sensitive to the heterogeneity of the waste than a scenario that homogenizes the results.

I don't think you would want somebody because of this hypothetical intruder scenario and they do a drilling analysis and they say, "We don't know where they are going to drill. Let's see what happens when they hit the bad spot."

They drill and hit the bad spot and you get a bad result. So then they say, "Let's put it shallower because then we can assume it's mixed up and we get a lower result." How is that protecting? That's backwards. You don't want to do that.

CHAIR RYAN: Part of the problem is when you think about the inventory, whether it's concentration based on or total quantity based on. I think there is some room to think about the idea that a fractional release from the inventory is really what we're driving and controlling that long-term case. That's really, as you just pointed out, very different than when an intruder goes in and takes a chunk of shiny stuff that happens to be a radiated stainless steel and makes a

mantelpiece out of it. I think it's important to think about that scenario maybe in a little different way. Do we recognize it or do we not recognize it, how deep is it, how much we bring up. what we use it for. That's something maybe we ought to think about exploring in a little bit more detail and not just accept.

MEMBER SIEBER: I think there are some lessons learned from the work going on by DOE in Richland. They have found some surprises in the waste remediation and I did, too.

CHAIR RYAN: Jack, they are advert intruders. They are not inadvertent. They know what they're digging into. They just don't know how much. MEMBER SIEBER: They don't know exactly where. On the other hand, there's some significant stuff there. My impression was I was surprised that there was some higher than I expected specific activities in concentrations. But I was also surprised when you look at the hydrology, and the boreholes and measurements that were made, that it had not travelled further than it did.

That sort of tempered my thoughts about how all this works. On the other hand I think that

there are some insights that can be gained just by looking at the work that Richland did that is now going on in waste remediation to get some insights as to what the uncertainties really are and how we should account for them. Now, taking that admittedly very limited experience and trying to turn that into a rule that covers everything I think is going to be --

MR. ESH: That's a tough challenge. In our guidance document plus we're revising our Branch Technical Position on concentration averaging and we are trying to make sure the two are consistent and integrated. We are dealing with this issue of waste heterogeneity. We have approaches that we are recommending about how you handle that problem and it does not involve, I don't believe, assuming the worst spot is hit by the guy that is drilling the well, for instance.

MEMBER SIEBER: Right.

MR. ESH: It involves some consideration of the distribution of waste and the distribution of results that you would get from doing an activity on the site. And it does take consideration of the fact that the whole disposal site is not going to be

waste.

MEMBER SIEBER: That's right.

MR. ESH: You have cells and uncontaminated areas in between, a buffer zone around the facility. We are allowing consideration of all the real features of the site, not just that you hit waste.

MEMBER SIEBER: It will actually look like Hanford the way it was laid out. It's laid out that way.

You had a comment?

MR. McKENNEY: Yes. Actually I would like to remind the Committee that we are going to be coming and talking about the Branch Technical Position in a few months. Because we just changed the schedule, that's when we are going to get into how from a waste generator standpoint how do you assess and how much do you need to assess heterogeneity.

As Dave just said, there's two aspects of the waste problem. Of course, what can you accept to the site and what's the heterogeneity going to allow in your site. But then from an individual shipper's point of view how did they

comply to make sure that the site doesn't get out of whack.

Our Branch Technical Position on concentration averaging is for the generator and that's for looking at the generator point of view of how they would fill a barrel and how to classify the barrier. They actually deal with the heterogeneity. That issue is on a future committee session.

We just haven't actually -- I think right now it's on for October 4th so we'll be getting back into that issue specifically from the generator's point of the guidance. Maybe near that time we'll have our other dragons from this sort of play show how they are --

MEMBER SIEBER: I would hate to depend on the transportation rules to limit my total burials as far as a lack of heterogeneity. I think everybody gives the point that those are sort of the things I'm concerned about.

Frankly, I'm glad you are not exactly at the proposed rulemaking stage because I think we all need a rule thinking to get the words right so that we don't make it excessively restrictive and, therefore, impractical and not solve the problem

because not very many things works like that you can do in that area and in some other areas.

On the their hand, there is a limit as to how much the cost is reasonable to be able to dispose of waste in a manner that does not generate a lot of harm to the public.

CHAIR RYAN: The bill for disposal includes two things; the cost and the taxes. The taxes outweigh the cost.

MEMBER SIEBER: Right. Okay. That sort of summarizes my comments.

CHAIR RYAN: Thank you, Jack.

MEMBER SIEBER: I can make this brief because I know I'll get another chance.

CHAIR RYAN: John.

MEMBER STETKAR: Thanks. If I were going to vote, I would vote for Option 4. I'll just make that statement.

CHAIR RYAN: Okay.

MEMBER STETKAR: I'll just keep it brief. I do think there might be some merit in considering something that Dr. Ryan mentioned, that within the context of the rule rather than specifying a fixed -- I don't care whether it's

10,000 or 20,000 fixed duration of the performance period that there is perhaps some fixed value specified in the rule as let's call it a backstop for lack of another terminology.

The allowance within the rule to demonstrate another acceptable performance period which gets more into the sort of risk-informed performance-based process. It makes writing the guidelines, the appropriate regulatory guides, in terms of how do you demonstrate that is a bit more difficult but, indeed, it doesn't block everyone into that one size fits all regardless of the inventory, regardless of the site characteristics, regardless of the depth of disposal types of issues.

I think that's the only comment I would make right now. I'm not sure quite now to handle the intruder scenario. As I said, I would personally prefer Option 4 which would handle the intruder scenario holistically under that context.

CHAIR RYAN: John, well said. I second that John seconded my comment.

On this slide, which is the differential slide, I think that's a very important one if we

could maybe get that out. I was very taken by the fact that this really is kind of the guidance we can think about with radionuclides and different environments in one picture.

The idea that comes to my mind which I think about probably more often than intruder scenario is the fraction release from inventory under whatever the disposal system is. At the end of the day that is the principal protection criteria. It's what is the fractional release from the inventory over the performance period.

This is really a good way to think about it. A paper on the French disposal system looks at exactly this kind of fractional release from the inventory based on all the features. They end up with an inventory limit as the license criteria. Not a period of performance because that is part of the calculation.

I think that thought is worth thinking about because a dry site and a deep disposal depth probably could take more material than a humid eastern site near a coastal area. I offer that as a different way to think about this. It's not inconsistent with particularly this strategy. Maybe

that's a way to think about unifying things.

We talk about the need to use these tools to derive an inventory limit appropriate for your setting of waste characteristics, packaging, disposal technology, cover technology, and geohydrology. You have represented, I think, very well here in terms of what becomes important at what period of time. Does that make sense to you?

MR. ESH: Yes. I guess I would ask, though, if you were using this fractional release rate concept, I mean, don't you still have to relate it to some period of time or do you just say flatly the fractional release rate has to be .01 or whatever the number is regardless of time?

CHAIR RYAN: I think you develop that release rate into some exposure scenario so you take that into whatever environmental media to expose theoretical people you want which is not uncommonly done and not the way it's done now for those kinds of uses on the contaminated water. I just tag that into the same kind of assessment there. No luck with the dose assessment but it's a little bit different than what we talked about so far.

MR. ESH: I'll have to think about it,

of course. When you pull the string on it, my expectation is you still eventually butt up against this issue of how long were you trying to do this for. The one advantage I do see of it, as you are probably well aware, concentration isn't everything. Some process say it's concentration matters and in others it doesn't.

If you have a solubility limit, your fractional release rate is not sensitive to your concentration above the solubility limit. If your system would just keep putting out material at the flux rate multiplied by the solubility limit, those are the curies per year or grams per year or whatever, grams per meter square per year that comes out of your system, that's rolled up in a fractional release rate metric.

Whereas if you are trying to make decisions based on concentrations, sometimes it does impact the results and sometimes it doesn't. If you have materials that aren't solubility limited, then, of course, it makes a big difference in what you see at a receptor location if you have a concentration that is 1,000 times less or 1,000 times more. Send water through and the peak comes out, it's dispersed

as it travels, and you end up with a bigger peak at the receptor.

CHAIR RYAN: I know some good examples where the solubility is so high it's just whatever the water does it's going to show up.

MR. ESH: For low-level waste you have some things that are not necessarily infinitely soluble but very soluble, the technetiums and chlorines in the world under typical conditions. Then you have some that are kind of moderately soluble I would call them, the uraniums and the neptuniums of the world. And you have some that are very insoluble; the thoriums, for instance.

I think americium is way down the list under most conditions. The problem is you have heterogeneity and conditions, too. The geochemistry can be both variable from site to site spatially and temporally. I have hydrangeas in my yard that change color based on whether the soil is acidic or basic and they get pink hydrangeas when the soil is a certain way and then they turn to blue when it's the other way. I forget whether it's acid based or base acid.

I think the idea that I'm trying to get

across is that the concentration tables as they exist now I'm not sure exactly what those numbers were all based on at this point. I would have to go back and restudy the old EISs and so forth.

I think we have an opportunity to rethink should some things be based on the concentration limit or the quantity disposal of it in the context of a PA. Sometimes it's very confusing when you think about just concentration. Some of those are based on a physics assessment. It's not necessarily proposed assessments once disposed.

MR. ESH: Primarily, I mean, we have Table 1 and Table 2, short-lived radionuclides and long-lived radionuclides. The concentrations that are in those tables a number of scenarios were evaluated with them. Primarily they were derived from different variants of intruders scenarios.

But the regulation is very clear that you may need to specify imitations on your long-lived other species based on your 61.41 analyses especially. The concept of you need to do an analyses and that analyses should determine if you need some limitation on what you take.

DOE uses a much shorter period of performance and I would argue it's too short for a lot of the long-lived things they are dealing with. But their process of how they go about it and using the analysis to set some concentration limits that particular facility can take, I think that has a lot of merit. We have talked about --

CHAIR RYAN: It's an inventory thing. It's not really just concentration.

MR. ESH: It's a product of concentration and quantity. You can take like, for instance, you may --

CHAIR RYAN: Which gives you the volume you can take.

MR. ESH: You may be able to take small quantities of high concentration. If the pathway that that material is affecting in, say, a water pathway, you can take small amounts of high concentration or high amounts of low concentration.

CHAIR RYAN: So, in essence, the inventory is what's being regulated.

MR. ESH: The inventory is what's being regulated but for some pathways and scenarios like if you are basing some limitations on a disturbance

calculation, it gets much more driven by the concentrations within that disturbance volume. Concentration within whatever the disturbance volume is for that scenario.

CHAIR RYAN: Of course, if you have some other feature like that for burial or other barriers that prevent that or mitigate that then, again, you are back to fractional release from the inventory.

MR. ESH: Yeah.

CHAIR RYAN: I think trying to translate everything in a concentration can be a little bit confusing sometimes, but also it doesn't really give the ability to analyze in a rigorous and consistent way what happens if you really are driven by fractional release from inventory due to water intrusion. That's just something to think about.

MR. ESH: I think many times in practice they aren't looking at -- the disposal facilities that are operating that way they are keeping track of just total curies of whatever isotope it is and seeing when it meets their total curie number because they did an analyses over some volume and they said, "We can take X curies in this volume." Then they just track how many curies come in until

they reach their limit for that volume and then, "Okay. I can't take anymore of those." I'm agreeing with you.

CHAIR RYAN: In the French case that is how they determined the critical radionuclides is what's the one we can take the least of.

MR. ESH: Yeah. I think they do also use an intruder analysis in their process. As far as I understood, they have like an inventory limit that they take and then they also have a package limit that they take. My guess is the package limit is being driven by an intruder calculation of some sort. The total inventory limit is driven by their other calculations that they've done.

MR. PERSINKO: The only thing I wanted to say is I'm not disagreeing with you whatsoever but I think we also were told by the Commission do a limited scope rulemaking. We have comments right now saying, "You went way beyond limited scope." I don't know where that line is.

CHAIR RYAN: We certainly appreciate that but we are unencumbered technically.

MR. PERSINKO: Maybe you can convey that to other folks, too.

CHAIR RYAN: Anything else?

MR. McKENNEY: The rule as it stands already in the concept section does state that there probably will have to be an inventory limit especially for mobile radionuclides which we are changing with the text right now in the new rule to add the concept of also other long-lived radionuclides may also need to be limited by inventory limits rather than just reliance on the concentrations.

In addition, in the guidance sections that Dave has been working on, we do have a section in that one on how to use inventory limits establishing that. As you said, the PA is not the only way you could maybe do either package or inventory lists because package limits could also be based off your handling technology for each health physics, especially for your strong gamma emitters. You could possibly take a lot of heavy gamma emitters but there is no way you could get into the ground without --

CHAIR RYAN: 10,000 radionuclides the package is not a problem.

MR. McKENNEY: Right.

CHAIR RYAN: For hardware. That could be handled quite well.

MR. McKENNEY: Yes. It all depends on the site facilities, site design, and everything else like that. There could be some combinations where one site that's fine and one site because of it you don't want to do that. And also in our regs we put out we also put a section again on consider inventory limits on the radionuclides that are controlling the Performance Assessment.

MR. WIDMAYER: According to the schedule I can talk for an half an hour.

CHAIR RYAN: According to me you can't.

MR. WIDMAYER: Okay.

CHAIR RYAN: But go ahead.

MR. WIDMAYER: Yeah, we'll stop you at an appropriate time.

CHAIR RYAN: Thank you very much for your comments.

MR. WIDMAYER: When I reviewed a lot of your materials, or all your materials, the voice of Gary Roles kept coming up in my head. For those of you who don't know, he's one of the godfathers of the analysis for Part 61. He was always telling me,

"Derek, this intruder is not a real person." Now we have gradually moved over the years to where this intruder you are actually needing to protect this intruder so he's turning more into a real person.

The first thing that came to my mind as far as how do we put these two things together and come to a solution. The depth of burial was the first thing that I thought of where you are protecting the intruder as a real person by putting it below where ne intrudes without having to do all of these fancy calculations.

That having been said, I think I also agree with John Greeves' comments that if you really need to leave flexibility, not put depth of disposal in, that some of the words that he suggested probably are good as far as providing some way to reduce the uncertainty on the analysis. That was all I really had to say.

CHAIR RYAN: Okay. That's great. You have a half hour to go.

Any other comments?

MEMBER SIEBER: I just think that the technical issues, I think, are difficult enough here because there is a fair amount of uncertainty and we

are looking far out in time. The actual drafting of the rule is equally important to get the language exactly right. I encourage the same diligence for drafting the rule as the staff has put toward developing technical understanding of what is going on. Perhaps you understand what I mean.

MR. ESH: And we may not be there yet but if you had the pleasure of being in a working group you would see that we did exercise that diligence. When this issue first came up I was like, "I can write the rule language this afternoon."

MR. WIDMAYER: I guess the Performance Assessment Working Group that took them like 10 years to write the NUREG document, that kind of gives you some indication of how much fun you are having.

MR. ESH: It took quite some time for them to produce that document. The working group had weekly multi-hour meetings talking about rule text, revising it, going back and forth trying to think of unintended consequences, the whole thing. Hopefully when we get to some proposed draft language that gets put out publicly, we are 99

percent of the way where we wanted to try to get to.

MEMBER SIEBER: All I'm saying is that the drafting of the rule is not the easiest part of the job.

MR. ESH: It is not. I agree with you.

CHAIR RYAN: One of the other questions that I want to just revisit and make sure I have my understanding right is the 20,000-year basis. I think you said a number of how much additional radioactive material is captured by going from 10,000 to 20,000 years. Could you just revisit that one more time?

MR. ESH: When we looked at it, we said, okay, there is this perception that NRC has a rich policy of using 10,000 years. The reality is that NRC has not used 10,000 years for a single licensing decision yet. It's in Part 60, of course. It was originally in Part 63 and there are still two phases in there. There is still 10,000 years in it.

In our low-level waste program I believe Washington is the only state that used 10,000 years so I have to give kudos to Drew Thatcher. Our other Agreement States picked all different values so if you want to say what is our policy on low-level

waste, our policy on low-level waste is it's not defined. Agreement States pick it. Whenever we looked at that we looked at what the working group recommended. As I indicated on this slide, they looked at radionuclide transport characteristics and they looked at one box at that table, the shallow humid box, in making their recommendation.

We looked at that in a little more detail. This was done probabilistically, I forget, 25 elements or so, nine different conditions. You're talking about 225 sets of horse tail plots that this table is condensed from. When you say it's complicated, yes, it's very complicated. We looked at the transport characteristics.

We looked at the decay and ingrowth and we looked at the stability issue. I think those three components are getting at different parts of the risk assessment. This is getting at like groundwater transport. The waste characteristics is more important, I would say.

It does affect this part of the calculation but it's also important for like the intruder or disturbance type calculations that you

have captured waste characteristics. Essentially an air pathway for materials like uranium that produces radon. Then we have this issue about near-surface stability which is associated with 61.44, the performance objective on maintaining stability at a site.

We looked at the performance objectives and how these different technical variables could affect that and all of them pretty much pointed in we should take a step up in the longer direction if you wanted to consider the technical features.

Your specific question on the radiological characteristics, basically at 10,000 you're off by about a factor of 30 from where you are at 10,000 and where it peaks out. When you go to 20,000 you gain an extra factor of like 2.3 or something like that so it gets you down close to an order of magnitude. Not quite there but you are pretty close to it.

I think we have to recognize that when you're talking to stakeholders they are going to say, "How are you protecting me from this material?" Well, the waste characteristics is something that we know pretty well. I don't want to over-simplify

it though. As I tried to indicate a couple times, you can't solely just look at the gain and ingrowth curves. It's a more complicated calculation.

CHAIR RYAN: I understand that but I just wanted you to repeat that because I think that is an important reason that justifies your thinking that 20 is a better number than 10.

MR. ESH: I think, as you've indicated, Dr. Sieber, you could go through all this information I could see how somebody would come up with 10 as opposed to 20. I can also see how they could come up with 50. Personally, I don't see how you could come up with a 1,000. I think that is not being reasonable considering the characteristics of the material you're dealing with.

I also don't see when you think about the uncertainty context and what's going to be affecting people and society outside of radioactive waste how you can go to a million or billion or peak, whatever it is. I mean, I think we lose site of that we have to pay for this.

There is no free money. Somebody gets charged for these requirements and these activities that we in place. I pay for it and so do you and so

does everybody in the room. When you look at nuclear things, especially nuclear waste disposal, the dollars spent per life saved or person protected is off the charts compared to some other things.

We at least should take that into our thinking. Whether we drastically change our approach because of it, that would be a different story. We should at least acknowledge that whenever we are trying to develop our requirements and what approaches we recommend.

MR. WIDMAYER: So, Dave, I was intimately involved in development of DOE Order 435.1 and all of their analysis and methodologies. We didn't spend 10 years working on the performance assessment that we included in there, just three years.

There were some folks, you know, intimately involved in disposal of DOE that felt like 1,000 years for compliance was absurd. I understand where you're coming from but we stuck with 1,000 years because at least some people thought as a measure of compliance there is some reasonability associated with doing a calculation of 1,000 years. Anything after 1,000 years they felt

there was too much uncertainty. You didn't want to provide that as your measure of compliance.

MR. ESH: I think --

MR. WIDMAYER: Well, just to finish, I was intrigued with Option 4 as far as what you might be able to stick with and you can stay with 1,000 years as your compliance period, justify why 1,000 years. Then all these other arguments that you're talking about is the reason you want to go beyond 1,000 years. It gives you a notion as to how much things cost. Maybe you adjust things that we don't spend all the resources and all those arguments.

CHAIR RYAN: I guess I'm still rattling it around in my head but the important point is what requirement you attach to whatever number you pick, whether 1,000, 10,000, or 20,000. What does an applicant have to do to satisfy that numerical, whatever is around that numerical requirement. Is it to do a calculation?

Is it to have very high degrees of certainty? Is it to look at something like this sort of analysis that says we think things are in the right direction and below the line on the d/d Esh curve from now on. So what I have to do to

demonstrate that I'm okay with whatever the number is critical. The language that ultimately ends up in the rule and the guidance that follows behind it I think is the important part of all this.

MR. ESH: I think part of the issue is that the decision makers on these problems what certainty. They want an easy decision. In some ways some of these types of problems are not going to be amenable to an easy decision. I think it is practical to think you can generate some future impacts even at some longer times and say, "I believe that the range of impacts is going to be one to 100," or whatever the case may be. "Some distribution over a couple orders of magnitude and here is why I think that is a suitable decision." I don't think we can get to the point of saying that the result is 23.7.

CHAIR RYAN: Oh, no. I don't think so either. What I'm trying to get at is risk is likelihood. We talked a lot about what's the consequence but we really haven't focused on how we give guidance on how to figure out the likelihood.

MR. ESH: One thing I think I forgot to mention in my talk is part of this issue, especially

for low-level waste, low-level waste is the first step in the waste management process. It's not the last step. Okay? You have other alternatives to go further down the line if you need to to manage the material.

When we talk about uncertainties and results at long time and whether they are meaningful or not, in many areas of life that we operate in, I think if we were faced with try to decide if there is a risk to us or a safety impact and said, "That's really uncertain," we probably wouldn't take that action or we would take some sort of protective action. We wouldn't just charge and have them with the action because we say, "Well, we have a lot of uncertainty."

CHAIR RYAN: Basically it will still come down to a different metric. What is the likelihood and if I'm not happy with the likelihood I calculated, or the uncertainty in the likelihood, I have to do things. I'll get back to the analytical side to maybe reduce the uncertainty of the likelihood and then decide if I'm happy or unhappy with that likelihood.

MR. ESH: Part of the issue is, I think,

sometimes in performance assessment when we are trying to generate a single metric output to, say, the peak mean dose from a probabilistic analysis is X or it's below whatever our limit is, I'm not sure if that's the right thing that we should be doing.

CHAIR RYAN: I agree.

MR. ESH: Maybe we should be generating the range of outcomes and say, "This is the range of outcomes," and they may not be averageable. You may be representing -- depending whether it's representing variability or uncertainty, you shouldn't be reducing that range of output to a single number. It's not a number that makes sense.

It's like if you have a river and the river is six inches deep the whole way across and 50 feet deep at the other side and you say, "On average the river is nine inches deep. Our send my toddler across it." Well, you probably shouldn't do that.

CHAIR RYAN: Again, I know this is a hard question but to get back to this analysis, it basically kind of categorizes what things are important and what things aren't to these various scenarios and then how we can deal with that over

time.

Adding how we can deal with it over time is real important to understanding what does a 10,000 or 20,000-year calculation mean. We are forced to assume some regularity of the environment, you know, averaging for the nine-inch depth. There is no way around it so we are going to be faced with those uncertainties that we have to somehow wrestle with. I guess I would offer to you the thought that having guidance on how to wrestle with those uncertainties it will be an acceptable methodology. It will be very, very important to add to this effort to give people that guidance.

MS. YADAV: We absolutely have draft guidance written on how to handle uncertainties and the time frame, how to do the long-term analysis beyond the 20,000 year compliance period. We have all that that we're working on.

CHAIR RYAN: Just 10 to 20. Let's not talk about beyond 20 yet. I think the details of that guidance hopefully will give people the answer to, "What do you want? What do you want from the applicant."

MS. YADAV: Right.

CHAIR RYAN: And then how detailed does it have to be and what does it need to assess. I think that is very important guidance to make this workable. MS. YADAV: Yes. Maybe we need a session after the guidance is more complete on specific details in the guidance.

CHAIR RYAN: Right.

MR. WIDMAYER: Speaking of which, do you still want to bring the group to the full committee meeting in July for a letter report or do you want to have another meeting before you do a letter report?

CHAIR RYAN: Let's think about that.

MEMBER STETKAR: We certainly need a letter report probably by the September meeting to bring it up to the Commission.

MR. WIDMAYER: Right. You said October 21st?

MS. YADAV: Yes.

MR. WIDMAYER: I know that you talked before about the October meeting. You talked before about whether you want to come again after you do an analysis of the comments and see if you change course or --

MR. PERSINKO: We thought after we're here with this full committee we would then kind of regroup and decide where we need to go.

MR. WIDMAYER: My concern with that is we need a four-hour session with the full committee.

CHAIR RYAN: Let's maybe just take that as an action item and think it over.

MR. WIDMAYER: As it stands right now you guys are suppose to come back for the July full committee meeting.

CHAIR RYAN: Quite frankly, I think the July full committee meeting is not a bad idea because it gives the full committee the chance to digest stuff that they probably haven't seen in detail until then and then have a follow-up activity after that.

MR. WIDMAYER: Okay. They need some guidance on what to reduce their presentation to for the full committee.

CHAIR RYAN: We will deal with that --

MR. WIDMAYER: Off line?

CHAIR RYAN: -- as we prepare for that meeting.

MR. WIDMAYER: Okay. We could have Dave

come and use five slides and go from there.

CHAIR RYAN: That's not going to happen.

MR. ESH: I think I just talked about inappropriately reducing information.

(Laughter.)

CHAIR RYAN: Anything else? So we've got a scheduling action we'll take up and go from there. Anything else, Jack?

MEMBER SIEBER: No thanks. Well done.

CHAIR RYAN: John?

MEMBER STETKAR: Nothing.

CHAIR RYAN: All right. With that we'll close the meeting. Thank you all very much for a very informative morning.

(Whereupon, at 11:45 a.m. the meeting was adjourned.)

10 CFR Part 61: Site-Specific Analyses for Demonstrating Compliance with Subpart C Performance Objectives

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Advisory Committee on Reactor Safeguards
Meeting of the Radiation Protection and Nuclear Materials Subcommittee
June 23, 2011

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Why are we here today:

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Provide update of Part 61 rulemaking and solicit input on certain technical issues

- ACRS briefing
  - December 2009 and March 2010

- Commission directions
  - Proceed with a rulemaking to require a site specific performance assessment prior to the disposal of significant quantities of DU and blended waste

Why are we doing a rulemaking:

U.S.NRC
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- Emerging regulatory issues in LLW disposal
  - Discrepancies from original 10 CFR Part 61 assumptions
    - Disposal sites are currently faced with disposing of waste types that were not considered at that time
  - Uranium enrichment
    - More than 1 million metric tons of depleted uranium (DU) require disposal
  - Industry innovation to address Class B & C LLW
    - Industry contemplating large-scale blending

Today's topics and presenters:

U.S.NRC
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Topic	Presenter
Background: *Commission Direction, 2009 DU Workshops, 2010 ACRS Letter*	Priya Yadav, DWMEP
Draft Proposed Rule: *Summary of Preliminary Proposed Rule Language*	Andrew Carrera, DILR
Discussion: *Intruder Analysis Requirement, Period of Performance Proposal*	David Esh, DWMEP
Overview of May 18, 2011, Public Meeting and Summary of Public Comments	Drew Persinko, DWMEP

10 CFR Part 61: Background of the Site-Specific Analysis Rulemaking

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Advisory Committee on Reactor Safeguards Meeting of the Radiation Protection and Nuclear Materials Subcommittee

June 23, 2011

U.S.NRC

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Overview

U.S.NRC
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- Background
- Recent Activities
- Comments
- Working Group Approach

Staff Requirements Memorandums

U.S.NRC
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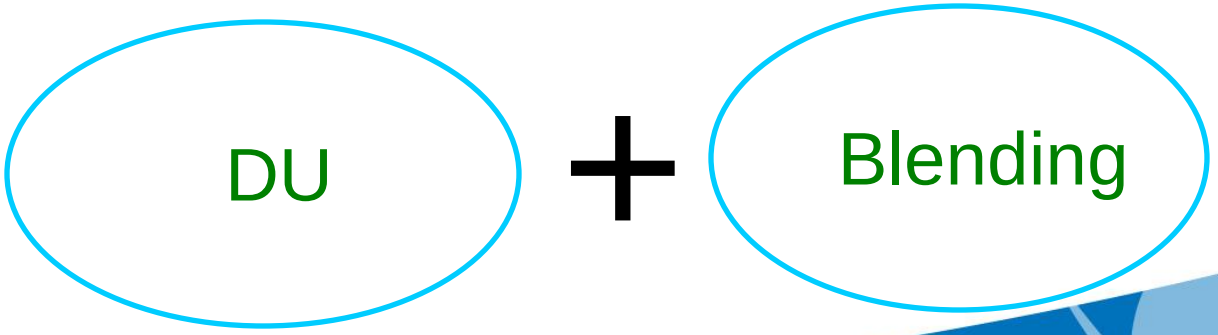
- SRM-SECY-08-0147:
  - Require site-specific analysis for disposal of large quantities of DU
  - Meet performance objectives
  - Specify criteria needed for analysis
  - Develop supporting guidance
- SRM-SECY-10-0043:
  - Incorporate blending issue into the existing rulemaking for DU



Recent Activities

U.S.NRC
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- 2009 Unique Waste Streams Workshops
  - Workshop 1: September 2-3, 2009
    - Approximately 75 people attended in Bethesda, MD
    - Transcripts: ML092580469 and ML092580481
  - Workshop 2: September 23-24, 2009
    - Approximately 90 people attended in Salt Lake City, Utah
    - Transcripts: ML092890511 and ML092890516
- ACRS Briefings
  - Subcommittee on Radiation Protection and Nuclear Materials: December 16, 2009
  - 570th meeting ACRS: March 4-6, 2010

Recent Activities

U.S.NRC
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- Interim guidance, April 13, 2010
  - Letter to Agreement States
    - "Summary of Existing Guidance That May be Relevant for Reviewing Performance Assessments Supporting Disposal of Unique Waste Streams" (ML100250501)
- Public Workshop, June 24, 2010
    - Demonstrated GoldSim application of screening model supporting SECY-08-0147
    - Approximately 30 people attended
    - Summary (ML101790484)

Recent Activities

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- "Technical Basis for Proposed Rule to Amend 10 CFR Part 61 to Specify Requirements for the Disposal of Unique Waste Streams, Including Large Quantities of Depleted Uranium", April 2011, (ML111040419):
  - Describes existing regulatory framework
  - Identifies regulatory issues
  - Outlines basis for requested change
  - Stakeholder interactions
  - Alternatives considered

Recent Activities

U.S.NRC
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- May 18, 2011 Public Meeting:
  - Approximately 50 people attended in Rockville, MD
  - Similar presentations by staff
  - Ample time for public comments
  - Comments received until June 18, 2011
  - Visit the Site-Specific Analysis Website:
    - http://www.nrc.gov/about-nrc/regulatory/rulemaking/potential-rulemaking/uw-streams.html
    - Transcript (ML111570329), Meeting Summary (ML111600030), Proposed Rule Language, Period of Performance Technical Analysis Paper

2009 Workshop Comments

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- Identify period of performance in the rule (i.e., a specific number) so that all licensees are held to the same requirement
- Revise the performance objective for intruder protection (§61.42) to specify the dose limit for the assessment
- Specify a requirement in the rule to conduct a performance assessment for all waste streams disposed
  - No need to define “unique waste streams” or specify different requirements than other waste disposed

2009 Workshop Comments: Period of Performance

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- Broad range of opinions
  - 10,000 years is too long
  - 10,000 years is sufficient
  - More than 10,000 years but less than peak
  - Evaluation to peak dose is needed

ACRS Letter

U.S.NRC
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- Letter to Chairman, March 18, 2010
  - Recommendations:
    - Risk-informed, Site-specific, realistic performance assessments
    - Articulate standards applications will be reviewed against
    - Quantification of uncertainties
    - Treat proximity of potentially exposed members of the public in a probabilistic and risk-informed fashion
    - Base scenarios on:
      - Realistic assumptions for release and transport, fate of the DU
      - Realistic likelihood of intrusion
      - Range of site-specific conditions

ACRS Letter (continued)

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- Letter to Chairman, March 18, 2010
  - Recommendations:
    - Determine doses over a timeframe determined on a case-by-case site-specific basis
    - Guidance should include:
      - Quantities, physical, and chemical forms of disposed DU
      - Waste packaging and disposal technology
      - Site-specific properties that influence mobilization and transport
      - Local climatic conditions
      - Depth of disposal
      - Cover technologies that limit infiltration and intrusion

Working Group Approach

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- Require performance assessment for all radionuclides
  - Discuss reasonably foreseeable scenarios in guidance
- Require intruder assessment for all radionuclides
  - Ensure similar analysis as done for §61.55 tables
  - Likelihood of intrusion considered by dose limit
  - Discuss use of generic or site-specific scenarios in guidance
- Define a specific time period for period of performance
  - Recommend compatibility category to allow for flexibility on case-by-case basis
  - Clarify in guidance a graded level-of-effort is expected for less complex sites with shorter-lived radionuclides

10 CFR Part 61: Preliminary Proposed Rule Language

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Advisory Committee on Reactor Safeguards
Meeting of the Radiation Protection and Nuclear Materials Subcommittee
June 23, 2011

U.S.NRC
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Working group

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Office	Working Group Members
FSME/DILR/RB-A	Andrew Carrera, Gary Comfort
FSME/DILR/RB-B	Jeffrey Lynch
FSME/DWMEP/EPPAD	Priya Yadav, Mike Lee, James Kennedy
FSME/DWMEP/EPPAD	Christopher Grossman, David Esh
FSME/DWMEP/ERB-A	Stephen Lemont
ADM/DAS/RADB	Angella Love-Blair
OGC	Lisa London, Tison Campbell
NRR	Shawn Harwell
OIS	Kristen Benney
NMSS	Greg Chapman
OAS/CRCPD	Devane Clark

Purpose of the Rule

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- Specify site-specific analyses requirements.
- Strengthen and clarify existing regulations to reduce ambiguity and facilitate implementation.
- Better align the requirements with current health and safety standards.

Proposed Amendments to Part 61 Regulations

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- Waste-Stream Neutral:
  1. Site-specific-analyses requirements would apply to all wastes
- Site-Specific Analyses:
  1. Performance assessment
  2. Intruder assessment
  3. Long-Term analysis
  4. Update analyses at facility closure
- Other Supporting Changes:
  1. New definitions, concepts, and long-term analysis
  2. Use of total effective dose equivalent (TEDE)

Site-Specific Analyses: Performance Assessment

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- § 61.41 Protection of the general population from releases of radioactivity.

  Revised requirements:

  § 61.41(a)—Revised to include TEDE.

  § 61.41(b)—Added requirement to demonstrate compliance with a performance assessment for 20,000 years.

Site-Specific Analyses: Intruder Assessment

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- § 61.42 Protection of inadvertent intruders.

  Revised requirements:

  § 61.42(a)—Added annual dose of 500 mrem TEDE.

  § 61.42(b)—Added requirement to demonstrate compliance with a intruder assessment for 20,000 years.

Site-Specific Analyses: Long-Term Analysis

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- § 61.13 Technical analyses.

  New requirements:

  § 61.13(e)(1)—Discuss how the design of the facility considers the potential long-term radiological impacts, consistent with available data and current scientific understanding.

  § 61.13(e)(2)—Calculate the peak annual dose that would occur 20,000 or more years after site closure. No dose limit applies to the results of these analyses.

Site-Specific Analyses: Updated Analyses

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- § 61.28 Contents of application for closure.

  New requirement:

  § 61.28(a)(2)—Submit revised analyses for § 61.13 using the details of the final closure plan and waste inventory.

- § 61.52 Land disposal facility operation and disposal site closure.

  New requirement:

  § 61.52(a)(12)—Dispose of waste consistent with the description provided in § 61.12(f), and the technical analyses required by § 61.13.

Other Supporting Changes

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- § 61.2 Definitions.

  New definitions:

  intruder assessment, long-lived waste, and performance assessment.

- § 61.7 Concepts.

  New concepts:

  intruder assessment, performance assessment, and long-term analysis.

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Thank you

10 CFR Part 61: Technical Issues for the Low-Level Waste Rulemaking

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Advisory Committee on Reactor Safeguards Meeting of the Radiation Protection and Nuclear Materials Subcommittee

June 23, 2011

U.S.NRC

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Main Topics

U.S.NRC
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- **Intruder Assessment**
- **Period of Performance**
- **Guidance**

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Intruder Assessment

Intruder Assessment

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- New requirement for an intruder assessment.
- Necessary because the Commission directed the staff not to alter the waste classification system.
- Waste classified under 61.55(a)(6) could represent an unanalyzed condition from an intruder protection perspective.
- Intruder assessment has three parts: waste classification and segregation, intruder barriers, and intruder dose assessment.

Intruder Assessment

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- Regulatory construct.
- Intruder assessment is supported by a variety of groups (IAEA, ICRP, NCRP).
- Evaluate potential exposure of inadvertent intruders after institutional control period (100 years).
- Dose limit of 500 mrem TEDE reflects NRC belief that exposures are unlikely, albeit possible, and impacts will be limited to a few individuals.
- Reasonably foreseeable land use scenarios, impacted by timeframe and change in natural site conditions.

Intruder Assessment

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Intruder assessment is an analysis that:

(1) Assumes that an inadvertent intruder occupies the site at any time during the compliance period after institutional controls are removed and engages in activities (e.g., agriculture, dwelling construction, and resource exploration) that might unknowingly expose the inadvertent intruder to radiation from the waste;

(2) Examines the capabilities of intruder barriers to inhibit contact with the waste by an inadvertent intruder or to limit the inadvertent intruder's exposure to radiation; and

(3) Estimates the potential annual total effective dose equivalent, considering associated uncertainties, to an inadvertent intruder engaging in activities that might unknowingly expose the inadvertent intruder to radiation from the waste.

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Period of Performance

Background

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- Period of performance is one of many important elements in the safety evaluation of low-level waste (LLW) disposal.
- Different approaches are used in the US and internationally for LLW.
- Diverse views among stakeholders.

NRC Background

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- The Advisory Committee on Nuclear Waste (ACNW) commented on the period of performance on numerous occasions (since 1994).
- ACNW communicated basic principles (see next slide).
- Commission direction (SRM-96-103).
- NUREG-1573: Performance Assessment Working Group (PAWG) recommended 10,000 years with longer-term impacts in site environmental assessment.

ACNW Principles*

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- Two tiers:

Consider site-specific characteristics

Tier #1

- No less than time for more mobile radionuclides to produce peak dose.
- No longer than a time period over which scientific extrapolations can be convincingly made.
- If the disposal system fails to meet the standard during the specified time period, ameliorating actions should be required or the site should be rejected.

* Full text provided on backup slides

ACNW Principles*

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Tier #2

- Evaluate robustness of the facility over the range of external processes and events that may affect the performance of the facility over long time periods.
- This evaluation also will ensure that no significant changes in the dose from the disposal site will occur.
- Estimates of the peak dose from the facility beyond the time of compliance are qualitatively compared with the dose standard.

* Full text provided on backup slides

General Objectives

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- Provide protection to present and future generations
- Consider uncertainties
- Communicate long-term impacts
- Facilitate decision making

Period of Performance Selection Process

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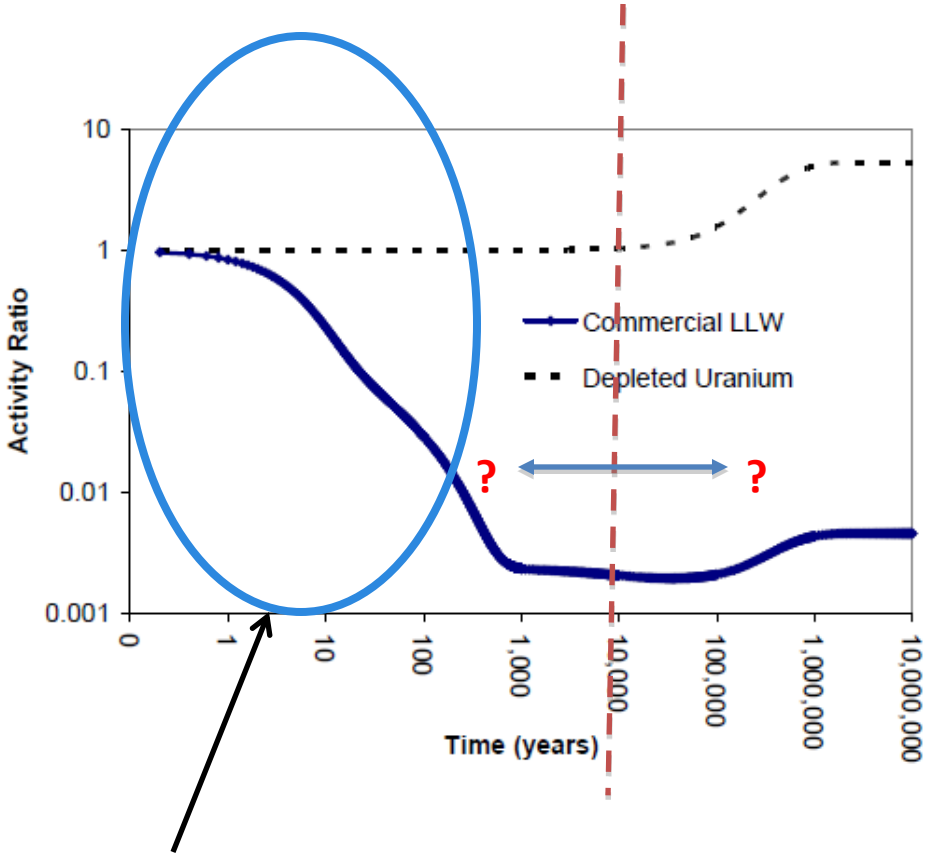
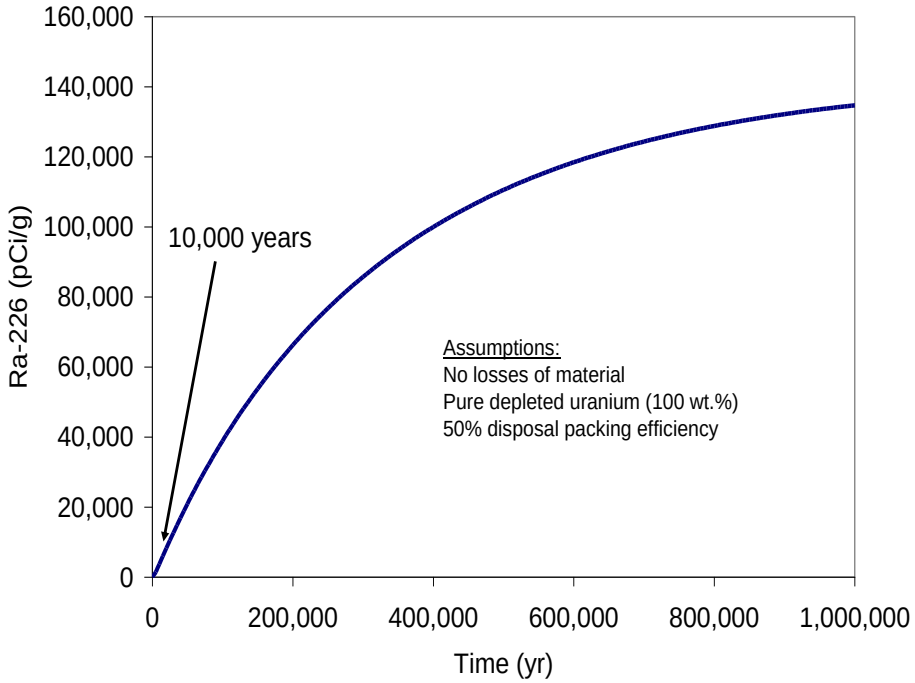
- Literature review:
  - Characteristics of waste
  - Analysis framework
  - Uncertainties (societal, natural, engineering, technology)
  - Socioeconomic considerations (transgenerational equity, discounting)

Waste Characteristics





This 99% of the waste does not cause risk from disposal

Waste Characteristics - HLW

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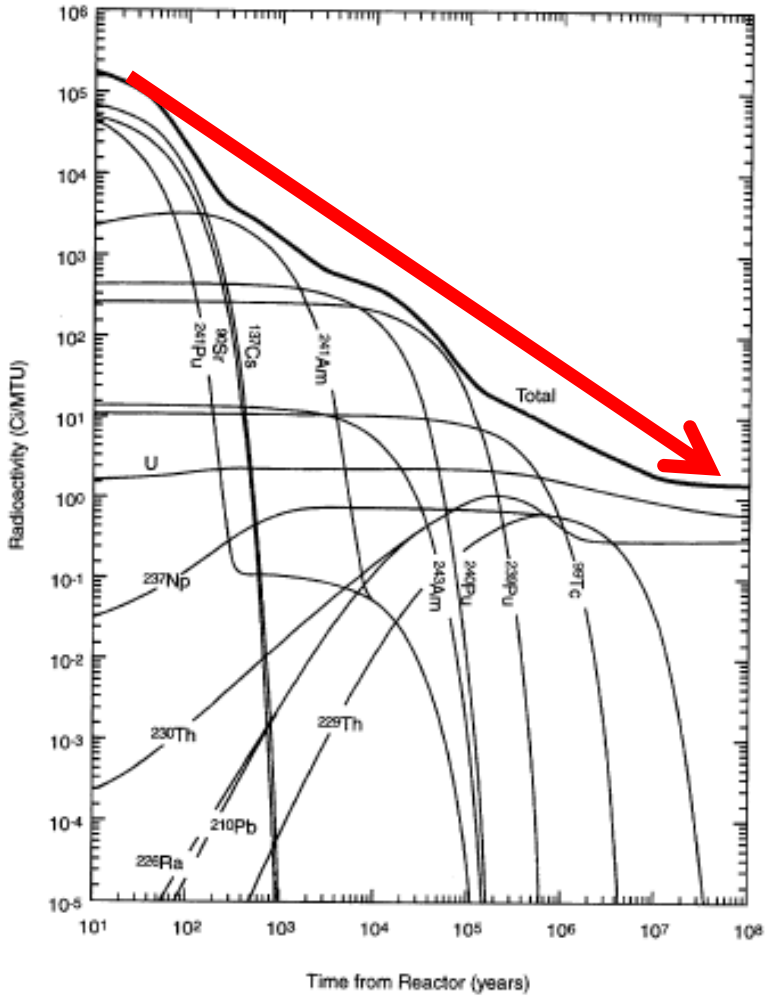

From NUREG-1538

LLW Inventory Analysis – Rulemaking Context

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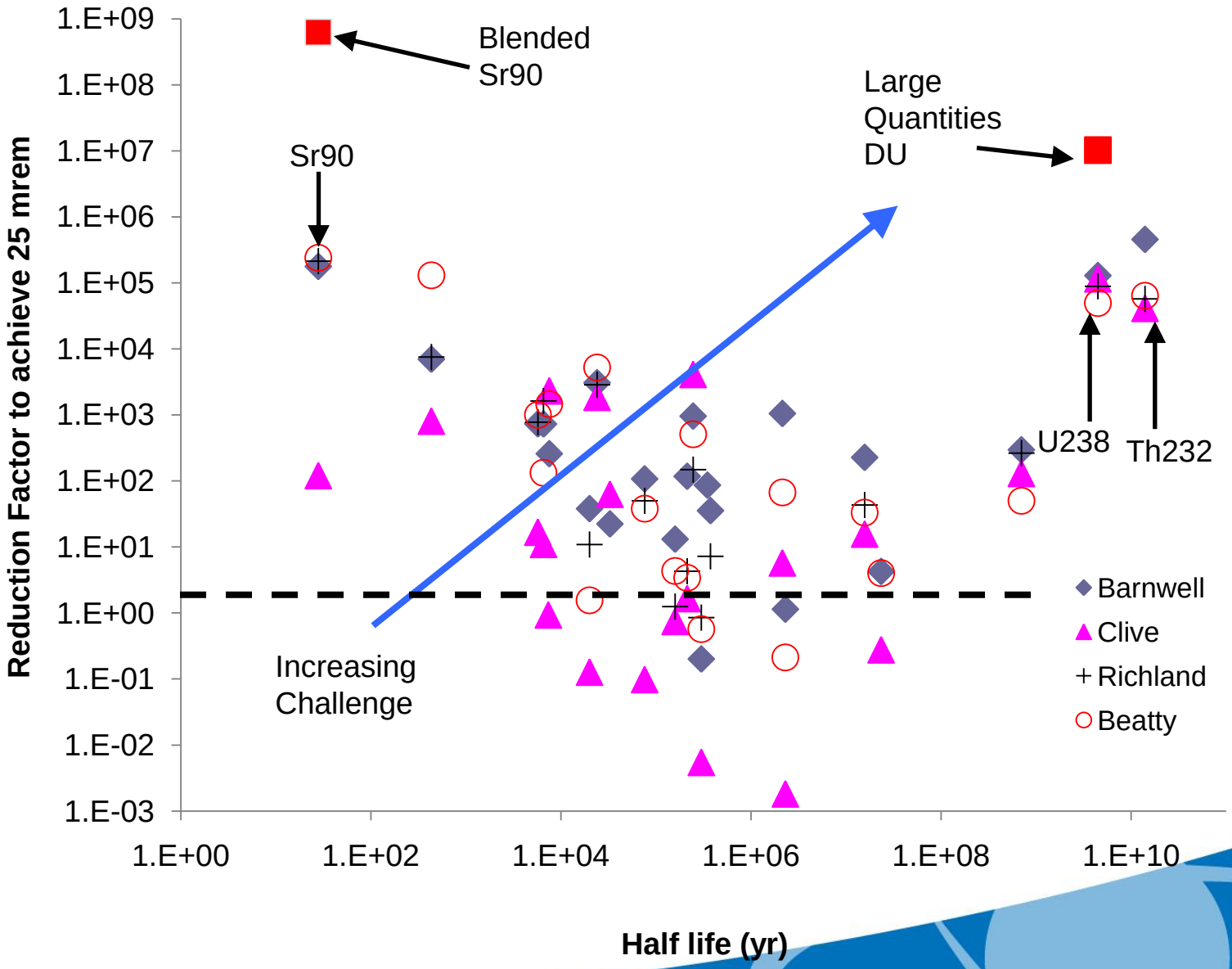
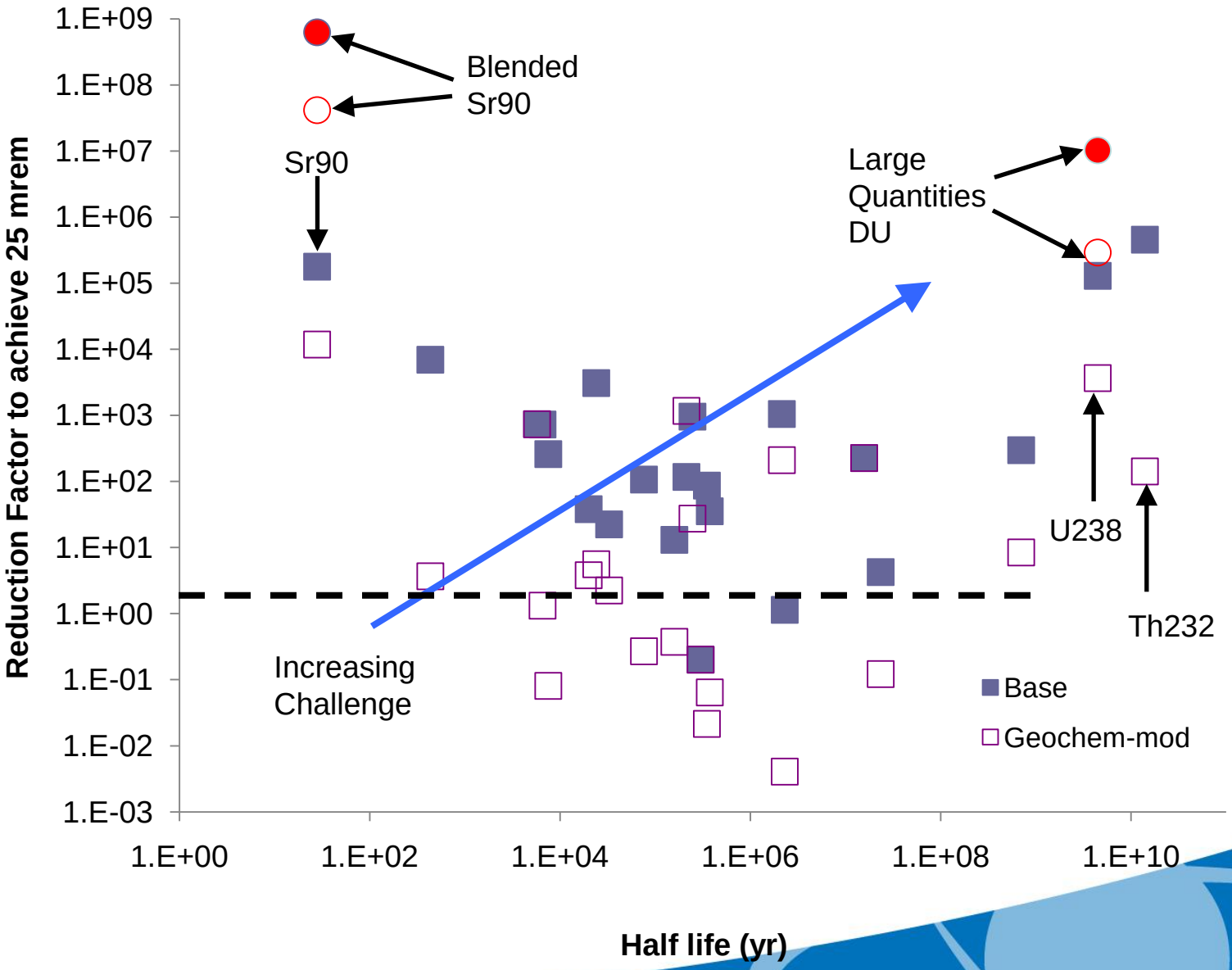
- Look at actual inventories disposed (use DOE MIMS database).
- Estimate the reduction factor needed to reduce the waste concentration to a groundwater concentration that would produce 25 mrem TEDE.
- Performance assessment is the process to verify that the necessary reductions will be achieved (sorption, solubility, dispersion, dilution).
- The next two slides are <u>not</u> PA results.

LLW Inventory Analysis



LLW Inventory Analysis



Uncertainty

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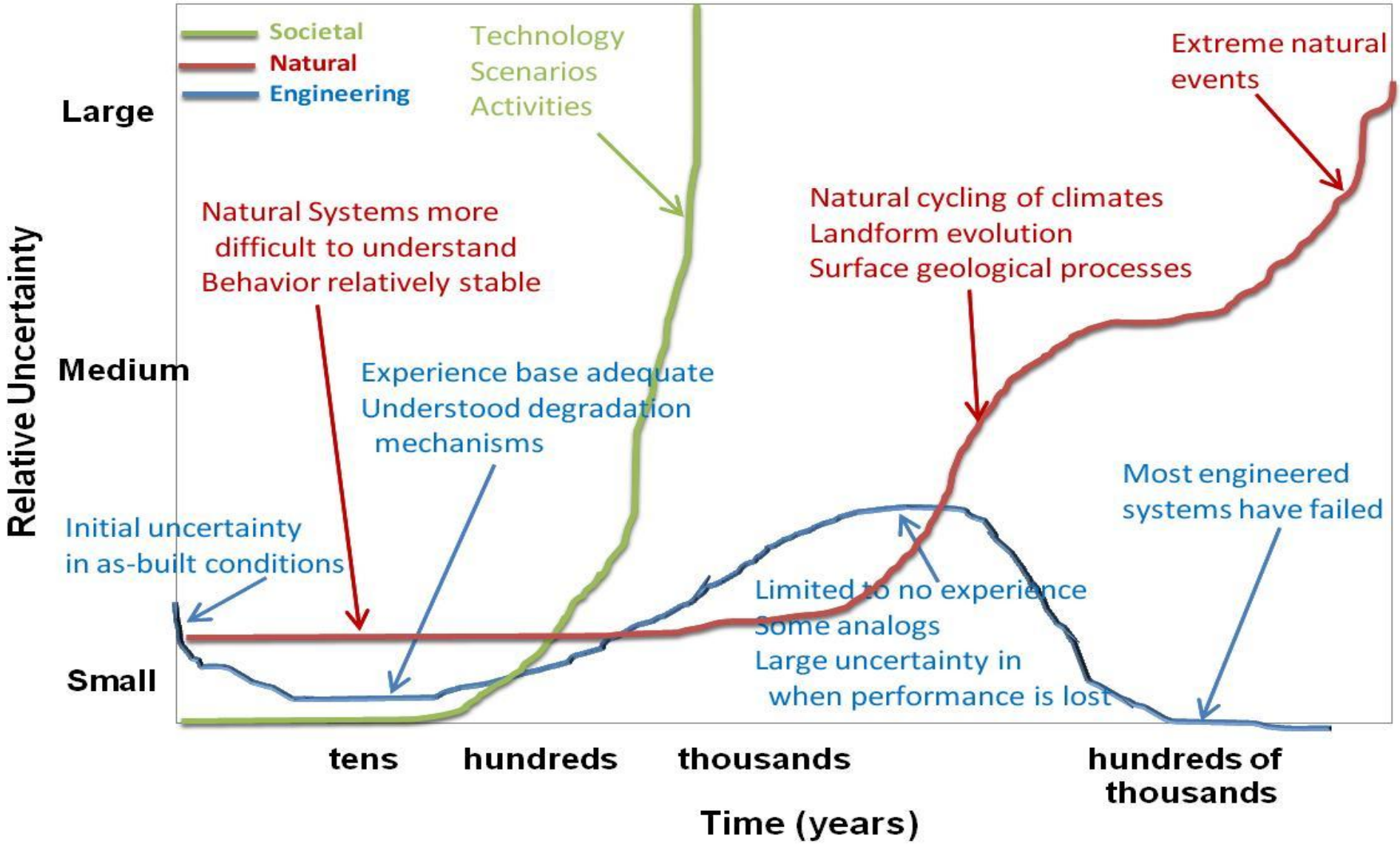

Socioeconomic

- National Academy of Public Administration (NAPA) recognized that intergenerational decision-making involves a number of variables (NAPA 1997)*

  1) Every generation has obligations as trustee to protect the interests of future generations.
  2) No generation should deprive future generations of the opportunity of a quality of life comparable to its own.
  3) Each generation's primary obligation is to provide for the needs of the living and succeeding generations. Near-term concrete hazards have priority over long-term hypothetical hazards.
  4) Actions that pose a realistic threat of irreversible harm or catastrophic consequences should not be pursued unless there is some countervailing need to benefit either current of future generations.

  - Discounting

* NRC has not formally adopted

Options Considered

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1) No Change
2) Peak Dose
3) Regulatory Precedent (two tiers)
4) Uncertainty Informed Approach – three tiers, Compliance, Assessment, Performance (CAP)
5) Industrial Metals

Rating Factors

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- *Protectiveness of Public Health and Safety*—The level of protection afforded to current and future generations. A low rating does not mean that the option considered does not provide adequate protection of public health and safety; a low rating means that on a relative basis that option could provide less protection than other options.

- *Consistency with Intergenerational Principles*—The degree to which the option would account for the intergenerational decision making principles listed in this section. Ratings were assigned based on the ability of the option to satisfy all five principles.

- *Consistency with Current NRC Policy*—The degree of consistency with current NRC policy with respect to assignment of a period of performance in waste disposal and decommissioning activities.

- *Treatment of Uncertainty*—The rigor with which the option considers uncertainty. The consideration of uncertainty has technical and socioeconomic components.

- *Facilitate Regulatory Decision Making*—The degree to which the option will allow regulatory decisions to be formulated, explained, and understood.

Rating Factors

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Option #	Protectiveness of Public Health and Safety	Consistency with Intergenerational Principles	Consistency with Current NRC Policy	Treatment of Uncertainty	Facilitate Regulatory Decision Making
1	L to H	L to H	H	M	L to H
2	H	L to H	M	L to H	L
3	M to H	M	H	L to M	M to H
4	H	M to H	L to M	H	H
5	H	H	L	L	H

Recommendation

- Option #3 – Regulatory Precedent (two-tiered approach with elements selected for the problem)
- Option #3 provides the best balance considering all factors and stakeholder views (at the current time)

Recommendation

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Tier 1

• A compliance period of no less than 20,000 years, with a peak annual dose limit of 25 mrem TEDE.

Tier 2

•A requirement to perform a calculation of peak annual dose that occurs after 20,000 years as an indicator of long-term facility performance. No dose limit would apply to this analysis.

•A requirement to provide analyses that demonstrate how the facility was designed to mitigate long-term impacts.

•Associated changes to the regulations to highlight the uncertainties associated with disposing of long-lived waste and that limitations on the disposal of those materials may be needed to properly manage the uncertainties.

Basis for 20,000 years

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- Near-surface disposal is not geologic disposal – the stability issues are much more challenging.
- Natural cycling of climate is known/expected.
- A value of 10,000 years is more likely to be in the period of climate transition.
- Including climate cycling within the compliance period will encourage disposal of long-lived waste at more stable sites.

Basis for 20,000 years

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- While 20,000 years does not capture peak risk for all wastes, it captures more than shorter values. Possibly within 10x for depleted uranium.
- A value of 20,000 years better captures radionuclide transport characteristics (compared to 10,000 years).
- Diminishing returns for longer periods (affected by increasing uncertainty).

d(Radionuclide Transport) / d(Period of Performance)

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Depth (Horizontal) / Climate (Vertical)	Shallow	Moderate	Deep
Arid	Se, Sn, Eu, Nb, Mn, Fe	U, Np, C, Sr, I	Tc, H, Cl U, Np, C, Sr, I,
Semi-arid	Pu, Ac, Co, Pa	Se, Sn, Eu, Nb, Mn, Fe	U, Np, C, Sr, I
Humid	Pu, Ac, Co, Pa, Zr, Th, Cs	Pu, Ac, Co, Pa	Se, Sn, Eu, Nb, Mn, Fe

Sites with slow water flow

more mobile

less mobile

[1] Ra, Pb, and Am were not influenced under any of the nine conditions

Sites with fast water flow

Basis for No Dose Limit for Second Tier

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- Impacts can be better placed in proper context (NRC would complete environmental analysis of impacts for disposal licensing actions taking place in non-Agreement States).
- Approach better aligned with long-term decision making in other programs (e.g. disposal of industrial metals).
- Impacts better aligned with uncertainties.

Guidance on Period of Performance

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- Risk-informed, performance-based guidance:
  - Would allow flexibility for short-lived waste or low concentrations of long-lived waste.
  - Would allow to go longer for high-concentrations of long-lived waste.

- Expectations for long-term analysis.

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Guidance

Guidance

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- Guidance is being developed and will be issued in parallel with the proposed rule for public comment.
- Guidance will supplement existing guidance.
- Main topics:
  i. General Technical Analyses
  ii. Performance Assessment Modeling Issues
  iii. Intruder Assessment
  iv. Stability Assessment
  v. Long-term Analyses
  vi. Other Considerations

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Backup

NRC Background - Backup

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- From the ACNW, June 3, 1994: "The committee believes that there is significant uncertainty about the required time frame for PA. The presently used arbitrary numerical values (e.g., 10,000y) lack bases in either standards or regulations."
- From the ACNW, June 28, 1995:".. We believe the application of peak dose calculations to be an important issue…"
- From the ACNW, June 7, 1996:

  "The maximum climate change is not predictable with our present science, but all evidence from extrapolations indicates that the principle effect will occur prior to ca. 20,000 years."

  "On the basis of currently available information, the ACNW anticipates that the appropriate compliance period will be somewhat greater than the present standard of 10,000 years."(for Yucca Mountain)

  "The time span for the compliance period should be no shorter than an estimate of the anticipated time it takes for potential radionuclide contaminants to reach the nearest critical group and no longer than a time period over which scientific extrapolations can be convincingly made."

NRC Background - Backup

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- SRM-96-103 "*The staff should provide to the Commission the technical basis used to support the truncation of the performance assessment at 10,000 years..*"

- SECY-00-0182 "*…therefore, PAWG is not recommending that the dose calculations be truncated at 10,000 years, if doses are still increasing at 10,000 years.*"

- NUREG-1573 – PAWG recommended 10,000 years for LLW performance assessment and a qualitative consideration of longer-term impacts in the site environmental assessment.

- From the ACNW, March 18, 2010: Don't specify a period of performance in the regulation (case by case basis).

ACNW Principles – LLW (Pomeroy, 1997)

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- This time span should be no shorter than an estimate of the anticipated time it takes for the more mobile radionuclides to produce a peak dose to the critical group and no longer than a time period over which scientific extrapolations can be convincingly made. This time period should be determined on the basis of site-specific characteristics of the entire disposal system using modeling, analog studies, and results from laboratory and in situ experiments. If the disposal system fails to meet the standard during the specified time period, ameliorating actions should be required or the site should be rejected.

ACNW Principles - LLW

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- The time period of compliance must be defined in concert with the reference biosphere and the critical group. Thus, the regulations also must include requirements and guidance for defining the latter on a facility-specific basis using known site characteristics and effects of long-term processes that are technically supported.

- In certain cases, the calculated time of compliance should be replaced with a maximum time of compliance such that uncertainties in performance assessment can be reasonably bounded.

ACNW Principles - LLW

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- The second part of the compliance regulation is designed to be used in evaluation of the robustness of the facility over the range of external processes and events that may affect the performance of the facility over long time periods. This evaluation also will ensure that no significant changes in the dose from the disposal site will occur in the near term after the calculated time of compliance. Estimates of the peak dose from the facility beyond the time of compliance are qualitatively compared with the dose standard. This part should not become a *de facto regulation.*

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NRC Guidance Outline (Draft)

Main Topics

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1. Introduction – Background, purpose, and regulatory framework.
2. General Technical Analyses Considerations:
   i. Scope of analysis (FEPs)
   ii. General elements (data uncertainty, model support, integration, etc.)
   iii. Period of performance
   iv. Dosimetry
   v. Uncertainty
   vi. Peer review, expert judgment and elicitation

Main Topics

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3. Performance Assessment Modeling Issues:
   i. Source term
      a. Inventory
      b. Wasteform
      c. Geochemistry
      d. Release mechanisms
   ii. Radionuclide transport
      a. Groundwater transport
      b. Surface water transport
      c. Atmospheric transport
      d. Biotic transport

Main Topics

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4. Inadvertent Intrusion
    i. Waste classification and segregation requirements
    ii. Adequate barriers to intrusion
    iii. Inadvertent intrusion assessment
    iv. Institutional controls

5. Site Stability Analyses
    i. Disruptive processes
    ii. Technical assessment
    iii. Engineered barriers

Main Topics

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6. Long-Term Analyses
    i. Guidelines for long-term isolation
    ii. Scope of long-term analyses
    iii. Analyses for long-lived waste
    iv. Barrier and component analyses

7. Other Considerations
    i. Inventory limits
    ii. Mitigation
    iii. Insignificant quantities

8. Use of Other NRC Guidance Documents

10 CFR Part 61: Preliminary Summary of Stakeholder Comments

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Office of Federal and State Materials and Environmental Management Programs

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Advisory Committee on Reactor Safeguards
Meeting of the Radiation Protection and Nuclear Materials Subcommittee

June 23, 2011

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May 18th Public Meeting

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- Opportunity to Discuss Draft Proposed Rule Text and Technical Analysis Supporting Definition of Period of Performance

- Sought Initial Stakeholder Reaction to Draft Proposed Rule Text
  - Public Meeting
  - Public Comment period ended June 18
  - 15 sets of written comments submitted thus far
  - Public comments are being reviewed

Initial Stakeholder Comments

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- Part 61 Framework for Addressing DU
- 20,000-year Period of Performance
- Treatment of Future System States
- Intruder Assessment Requirement

Initial Stakeholder Comments *(continued)*

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- NRC/Agreement State Compatibility
- Other

Next Steps / Conclusion

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- Staff Intends to Review All Stakeholder Comments
- Concluding Remarks