UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

April 16, 2014

MEMORANDUM TO: ACRS Members

FROM: Derek A. Widmayer, Senior Staff Scientist **/RA/**
Technical Support Branch, ACRS

SUBJECT: CERTIFIED MINUTES FOR THE ACRS RADIATION PROTECTION AND NUCLEAR MATERIAL SUBCOMMITTEE MEETING, NOVEMBER 19, 2013 – ROCKVILLE, MARYLAND

The minutes of the subject meeting have been certified on December 12, 2013, as the official record of the proceedings for that meeting. Copies of the certification letter and minutes are attached.

Attachment: As stated

cc w/o Attachment: E. Hackett
C. Santos

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

MEMORANDUM TO: Derek A. Widmayer, Senior Staff Scientist
Technical Support Branch, ACRS

FROM: Dr. Michael T. Ryan, Chairman
Radiation Protection and Nuclear Materials Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES FOR THE MEETING OF THE RADIATION PROTECTION AND NUCLEAR MATERIALS SUBCOMMITTEE, NOVEMBER 19, 2013 – ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on November 19, 2013, are an accurate record of the proceedings of that meeting.

/ RA / 12/12/2013
Michael T. Ryan, Chairman Date
Radiation Protection and Nuclear
Materials Subcommittee

Certified on: December 12, 2013
Certified by: Michael T. Ryan

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
RADIATION PROTECTION AND NUCLEAR MATERIALS
SUBCOMMITTEE MEETING MINUTES
November 19, 2013
Rockville, MD

The Advisory Committee on Reactor Safeguards (ACRS) Subcommittee on Radiation Protection and Nuclear Materials (RPNM) met on November 19, 2013, at 11545 Rockville Pike, Rockville, MD, in Room T2-B1. The meeting was convened at 1:00 pm and adjourned at 5:20 pm.

The entire meeting was open to the public. Mr. Derek A. Widmayer was the cognizant ACRS staff scientist and the Designated Federal Official for this meeting. No requests for time to make an oral statement or written comments were received from the public concerning this meeting.

ATTENDEES

ACRS

M. Ryan, Chairman
H. Ray, Member
C. Brown, Member
S. Schultz, Member
J. Rempe, Member
P. Riccardella, Member
D. Widmayer, ACRS Staff
D. Skillman, Member
S. Armijo, Member
S. Banerjee, Member
R. Ballinger, Member
J. Stetkar, Member

NRC Staff

R. Tadesse, COM/WDM
A. Carrera, FSME/DLIR
A. Schwartzman, FSME/DWMEP
A.C. Ridge, FSME/DWMEP
C. Grossman. FSME/DWMEP
D. Lowman, FSME/DWMEP
G. Comfort, FSME/DLIR
M. George, FSME/DWMEP
J. Smith, NMSS/FCSS/UEB
P. Castleman, COM/KLS
A. Mohseni, FSME/DWMEP
C. Barr, FSME/DWMEP
J. Kennedy, FSME/DWMEP
D. Esh, FSME/DWMEP
J. Shaffner, FSME/DWMEP
G. Suber, FSME/DWMEP
J. Maltese, OGC

US Departrment of Energy Staff

C. Gelles, DOE/EM
R. Boehlecke, DOE/NV.
E. Regneir, DOE/HSS
K. Martin, DOE/OGC
A. Wallo, DOE/HSS
S. Ross, DOE/SR
R. Seitz, SRNL
C. Corredor, DOE/HSS

Others

J. Schlueter, NEI
K. Fletcher, Exchange Monitor
J. Tauxe, Neptune and Associates
W. Goldston, EFCOG/EnergySolutions
R. Thomas
M. Lewis

SUMMARY

The purpose of this Subcommittee meeting was to hear presentations from and discuss the US Department of Energy (DOE) low-level waste disposal requirements and technical bases for conducting performance assessments (PAs) as they relate to the technical basis for revisions to 10 CFR Part 61, *Licensing Requirements for Land Disposal of Radioactive Waste* published in December 2012. The RPNM Subcommittee will also hold a meeting on the technical basis for Part 61 revisions on December 3, 2013 with presenters from Agreement States, operators of low-level waste (LLW) disposal facilities, LLW generators, and other stakeholders. The Subcommittee planned to gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, from this Subcommittee meeting in conjunction with the December 3, 2013, Subcommittee meeting for deliberation by the Full Committee at its February 2014 meeting.

SIGNIFICANT ISSUES	***Reference Transcript Pages***
Dr. Michael Ryan, Chairman of the Subcommittee, introduced the meeting and its purpose and the first speaker from the DOE.	4 – 7
Ms. Christine Gelles, Deputy Assistant Secretary for Disposal at the US DOE Office of Environmental Management began the presentations with an introduction of the DOE speakers for the day, and introductory remarks about the topics the speakers would be covering.	7 – 13 (Slides Pgs 210 – 216)
Mr. Roger Seitz of the Savannah River National Laboratory provided an overview of the systems approach used by the DOE in assessing performance of their LLW disposal facilities and introduced some of the basic requirements in the DOE rules and guidance on performing PAs and Composite Analysis (CAs) at DOE sites. The members addressed the following issues during this presentation:	13 – 74 (Slides Pgs 217 – 234)
• That hazardous waste is regulated under RCRA and radioactive waste is regulated under the AEA, but the time that some hazardous waste and radioactive waste, like U, is dangerous is basically forever. (Ryan/Armijo)	19
• Whether DOE's approach to time of compliance is different than NRC's by the use of the term, "reasonable expectation." (Armijo)	20 – 22
• Clarifying that DOE's "maintenance" of PAs does not mean the mathematical models are run every year, and what is included in the required Annual Report. Addressing new waste streams, for example from	23 – 27

decommissioning a facility, is what is often addressed when the models are needed to be run. (Rempe/Ryan) • Whether other countries also followed the recommendations of IAEA. (Schultz) • Using the long-term analysis for restricting inventories if a problem is perceived. (Ryan) • The "safety benefit" of a 10,000-year performance calculation, when DOE's long experience with disposal is probably adequate in determining how to properly dispose of waste. (Armijo) • The importance of the terms "compliance" and "reasonable" when used together and what meaning should be attached to calculations out to thousands of years. (Ray/Schultz) • Clarifying the meaning of "institutional controls" to the DOE in assuming they are no longer effective in the performance modeling. (Armijo) • The volume of LLW disposed by DOE compared to other waste streams, particularly U mill tailings, and compared to the Barnwell, SC disposal facility. (Banerjee/Ryan) • The meaning of "defense-in-depth" and how conservative assumptions in the modeling help you identify the proper measures to employ. (Schultz)	 31 34 35 – 37 41 48 – 50 52 – 54 61 – 63
Mr. Andy Wallo of DOE's Office of Health, Safety and Security continued the presentation on DOE's systems approach used by the DOE in assessing performance of their LLW disposal facilities, including the history and justification for some of the requirements in the DOE rules and guidance on performing PAs and CAs at DOE sites, including the time of compliance. The members addressed the following issues during this presentation: • The length of time for which DOE authorizes operations of a LLW disposal facility. (Banerjee/Ryan) • Clarifying the radon dose flux rates in the DOE Order 435.1 and where the receptor is for modeling. (Brown/Ryan) • Clarifying the configuration of the 100-meter buffer zone (Skillman)	74 – 119 (Slides Pgs 235 – 262) 82 – 84 86 – 91 91

• The perspective DOE has that it, or a successor government agency, will care for the site in perpetuity, similar to RCRA hazardous waste disposal sites. (Ryan) • From DOE's perspective, what was wrong with 500 years for time of compliance, excluding long-lived waste. (Armijo) • That the value of the compliance metric (25mrem/yr) also has increasing uncertainty as time goes on, and therefore, there is a limit to its meaning that is commensurate with uncertainty with other parameters. (Armijo/Ryan/Schultz)	93 – 95 101 105 – 109
Mr. Seitz continued the presentation on the history and justification for some of the requirements in the DOE rules and guidance on performing PAs and CAs at DOE sites, including the intruder assessment and how it is used. The members addressed the following issues during this presentation: • When does an inadvertent intruder become an "advertent" intruder (e.g., anthropologist or graverobber) and why the speculation and uncertainty contributes to the DOE belief there should not be a dose constraint for which compliance is measured for the intruder. (Ryan/Armijo/Brown) • Why hazardous waste disposal uses a design standard as opposed to a performance standard, and that it is a completely different waste management strategy, and why there is a design standard for U mill tailings, rather than a performance standard. (Ryan/Banerjee)	119 – 135 (Slides Pgs 263 – 271) 119 – 124 127 – 133
Mr. Robert Boehlecke of DOE's Nevada Field Office presented introductory material on the DOE's Nevada National Security Site (NNSS) low-level waste disposal facility and how they perform and maintain their PA and CA, including how it establishes the Waste Acceptance Criteria (WAC). The members addressed the following issues during this presentation: • The types of things that were addressed in revisions to the WAC (current version is Revision 10). (Schultz) • What regulatory authority the State of Nevada has over the NNSS. (Ryan)	135 – 161 (Slides Pgs 290 – 311) 141 143

• The applicability of the experience at NNSS and DOE responsibilities with siting and regulating a commercial LLW disposal facility under Part 61. (Ray)	159 – 160
Ms. Sherri Ross of DOE's Savannah River Field Office presented introductory material on the DOE's Savannah River Saltstone and LLW disposal facilities and how they perform and maintain their PA and CA. The members addressed the following issues during this presentation: • Clarification of the meaning of graph lines on Slide No. 11 (Slide Pg 282) (Rempe)	161 – 186 (Slides Pgs 272 – 289) 172 – 175
The Subcommittee discussed the presentations and provided the following insights from the meeting: • Member Ray reiterated his concern about the applicability of the DOE experience with siting and regulating a commercial LLW disposal facility and also commented on the uncertainty associated with calculations way out in time. • Member Skillman provided a perspective on why 1000 years is easier to understand than 10,000 years through the example of the Magna Carta. • Member Rempe asked a question about why calculations are taken out to 10,000 years and the value of the results and their use. • Member Armijo commented that the expense of the analysis might not be the best use of resources. Member Ray responded by saying it was not so much the cost that concerned him, but the needless introduction of controversy. • In response to a question from Member Ballenger, Ms. Ross answered that the public around the Savannah River Site is more concerned about current risk reduction (i.e., tanks which could leak in the short term) than future risk as demonstrated by modeling.	186 – 198

The following members of the public who were attending the meeting via teleconference provided questions and comments: John Tauxe Ruth Thomas Marvin Lewis	198 – 208

ACTION ITEMS	***Reference Transcript Pages***
The DOE representatives were asked to provide details on the public comment period for the upcoming revision to Order 435.1. *Response: The current plan (although subject to change) for the public review of DOE Order 435.1 revision is 60 days, with two public meetings to be conducted by webinar. The start of this comment period is still TBD.*	116
The DOE representatives were asked to provide the waste form and/or packaging details for the thorium nitrate waste for which a special analysis was conducted for disposal at the NNSS. *Response: To be delivered by DOE in early 2014.*	155

ATTACHMENT

Official Transcript of Proceedings, Meeting of ACRS Radiation Protection and Nuclear Materials Subcommittee, November 19, 2013, Rockville, MD.

Documents Provided to the Subcommittee:

1. DOE M 435.1-1, *Radioactive Waste Management Manual*, U.S. Department of Energy, July 1999

2. DOE G 435.1-1, *Implementation Guide for use with DOE M 435.1-1, U.S. Department of Energy, Chapter IV, Low-Level Waste Requirements*, July 1999

3. *Performance Assessment For The Saltstone Disposal Facility at The Savannah River Site*, SRR-CWDA-2009-00017, Revision 0, Prepared by SRR Closure & Waste Disposal Authority, Prepared for U.S. Department of Energy Under Contract No. DE-AC09-09SR22505, July 2009

4. *Composite Analysis for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, DOE/NV--594-ADD1, Prepared by Bechtel Nevada, Prepared for U.S. Department of Energy, National Nuclear Security Administration Under Contract Number DE-AC08-96NV11718, November 2001

5. *Compliance Evaluation for the Savannah River Site Saltstone Disposal Facility Performance Assessment*

6. Memorandum, Frei, DOE/EM-43, to Carlson, Nevada Operations Office, *Disposal Authorization for the Nevada Test Site Area 5 Radioactive Waste Management Site Submittal of Performance Assessment and Composite Analysis Addenda*, May 23, 2002

7. *Nevada National Security Site Waste Acceptance Criteria*, DOE/NV-325, Revision 9, Prepared by U.S. Department of Energy, National Nuclear Security Administration, Nevada Site Office, Waste Management Project, February 2012

8. *Integrated Closure And Monitoring Plan for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site*, DOE/NV/11718—449, Revision 1, Prepared for National Nuclear Security Administration, Nevada Operations Office, under Contract Number DE-AC08-96NV11718, September 2001

9. *Nevada National Security Site 2010 Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites*, DOE/NV/25946—1226, Prepared by National Security Technologies, LLC, Prepared for U.S. Department of Energy National Nuclear Security Administration Nevada Site Office, June 2011

10. *Maintenance Plan for Performance Assessments and Composite Analyses of the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site*, DOE/NV/25946—091, Prepared by National Security Technologies, LLC, Prepared for U.S. Department of Energy National Nuclear Security Administration Nevada Site Office under Contract Number DE-AC52-06NA25946, January 2007

11. *2011 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada National Security Site, Nye County, Nevada, Review of the Performance Assessments and Composite Analyses*, DOE/NV/25946—1451, Prepared by National Security Technologies, LLC, Prepared for U.S. Department of Energy National Nuclear Security Administration Nevada Site Office under Contract Number DE-AC52-06NA25946, March 2102

12. *Special Analysis of the Area 3 Radioactive Waste Management Site at the Nevada National Security Site, Nye County, Nevada*, DOE/NV/25946—1617, Prepared by National Security Technologies, LLC, Prepared for U.S. Department of Energy National Nuclear Security Administration Nevada Site Office under Contract Number DE-AC52-06NA25946, September 2102

13. Result Summary for the Area 5 Radioactive Waste Management Site Performance Assessment Model Version 4.113

14. U.S. Department of Energy, Office of Environmental Management, Comments on the U.S. Nuclear Regulatory Commission's Preliminary Proposed Rule Language and Regulatory Analysis for Proposed Revisions to the Low-Level Waste Disposal Requirements, 10 CFR Part 61, November 29, 2012

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Radiation Protection and Nuclear Materials

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, November 19, 2013

Work Order No.: NRC-428 Pages 1-213

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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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RADIATION PROTECTION AND NUCLEAR MATERIALS

SUBCOMMITTEE

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TUESDAY

NOVEMBER 19, 2013

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Michael T. Ryan, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL T. RYAN, Subcommittee Chairman

J. SAM ARMIJO, Member

RONALD G. BALLINGER, Member

SANJOY BANERJEE, Member

CHARLES H. BROWN, JR. Member

HAROLD B. RAY, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

ALSO PRESENT:

EDWIN M. HACKETT, Executive Director, ACRS

ROBERT BOEHLECKE, DOE-NV

RUTH CHALMERS*

CHRISTINE GELLES, DOE, Office of Environmental Management

MARVIN LEWIS

SHERRI ROSS, DOE-SR*

ROGER SEITZ, Savannah River National Laboratory

JOHN TOTES, Neptune & Company*

ANDREW WALLO III, DOE, Office of Health, Safety and Security

*Present via telephone

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

(1:02 p.m.)

CHAIRMAN RYAN: All right, we'll begin the meeting please. The meeting come to order. This is a meeting of the Advisory Committee on Reactor Safeguard Subcommittee on Radiation Protection and Nuclear Materials. I'm Mike Ryan, Chairman of the Subcommittee.

ACRS members in attendance are Sam Armijo, Dick Skillman, Steve Schultz, Charlie Brown, Joy Rempe, Harold Ray, Sanjoy Banerjee, Pete Riccardella and who did I miss? Oh, I'm sorry. I missed Ron Ballinger.

FEMALE PARTICIPANT: And Roland.

MALE PARTICIPANT: John Stetkar.

CHAIRMAN RYAN: John Stetkar. I have an incomplete list on my paper.

MEMBER STETKAR: Well it's complete, you have to read between the parentheses.

CHAIRMAN RYAN: Yes, it was here, thank you. The purpose of this meeting is to hear presentations from and hold discussions with representatives of the U.S. Department of Energy on their regulatory approach for near-surface disposal of low-level radioactive waste.

Subcommittee members will recall that in the Committee's last letter to the Commission on the proposed revision of 10 CFR 61, in July of 2013, the ACRS said it would conduct additional meetings on the subject to better understand the technical basis for some of the revisions being proposed by the staff.

This is our first of two subcommittee meetings planned to collect information toward that end. The Subcommittee will gather information, analyze relevant issues, facts and formulate proposed positions and actions as appropriate. The Subcommittee meets again on December 3rd with other stakeholders on revision to Part 61.

Then the Subcommittee plans on composing a letter report on this matter for consideration by the full committee at the February 2014 full committee meeting.

Today's meeting is open to the public. We have not received any requests from members of the public to provide comments. However, I understand that there are folks on the bridgeline, or who will be on the bridgeline, who will be listening in on today's proceedings. An opportunity will be provided at the end of the proceedings for anyone listening to make a comment.

A transcript of the meeting is being kept.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can readily be heard.

Derek Widmayer is the designated federal official for this meeting.

I understand that one of our presenters today, Sherri Ross from the Department of Energy's Savannah River Field Office, is providing her discussion via the telephone meeting. Sherri, are you there? Can you hear us?

MS. ROSS: Yes, I'm here and I can hear you all.

CHAIRMAN RYAN: Okay. Great, if you would just kind of keep your phone on mute that would work for us. And when it's your turn we'll give you a holler and we'll go from there, okay?

MS. ROSS: Okay. Thank you.

CHAIRMAN RYAN: Oh, thank you. We will now proceed with the meeting and I call upon Christine Gelles, Associate Deputy Assistant Secretary for Waste Management in DOE's Office of Environmental Management to open the proceedings. Let me welcome you and all of your colleagues here, and our other participants, for giving up your time and your information to us. It's very important we hear from you and thanks so much for being here.

MS. GELLES: Well thank you very much, we're pleased to be here. Thank you, Dr. Ryan. Thank you also to all the other members of the Advisory Committee.

I'm going to begin just by giving an introduction and teeing up what some of our key messages are and then I'm going to turn over the details to my best colleagues here. Roger Seitz from the Savannah River National Laboratory. Andy Wallo from our office of Health, Safety and Security. You already indicated Sherri Ross from the Department of Energy Savannah River site. And we have Rob Boehlecke from the Nevada Site Office, the Nevada National Security Site.

So we're going to begin the purpose of our presentation here. And again, thank you for the invitation. We're looking forward to providing you an overview of our integrated protection systems approach to near-surface disposal.

We've been employing the system for over 25 years. We feel very confident about its technical efficacy. We're going to work hard to highly the use of defense-in-depth and the role that performance assessment specifically has as just one of our many inputs to our risk informed decision-making regarding near-surface disposal.

We're going to describe the emphasis that we have on consistency with promulgated requirements. We're well aware of both other national standards as well as international standards and we work hard to harmonize ourselves with those.

And then through our presentation here this afternoon we're going to summarize our considerations on a few key topics.

One, that I think is of primary interest, the fact that we use a 1,000 year time frame for quantitative compliance followed by a transition to a more risk-informed interpretation that recognizes the increasing speculation and uncertainties of longer time periods.

We also are going to discuss how we rely on analysis related to inadvertent intruders. And we consider them within the context of optimization rather than a point performance objective.

And Radon is considered separately from the all pathways objective. Scott, please.

The structure of our presentation. Again, my introduction followed by a pretty detailed overview of our regulatory approach by Roger. A discussion of the history and implementation of our DOE regulations for near-surface disposal. And then some site-specific details by the Savannah River site and by the Nevada Field Office.

This is a graphic that we borrowed from the IAEA, a Safety Case Concept. But it's very consistent with the Department of Energy's approach to our low-level waste disposal regulations.

The box highlighted in the middle, or highlighted in red, Safety Assessment is analogous to our performance assessment terminology in the DOE. We do employ an integrated approach to the safety using a defense in depth similar to the safety case of the IAEA literature.

Performance Assessments are just one part, or one argument of the overall integrated safety case. We are confident that our near-surface regulations are consistent with other regulatory frameworks for near-surface disposal and we do consider international recommendations.

And as I mentioned before, we have 25-year history in our employment of these regulations. We continuously review them and have strengthened them over time. And as you'll hear late in our presentation, we're in the process of updating our Department of Energy order on radioactive waste management.

Continuing. Performance Assessments, they provide us a reasonable expectation that our disposal facilities will not exceed the quantitative performance objective within our DOE order. And we support our decision making with design, operations and closure. The PAs are part of that but they are not a single consideration in the decision-making framework.

We do use a two-tiered approach to the time frames with no specific cutoff. Our 1,000 year period, the quantitative period for compliance, is important to us. But we evaluate out to beat those so we do longer term calculations to consider the peak impacts to support our risk-informed decision-making in the context of the increasing uncertainties that --

CHAIRMAN RYAN: When you say for a longer period of time, how long?

MS. GELLES: There is no limit. There's no specified cutoff. So considering the specific inventories that we're modeling within our performance assessment, we're going to evaluate out to identify the peak impacts and use that information to inform decision-making related to the acceptance of the specific --

MEMBER ARMIJO: In the case of uranium where there is no peak, you know, how do you terminate that? I mean, what's the end-point for, let's say, depleted uranium? That's an issue that's been churning around here that, you know, it's always building up. It's riskier in the future than it is today. All that. What does DOE do?

MS. GELLES: Well can we table that for some detailed answered after Roger's presentation, if that's okay.

CHAIRMAN RYAN: Sure, if we're going to get to it that would be great.

MS. GELLES: And truly, with all respect, we will answer that question. It's just we're kind of laying out the overall framework right now. Thank you.

MEMBER ARMIJO: Okay, I got you. Thank you.

MS. GELLES: Please. You're going to see this graphic repeatedly, it's how we're going to present the defense-in-depth nature of our system. So at the very center of the bull's-eye is our site characteristics, that we make very careful consideration of what sites we select to host our near-surface disposal facilities.

We make those site selection decisions based on geologic and hydrologic considerations, facility design and engineered barriers then of course offer another expanded circle of defense. And then additionally, administrative and technical controls.

Moving out on the bull's-eye, we have employ a conservative bias in the objectives and assumptions that we use in constructing and calculating our performance assessments.

We set site-specific waste acceptance criteria and have rigorous waste generator certification requirements. And you're going to hear that in spades from Rob when he describes the Nevada Site Offices program.

Some additional controls that we have. We have federal ownership and specified buffer zones. Federal ownership in perpetuity until such time that the sites could be released, if in fact we ultimately make a decision to release them. And there are no decisions in the near-term, in the foreseeable future, about a future release of any of our decommissioned near-surface disposal facilities.

We have a commitment to continuous improvement of our performance assessments. We have a robust federal review group that consistently, annually, reviews our disposal site systems of controls. And there's an expert peer-review process that we'll share with you.

We have monitoring of our performance assessments. And we are very focused on permanent maintenance of our records to ensure institutional knowledge for future generations. So if we do have waste forms, such as uranium, that present very long-term hazards after our institutional controls have been terminated and we're just relying on federal ownership and records management, that information will be available for us.

And again you'll see that slide again. And you'll hear more about each of those details of that defense-in-depth system.

And I'll turn it over to Roger Seitz, please.

MR. SEITZ: Okay. My name is Roger Seitz and I work at the Savannah River National Laboratory. And I've been involved with radioactive waste management for more than 28 years. I started on the BWIP Project at Hanford. And then spent time at Idaho, Savannah River and also consult for the International Atomic Energy Agency.

I think one of the themes that we want to emphasize here is a lot of the information in this regulatory approach has evolved over time. And it reflect experiences. It reflects what has been implemented in DOE programs for more than 25 years.

We have what we call a Radioactive Waste Management Basis and that's very similar to the safety case that was introduced by Christine. And you'll hear this over and over. We view PA as just one piece of a much bigger case that demonstrates the safety of a disposal facility.

Defense-in-depth and a total systems perspective are two things that you'll hear emphasized. This idea that we try to maintain consistency with promulgated requirements related to near-surface disposal.

And finally, as Christine mentioned, we are trying to be consistent and consider recommendations from international organizations.

Here's our defense-in-depth figure again. There's a few key points I wanted to emphasize related to this. And I want to drill down a little more that within each of these different defense-in-depth considerations there's safety factors built in as well.

And I think one point that I like to make is when we look at the radioactive waste management industry, this industry goes to extraordinary lengths to consider potential consequences in the far future. I think you're hard-pressed to think of many other industries that would be considering impacts hundreds or thousands of years in the future and making significant decisions based on that information.

PAs are one contributor. There's many different features that you can see in this defense-in-depth figure. PAs help us risk-inform decisions, along with all those other features. And within each of these, there's safety factors built in our dose constraints. There's safety factors built in those.

We build in conservative bias in our calculations that are done. And our assumptions about site performance. And just the fact that we also consider inadvertent intrusion, that's something that you don't see in other waste-management situations. So there's these other factors that are built in. Okay?

On this slide I'll drill down a little more -- Go ahead and hit it one more time, please -- On this safety case figure. And this really highlights, the box with the red line around it in the center, that's the PA. And it's just one piece of many different components.

And what I really like about this safety case concept is it captures this integrated approach. But also from a perspective of explaining what we do for waste-management, it provides a very effective means to communicate all the different pieces that go into making these decisions. And help build confidence that we are making good decisions. Go ahead and click it.

At the top there, talk about the context and the strategy. And that's where you'll see things like robustness, defense-in-depth, our safety objectives, regulations. So these are kind of the core starting point.

And then we have one thing that it also highlights is the idea there's iterations and design optimizations that occurs as we learn more about the system. We can establish limits and controls and conditions based on information that we obtain or if we want to say a certain type of waste can't be disposed in this location.

And, finally, there's a box called management of uncertainty and you'll hear about our performance assessment maintenance process. And you'll hear more about that later. And, as I mentioned before RWMB, our Radioactive Waste Management Basis, is very consistent with this safety case approach.

Go back in history a little bit on Performance Assessment. We've been working on site and facility-specific performance assessments and they've been required by our regulations since 1988. And they've been risk-informed performance-based. We've always had an emphasis on reasonable expectation or reasonable assurance of meeting performance objectives.

And it's viewed in a graded an iterative approach. And what I've done, I've cut a figure out of a 1988 guidance for performance assessment that was drew up by Marilyn Case and Mark Otis. And even at that time there was a big emphasis on this feedback and working through the process and perhaps back stepping to get more information.

So this graded and iterative process has been built into our approach for many years. Over the years we've continued to refine it. And I think probably the most important refinement is we've really gotten much better at focusing on what really matters.

We use this process to really start to identify, what's driving performance, what are the things that we really have to understand.

MS. GELLES: If I could interrupt you for just one moment.

MR. SEITZ: Okay.

MS. GELLES: So I apologize for the interruption. But I realize too late that I failed to begin with we are very keenly interested in what the

NRC staff are doing and the Commissioners are considering relative to revisions to Part 61. And we've been monitoring the ongoing rulemaking efforts for many years now it seems. I think since about the 2008 time frame when the depleted uranium unique waste effort began.

And we were very pleased to know that the NRC staff were giving very careful consideration to the use of site-specific performance assessments, because it has been such a central component of our system for over two decades. Thank you.

CHAIRMAN RYAN: Thanks.

MR. SEITZ: So time of compliance. This is one of the important questions that we're addressing. As Christine mentioned, we've focused on a 1,000 year time of compliance. And that decision is based on a number of factors. And you'll hear different pieces of the story as we go through our presentations today.

But at its core, first we're consistent with our overriding radiation protection regulation. And we believe we're also consistent with promulgated rules from the NRC that are associated with near-surface disposal. And we're also, we believe, we bound what's considered for RCRA Subtitle (C) type disposal facilities.

Part of this basis for 1,000 --

CHAIRMAN RYAN: Just to clarify, Roger, if I many. So you dispose mixed waste?

MR. SEITZ: Yes we do.

CHAIRMAN RYAN: Okay. So I just wanted the Committee to be aware that there's a category of hazardous waste that's hazardous under RCRA. And radioactive waste, which is under DOE or NRC, or both.

MR. SEITZ: But our low-level waste sites are low-level waste sites, not mixed waste sites. We do have mixed waste sites. And I just want to make sure --

MS. GELLES: We do.

MR. SEITZ: We have --

CHAIRMAN RYAN: Yes, they're separate. Yes and I understand that. But I just wanted folks to realize that they're in the business of both.

MS. GELLES: Thank you. That's an important note.

CHAIRMAN RYAN: Yes, that's important to us for a couple of reasons when you think of time of compliance. The hard thing to get some folks to think about is 1,000 years is a long time. Well, forever is even longer, because uranium will be here when the planet is cleaved in half. It's 10 to the 9th year half-life.

It's not going anywhere soon. So it's a forever waste.

I'll be curious when you get to that stuff. We'd like to hear about your strategies for dealing with these longer-lived radionuclides and their persistence in the environment beyond almost any kind of engineering you can think of. So with that little tidbit laid out there for the future discussion, go ahead.

MR. SEITZ: Well I think the link to the mention of hazardous waste brings up that concern as well. Because when we're dealing with hazardous waste, a lot of that has no half-life. So its hazards are not going away.

MEMBER ARMIJO: Like uranium.

MR. SEITZ: Well uranium, or even metals and things like that.

CHAIRMAN RYAN: Of course uranium is regulated on its chemical toxicity, not on its radiotoxicity.

MEMBER ARMIJO: I had a quick question in reading some of your material and want to make sure I understand it. In meeting your 1,000 year time of compliance objection, you have sort of reasonable expectation criteria that you meet as opposed to something more binding?

You know, I like reasonable expectation, I think I understand that. But is there a distinction between the DOE approach and the NRC approach in meeting whatever the time of compliance is?

MR. SEITZ: I believe that, I think the NRC uses reasonable assurance. And there are, I think if you drill down to details there can be some little differences in interpretation. But at their core they're fundamentally similar.

MEMBER ARMIJO: Okay. Thank you. Thank you.

MR. SEITZ: But a lot of it is interpretation and that's a big part of what happens for these longer time frames. And you'll hear me mention that. But it comes down to how you interpret things.

CHAIRMAN RYAN: Well, and correct me if you don't agree, Roger. But to my way of thinking some of that interpretation is not specific to so much the agency, but specific to the waste form, the waste constituents of interest, the physical location. What part of the country, you know, wet/dry, north/south, hot/cold. All that sort of stuff really can shape what you think is reasonable.

MS. GELLES: Absolutely.

CHAIRMAN RYAN: What could be reasonable at one site might be not good enough at another, right?

MS. GELLES: And that is absolutely the fact.

CHAIRMAN RYAN: Okay.

MS. GELLES: In the Department of Energy complex.

CHAIRMAN RYAN: Okay. That's very helpful, thank you.

MR. SEITZ: And I think as you look at those spheres that we showed, you'll see as we do the two examples, the defense-in-depth, the site sphere for Nevada will be much different than the site sphere for Savannah River.

CHAIRMAN RYAN: That's very helpful. Thank you.

MR. SEITZ: And part of this basis for 1,000 years is that, you know, when we look at PA as one piece of the puzzle, so focusing too much on one piece of the puzzle you lose sight of all the other arguments that go into demonstrating the safety.

Probably from a technical perspective, one of the key factors is just the idea that we're trying to make decisions. And as you get into these longer time frames there's decreasing relevance and usefulness of information that's increasingly speculative and uncertain.

So I put it in the context of like a value of information. At some point you have to ask yourself how much do we really believe this information that we're using to support the decision.

MEMBER REMPE: But it appeared that you had almost annual updates, is that right? Or semi, and then if something happens to change things you might even do it more frequently, is what I recall reading in the information.

MR. SEITZ: Yes.

MEMBER REMPE: Which is something we don't quite do, I think, at the NRC.

CHAIRMAN RYAN: No, that probably isn't quite right, but --

MEMBER REMPE: Annual updates?

CHAIRMAN RYAN: In the sites I'm familiar that are regulated through agreement states, it's sometimes more frequent than that.

MEMBER REMPE: Okay.

CHAIRMAN RYAN: They are are alive and well and they're running them all the time for one reason or another. So I would say it's probably on a par at least.

MEMBER REMPE: How much is the annual update that the DOE requires from these sites? Is it an extensive document or is it a --

MR. SEITZ: It's an annual report. It's more of a summary of what has happened that year.

MEMBER REMPE: Okay.

MR. SEITZ: And I think Andy has a slide that gives you a little more perspective on it.

MR. WALLO: And one of the things to note is when you say we're running the models, actually we have a layered regulatory approach at DOE. At the top we have the headquarters, and I'm going to talk about the low-level waste review group, that looks at these annual summaries and then reviews each PA and all the monitoring plans and so forth on a periodic basis.

But are regulator in the field, the site office, is always following the sites and they may do special runs, as you'll hear from our sites, monthly on various things that come in. So it's not like we just even do an annual. We will do special runs all the time to determine if we need any kind of special treatment of the waste.

CHAIRMAN RYAN: And just on a commercial site, Joy, there's the same kind of thing between a power plant or another kind of licensee in getting their waste to a disposal facility, whether it's Washington or Barterella, wherever it might be. That there's on-site inspection at the point of generation and --

MEMBER REMPE: That's true for the commercial plants too. There's on-site inspections. What I just am wondering is if that is a little more fuzzy in the DOE world and there's a lot more required. You know, is that a difference that we need to consider. Is just they're a little more oftenly done. I'm coming from a national lab as I'm asking that question, that the site office and the oversight and how rigid the rules are. And so sometimes fuzziness is more difficult is what I'm trying to say.

MR. SEITZ: Okay. And really it's an annual report. So as Andy was saying there may be a lot of things going on over the course of the year.

MEMBER REMPE: Right.

MR. SEITZ: But each year we publish an annual report that summarizes all these things that have happened over the year.

CHAIRMAN RYAN: So you don't really update your performance assessment every year? I mean that would be kind of --

MR. SEITZ: No necessarily. No, not unless there was a need. And, for instance, as I said in our layered approach, the site office could decide that they want to make a change, they want to do something, and then they come up through the regulatory process and we get the whole process rolling. Or the site can decide that it can handle it itself and do the approvals and that it isn't significant enough to bring up.

And if that's the case then we check into that at the annual reviews and say, oh yes, you were right. Or, wait a second, maybe you exceeded your authority here and we needed to look at this kind of approach.

CHAIRMAN RYAN: Andy, correct me if I'm wrong, but my recollection and knowledge from working at a few of the DOE sites over the years is that very often these waste-generating activities are part of decommissioning one thing or another. And any time you go to decommission all the facilities that have been bolted up for, pick a number 20, 30, 40 years, there's always surprises.

There's always inventories you didn't know were there. And then some of the other ones might not be there, they've already been taken care of under some other banner. And so it's a little bit tougher because the history is so dragged out in time that sometimes you've got to almost rediscover things, I think, before you really kind of say well now we've got the plan out. We've figured out all the nooks and crannies and details. Is that a fair view?

MR. SEITZ: I think, actually, from my perspective, from the DOE perspective at a DOE site, it is much more dealing with exceptions. Dealing with something you haven't dealt with before. There's a lot of that. Where I suspect at commercial sites it may be a little more routine.

MS. GELLES: I think it's at the very core of why the Department of Energy is responsible for the disposal of Department of Energy generated waste as well as special waste from the Naval Reactors Program or classified Department of Defense wastes.

They recognize that we are in the best position, we have this robust performance-based, risk-informed, defense-in-depth system that allows us to deal with the unusual waste streams that are not generally generated by NRC licensed activity.

So absolutely, it's very routine operations for us to have a site that's operating as a disposal facility supported by a site-specific Performance Assessment and the regulatory system surrounding that reviewed and approved by the LFRG, which is the federal review group that I alluded to, that Andy will discuss in some detail.

And it has a waste acceptance criteria. And all of our sites will profile waste that would fit within that acceptance criteria and then some cleanup activity or some one of a kind mission activity will generate a waste stream that seems to challenge that WAC. And we have a process defined in our order and in site-specific regulations and procedures that allow for special analyses, special runs of our models, special consideration.

Sometimes we modify waste package requirements. Sometimes we modify the disposal method. We might dig deeper. We might use greater engineered barriers in a trench before we place other waste attendant to it. We might isolate it from other waste within the same trench or in the same facility.

And that is what our system is set up to do because of the very historic and unique nature of our DOE missions. It's why we have a DOE disposal system.

CHAIRMAN RYAN: Thank you.

MS. GELLES: You're welcome.

MR. SEITZ: And back on the second point

on this slide, it really gets to the core that 1,000 years is by no means a cutoff. And I guess I've thought about this, how do we explain this. And I think from my perspective the best way to explain it is it's really a transition in how you interpret things.

There's some point where we go from this absolute quantitative compliance to recognizing that as uncertainties grow, as it becomes more speculative, you begin to get to more of this risk-informed decision making recognizing those uncertainties. So it becomes more fuzzy, it becomes a true decision framework.

And you go from this, I can say you go from this idea of from 1,000 years basically it's making a decision for you. If you don't comply the decision is made for you.

Beyond that time it informs your decisions. It's not this idea of compliance/non-compliance. It's no longer a decision maker, it's informing your decision in the context of all these other factors.

MEMBER SCHULTZ: Roger, are you going to talk more about that? I'm a card-carrying PRA guy. And as soon as somebody says risk-informing I immediately go back to what can happen, how likely is it and what are the consequences and what are the uncertainties.

MR. SEITZ: Yes.

MEMBER SCHULTZ: How likely is it tends to get into numbers. So I'm interested if you're saying that after 1,000 years you're transitioning from a quantitative framework to a risk-informed framework, I'm interested in understanding what that means.

MR. SEITZ: Okay. And I guess I'm not saying it's not quantitative. So you continue the quantitative calculations but even those calculations become more and more suspect.

MR. WALLO: But we're not necessarily --

(Crosstalk)

MR. WALLO: But we're not necessarily talking about probabilistic assessments. We are generally talking about consequence assessments in most cases. Though we do use probabilities sometimes in these analysis. But we're informing the decision by looking at the long-term consequences and numbers are involved, it's just that we don't use them to compare them against a performance metric or a quantitative metric. You don't have to meet 25.

CHAIRMAN RYAN: Correct me if I'm wrong again, but I think DOE has spent a tremendous amount of time, energy and funds on characterizing wastes, physical, chemical and most importantly radioactive material content. Whether it's tritium, which is, you know, fairly innocuous on the big scale up to those that are much more important from a health and safety and environmental protection perspective.

So is that kind of where you start? Is trying to develop the best sort of insight into the inventory that you have that you're dealing with? Or is that one of the term things you look at first?

MR. SEITZ: It's all part of the package.

CHAIRMAN RYAN: Right, okay.

MR. SEITZ: You really can't -- As you go further out in time you start looking at factors like that that all contribute to the safety.

CHAIRMAN RYAN: Okay. Thanks.

MEMBER SCHULTZ: Roger, will you go back to that slide for a moment. And with regard to the 1,000 year time frame for compliance, in the bullets there, you've got that this conforms with recommendations from ICRP and IAEA. Do those agencies also support the discussions related to beyond 1,000 years?

MR. SEITZ: I have some quotes coming up here.

MEMBER SCHULTZ: Okay.

MR. SEITZ: And I think you can't really pick out a number, which I think is by design when you look at the international recommendations. But I have some quotes that will give you some perspective. And then we can address it more if you'd --

MEMBER SCHULTZ: And are you influenced by, clearly the international agencies would have an influence, but other countries have chosen other time frames, other ways in which to perform their overall assessments. I presume you're reviewing those, are you going to discuss that later?

MR. SEITZ: Well yes, I have one example that illustrates a point about looking at other country's approaches.

MEMBER SCHULTZ: I'll appreciate that. Thank you.

MR. SEITZ: Okay. And this kind of leads into what you were just asking about. The next few slides I'm going to talk a little bit about the ICRP, some statements that they have in their recommendations. And one of them relates to the use of the term, the concepts of dose and risk as measures of health detriment over long periods of time.

The IAEA has some recommendations related to how long our calculation is really meaningful for surface, near-surface disposal facilities. And this fits with the questions about probabilistic risk-assessment.

One of the things that I found when we look at other countries, and countries or situations even for radiologic disposal, when people talk about much longer times it's not unusual in those cases to see them using probabilities, event probabilities or things. So that becomes part of the equation.

So it comes down to how, we may say we do it for a certain amount of time, but what you're doing for that amount of time can be different. And I've got an example coming up here.

So just a couple quotes, and I'll just read through them real quick. "Doses and risks, as a measure of health detriment, cannot be forecast with any certainty for beyond around several hundreds of years in the future."

They do on to say that that doesn't mean you can't use them to compare with things. You can do calculations longer. But I think what that, in my mind, what that says is there may be a change in how you perceive things after that time. How meaningful is this as an indicator at later times? We can use it for a comparison, but there may be a difference in how strictly you conform to it.

CHAIRMAN RYAN: Again, just a question.

To me it also implies that if you found that for whatever reason or reasons this 1,000 or 10,000 year period gives you some kind of an estimate of an impact that you don't like you can restrict the inventory.

MS. GELLES: Absolutely.

MR. SEITZ: That's true. Yes.

CHAIRMAN RYAN: So I think it's kind of, it's not just an arrow going one way. You know, your analysis and your thinking goes, you know, from what's happening long times in the future to what's happening today and kind of judging what's appropriate for that timeline, whatever it is.

MR. WALLO: Absolutely. But one of the things you think about is the decision is to try to isolate and dedicate as few of our natural resources to those as possible. I mean, obviously we could solve this problem by just diluting all the waste and making it --

CHAIRMAN RYAN: Oh no, I wasn't saying dilution.

MR. WALLO: No, I'm just saying, so when you decide to limit a waste inventory on a site because of a number 10,000 years in the future you're basically making more sites.

CHAIRMAN RYAN: Maybe. Maybe not.

MR. WALLO: Yes, well it has to go someplace.

MS. GELLES: Or you could go deeper, which is the result of --

MR. WALLO: Yes, but then you're spending more resources.

CHAIRMAN RYAN: And you're digging more holes, but you're not --

MR. SEITZ: And I guess within the DOE system we have the capability that if we find that it's not, we don't believe that it should be disposed at one site there may be another location that's a better place for a specific waste.

In terms of time frames for modeling, the quote the ICRP recommendation talks about, "To evaluate the performance of waste disposal systems over long time scales, one approach is the consideration of quantitative estimates on the order of 1,000 to 10,000 years."

And here they're not talking about quantitative calculation.

MEMBER ARMIJO: Then when you do those calculations what's the benefit of it, you know? You can do calculations to any time period. You can get numbers and you may or may not believe them. But, I mean, so what's the safety benefit of doing that?

MR. SEITZ: I've got a slide coming up that maybe will talk about it a little bit more. But in essence you're trying to learn about the system. Are there things that we can improve in the design to address potential longer term consequences. Maybe there's things that can be done that are reasonably, kind of from an ALARA perspective, things that make sense to do.

CHAIRMAN RYAN: Well are they fairly straight-forward and not that expensive to add a fence in depth kind of barrier or something that might come in. So I think if you kind of inform your assessment based on those sorts of those things you might choose Barrier B or Barrier A, because it's going to be, you know, another 500 years or another 400 years. That kind of thing that can help you, you know, make the decisions I think Roger is talking about.

MEMBER ARMIJO: Well where I'm trying to go with this question is, with all the experience DOE has over the years in the design and operation of a variety of waste sites with all different kinds of barrier systems and waste forms, don't you already know the answer or the right way to handle this waste at this particular site?

So why isn't it just a pure, deterministic, procedural thing that says, hey, we know how to handle this stuff. We put it in these kinds of cans and bury it this deep and all that. And so what's the need for an analysis out to 10,000 years just to do the analysis? Unless something new, you know, that you might benefit. But I find it hard to see how --

MR. SEITZ: It's really hard to come up with a kind of a varying structured approach because it's different at every site. And, I mean, we can look at certain classes of waste forms and things and we have a general idea of what works. But at one site you may do something different that you do at another site.

There are situations which, from my perspective, personally as a technical and a decision-making rule, it becomes less relevant the farther out you go.

MEMBER ARMIJO: Sure.

MR. SEITZ: And so you're right. But there can be things out there that are relevant and will help you. But one of the things is the assurance. For instance I may see something that in 20,000 years is at 200 millirem you could get an individual dose. Am I worried about that? No I'm not.

MEMBER ARMIJO: I hope not.

MR. SEITZ: No. So you see that and you see, you know, I'm going to talk a little later about the NAPA Study and one of the things they told us to look for was catastrophic events. So we provide that assessment to make sure there's nothing catastrophic. And there's rarely a chance of that ever happening. But it is that confirmation that we've met that goal, we know we're not doing something that's resulting in something that's catastrophic.

MS. GELLES: And I just want to clarify to make sure that there's not a misunderstanding. What Roger was presenting on the previous slide is the ICRP perspective. And we actually have a policy position that we don't believe 10,000 years is needed as a deterministic evaluation for every site because we do have great confidence in how the waste we generate and have safely disposed will perform in our disposal systems.

But we do have a requirement within our system to quantify to 1,000 and then continue to evaluate out to the peak impacts that are presented by the waste inventory that we're modeling. We do not run a PA and isolation for one individual waste stream, we're modeling the entire aggregated inventory that we have received, or are projecting to receive in the foreseeable future.

So 10,000 years we're not willing to say is necessary for every site, but we certainly are identifying where that point is beyond 1,000 years that is relevant to the inventory at the specific site.

And we do exactly what you've just described. The accommodate the specific challenges associated with that as appropriate within a risk-informed defense-in-depth system, whether it's greater depth, more engineered barriers, greater waste form stability, all to be determined by the specific set of --

CHAIRMAN RYAN: Well that's radioactive material.

MS. GELLES: Right.

CHAIRMAN RYAN: You could end up with two sites that could do -- might not be the right answer.

MEMBER BANERJEE: So one could be a catastrophic event.

MR. SEITZ: I think catastrophic's in terms of doses, right? A dose.

MEMBER BANERJEE: Is it a river running through the site suddenly or something?

MR. SEITZ: No, I don't think --

MR. WALLO: Well we'll look at the NAPA Study. Frankly, for dealing with low-level waste I can't think or imagine an event that would be catastrophic.

MEMBER BANERJEE: That's what I look, is how do you define it?

CHAIRMAN RYAN: One interesting one was the Russian's concern was the meteor that hit Chelyabinsk. Chelyabinsk is a famous city for a lot of other reasons, but --

MEMBER BANERJEE: Chemical weapons.

CHAIRMAN RYAN: So, you know, 40, 30 miles difference, it could have been a whole different, you know, situation. So it's interesting to think about. You know, I don't know if Europe does kind of catastrophic sorts of things, but they're out there.

MR. SEITZ: I think that would fall in the category of a low probability event.

CHAIRMAN RYAN: Sure.

MR. SEITZ: Chelyabinsk could tell you the probability as well. Anyway it's a rare event, that's for sure. But, you know, I think --

MR. WALLO: But again, for low-level waste sites, even our biggest ones, I can't think even if the meteor hit it that that would be, the low-level waste would be a catastrophic result as a result. The meteor certainly would be.

MEMBER BANERJEE: Yes, that's the issue really. Would the low-level risk be the catastrophic?

MR. WALLO: No, again.

CHAIRMAN RYAN: Just spread it around.

MEMBER BANERJEE: Does it matter?

MR. WALLO: Well it may matter and we may have a cleanup, but again, the term catastrophic, are we destroying the planet? No. Are we destroying a significant part of the planet? No.

MEMBER ARMIJO: Killing a lot of people? No.

MR. SEITZ: And Christine made a good point. I think the purpose on these slides is just to talk about kind of the modeling timeframes that are being discussed by the ICRP. And so they're talking on the order of thousands of years, you can learn from quantitative calculations. They don't mention compliance.

And you see similar things, the IAEA recently published their safety guide on safety case and safety assessment, which is performance assessment in our --

MEMBER RAY: Can I interrupt you for just a second? Because I want to draw my colleague's attention to something you just said. They don't mention compliance. As I look at this and listen to all of it. That's the big difference that we have to bridge somehow. Because we have to live in a world of litigious challenges to compliance. More so that you got, I don't mean you disregard that, but that is a difference that makes some of this reasonableness a little more difficult to transfer.

MR. SEITZ: And I think that that's kind of the underlying point here, is they talk about you can do some calculations over these times. They may have meaning over a few thousand years. But how much meaning do you want to apply to it?

MEMBER SCHULTZ: That's an important point because each of these statements is surrounded by its own context. And if you read this in and of itself it's very interesting. It's suggesting that if you know a lot about what you've done and have performed a very careful Performance Assessment then you might be able to quantitatively perform a calculation that would be meaningful over a longer period of time.

If you haven't done all of that then, boy, ten years, 100 years. You're beyond uncertainty bounds of the situation. So it's an interesting concept.

MR. WALLO: And the thing to remember is even if you did good calculations, had good uncertainty and you know, had some feeling for how the site and the system was going to perform, the question of your metric in the future what does 25 millirem mean in 500 years let alone 1,000 years. It is not a meaningful metric when you get out that far.

So you can gain insights about the performance of the safety system by seeing how things move and where they move. But in terms of relevance to today's standards it's of minimal value.

CHAIRMAN RYAN: Well I guess when I think about that question, Andy, which I've thought about a lot over the years, is predictability and stability is really what you're hoping for in a waste disposal system.

You know, whether it's absolutely rock-solid and there's not one atom of anything getting out. Or whether it's a 25 millirem per year commitment or 50 or whatever it is, within reason it's performing.

MS. GELLES: Right.

CHAIRMAN RYAN: So I take your point well. It really is something to think about for time horizons that are quite long that's different than say routine monitoring. And let's say the monitoring lies in the groundwater system, if something starts happening there fairly soon you need to act because it's not supposed to happen at all. That kind of thing.

So, you know, that's kind of a different sort of a strategy. You want to make sure it's working so it's a confirmatory measurement as opposed to a compliance measurement. I see those as very different.

MR. SEITZ: Yes. And I won't read the whole thing but there's a couple key statements. When we think about things on the ground surface or perhaps a facility that's on the surface or above-ground, they refer to timeframes of hundreds of years. And quantitative estimates may become meaningless beyond that time, of beyond maybe 1,000 years for that case.

If it's near the surface, slightly below ground, a few thousand years they're talking about, you know, maybe some useful calculations. When they talk about deep geologic disposal they actually refer to tens of thousands of years.

And that's a big distinction. We have to be careful of applying timeframes that are applied for geologic disposal with timeframes that are compared with near-surface disposal.

MEMBER ARMIJO: And what would you say, just kind of a rough estimate of what deep means for everybody's benefit?

MR. SEITZ: What do we say? More than a few tens of meters?

MR. WALLO: Yes, 30 meters.

CHAIRMAN RYAN: So 100 feet plus?

MR. SEITZ: Yes, I think that's the terminology now, it's something like more than a few tens of meters. Yes.

MS. GELLES: Right, I think there's room for interpretation there. So near-surface is in the upper 30 meters. I mean there is a concept of intermediate depth, but clearly geologic is, you know --

CHAIRMAN RYAN: Yes, okay. Thanks.

MS. GELLES: -- not necessarily measured by the depth but so much as the reliance on the geologic barriers. But they all tend to be very deep.

CHAIRMAN RYAN: Okay.

MR. SEITZ: You get stability. When you go deeper things are going to be a bit more stable. So also stable.

CHAIRMAN RYAN: Okay.

MR. SEITZ: Okay, I mentioned I would show an example. And what I really want to highlight is it's really difficult to just take times. If you're looking at different countries and well, this country uses this time. This country uses this time. You really need to understand how they use those times. And I think all the countries believe they're being protective, they're genuinely trying to be protective, but it's just different approaches.

And the example that I have here is for the low-level waste repository in the United Kingdom. What you find in their regulatory system, the dose constraint applies through closure.

So although they do calculations, they assess safety, I don't think they establish a timeframe. But in practice the dose constraint itself applies through closure of the facility. And I think their logic there is that this is when they can actually observe it. You can actually measure compliance with a constraint.

CHAIRMAN RYAN: And just for everybody's benefit, you're talking the Sellafield facility?

MR. SEITZ: It's near Sellafield, yes. They refer to it as the LLWR, which is located near Drigg.

CHAIRMAN RYAN: Yes, right.

MR. SEITZ: But this is from their assessment that was just completed a couple years ago. So that first timeframe is the absolute dose constraint. Beyond that time for perspective calculations they talk about a risk guidance level, which becomes much more of this true risk where you add probabilities in.

And over that timeframe they actually consider the probability that someone would put a well somewhere. So it becomes more of a true risk perspective.

CHAIRMAN RYAN: Of course the interesting part of that example is it's on the beach.

MR. SEITZ: And that's the timing, and it's a coincidence, but their timing --

MEMBER STETKAR: Today it's on the beach.

MR. SEITZ: Yes. The timing there, for their reference case, they assume that coastal erosion is going to start impacting the facility in about 1,000 years. And that's considered in their assessment. They have scenarios that look at the facility being, basically chipping away.

MEMBER BANERJEE: So what's the period of authorization for? Is it 1,000 years?

MR. SEITZ: They don't specify a time. So they're looking for things that are happening. But at 1,000 years things start changing dramatically. And they have some calculations for doses in at 2,000 or 3,000 years maybe where they use those for the risk guidance levels. They also ran a sensitivity case for what they call delayed erosion, which they looked at happening at 10,000 years.

MEMBER BANERJEE: The black box is notional box, they haven't put any numbers on the time scale.

MS. GELLES: The question is, is there a defined period of closure for the U.K. --

MR. SEITZ: Oh, I see. There may be but I don't remember what that is.

MS. GELLES: I believe it is. I don't know what the answer is but it is not a notional concept of closure goes on for an undefined period of time. There is a projected period of operations of several decades followed by a closure period, which I believe it's in the decades. It's not hundreds of years, right.

MEMBER BANERJEE: Not hundreds.

MS. GELLES: The point is that this is, our system of a point of compliance with the 1,000 years is more conservative than what the UK model is, because they have the dose constraint only for their operational and closure period. Correct?

MR. SEITZ: Yes, and it's all in interpretation. I think it's safe as well.

MEMBER ARMIJO: This is rather interesting. One is institutional control, which means some organization, whether it's a government agency or business or whatever it is, that is paid or gains, you know, their livelihood or whatever you want to think about for providing these services. That's one.

And then the second part of that is well what if there is no institutional control and people lose track of where it is, you know. So I have a hard time sort of, how do I get from one to the other and when does that happen? Because that's tells you an awful lot about what's left or what's important or not important. So I'm guessing from your nod you're wrestling with the same kinds of questions.

MR. SEITZ: Yes, institutional. How much can we take credit for passive controls, active controls?

MR. WALLO: I mean, you know, there's one thing to take credit in the decision making in authorizing the site. But our plan is that these will be under, our sites will be under institutional control forever, or until they can be released.

Now, you say well you can't guarantee that the United States will be here forever. No. But part of that if it's, you know, and the point to the PA, the PA doesn't protect anyone. All the PA does is inform us on what kind of defense we need to put in place.

And so if this is that important we've got to make very sure not only do we have the records in place and the passive institutional controls in the design, but we need to make sure we have a record of why we're isolating this place.

And one of the things we'll talk about later is we don't want to foreclose on future generations. If they look at what we did and say that's nonsense, we don't need to isolate that, that's their choice. We just want to make sure they know in the future.

So that's where we would be putting our emphasis is to make sure, as we have this rolling future, that we inform the future generations of what we did, why we did it and why we think it needs to stay secure.

CHAIRMAN RYAN: So a loss of institutional memory would be the biggest challenge?

MS. GELLES: Yes.

MR. SEITZ: We have to address that. We have to address that possibility. And one point on this, I think from a high level this isn't so different. The times may be different, they may shift. But philosophically there's a lot of similarities to what we do.

There's a recognition that at some point it becomes a more fuzzy argument. Okay?

CHAIRMAN RYAN: Just we were stuck on the option of, you know, using copper canisters for waste and burying them so deep they would be real hard to get to. So they've kind of taken a different track but, again, I think the goals are the same.

MEMBER BANERJEE: For even low-level waste?

MEMBER ARMIJO: That's only for high-level waste.

CHAIRMAN RYAN: That's for high-level.

MEMBER BANERJEE: What do they do for low levels?

MR. SEITZ: They use geologic disposal.

CHAIRMAN RYAN: It's all one deal and the copper canisters are, I don't know, are they ten inches thick?

MEMBER STETKAR: I'm not sure.

MEMBER BANERJEE: So all radionuclides --

CHAIRMAN RYAN: And they pick copper because it fits in the geochemistry without having any real problems.

MEMBER BANERJEE: But isn't the volume very less?

CHAIRMAN RYAN: Not so much.

MR. SEITZ: Yes, I think that's actually

in important point. In general we're not talking about a lot of waste, even relative to hazardous waste disposal. The quantities of waste that we're talking about are -- DOE may be more so with the cleanup activities but in general low-level waste is not huge quantities.

Okay. I just wanted to touch on a few things specific to Performance Assessments --

MEMBER BANERJEE: Just going back, how much is it involving typically?

MR. SEITZ: Oh, I don't know the number.

MEMBER BANERJEE: Is it many football fields?

MS. GELLES: Are you asking about the Department of Energy's or the Swedish site?

MEMBER BANERJEE: No, the DOE. The Swedish site I assume is --

MR. WALLO: It depends. You know, I mean we clean up waste. Just like tailings are very voluminous, so we have very big sites for those. Clearly probably all our low-level waste could go to Nevada if it wasn't the transportation cost, and we could dispose of it all there. But then we have the tank cleanups and so forth. And the Saltstone at Savannah River. I mean --

MS. GELLES: We would need to clarify the question, I'd be happy, we could provide you lots of historical information. But as an example the Nevada Field Office accepts nominally a million cubic feet a year of waste. And historically has received --

MR. BOEHLECKE: I think in 2012 we had, I think it was a little over a million and that represented about two percent of the DOE complex waste that year.

MS. GELLES: Of the total volumes of waste that we dispose?

MR. BOEHLECKE: Yes.

MS. GELLES: Thank you. So that's a great -- the vast majority of it is disposed at facilities at the site where it is generated to support our environmental cleanup activities. So a small portion, historically it's averaged about five percent of our annual generation, travels offsite to offsite disposal facilities like Nevada.

But all waste is not the same. So you'll hear Sherri talk about Saltstone and the way that that is stabilized and disposed is markedly different than the solid waste packages that are being transported to Nevada for disposal in the trenches there.

So we'd be happy if you want to refine the question a little bit, we could give you a more credible answer.

MEMBER BANERJEE: Well no, I don't even know --

CHAIRMAN RYAN: So the Barnwell site, which is taking quite a large fraction of the waste from reactors, except for fuel. All the operating waste, large components, is a 300 acre site that's got about 40 feet of disposal height from the top down. And it's 300 acres and it's, I don't know, 75 percent full. And that's from 1971 to the present.

MEMBER BANERJEE: That's reactor waste.

CHAIRMAN RYAN: And hospitals and universities and all that stuff. It's all materials used within the U.S. pretty much.

MR. SEITZ: I mean for hazardous waste, I think the last time I looked, you're talking billions.

CHAIRMAN RYAN: Oh absolutely. Hazardous waste far outspans radioactive waste.

MR. SEITZ: Okay. And I mentioned, we have a definition, and I think there was a question earlier about how do you use calculations, and I think this definition which came from the NCRP, it's after the NCRP, but two things in this. One part is demonstrating compliance, we use them for that.

But I think equally important, perhaps more important, is we use these calculation to gain a better understanding of what really matters. What can we do to improve performance and make our defensible, cost-effective and risk-informed decisions?

So you've got compliance on one side but part of it is this really this learning, understanding what really matters. Okay?

One thing with in defense-in-depth I mentioned that there are safety factors built in. And this slide's just a few examples of how these safety factors, that I think people forget about sometimes. For example, our dose constraint, 0.25 millisievert per year.

It's 25 times less than the average annual dose received in the United States. So there's a factor of 25 less than what people are exposed to routinely from all sources of radiation.

MEMBER SKILLMAN: Where did that 6.3 come from? I thought it was three?

MR. SEITZ: It's changed with medical procedures.

MR. WALLO: Actually it's not a truly average dose, it's a per capita dose. So younger folks that don't get a lot of CT scans are only getting your 360.

MEMBER SKILLMAN: Okay. Thank you. But then the older folks are getting more like ten millisieverts.

MR. SEITZ: Thank you. And also our dose, the true dose limit is one millisievert so we have a factor of four there that's been built in to these disposal requirements. Okay. That's our constraint.

The next step we take is we assume --

MEMBER BANERJEE: What sort of dose would be expected from a typical mill tailings pile? Uranium mill tailings?

MR. WALLO: Actually the tailings pile standards are, as you know, flux rates. So it certainly depends on where you put your house and how much you're affected by the flux. I think we did some very soft analysis and that's why you'll see later in our standards where we say if our low-level waste sites dispose of radium-bearing wastes then they need to meet either the 20 meter squared per second flux standard or a 0.5 picocuries per liter at the fence line.

We think those are generally comparable, very soft modeling calculations, so if you wanted to use the fence line. The 0.5 picocuries per liter probably borders on something over 100 millirem. If you were staying there for a long time.

MEMBER BANERJEE: Okay.

MR. SEITZ: Okay. So we have our constraints and then when we do our --

MEMBER BANERJEE: That's not the airborne --

MR. WALLO: Yes, that would be the rate of this decayed product, airborne.

MEMBER BANERJEE: Airborne. Okay. Thanks.

MR. SEITZ: So our constraint has some built in safety factors. Then we assume that all memory of a facility is lost. That's how these exposure occur, so at some point commitments, land use agreements are ineffective. And then when someone moves on the site we're assuming that they would no longer be testing well water or be able to recognize that they're on a waste site.

And then when we get into the actual calculations we consider highly exposed individuals as these receptors and oftentimes we're not talking credit for all the barriers or processes that may be involved.

Frankly, from a practical perspective, that it may be easier to just assume that they're not effective rather than spending the time and effort to defend every single process.

MEMBER BROWN: When you say compliance decisions are made in context of assuming all memory of the facility is lost, does that mean after 1,000 years. For relative to your overall assessment? Or does that mean even if a site is declared open after five years, I mean --

MR. SEITZ: Typically is 100 years.

MEMBER BROWN: Hundred years.

MR. SEITZ: Is our institutional control. And there can be some differences. It can be justified --

MEMBER BROWN: Okay. I need to get the institutional out of this, I'm sorry.

MR. SEITZ: Yes, that's a different, that's true. Yes, the memory of the facility will be lost when we assume controls have gone in --

MEMBER BROWN: Okay. So that's when you relinquish institutional control?

MS. GELLES: We have a requirement for active institutional controls for a 100 year timeframe. After that you assume that we have complete loss.

MEMBER BROWN: Oh, okay.

MS. GELLES: And this compliance decision is relative to the quantitative period of compliance. Can we demonstrate that this system, if you assume total failure, people access the site. Don't know it's a site. Drill into it and use water that is contaminated by the radionuclides from our disposal activities, we're determining if that exceeds our PA limits or not. Based on that 1,000 year timeframe.

MR. SEITZ: Yes, so we're intentionally biasing a lot of factors towards more of a worst case.

MS. GELLES: A worst case.

MR. SEITZ: I don't like to say worst case, but it's pushing it that way. And the next slide I talk a little bit more about the scenarios themselves. And within the scenarios it's a probability of one, we're assuming someone will reside at that site.

Typically we assume they drill a well at the point and time of peak concentration. So they're very precise in where they put their well. Then we assume that they're a resident farmer, typically. And you could argue that's not a typical person in the current society.

So there's a lot of exposure pathways there. Some sites our stakeholders ask us to look at other scenarios that are specific to considerations there. And of course we have our intruder, and I'll talk more about intruders later.

So there's a lot of safety factors built into this. And I think where this leads is how do we interpret things for these longer time periods. So for compliance time we use this. We agree, okay, we're going to work within this construct.

When you get to longer times maybe you walk back a little bit and say, you know, what's the real likelihood that someone is going to reside at this location. And you can start asking those kind of questions and risk inform the decision.

MS. GELLES: And just to reinforce --

MEMBER STETKAR: When you say you can, do you in fact?

MR. SEITZ: I think --

MS. GELLES: Yes. The answer is yes, we do.

MR. SEITZ: I think so, yes.

MEMBER STETKAR: I mean that leads you to a conclusion that 200 millirem is okay.

MR. WALLO: Yes, I mean if you don't take into those themes and you come up with 200 millirem in 40,000 years I would say no, we shouldn't waste time refining or doing probabilistic assessments on when the other things.

Now, if you get something that's significantly higher it may be worth refining stuff.

So that's, it's a decision making tool and you ask yourself, you know, data quality objectives. Do you have enough data to make a decision or do you need more? And that's where the question is. And there's some relative, it's subjective judgement to some degree.

We don't have a hard line to say, yes, if you're above 25 rem then you need to do some more.

MEMBER SCHULTZ: But the defense-in-depth discussion on this slide, as well as the last one, that's defense-in-depth as applied to future generations. It's not to say that we are creating the institutional controls or we're creating the allowable waste stream or usage of the facility within the first 100 years of institutional control to be affected by that. In other words --

MR. WALLO: We don't expect that to affect, I mean, again, our commitment is, in all our policies and our directives, is to control that site forever. As long as it's hazardous. So this is only a planning tool in terms of deciding how many -- It's really a resource allocation tool. How many resources do we put into mitigating this risk for the future. Wherein our intent is as long as we own it we're going to make sure that this never happens.

MS. GELLES: Well but I'm not 100 percent sure I understood the nuance of your question. I apologize if this is off target. But what Roger just described is we're constructing our PAs with these worse cased assumptions. As a result of these PAs we're constraining our waste acceptance criteria to ensure that we don't exceed our quantitative limits for our 1,000 year period, our point of compliance.

But then in our defense-in-depth system we're also ensuring that we don't lose, that we have institutional control so we don't have this kind of loss of institutional knowledge. That we are ensuring that these worst case instances never, ever occur.

So we've got conservatism built into the center of the target in the type of site that we select. The constraints of the PA or the assumptions of the PA that we conduct. The waste acceptance criteria we arrive at deriving it from the PA and then all of the other system controls that we ensure in perpetuity.

So I believe there is defense-in-depth that is protective of the future generations but it also is effecting what we do today. If we didn't have such conservatism built in to these PAs we could probably tell ourselves that it's safe to accept more waste or greater concentrations of waste in this operational period. And we'll worry about it later.

But we've built in conservatism at every step of our process. Is that responsive to your question? I don't think it was, but I think it's an important point for us to make because the defense-in-depth happens at every step of our system.

MEMBER BANERJEE: I guess I'm having trouble with -- Let's forget this for a moment but imagine that you're trying to put the waste in a place where you've got some form of an engineered barrier and you're preventing water runoff or something like that. I can imagine that, I'm thinking of a mill tailings pond. You've populated your stuff and, you know, it's fallen to the bottom now you've got it in there and all this stuff.

This is going to deteriorate after a period of time. You know that. You can probably figure that out. So how are you going to ensure that it will not in 1,000 deteriorate and get somewhere into the water?

MR. SEITZ: Actually we look at it from, my personal perspective is, some deterioration is good. We're better off with a gradual release than you are with something that happens quickly.

MEMBER BANERJEE: So you take that into account?

MR. SEITZ: Definitely.

MS. GELLES: Yes.

MEMBER BANERJEE: All right. So you take iron exchange and all this sort of stuff.

MR. SEITZ: Oxidation.

MEMBER BANERJEE: And that's part of your model?

MR. SEITZ: And that's an example of something you can't always take credit for, but it's part of this thought process of --

MEMBER BANERJEE: So you set up sort of a geochemical model to take care of some of the dilutions and iron exchange and breakthrough curves and all this sort of stuff. The usual things people do. You do that for the level as well?

MR. SEITZ: Right. And it tends to be much more focused. We're going to go into more detail on what matters. And a lot of effort goes into identifying things that don't matter from things that do matter so we know where to focus our efforts.

CHAIRMAN RYAN: Sanjoy, I think there's been a lot of effort too in that concept that you're reaching for is that on the surface there's lots of other things to look at to understand the system. And as you go down in depth of burial it becomes a little bit simpler in the sense that on the surface weather processes are probably out of play, except when weather contributes to infiltration.

So all you need to know is the infiltration, so that one --

MEMBER BANERJEE: A little easier problem.

CHAIRMAN RYAN: So, you know, you're on the right track. But you almost have to say let's figure out what's for this system. And the point you made kind of at the beginning, is each one has to be looked at for its own parts, pieces and merits and strengths and weaknesses.

MR. SEITZ: Okay. And actually it's a really challenging problem. Because every problem has its different idiosyncracies.

MEMBER BANERJEE: Yes, because the geomorphology can change with time as well, right?

MR. SEITZ: Yes.

MS. GELLES: Absolutely right. I'm a little concerned about time, just because we want to make sure we get to the important aspects of Andy's presentation as well.

MR. SEITZ: And too, we're covering some of them.

MS. GELLES: And that's fine.

MR. SEITZ: Okay, we'll move through these.

This one, I just wanted to make a couple statements about scenario development. And there's been a lot of discussion of the use of features, events and processes.

And I think from a DOE perspective our experience is we tend to start from a conceptual model focus. We want to start with describing the system and its evolution and then refine it as we go. Where we need to.

And then as Mike was referring too we look at it from a systems approach. So as we refine it it's not just one part of the system is interesting, we need to understand it. It's how does that part of the system contribute to the overall performance? So something on the surface that seems like it would be important, like a cover, you may think boy we really have to understand that.

But for example in a case like this with a tank, the cover's probably going to fail before the tank does. So it really doesn't matter. The cover performance is less important in a situation like this. So you always have to keep perspective about the whole system.

MS. GELLES: Which reminds me of a point that perhaps we need to not assume everybody understand. There's great diversity in the types of low-level waste disposal systems that we have across our sites. Much as you accounted for, we might have site-specific considerations or constraints at sites in the west than we would in the east relative to the constraints of our waste acceptance criteria.

There are great differences in the types of waste we're dealing with and the types of facilities. Thank you. I apologize for the interruption.

MR. SEITZ: And the concept that's appeared more in the last few years internationally is the idea of safety functions. I think it's actually related to reactor concepts. And I think it's a very good concept. It's how we really think about these systems. We're looking at the different parts of the system and then we try to think about which ones are we relying on? What is the function that's expected of that part?

For example, reducing grout in this case. That's related to technetium release. If we keep it reduced it's not as mobile, it's not as soluble. So then you start to think, the FEPs come into it. Okay, well what could happen to change it from reducing to oxidizing. What kinds of things could happen that would change it and make it more mobile?

And the safety functions perspective helps you to think about these things as different safety layers in a system. And you can see we look at multiple levels of detail in our models as well.

I'll just go through these pretty quickly.

MS. GELLES: I'm not trying to rush you, I just want to make sure we continue it along.

MR. SEITZ: And in terms of scenario development, internationally there's been quite a lot of work in the last several years. And I think they're mirroring this idea that really what's been done in practice is more of a top down, bottom up. So kind of this conceptual model first. Development under initial conceptualization of the system.

And then once you have that conceptualization you refine it. Then you start looking at, okay, what can impact that. And the two codes basically in all programs, the starting point is development of a detailed description of the initial state of the system. So it reflects this conceptual approach.

And when they talk about FEP lists, FEP databases, it's in the context they've evolved, at least in more advanced programs, to become mainly a tool for checking completeness in a system and scenario description that's already been derived, rather than something that you're building from the ground up.

I mentioned the PA maintenance process. This is how we manage uncertainties. And one that's become very clear over the years is, if you've been involved with radioactive waste management, we have to make decisions under uncertainty. There's always uncertainties involved.

And what the maintenance process does, it gives us a means to try and address those uncertainties. And we've also, as a result of some of these uncertainties, we've increased the use of probabilistic modeling. And I'd like to emphasize, it's both for sensitivity analysis and uncertainty analysis.

And in my opinion, sensitivity analysis may play a more important role than in uncertainty analysis because using sensitivity analysis is how we get some priority. We can identify parts of the system that are important for the conclusion as well as parts that really have no bearing on the conclusion and don't warrant a lot of effort.

When talked about the maintenance process, in the early 90s the initial thought was, it's kind of per the previous discussion, we're constantly getting different kinds of waste, different waste forms. And we needed a formal approach that to be able to address these changes that would occur from our initial basis.

It's evolved from that to more of a broader confidence building concept. And you'll about some of the maintenance activities and the site-specific presentations.

And confidence building, now we have demonstrations. We've got field studies. There may laboratory experiments or, this picture is actually, it's a mesoscale laboratory experiment. We have monitoring that goes on at the facilities. And we've developed a process that's modeled after the USQ process that really focuses on that initial idea of changes. We're trying to address changes.

And that's the unreviewed disposal question evaluations gives us a procedure to address, if we get a design change, a container that wasn't considered in the performance assessment, it gives us an approach to evaluate those.

MEMBER ARMIJO: Roger, I just want to just quickly go back to your Slide 22 and ask a quick question.

MR. SEITZ: Okay.

MEMBER ARMIJO: That's a pretty robust looking disposal. It's got grout, it's got some sort of concrete and steel container and high density polyethylene layers and all sorts of stuff. So you put something in there that you want, low-level waste, that you want to keep out of the environment but some time in the future then you have a scenario a probability that, one, somebody wants to drill right through that.

MR. SEITZ: In this case not. The drilling would occur nearby. This is actually a tank closure problem.

MS. GELLES: And this is a case we're not emplacing low-level waste in the tank. We've removed --

MEMBER ARMIJO: You're just vouching it's in place.

MS. GELLES: -- the liquid waste and we're leaving the tank structure in place as a low-level waste disposal system rather than exhuming the entire construct of the tank.

MEMBER ARMIJO: So for this particular case you do not consider that somebody is going to decide to plant his farm right on top of it and drill a hole?

MR. SEITZ: We do.

MS. GELLES: We do.

MR. SEITZ: No, we do. But one of the nuances for intrusion is you can take credit for engineered features. There may be, in certain environments if you have a solid concrete tank, like at Savannah River, it's unlikely someone's going to drill through it.

MEMBER ARMIJO: You'd think he'd stop at awhile.

MR. SEITZ: Right. And when you drill down and think more detailed about these intrusion scenarios, we kind of have these base scenarios that there may be engineered features that can change the timing of the scenarios or things like that.

MEMBER ARMIJO: Or make the intrusion event stop. Somebody's drilling and he grinds up a bunch of drills and says this is not a good spot and moves along.

MR. SEITZ: Exactly.

MEMBER ARMIJO: Okay.

MS. GELLES: But we don't assume that necessarily. We assume that he hits it and then moves over and drills somewhere nearby. There is some modeling in impact.

MR. SEITZ: And actually there is -- And we assume that they drill through a transfer line actually.

MEMBER ARMIJO: Okay. And then based on, after radioactive decay, time and everything else, then you calculate their dose assuming they'd lived there for a year?

MR. SEITZ: It's right back to this --

MEMBER ARMIJO: So a one-year --

MR. SEITZ: Yes, and we have a little discussion later about the intruders.

MEMBER ARMIJO: Okay. Thank you.

MS. GELLES: Thank you.

MR. SEITZ: Okay. And the last slide for my part is one thing that we've found, as more and more people got involved with waste disposal and doing performance assessment it became apparent that we really needed to work hard to share information. And so we've created a Community of Practice.

And a lot of the reason for creating it is we saw that there's this potential for inconsistencies in how things are done. So we wanted to make sure people were aware of what was being done at other sites.

We also use it for continuous improvement. If someone has a good idea at one site we want them to be using that approach at another site. And also it's a means for us to maintain some enduring capability. We're all getting older and so this is an opportunity to share experiences in a more broader fashion.

So the Community is implemented through technical exchanges, workshops, we even have technical support for sites that are embarking on a new PA. And these meetings, we've had NRC staff participating in these meetings. We have state regulators, EPA, international participants. These meetings have been pretty well attended. It's proven to be a good approach to share this information.

Okay. Now we'll pass it on.

MR. WALLO: Okay. As we move along here I may or may not read from the slides so if I skip over something you really wanted to talk about, I may get to it, but feel free to stop me if I don't cover something in a slide. I'm going to just use those as memory joggers and just kind of talk here.

The first slide basically talks about our authority, which as you know is the same as the NRC. It's derived from the Atomic Energy Commission. But we had a little bit broader authority, unlike the Commissions, we weren't just charged to regulate special nuclear and source byproduct material, but rather we had additional charges under that AEA to protect the public from radiation and radioactive material as a result of our research, development and production activity.

So we do regulate, and have always regulated, accelerator produced materials. And various norm and T-norm materials.

One of the things we wanted to note about our regulatory structure is we do have a real regulatory structure. And it's not a random thing that everyone gets to do what they want. But we have a series of, it's as I said a weighed approach with many oversight organizations and many arms of the regulatory process.

We define responsibilities and authorities, which again come from the Atomic Energy Act primarily, but also the Energy Reorganization Act. And our general protection standard, like NRC's, is the 100 millirem that we derive from the advisory groups. And it's 100 millirem from all sources and all pathways combined, which is why we use dose constraints.

As Roger noted we try to look at others and try to design our standards to be both internally consistent as well as externally consistent to the extent we can.

And one of the things we really try to do is, within the Department, to make sure all our directives move ahead together. When a few years ago our occupational standard, 10 CFR Part 835 moved ICRP 60, we moved our public standard which is the other element that would be equivalent to NRC's 10 CFR Part 20 for the public, 458. We moved that to ICRP 60 and as this latest revision of 435 comes out it will be due in ICRP 60, we're moving our nuclear safety directives too.

So we really try to do it within a few years to keep everything consistent and in the same general timeframe. And that's how we design all these requirements, to try to help them move along.

Go ahead.

So I just want to talk briefly, and I'll go over this quickly, is our radiation protection of the public and environment. And this, as I said, is equivalent to the public protection side of 10 CFR Part 20 in our C Space.

We have a general standard of 100 millirem per year for the public. And we set a dose constraint of 25 for DOE activities. And it's all sources and all pathways.

Radon is handled separately. As is in most standards. We don't count medical exposures or background radiation. And obviously those folks that are exposed under occupational exposure, that's dealt with under 10 CFR Part 835. And we also apply ALARA in all cases.

I do want to note that we do control radon separately. We have specific standards for cleanup for radium and radon. So even in our equivalent to Subpart E of 10 CFR Part 20, which we actually started developing back in 1985 and first issued in the previous order 5400.5 in 1990. And have since updated to 458.

We had a cleanup standard that was approximately 25 millirem. Again initially because we don't feel models project anything beyond one significant digit we did start out with 30. But ultimately to be consistent with NRC we did change to 25. I'd like to say it's one-quarter of the dose limit. So I can still say we're using one significant digit.

And that's the same kind of concept that we're looking at in terms of looking at the low-level waste modeling as I get to talk about that, is really what are you getting, what is your model telling you and what's the significance of it. And the realism of it.

And it's the same thing we did with the public protection, except there we're not projecting. Those limits actually apply at the time and true releases, those are not to real people. But they're to stylized the people just like we do in the 435.

I will briefly mention, we noted that actually the radioactive waste management concept that we have now dates back to '88. It was issued as one of our four-digit orders, 5820.2A. And in starting to implement that we learned a few things and there have been developments that led to the current 435 and then refinements that Christine will be talking about in what we anticipate from the next 435.1 Order.

We did get a recommendation now implementing 5820.2A from the Defense Board in oversight. And one of the major things about that was they wanted -- We were focusing on low-level waste sites and they gee, you're putting these low-level waste sites along with all your other sites.

Now, the predecessor to our public protection order took that into account because we have to look at all doses from the sites to identify who are maximally exposed individual. But the Board was saying well you're projecting things hundreds, thousands of years in the future, what happens to the combination of all of these sites in that period. So we took that to heart in the development of 435.1, as we did those.

Next slide.

So we began 435 in the mid-90s. It does cover high-level, transuranic, low-level and has general requirements in it. I'm going to talk mostly, and we've been talking mostly, about the low-level waste requirements.

In developing the revision to the 5820 Directive we had many, many workshops. A lot of interaction with those that were being regulated by the orders and those that were the disposers and the customers of the disposal sites.

MEMBER BANERJEE: What do you mean by mixed low-level there?

MR. WALLO: Well the order also covers low-level waste that's mixed with hazardous waste. So any of the waste forms that we dispose of, which would include high-level waste, transuranic waste, low-level waste or chemical and radioactive waste mixed. There are requirements in this order to make sure we manage it appropriately.

The package with the order included the order itself, which gave the general and overarching requirements, the manual which was a requirements document and fairly substantial, that gave the detailed requirements of the order. And then there were technical basis documents and guidance materials that gave some insights of how you might best comply in a training program.

And again, the goal of this order is to implement our radiation protection requirements that are in 10 CFR Part 835, for workers. And 458 for the public in the waste management area. This is the implementing order to make sure those things are all effective.

The order was effective in July 2000 and we've been implementing it ever since. One of the big outcomes, and partly influenced by the Board recommendation, was the creation of a Low-Level Waste Federal Review Group.

Previously under 458 DOE Office, deputy assistant secretaries were responsible to approving disposal authorizations. And the Department had in place a guidance group that was made up of contractors that would review each PA and go through a process with the site and the developers and the exchange.

Two things happened. First of all, we realized that that function was probably inherently governmental, hence the creation of a DOE Low-Level Waste Federal Review Group.

But also, the focus of this technical group really got to be very technical. And a lot of time there would be year's reviews done on a PA. The PA sent back and back and back, all for technical questions that maybe didn't make, wasn't a lot of value for the decision to whether to authorize the disposal or not.

And what we found was we needed to combine not only technical reviews, but we needed decision makers that were thinking of the process of what's important to authorizing this site. Not is that KD factor for that particular radionuclide exactly right, should we adjust it up and down.

And in all honesty those things did delay a lot of PAs back then, in the '80. And so one of the real benefits of the Federal Review Group is that focuses it. We still use contractors. We have review groups that we set up when a PA is ready for review and ready for authorization that includes contractors as well as the DOE staff.

And then the results of that review and its analysis come to the Low-Level Waste Federal Review Group, and basically just like a licensing procedure, the decision is do we recommend that the deputy assistant secretary authorize the operation, or the continued operation, of this disposal site.

In addition, part of that review covers the composite analysis that was the other element of the Board recommendation. We do look at all DOE operations impacting or that that low-level waste site may impact or those sites may impact in terms of an off-site receptor and asked the question is there potential for doses to exceed our dose limits over 1,000 year period as a result of combined operations for the facilities.

Now, this is not a compliance decision because we're projecting these doses in the future. What it is is a decision to say, gee if this starts to exceed our 25 millirem constrain, or 30 millirem constraint, combined then we need some time in the future to figure out what we're going to do and we need a plan to do that.

MEMBER BANERJEE: So is that authorization given for a period of time? Like 60 years or 100 years?

MR. WALLO: The authorization has to be re-reviewed at the time when the PA is resubmitted. There is an update on the PAs. Once it's closed then it will be the periodic reviews. But yes. And many times the authorization may include constraints or conditions. And those conditions then are reviewed annually to see that the site is meeting the conditions or taking actions that the conditions can be lifted.

MEMBER BANERJEE: But it's authorized with conditions for a certain period of time.

MR. WALLO: Yes, that's right. And the authorization will be revisited at some time.

CHAIRMAN RYAN: And then just for the member's benefit, that's not different by much of what the NRC does. They issue a license, there's license conditions for the same kinds of things Andy talked about for waste acceptance criteria, for operations. The requirements for monitoring, personnel, environment, all of that.

MEMBER BANERJEE: But then we have a review --

CHAIRMAN RYAN: And that's inspected routinely by onsite inspectors who are there, for the most part, every operating working day. And then there's larger groups that come from the home office to do a more thorough and detailed review of paperwork and all the rest. So it's not atypical at all on either side of the DOE --

MEMBER BANERJEE: Is it typical to authorize for 40 years or something like that and then have a renewal process?

MR. WALLO: It's a function in the PA. Generally the PA includes an assumption of an operating period. So that's part of the review.

MS. GELLES: And how long that is is going to depend upon the functionality of that disposal system for the site to meet the site's needs. So a site like Nevada that is serving as a regional disposal facility is going to operate for a longer period of time than a low-level waste system devised at site that's going through a complete decommissioning and will be closed within a two-decade period of time.

So it's going to differ depending on the location and the mission of the facility.

MEMBER BANERJEE: The authorization comes from the deputy assistant secretary?

MS. GELLES: Right.

MR. WALLO: Generally the composite analysis is not as rigorous as a PA analysis. We use whatever data are available because things that are included may be plant cleanups or some estimates of residual activity. Some old disposal sites that may exist on our facility. Whatever information we have we do the best estimate we can to come up with a composite analysis and then determine what more needs to be done, if anything.

I just want to talk briefly again about the Low-Level Waste Federal Review Group. They are responsible for reviewing both the PAs, the CAs as well as monitoring the monitoring programs and the various updates that the sites do. And they track and report on the compliance documentation and then report back to, as we said, the senior managers.

This was, I feel, a real improvement in our regulatory system, was the development of a DOE functional Low-Level Waste Federal Review Group. Not that we didn't have technical experts and staff on hand that advised the deputies before, and the decision makers, but this kind of makes a little more formal and, I would say, institutionalized regulatory structure that we have at the Department.

All right. So what are the performance objectives in the Order? Basically it's 25 millirem total effective dose equivalent from all exposures excluding the radon. And then we have separate requirements, if you end up disposing of a radon generating radionuclide in your facility.

This is, as I said, consistent with the way we handle mill tailings and the way we do cleanups in our analysis for cleanup standards.

Next slide.

The air pathway, we have 10 millirem from the air consistent with the NESHAPS in addition to our 25 millirem all pathways. So no more than 10 of it can go through the air pathway.

And then for radon the disposal sites, consistent with 40 CFR 192 and our 458.1 requirements, is a flex limit of 20 picocuries per meters squared per second. Or as an alternative you can demonstrate 0.5 picocuries per liter.

I will note that the one difference between a low-level waste site that may have some radium generating wastes in it and another site is you demonstrate compliance with a mill tailing site by once you cap it you do the measurements. And you've done that and then you monitor forever, just watch the site and make sure the cap's still stable. You don't have to do any more major measurements to demonstrate compliance.

For the low-level waste site we allow them to model that dose and project it rather than measure it. So we don't wait until closure. They can demonstrate that they're going to comply with their design and their waste acceptance criteria by modeling as opposed to the measurement.

MEMBER BROWN: Is this when you put the site into service or is this after it is, you talk about a representative member of the public or when the public has unrestricted access to that site? I ask the question --

MR. WALLO: The 25 millirem, the dose?

MEMBER BROWN: No, the 10 millirem in the air --

MR. WALLO: Yes, that's for operation and closure of the site. When we cap the site and --

MEMBER BROWN: When you cap it, does that mean --

MR. WALLO: Well if the site is closed the PA needs to demonstrate that they meet a 10 millirem per year offsite dose limits.

MEMBER BROWN: Okay, so it's open --

MR. WALLO: Yes.

MEMBER BROWN: So the public can now enter the site? When you say close, I'm trying to understand what you mean by close.

MS. GELLES: This is in the 1,000 year. We would distinguish, these are limits that we need to demonstrate we're meeting within that 1,000 year period of compliance.

MEMBER BROWN: This is not for the intruder though? This would be for the member of the public that lives around the site?

MR. SEITZ: And it will be controlled by the site monitor.

MEMBER BROWN: Okay. Nobody is on the site.

(Crosstalk.)

MEMBER BROWN: Nobody's on the site, okay.

MR. WALLO: But over time the site's going to --

MEMBER BROWN: Assume 1,000 years, how can you even know that even after 100 years is your --

MS. GELLES: It's our active institutional control requirement.

MEMBER BROWN: That's right, so after 100 years and if you pick the 10 millirem and say the 20 picocuries per meter squared per second for the radon, do you expect those numbers, if nothing else happened on the site, would those go down to what you would consider after 100 years public? Somebody could live on top of that?

MR. SEITZ: Your receptor location changes with time.

MEMBER BROWN: I have no idea what that means. I'm a person. After 100 years I go build a house on top of that site that had 20 picocuries per meter squared per second. I'm --

MR. WALLO: It would be assessed against the 100 millirem chronic standard, not against that 10 millirem. The 10 millirem is for the operation of the site.

MEMBER BROWN: I'm trying to get a feel for after 100 years.

MR. WALLO: Yes, after 100 years we would an assessment and --

MEMBER BROWN: Can somebody go build a

house on it if --

MR. SEITZ: There's a buffer zone that is assumed to be maintained over time. But say at 100 years the site boundaries may go away and the person who's getting exposed would be --

MEMBER BROWN: Not an intruder. This is a person.

MR. SEITZ: Right. The person, the member of the public that's getting exposed would be within about 100 meters. That's the location.

MEMBER BROWN: That's a arbitrary buffer zone?

MR. SEITZ: Yes.

MEMBER ARMIJO: So you assume they don't put their house right over?

MR. WALLO: That's correct. That's the intruder. The undisturbed performance individual is 100 meters within the site.

MEMBER ARMIJO: But the intruder can go sit right on top.

MR. WALLO: Right. But these performance objectives are for the undisturbed performance and the member of the public that lives around the site.

MEMBER ARMIJO: Right. Okay.

MEMBER BANERJEE: You could live closer to the site.

MEMBER BROWN: Okay, if somebody was sitting right out in their background right at the boundary, they could get 20 picocuries per meter squared per second while they're sitting there having a beer or watching a ball game.

CHAIRMAN RYAN: Actually not enough to cause any problem because that's the radon flux rate, and the radon's going to whiz by his nose rather than just go up his nose.

MEMBER BROWN: Yes, I was trying to calibrate that with the publicly --

(Crosstalk)

MEMBER BROWN: -- four picocuries, to measure it in your basement, for instance.

MR. WALLO: I can't say that we've done it hard, but the 0.5 picocurie per liter has a general qualitative, I would say, order of magnitude estimate with, depending on the boundary of the site. But the 0.5 picocurie per liter, which is one-eighth of the 4 picocurie per liter indoor standard, is our boundary line standard.

MEMBER BROWN: Okay. All right. I've got it now. I'm just trying to put it in a practical context of --

MS. GELLES: Clarifying question.

MEMBER BROWN: -- human being that might understand what you're talking about.

CHAIRMAN RYAN: Charlie, you've got to wrestle with another one. Outdoors that radon is going to dilute real fast.

MEMBER BROWN: I understand that.

MR. WALLO: Equilibrium. Go to the next --

MEMBER SKILLMAN: Let me build on Charlie's question for a second. Point of compliance. The initial assumption or point of departure for point of compliance is DOE M 435.1-1. For performance assessments is the point of highest projected dose or concentration beyond a 100-meter buffer zone.

MR. WALLO: Right. That's, if you go to the next slide.

MEMBER SKILLMAN: Does this mean that there's a 200-meter radius around the point? Excuse me, a 200-meter diameter, a 100-meter radius? Is that how --

MR. WALLO: It's 100 meters from the boundary of the disposal facility.

MEMBER SKILLMAN: So if the boundary is as big as a football field, there's another 100 meter on each of the --

MR. WALLO: Each end of it, yes.

MEMBER SKILLMAN: Now I understand. Thank you. I was just curious.

MR. WALLO: And actually the next slide talks about the conditions. It's not an anything can happen kind of situation. The order actually defines certain conditions under which to do the compliance analysis. We define certain living habits of the critical group, the most highly exposed individuals. It's not just anybody random.

Yes, you can probably think of putting someone in the ground and covering them up and leaving them there for awhile and they might get a higher dose. It's an actual average dose to a member of the critical group, somebody living near the site. The condition unless justified otherwise is 100 meters from the boundary of the disposal unit.

We evaluate reasonably foreseeable natural processes. We probably won't look at the meteorite hitting. But 100-year floods, if there's any seismic possibilities we may look at those things. And we do evaluate sensitivity and certainty.

And then we apply an ALARA process to make sure that our designs result in doses that are as low as reasonably achievable. Now let me say with that this is again kind of like the question of do you ever expect anything catastrophic?

Our ALARA requirements are tailored, and basically we say you do quantitative ALARA analysis and spend a lot of money if you have a lot to gain. If you don't have much to gain your ALARA is qualitative. We always do ALARA, but unless you're going to get, you know, we use $1 to $6,000 per person-rem as opposed to the NRC's two. We always talk in a range.

And if the analysis, if you're going to get, one person-rem benefit is the most you can get at it, and your analysis it's going to cost you $1 million, you're probably not going to do a quantitative analysis.

CHAIRMAN RYAN: Andy, one point that I think would help the members kind of put all of this into perspective is to answer the question of does DOE ever really walk away from these sites? You know, I think the program, correct me if I'm wrong, is that you develop a remediation plan, closure plan and then a monitoring plan for the future. So it sounds like to me that that doesn't really have an end.

MR. WALLO: No, it doesn't. As a matter of fact, the conditions that we state is the only time we will release these sites is if they can meet the clearance or release requirements stated in 458.1.

CHAIRMAN RYAN: I think that's a very important point because, you know, sometimes we get a little bit, sort of thinking about the details of how we're going to close this site, you know, what conditions we have to leave it in.

But the DOE's view is that they're not walking away from it. They're not going to lose knowledge that they're there, and there will be an ongoing process to make sure they are maintaining whatever requirements you set forth. Do you think that's fair?

MR. WALLO: Yes, it is. Absolutely. And we didn't state that there's a DOE institutional control policy where we basically did that in support of this order and 458 that states our position. Did we --

MS. GELLES: We did. It was in the first target. It was the outer ring in our defense-in-depth system in the slide that I presented. But that's one of our systems of control is institutional control in perpetuity, federal ownership.

CHAIRMAN RYAN: On the commercial side, there's a very similar requirement to maintain an institutional control fund which will operate for, at this point it's 100 years, plus any period deemed to be necessary after that.

MR. WALLO: Yes. I mean, keep in mind that EPA basically, we had some trouble, but their design standard for RCRA cells, initially they were talking about 30 years but that's evolved where they clearly state now, no, there is no release period. We will look at it every five years and make sure it's still safe. So it's the same thing done for the hazardous waste sites that basically we're doing for our disposal sites.

MEMBER BROWN: And in light of that question never walking away. What did you all do with the Windsor site? That was a DOE site wasn't it?

MS. GELLES: What site?

MEMBER BROWN: There was a nuclear prototype up at Windsor at one time.

MALE PARTICIPANT: S1C.

MEMBER BROWN: S1C, yes. Totally was decommissioned and I thought it was Green Shield now, and that was --

MR. WALLO: We do release sites. He's talking about -- what I said was, under 458.1 we have release criteria just like NRC does under Subpart E.

MEMBER BROWN: Well, that's what I thought.

MR. WALLO: If they can meet those release requirements, yes, we will release it. But we will maintain a low-level waste site until it can --

CHAIRMAN RYAN: I wasn't talking about for free release forevermore. It's kind of what do you do with the waste site, you know.

MEMBER BROWN: I've got it.

MR. WALLO: We've decontaminated and released many sites.

MEMBER BROWN: Okay. Well, that's what I thought had happened, and all of a sudden I thought, no, you all hadn't walked away from that when I thought --

MR. WALLO: There's more to talk about, about the order, but I want to take time to just talk about Time of Compliance.

MEMBER BROWN: That's what I think we probably ought to touch on.

MEMBER BANERJEE: Could I just, you talked about air. Is it because near surface that becomes the determining dose and not water?

MR. WALLO: Actually, for the most time it always is water. The only site where air is the primary driver is Nevada.

(Crosstalk)

MR. WALLO: So we have to find some way to expose --

(Crosstalk)

CHAIRMAN RYAN: I want to ask at this point, we're going to take a break somewhere along the line and I'll kind of let you folks maybe help me choose when that ought to be. I'm going to suggest we do it now rather than later. We've covered a lot of ground so far and maybe we can take a 15-minute break and kind of plan on coming back and starting up at about five after.

MEMBER ARMIJO: If we get into Time of Compliance now we're not going to get it.

MS. GELLES: I think that's a wonderful suggestion.

CHAIRMAN RYAN: All right, in 15 minutes we'll come back. We're off the record.

(Whereupon, the above-entitled matter went off the record at 2:48 p.m. and went back on the record at 3:03 p.m.)

CHAIRMAN RYAN: Thank you. We have had a very good discussion this afternoon so far, and I want to suggest that we let our presenters get through this Time of Compliance piece as best we can, because that way I think our questions will be tailored to the whole presentation as opposed to the first sentence or two. We can probably make a little bit of time up if we do that. So good luck.

MR. WALLO: I'm going to continue on with the Time of Compliance here. The summary of the point I want to make here is we didn't pull a 1,000 years out of the hat, we didn't pull the process out of the hat. It was a very thoughtful exercise. And we looked at a lot of materials and even got some good advice, I think, in developing this.

As I told you before, one of the things is we wanted to maintain internal consistency. We already had in place our cleanup standards, the equivalent to Subpart E. Then we got feedback from many, many groups in the 435.1 working groups. We looked at NRC, EPA standards.

At the time we were doing this there was a lot of feedback on risk assessment and cost/benefit analysis and how we should make decisions, from OMB as well. I'll talk a little bit about that in a minute. And then the NAS was doing some studies. They were particularly focused on high-level waste, but still they gave us some things to think about and I want to bring those up.

From the OMB perspective, one of the things that were most troublesome, not troublesome, but most interested us is at that time they were stressing the fact and concern that regulations were starting to cost the country a lot.

They wanted more cost/benefit considerations, and they thought that we should be discounting our analysis. Any cost/benefit or risk analysis we did, they were making recommendations at the time that we should use some discounting factors. We didn't do that and we have never discounted either the cost or the health effects. I mean, we basically looked at them as flat.

But one question is, you know, is that one way of taking into account the future benefits and costs of something? Well, from our perspective it didn't, because in a matter of a 100 years you'll have discounted away any benefit of the health effects associated with these kind of regulations. They are virtually of no value if you use standard discounting. The other thing was the NAS, and flip to the charts. They had two studies going on at the time. One I thought -- yes, there we go. This was the first one from 1990, and again they were focusing on geologic disposal, but it still was an interesting thought.

A scientifically sound objective to geologic modeling is learning over time how to achieve long term isolation of radioactive waste. That is a profoundly different objective from predicting the detailed structure and behavior of a site. It is the latter use to which models have been put. The Board believes this is scientifically unsound.

We also are consistent with this. I mean, even then we were thinking that what we wanted to do with modeling is show how the system performed and give us some insights to that. The benefits of someone believing that you really could detail for a 1,000 years what's going to happen, for 10,000 what's going to happen, you're in a cartoon land then.

What happens is what you program to happen, and you try to make the models as realistic as possible. But the further out you go, the more questions, plus what you're comparing them to. The next one?

This was the '95 study. And this first statement I personally like. Do we believe there is no scientific basis for limiting the time period of the individual risk standard to 10,000 years or any other value? Totally agree.

We note that although the selection of a time period of application has scientific elements, it is also policy aspects that are not addressed. And another issue is intergenerational equity. And then unfortunately, the third thing was they went on to recommend that we carry the calculations out to a peak dose or a million years.

MEMBER ARMIJO: It sounds like they're a little bit inconsistent.

MR. WALLO: So this basically led us to saying, you know, this raises a lot of questions for us. So what we did, go ahead. We actually said, you know, we agree this is isn't a science issue. Let's go to the National Academy of Public Administration and ask them to evaluate this issue in intergenerational equity.

So we actually went to them and said, take a look at this issue, and we're interested in getting some insights in terms of decision making. And they did a fairly -- go ahead.

MEMBER ARMIJO: As you go through this, just keep this question in mind. You don't have to answer right now. From DOE's perspective, for low-level waste excluding long-lived, what's wrong with 500 years?

MR. WALLO: Well, actually I'll answer that right now. One of the things -- and we'll get to this. We looked at this, and indeed the conclusion we came to is that the appropriate modeling period for doing these is a few hundred years. Now the question was, well, should it be 300, 500, 600, 700?

And what we said, well, wait a second. We really think in general terms, this is some of my thinking, that this is an order of magnitude decision. We don't even have a significant digit. So 100 years is probably too short, and 1,000 years may be too long, but we're going to pick the 1,000 years.

So that's where we ended up. If we really think, and I think many of us think that a few hundred years is the appropriate time, and you'll see that's actually what the NAPA study said. For quantitative assessments--when we flip a little bit. They came up with the usual stylized standards.

There's a Trustee Principle. Every generation obviously is a trustee for future generations. The Sustainability Principle that basically said your goal is to have comparable life for future generations. But a Chain of Obligation, each generation is responsible for taking care of itself. You can't sacrifice the current generation for future generations. And that near term concrete hazards have priority over long term hypothetical risks.

And then the Precautionary Principle basically said that look, that Chain of Obligation Principle, you don't want to do something that could have irreversible and catastrophic harm to future generations unless it has a compelling countervailing need to benefit either the current or future generation.

So basically -- go ahead and flip to the next charge. They were basically looking at this pragmatically, and in my words saying, look, first you've got to take care of current generations and the next near generations, and then you look more broadly and qualitatively as you go farther out.

In terms of their discussions and what they came up with was two to four generations and that distant future was 500 to 1,000 years. So technically we could have used that I guess to say, yes, let's stop at 500 years, which I think is probably consistent with, as I recall, some of the initial Part 61 modeling in their EIS was out to about 500.

But anyway, the key was that future impacts needed to be weighted differently than current. You don't compare long term impacts against a near term metric. To take 25 millirem out to 1,000 years is probably too long. However, their finding was it was also inappropriate to use traditional economic discounting formulas for those long term risks. So we couldn't zero them away by discounting them.

And consideration of the future does not entitle anyone to impose injustice on the current generation. In general, the literature related to intergenerational equity clearly opposes making trade-offs favoring the future that fail to meet the crucial obligations to present generations, which in again, we're saying we need to focus on the predictable, reasonably predictable near term and appropriately weight those distant times where we make decisions. Go ahead.

And again, in terms of us doing the principle, the compliance time is not a simple matter of science but a public administration issue that needs to be selected to support good decisions. You don't just say, I can carry this number out and I'm going to compare it to a metric. It's not that kind of decision. It's what is it informing you about the safety basis and your disposal site, the safety basis and your disposal system.

It's the question of intergenerational equity and resource allocation. That's what we're deciding on. How much are we going to spend today to avert some hypothetical risk in the future? How big does it have to be and how likely does it have to be before we spend a lot of our resources?

Decisions that cost little are easy to make.

Decisions that are expensive is a little more difficult. And we want to basically extend the current resources to maximize both the benefit to the current and future generations.

I will stress again, which I stressed before, and this is a little redundant. That dose limits today are likely to have little meaning for protecting the public in 500 years, in 1,000 years certainly, and let alone in 10,000 years.

MEMBER ARMIJO: Andy, I really want to understand what you're saying. If I get 25 millirem today I'll have probably no health effect. But let's make it 250 or 2,500. Whatever the dose I get today, and 10,000 years in the future somebody like me gets the same dose, they clearly have the same health effects.

MR. WALLO: No, they don't. Let me talk about that I guess in relative terms. For instance, if 200 years ago you got 25 millirem, it probably wouldn't impact your life expectancy because we were dying of other things than cancer.

Today, if we look at this slide, for instance, in 1900 the primary causes of death, for instance, in the U.S., were pneumonia, tuberculosis and diarrhea. Cancer ranked eight. In the 1800s it ranked way lower than that.

Today, heart disease, cancer and vascular disease are the top three. Pneumonia's dropped to nine. I know diarrhea isn't listed in the U.S., but I think worldwide it's probably still five.

But the fact is, in 500 years what are you going to project that means? Will 25 millirem risk of cancer to us have any meaning? We just don't know. Not only are there uncertainties in the calculation, there's uncertainty in the value of the metric we're picking.

MEMBER ARMIJO: I see what you're saying. Yes.

MR. WALLO: Yes, I mean, you know, if 1900 we wrote 10 CFR Part, or I mean 435, we might have said, gee, we've got to avert diarrhea, to keep the doses down below diarrhea. Well, it wouldn't be very important today.

MEMBER ARMIJO: I see what you're saying.

MR. WALLO: Yes.

MEMBER ARMIJO: But up to a point.

MR. WALLO: Yes. Well, I'm just saying it's all these factors that become uncertain.

MEMBER ARMIJO: Okay. Kaopectate.

MR. WALLO: Yes. Let's just go --

MEMBER ARMIJO: They might cure for cancer, right?

MR. WALLO: Yes, if we'd cure cancer then we'd have to look at a different thing to see what we're doing here.

MEMBER ARMIJO: Out of business.

MR. WALLO: Be spending a lot for cleanup. Let me see, do I want to go back? Dose limits.

Well, you'll see that the previous slide just basically summarized that there will be technology changes. And again, the slide we were just looking at, we talked about the fact that 10,000 years ago we were hunting mammoths to extinction probably, some would say. And now we don't have any to hunt, but in the past 100 years you see there have been major developments and changes.

So all we're saying is times are a-changing, and not only the modeling is uncertain, but the meaning of the end result of that modeling is uncertain. We can say, all right, we know the uncertainty of releasing so much of technetium, so much of that, but we don't know what that impact is.

CHAIRMAN RYAN: I think the point is that I take away from what you're saying, it's a very simple one. The framework for any model is static at a given point in time. If you want to stretch that out to a very long time, let's say 500 years plus, forget it. It's not simple. You can't do it. Because you're stretching the framework of the model to some new thing, and then you've got to figure out what all the parts and pieces are of --

MR. WALLO: Yes. What I'm saying is, while you can understand in a certain confined time frame the meaning of the results, as you expand them out you have to broaden your understanding and reinterpret what they mean.

CHAIRMAN RYAN: I would say it's worse than that. You have to start over because you've got a whole new framework. You can't do it. I mean if you're going to take the guy that was hunting the mastodon and, you know, snap him into 2013, he's lost.

MR. WALLO: Well, that's true. Absolutely.

CHAIRMAN RYAN: So I challenge you to rethink that a little bit.

MEMBER SCHULTZ: Well, I think the comment on metrics is very important because it's thought that the metric is universal, that it's not changing with time, and of course it will. If we had a cure for cancer in 50 years so that any effects related to radiation could be cured, it would change the dynamic markedly.

I mean this is the goal of lots of human endeavors right now to make that happen.

MR. WALLO: And one would argue that maybe we should spend more on curing cancer than we do on researching a KD for a disposal site.

MEMBER SCHULTZ: Thank you for saying that.

MR. WALLO: It's certainly not a DOE position by the way.

MEMBER SKILLMAN: Before you go on, what you've done with the first line there has kind of convinced us that 10,000 years is a number that's not really worth considering. But what you haven't said is here's why 1,000 is the right number.

MALE PARTICIPANT: I think you did.

MR. WALLO: I did. What I said to you basically was we thought a few hundred years was the right number. That's what we thought when we did our modeling, what we thought when we did our uncertainty. We even, for ALARA analyses say we shouldn't carry our ALARA when you're looking at collective dose, not individuals out beyond a few hundred years in our guidance.

But when it came to the ultimate decision of what the compliance point would be, basically we said we're going to do it on an order of magnitude basis.

So we're going to pick ten to the one, ten to the two, ten to the three, ten to the four.

Ten to the two is too small. Ten to the three borders on too big. And we never want to go to ten to the four.

MEMBER SKILLMAN: Okay. And until now, I didn't hear your order of magnitude discussion. But I understand it. And I agree with the use of 1,000 or 600 or 800. Thanks, okay.

MR. WALLO: Okay. And to save time, I'm going to, oh well, I want to summarize this last one.

You know, just the cost of increasing compliance time doesn't just mean you run the model longer. We run the model longer, yes. That doesn't cost.

What costs a lot is arguing over the various parameters you put in the mill, the scheduled delays for trying to readjust parameters and assessing the extended licensing, in your case or in the NRC's case. In our case it would be the authorization reviews.

And as I said, we had, in the early 80s, a lot of experience with that happening over just technical arguments, where you just extended and extended the process and never got to a decision. Because you didn't focus on what really needed, what was important to decide on.

And obviously, the farther out you go, the more uncertainty there is, the more chance of litigation you're going to have.

MEMBER BANERJEE: Will it have a sort of a fund for this going on to take care of expenditures in the future?

MR. WALLO: We go under continuing resolution.

(Laughter)

MR. WALLO: No, it's DOE's budget. And it will be --

MEMBER BALLINGER: But that's all. It's not a fund?

MR. WALLO: Yes. We do not have a fund that we put aside money. The Federal Government will continue to fund it based on the importance of this decision until they decide that it's no longer important.

CHAIRMAN RYAN: Sanjoy, you've got to recall too this is not for a commercial waste. This is just for Government waste that they put in and he's talking about. The commercial waste still --

MEMBER STETKAR: By definition, DOE existed 10,000 years ago when we were hunting the mammoth.

MEMBER ARMIJO: Dr. Banerjee, you are their funding agent, a source.

MALE PARTICIPANT: Or taxpayer.

MR. WALLO: You know, we're not just talking about DOE. We're talking about the Federal Government and society.

And I want to say, that in these kind of cases, you know, there's a lot of, well, people thought the pyramids could remain safe. But they were intruded and taken.

Well, one of the problems with the pyramid is people knew there was valuables in them. And they wanted them. So they took them. That wasn't a good justification.

What our goal here is to make sure society knows the value of this. And in general, society has done a good job at protecting itself. Even if you look at, you know, the New York incident that caused the formation of CERCLA, there we had a situation where institutional controls failed.

But it was a short term failure. Society discovered it and arguably created a solution to it with the CERCLA program.

But anyways, what I'm saying is society does respond to challenges that they think are important to respond to. And they ignore challenges that they feel are not important to respond to. And that's probably appropriate.

MEMBER SCHULTZ: So we reference the NAPA study. Have there been similar studies since that we would reference today? Because --

MR. WALLO: I don't there's been any real follow-on to the NAPA study. I think there were some proposals. But obviously didn't have the resources at the time. Ed, do you --

MR. HACKETT: I don't know of any similar studies.

MR. WALLO: Okay. Let me just go on. I'm going to go over these additional requirements. Basically we have requirements in the order to protect water resources and then we talked about the inadvertent intruder. And Roger's going to summarize that a little later. So I'm going to just jump over it here to save some --

MEMBER ARMIJO: Yes. But you labeled not a performance objective.

MR. WALLO: Exactly.

MEMBER ARMIJO: So protection of the inadvertent intruder is not a performance objective?

MR. WALLO: No. It is a management tool. It's how we decide how much, "defense in depth" and how many controls we need. But it's not a quantitative requirement that has to be complied with under the directive.

You don't have to demonstrate in 1,000 years. What you have to do is do an assessment of the intruder analysis, determine what you can do to make sure that the projected doses, we're not protecting the intruder. We're basically limiting projected doses under this model.

MEMBER ARMIJO: If such an event happened.

MR. WALLO: Yes, for this event, for a stylized event that we've --

MS. GELLES: This is important in the distinction we were making about the receptor and how close he was, or he or she was to the point of exposure, so the 100 meters away from the boundary of the disposal facility.

CHAIRMAN RYAN: But that's still exposure on --

MR. WALLO: Roger's going to do more on this in just a few minutes. So let's --

CHAIRMAN RYAN: If we don't run out of time.

MR. WALLO: Well, that's why I'm doing

this. So he can get the details. And I'm going to go ahead and not go over this slide. Again, the focus of this slide is --

MEMBER ARMIJO: Go back to it. Somebody can come back to it.

MALE PARTICIPANT: Oh, okay. Now it's over.

MR. WALLO: What do you want to go back to?

MEMBER ARMIJO: No, when you mention we get to inadvertent intruders.

MR. WALLO: Yes. Then we can talk about that. Next one. Oh, no, I'm sorry, the one before it.

I just want to briefly note, again, PA and CAs are part of the analysis process that provide us some insights. They are not what protects the public.

All these different things form designs and institutional controls and all have input to our disposal authorization system, the monitoring plan, and the continued monitoring and continued assessment of the sites are all key to protecting the public. So it's not one element or one analyst. It's everything here and all the reports.

Go ahead. This is summary of the annual summaries, all the things that we do annually for each disposal site. I'm not going to go through it. We can talk about it. But I think we've talked about it before.

We look at the monitoring, we look at the unresolved disposal questions, and so forth and so forth. And now we're going to get to the update with Christine. And I'll make her talk as fast as me.

MS. GELLES: Actually, we're going to, we've agreed to skip this. So if you have any questions about this, this is just a summary of where we are in revising our DOE order.

Andy gave you a good detailed history of it. This has been a multi-year process informed by another cycle of the complex-wide review.

We expect a public comment process beginning this winter before we finalize it and put it into our formal approval system in the Department of Energy.

So if you have more questions, we'd be happy to talk with you about it. There will be no substantive changes to any of our performance objectives.

MEMBER SCHULTZ: How long is the public comment period? When does it begin? Do you have a date yet?

MS. GELLES: We haven't determined it.

MEMBER SCHULTZ: Do you know how long it will be?

MS. GELLES: I don't know that we have just --

MR. WALLO: Last time it was 90 days and extended. But I don't remember.

MS. GELLES: Yes. We haven't fully scoped that out. I apologize for not --

MEMBER ARMIJO: Just a quick question. Since NRC is a regulator in private sector, do they comment on the update to the DOE order? Are they in some way, do you communicate or --

MS. GELLES: We've been in very close communication with the low-level waste branch of the NRC staff, working very closely with Larry Camper. We've participated in their rule making efforts. They're aware of what we've been doing through our complex-wide review process.

The fact that they're happening in parallel, I think, makes it very important since we share stakeholders. And of course we're all aware that there are commercial facilities, the fact that we co-located with DOE facilities in the same geology, hydrology.

So it's critically important that we be able to plan it. So will they comment? I don't know. Will they be invited to participate in the process? Absolutely. And they have been.

CHAIRMAN RYAN: And we have a number of the staff members from all over, which I appreciate their attendance.

(Crosstalk)

MEMBER ARMIJO: You raised the issue of consistency in low-level waste regulation between major Government agencies, the Department of Energy and NRC, as being something that would be very valuable as opposed to big differences. And so it's good that you're --

MS. GELLES: Thank you. And we work hard for that. And we also believe that, if not consistency, being complimentary and not in opposition is critically important.

And that's why we care so much about this period of compliance issue. Because I hope we've convinced you. We are very confident about the technical efficacy of our 1,000 year period of compliance.

And not withstanding what might happen, the NRC adopts something that is closer to 10,000, we would have a significant difference between our systems. So we're hoping to inform that to the extent that we can.

Thanks. So any questions on 435 in the future, we'd be happy to speak with you more.

CHAIRMAN RYAN: Thank you.

MS. GELLES: It'll be a transparent process.

CHAIRMAN RYAN: Okay.

MS. GELLES: Aren't you going to get into inadvertent intruders?

MR. SEITZ: I'll just say a little bit more about inadvertent intrusion. And as Andy mentioned, it's not considered a performance objective. And that's consistent with the international viewpoint.

And there's some concern that people are kind of, it's becoming something real. And it never was intended to be something real. It's a hypothetical construct to evaluate, okay, if we do lose control, let's do something that kind of gives an impression of what could happen, what kind of consequences could occur.

And internationally they further specify, which we agree with, that we're protecting an inadvertent intruder, not someone that's deliberately getting into a facility.

CHAIRMAN RYAN: Well, I mean, my question for, I don't know, a decade or more, has been when does an inadvertent intruder become an advertent intruder.

MR. SEITZ: And that's a very good question. Because I would consider an inadvertent intruder as someone that does not realize they're getting into something that's waste. And that's an important distinction. That affects your scenario.

CHAIRMAN RYAN: Oh, absolutely.

MEMBER ARMIJO: Well, you know, maybe I'm, I don't see the difference.

(Crosstalk)

MEMBER ARMIJO: Let me finish. Historically I've been trying to think about the pyramids. You know, those people were grave robbers. Or they were archeologists. Okay, so they would meet your advertent, all right.

CHAIRMAN RYAN: Yes.

MEMBER ARMIJO: Okay. But then these tombs, this Chinese tomb where they found all these statues buried for a thousand years or more, that was a farmer digging around. He found a statue.

Then everybody came in and started digging it up. And so that was inadvertent leading to advertent. So what's the difference? You know, if you want to consider them, you know, just --

(Crosstalk)

MR. WALLO: The difference is the responsibility of the individual against, we don't want to foreclose on future generations.

If somebody goes to the sweetest repository and decides they want to recycle the copper that all that material is stored in, they're doing it on purpose. That's their responsibility. That's not something that we would plan for in the modeling.

So if somebody wanted to come into our geologic disposal and mine the nickel in the canisters that we're going to put waste in, they're free to do that. But we're not going to plan to protect them.

MEMBER ARMIJO: You're not going to worry about that.

MR. WALLO: That's right. That's up to them.

MEMBER BALLINGER: Do we want to do what the pharaohs did, the two booby traps?

(Laughter)

MALE PARTICIPANT: No traps.

MR. WALLO: All we want to do is inform them. And they can come and steal us blind.

(Off microphone discussion)

MEMBER BANERJEE: We can make the inadvertent advertent. Let it blow up in their face.

MEMBER ARMIJO: Okay, so we're looking at the totally innocent bystander, very small group, one person, ten persons. We're not talking thousands of people.

MR. SEITZ: Yes. And it's a very stylized view point. And I think that's another thing that people are losing sight of.

But when they talk about intrusion, internationally there's a big focus on, okay, when we look at these types of scenarios, these types of conditions, what we're really trying to do is if something like this were to occur, how can we reduce the potential that it would occur and how can we reduce consequences if it would occur.

It's not about meeting some specific limit. It's about looking, how can we make it more robust against this type of --

(Crosstalk)

MR. SEITZ: For those familiar with --

MR. BROWN: Why is that inconsistent with, it seems to be inconsistent. If somebody wants to come in and mine for nickel in a big tank that they happen to know it's there, and it's been there for 500 years, but yet you say you're not going to do anything to protect that. If they want to do it, they can go rip the lid off and mine down, pull the chunks out --

MR. SEITZ: Until they find out it's not --

MR. BROWN: Until they find out it doesn't have nickel in it, or it doesn't have copper or whatever it is. But yet you just said you're going to do something that takes care of the consequences of somebody doing that. It seems to me those two statements are a little bit inconsistent.

MR. SEITZ: No, it's branded towards inadvertent, I think.

MR. BROWN: Is it, okay.

MR. WALLO: In terms of nuclear safety space, I would say that the intruder analysis is akin to us doing accident analysis for a nuclear facility where you're saying, okay, we're going to look and we're going to put more resources to that facility, to the safety systems.

We're going to put safety significant, safety class systems in when it starts to approach or exceed 25 rem, the accident. Whereas if the accident can't cause more than 5 rem, we're not going to deal with those expensive systems necessarily. Standard defense in depth can happen.

So it's a tool to decide, again, how many resources you put to averting, or controlling or mitigating that kind of event.

MR. BROWN: Thank you.

MR. SEITZ: It's a difficult topic, because it's something that the industry has committed to internationally, that we would consider this potentially occurring.

But internationally there is good agreement that it is considered as an optimization issue in radiation protection parlance. And it's not a performance objective or a dose constraint. They're pretty clear about that.

CHAIRMAN RYAN: That's a very important statement you just made, Roger. That to me is a very important takeaway for everybody, is that it's not a dose constraint.

It's guidance on how to think about the system you're trying to manage. And that's a whole big different story than you've got to meet some number.

MR. SEITZ: Well, and I mean examples of optimization could be, okay, we have this waste form. If intrusion occurs we're showing that a dose could be 600 millirem. What can we do? Oh, well, if we put that package lower in the facility we can reduce that. So you're looking for things that can help mitigate it.

On its own, that wouldn't disqualify a site. And actually, that's another way of looking at this.

A big concern is if this becomes too much of a what if game for intrusion, you could potentially dream up scenarios that would disqualify what is an excellent site and an excellent disposal facility. And that's really not the intent.

CHAIRMAN RYAN: Well, that's the Achilles heel is that, you know, that can happen. And that's not a good thing. Because you can disqualify very good sites for no reason, you know, no real reason whatsoever. It's constructed, and that's conjecture.

MR. SEITZ: And that's part of the basis for behind it not being a dose constraint.

MS. GELLES: That needs to be compounded as well if you were dealing with a longer period of compliance.

CHAIRMAN RYAN: I need to move along.

MR. SEITZ: Okay. And so there's agreement, one or more stylized scenarios. Let's come up with, we've got acute, chronic scenarios. Acute is simply a member of the public that would actually be drilling. Chronic is something gets brought to the surface, a resident establishes a home there.

Next slide. For us in DOE, we look at it from the perspective of waste acceptance criteria, how we can improve designs. But as I mentioned, it's not a performance objective.

It's consistent with EPA's feedback on Part 20. They said it shouldn't be an objective. And as I mentioned, international recommendations are pretty consistent on that.

(Off microphone discussion)

MS. GELLES: Okay. We're transitioning out of inadvertent intruder and into a comparison of --

MR. SEITZ: It's kind of a last remark on time frames --

MS. GELLES: Yes.

MR. SEITZ: -- just from the perspective of consistency with other standards for near surface disposal.

MEMBER ARMIJO: Just one quick question. Can we come back to the one year occupancy? Does this inadvertent intruder analysis assume one year in the either chronic or acute case?

MR. SEITZ: Acute could be shorter. There's no, you notice on the acute standard there's no time. It's not per year.

MEMBER ARMIJO: Oh, it's just --

MR. SEITZ: Yes.

MEMBER ARMIJO: -- one, one event.

MR. SEITZ: Yes. It's an event. The

chronic could be a longer term, but it's averaged over, it's a year's exposure.

We wanted to try and have something that kind of illustrated what's done for near surface disposal, what do other regulations say. And at the top, we've got the ICRP, just this concept of how long do dose and risk have a real meaning as a measure of health detriment.

CHAIRMAN RYAN: Just for clarity's sake, I feel like it is not a regulation, it's guidance.

MR. SEITZ: Yes, it's a recommendation, yes. So that's not really a time frame. That is more just perspective of this is when they think is a reasonable amount of time for dose and risk to be somewhat representative of a health effect.

So starting with hazardous waste disposal, in that case it's a design standard. You design the facility a certain way, it's okay. And they rely on the controls. So they have the 30 year control period and then commitments to control it as needed beyond that time frame.

In our order, DOE order 435.1, it's 1,000 year time of compliance. We do extend calculations out for longer time frames to inform things. We have a commitment for 100 years of active controls. But there's also this longer term commitment to control it as needed into the future.

MEMBER ARMIJO: But the presumption there is that the Federal Government as we currently know it will exist during that time.

MR. SEITZ: It's for both actually, for hazardous waste and for us.

MEMBER BALLINGER: Then why such huge difference in, hazardous waste to me is no different than low-level waste. Why such a short time for hazardous waste?

MR. WALLO: It's a design standard. Basically they say build it, you know, and they'll monitor it for 30 years. And, I mean, physically you require monitoring the owner. And then they will watch it from then on.

MEMBER BALLINGER: That's exactly what you're doing.

MR. WALLO: Well, the only difference is we don't have a design that you say we build it to. We basically make our design based on our performance assessment.

MR. SEITZ: If a liner leaks a collection --

(Crosstalk)

MR. WALLO: And I'm not sure which would be, that might be cheaper, you know.

MEMBER BANERJEE: A hundred years is --

CHAIRMAN RYAN: It's very important to recognize that RCRA sites have double liners, and cover liners and all that good stuff. And they monitor them. And when they fail, they fix them, period. They don't want the waste problems.

MEMBER BANERJEE: Fix a double liner.

CHAIRMAN RYAN: So it's a much different strategy and system. So that's very important to not lose track of. That might as well be on another planet as far as this discussion is concerned.

MR. SEITZ: That's true, okay.

MR. WALLO: Well, no. I don't see any difference between, except the fact that we don't have the design standard. We design based on our performance assessment. But we do the same monitoring and the same corrective actions.

MR. SEITZ: That's all they do.

MR. WALLO: Well, I know.

MEMBER ARMIJO: They don't do a performance assessment.

MR. SEITZ: They don't do a performance assessment.

MR. WALLO: They don't require it, that's right. And they certainly don't consider intruders.

CHAIRMAN RYAN: Right, so it's a very different system. It's not anything like, you know, what you do for rad material.

MR. SEITZ: And that's where the red line just went back there.

CHAIRMAN RYAN: Okay. Well, I just wanted the numbers to not take away, confuse the message of what's what.

MEMBER BANERJEE: But what is the justification for the dual standards between hazardous waste and say your DOE order?

MR. SEITZ: In my mind it's a design standard versus a performance based standard.

CHAIRMAN RYAN: And two different agencies thinking two different ways. That's part of it.

MR. SEITZ: Yes, basically, I mean, and one of the reasons there could be the design standard is easier to implement across a much broader group of people.

MR. WALLO: Yes. And let's note that, you know, the standards for mill tailings, they are based on, you know, that we listed in 10 CFR 40, but it's 40 CFR 192 EPA standard.

Those are basically design standards. It's not a performance assessment. They say you shall design it this way, measure it, and once you demonstrate measurements then you watch it.

MR. WIDMAYER: The only consideration was there were going to innumerable amounts of these facilities in tons of varieties of places. So they said there's only one way to do this, is to come up with a design standard.

MEMBER BANERJEE: So mill tailings would go under hazardous waste, you're saying?

MR. WALLO: Well, I'm saying it's a similar kind of system, more similar than --

(Crosstalk)

CHAIRMAN RYAN: It's different. Because it's confusing everybody.

MR. WALLO: Yes, okay.

CHAIRMAN RYAN: It's different. It's not the same. It's not the same as a performance based system.

MR. WALLO: I agree.

MEMBER BANERJEE: Where will the mill tailings go here?

MR. SEITZ: They're Part 40.

MEMBER BANERJEE: Part 40.

MR. SEITZ: They would be part of that. And the note there is addressing what Andy had said earlier. Radon isn't assessed over this long period. It's assessed at closure.

MEMBER BANERJEE: At closure, okay.

MR. SEITZ: Right. But they do have, in cases where there's multiple radionuclides involved, they do have a 1,000 year assessment period.

MEMBER BANERJEE: So for example, this is an internal discussion, but why are we suggesting something so different from mill tailing, what they do for mill tailing?

CHAIRMAN RYAN: Because radioactive --

MEMBER BALLINGER: Yes. This is not a discussion for them but --

CHAIRMAN RYAN: -- material decays. A lot of the radioactive waste that's disposed decays. And then it's of no consequence. Uranium --

MEMBER BANERJEE: No, all I'm saying is why are we saying 10,000 years, our staff, instead of --

CHAIRMAN RYAN: Why do we think what? I'm sorry, Sanjoy.

MEMBER BANERJEE: Ten thousand years.

MR. SEITZ: We haven't yet.

MS. GELLES: He's focused in on, our core message in this is slide is look how different the NRC staff period of compliance is from these other regulatory regimes.

MEMBER BANERJEE: I think it's not a discussion.

MEMBER BROWN: Is proposing, not is, is proposing.

MS. GELLES: Right.

MEMBER ARMIJO: And that's what you're considering.

MR. SEITZ: And likewise, Part 20 has provisions for disposal or of granting exemptions for disposal of radioactive material in near surface facilities. And they specify 1,000 year compliance period there as well, or assessment period.

MEMBER BANERJEE: So do you get a lot of public comment on this and stuff like that with your orders?

MS. GELLES: Well, they're not readily available for public comment. I mean, we engage the public in a very continuous basis as we're doing clean-up level, or clean-up actions or making clean-up decisions.

And, you know, this ongoing multi-year effort of the NRC to revise Part 61 raises questions with some of our shared stakeholders. But they're questioning how our system is different or how this change would affect our system.

We'll see when we put our revision, or order revision, out for comment this winter. That will be really the first opportunity for folks to provide focused comment on the specifics of our regulatory system.

I think we all have to go to the conclusions, and I'd rather not brief these, but just remind folks that these are echoing the same points that I teed up before Roger and Andy started going into depth.

But we feel very confident about our 1,000 year process. Performance assessment is just one element of our system. It's an informing tool for decision making. It is not, in and of itself, ensuring the protection of the public or the worker.

We've got lots of detailed experience and we brought two of our sites to this panel to sort of acquire lessons, our system, and give you some hopefully really meaningful illustration.

And through this, we hope also to answer some of those questions we took for the later part of our presentation. So if we don't answer them, let's bring them to the table again.

In the interest of time, I think, Mike,

you'd like us to end at 4:30 so the members have time to discuss. So we'll spend about 20 minutes each site.

CHAIRMAN RYAN: Okay, we'll kind of make that decision when we get there.

MS. GELLES: Okay, that's fine. We'll go as fast as we can. And if you need us to go slower let us know.

MR. SEITZ: There's a couple of backup slides there with some quotes from the regulations related to radon and time frames.

CHAIRMAN RYAN: Okay, good.

MS. GELLES: Okay, so we're going to begin with Rob Boehlecke from the Nevada Field Office. And I said this earlier, but I think it warrants repeating.

Nevada is a very important facility within our Department of Energy complex. Because it operates as a regional disposal facility and can accept waste from any of our DOE generating sites as long as they meet the waste certification requirements and comply with the waste acceptance criteria which is, of course, an element of the low-level waste disposal system at Nevada. So, Rob?

MR. BOEHLECKE: Okay, thanks, Christine.

MS. GELLES: Thank you.

MR. BOEHLECKE: I'm going to talk a little bit about how we comply with 435.1 in Nevada. Again, we've got the target graphic here that you've seen a couple of times.

As you'll notice on this graphic, our center circle which represents the site characteristics is a bit bigger than in the previous graphics. And that's to key in on that our site characteristics are uniquely good for low-level waste disposal and the fact that it's very arid.

The rainfall, which averages about five inches a year, is greatly outweighed by the potential of evapotranspiration which is up to 12 times that.

And the depth of the ground water is about 700 feet or more. So we do not have a ground water pathway under current conditions. And in fact, the arid environment provides a significant buffer to potential climate change as well.

We use engineered barriers to enhance the natural barriers. I'm keying in on that defense in depth. Our performance assessment shows that the facility complies with the performance objectives.

And we use our PA, our performance assessment is used daily to help review waste profiles that come in from generator sites that are choosing to or selecting to send waste to us.

The maintenance program, which Roger talked a bit about, allows for continual improvement. Each year we evaluate that performance assessment. We look at our assumptions or models, all that stuff that goes into the PA to determine if it is still a reasonable representation of the disposal site. And again, that allows for continuous improvement.

We do have a strong working relationship with several external stakeholder groups, including our advisory board and the State regulators.

State has authority for the mixed waste component. We do dispose of the RCRA component. But they've also got agreement in principle. They have access to look at any of our documents, including our PA, and weigh in on profiles, waste profiles that we're considering accepting.

The site is, for those of you not familiar with the Nevada National Security Site, it's a rather large site, about the size of Rhode Island, about 1,300 square miles. We have the additional buffer of the Nevada Testing Training Range, which surrounds the site. And there'll be a graphic a little further on that shows you where our disposal site is within that.

The Area 5 Radioactive Waste Management Site, or RWMS, I might say Area 5 on occasion, because that's the location within the National Security Site that it's located, we've actually been disposing waste since 1961.

The first disposal authorization statement was issued in 2000. It had some conditions in it that were talked about a little bit earlier. As we resolved those conditions, it reissued the PA, and the second disposal authorization statement was issued in 2002.

The 2007 change was to update our PA from a deterministic to a probablistic modeling to help us quantify uncertainty and reduce the conservatism in the model.

The PA, I think it was discussed earlier, is revised when we determine that a significant change has occurred that requires and update. And we can determine that locally or, as was discussed, during the annual review process that may be picked up on by the members of the LFRG group.

The PA and composite analysis, again, prepared to understand the hypothetical projections, the dose calculations. The Area 5 PA determined the disposal facility dose calculations, and the CA looks at the dose from surrounding areas.

I'll mention that the disposal facility is located in Frenchman Flat in Area 5 where there were ten above ground nuclear tests or, I'm sorry, 14 above ground nuclear tests and ten below ground nuclear tests. So those source terms had to be considered.

Again, the above ground is there at the surface. But it's not moving very far. And the stuff below ground is deep below ground. And there's no current pathway to bring that to the surface.

Again, the PA looks at post-88 waste. And the CA looks at all the waste that was disposed of prior to 1988.

I've got something out of order here, so not good. I'm going the wrong way.

Okay, so some of the other documents that we're required to have for compliance of 435 include our maintenance plan which was discussed a bit earlier.

That contains our assumptions and our process that guide our day-to-day operations. And our closure plan, including our monitoring plan, looks at how we will close the facility. It has a planned cover design.

Final closure would be revisited at the time necessary. Currently it's assumed closure in 2028. But that will depend on decisions made down the road at other sites in terms of disposal need at the Nevada site.

MEMBER BANERJEE: You said 2028?

MR. BOEHLECKE: Currently that's the plan. It's our planning date. It's based on when we will finish our environmental restoration activities within the Nevada site. Other sites may go on further. And if the choice is made to keep the facility open, it'll have to be re-looked at then.

CHAIRMAN RYAN: You'll be out of current space in 2028?

MEMBER BANERJEE: Yes, based on space?

MR. BOEHLECKE: Right now, no. We've currently, and I think I talk about this a little further on, we've used about 174 acres. And we've got 760 acres.

CHAIRMAN RYAN: Oh, okay. So you're not going to run out of space.

MR. BOEHLECKE: And we still have room --

CHAIRMAN RYAN: That's an administrative decision.

MS. GELLES: Right. It's not a capacity constraint.

CHAIRMAN RYAN: Got it, thank you.

MR. BOEHLECKE: The Nevada waste acceptance criteria is our document that we use to communicate to all the generators about what they can send us. It has everything in there from the concentration levels to packaging criteria, transportation criteria, all of those things we want to communicate to our generators on how they should send waste to us.

MEMBER SCHULTZ: Rob, how would characterize, this is Rev 10?

MR. BOEHLECKE: Yes.

MEMBER SCHULTZ: So how would you characterize the revisions that had been made, is it new waste forms or what?

MR. BOEHLECKE: Many different things, yes. It could be new waste forms. The waste criteria reflects what's in our safety basis documents as well.

So if we look at something else on the safety basis side in terms of how we want to operate the facility, what kind of packages we want to accept, how we want to receive the trucks, something as simple as having uncovered or covered trucks that would potentially change. It also aligns with our RCRA permit, so waste codes and that kind of thing.

So we're currently on Revision 10 which was published this past summer. And that's over, what time period would that be, 16 years or so, I think.

MS. GELLES: Right. And all revisions are not equal. So this last revision was to align it with the documented safety analysis when we had realized we could handle larger concentrations of radioactivity within a single container.

Previous ones, a really significant revision was when we obtained our new permitted mixed low-level waste facility in the 2008 time frame. That was a significant change in the waste acceptance criteria. Because now we could accept offsite mixed waste.

Some changes have been more administrative in nature. When the Nevada Test Site ceased to be the Nevada Test Site and became the Nevada National Security Site, that required a revision to our documents.

MR. BOEHLECKE: Absolutely. There's always administrative changes. The technical changes in the last revision, we're looking at Type A containers, and also classified waste, and how we wanted to receive that and the process we wanted generators for classified waste to go through.

CHAIRMAN RYAN: Does the State have any licensing or authority over the site, State of Nevada?

MR. BOEHLECKE: As far as the RCRA component, yes. They have regulatory authority for our mixed level waste disposal on the RCRA component. And we do have a RCRA design cell that we were talking about earlier.

But again they can, through our agreement in principle, have access to any of our documentation, or we provide the WAC to them for review. They don't concur to it. But we address their comments.

They sit on our panel that reviews all of our waste profiles that come in. Again, they don't have approval authority, so to speak. But they do comment and are free to comment. And we try to address all those comments.

MS. GELLES: But they have no formal regulatory authority over our disposal of straight radioactive waste.

CHAIRMAN RYAN: Got it. Thank you.

MR. BOEHLECKE: A little bit on the natural site conditions that I spoke about earlier. Again, we're about 700 feet above the water, the ground water table, five inches annual rainfall a year, high evapotranspiration rates leading to no ground water pathway.

The water vapor flow is actually up in the upper regions of the vadose zone. And so there's really limited pathways for the buried waste to get to the surface.

You actually have to combine a couple of pathways in terms of the water vapor coming out. Because the actual top feet are not conducive to, it's so dry the water vapor can't get out.

So it has to combine with a biological pathway such as, I think it's on the next page here, such as rodent burrowing or root uptake, that kind of thing. You can see the liquid diffusion and advection stops at about the two meter mark.

So this is our conceptual site model, potential transport mechanisms. Again, outflow is upward in the waste zone and limited pathways, so I'll mention also both seismic and volcanic activity in the area. Key point, no ground water pathway.

Some additional characteristics, there you can see a layout of our site. And right now you can see that there's a flood control berm around the 184 acres in use. The remaining 740 or what's left of the 740 acres are to the west of the facility there in the undeveloped area at this point.

Unique to the rest of the land on the Nevada National Security Site, this is actually owned by the NNSA. Several years ago the deed was taken as opposed to, you know, use of the BLM land. But the deed is held by NNSA.

Again, I'll mention the disposal facility is located within an area that was previously used for nuclear testing. There are other sources of contamination in the area that were considered in the CA.

Only the land and the fact that there's this large buffer around the land, we feel helps ensure the long term management of the site and reduce the potential for those inadvertent intruders we've talked about a bit.

In addition, there are no attractive resources in the area. This is a closed basin, no surface water, ground water's at 700 feet or more. There's no historical evidence that this area has been used for any kind of settlement.

You see the blue lines on there, maybe if they show up. We actually have three wells around the area that are not necessarily for the low-level waste monitoring but were required as part of the RCRA, the hazardous waste monitoring.

Although the waste and contaminants is not ever expected to reach the groundwater, if it does the ground water table is relatively flat. You can see there from the northwest to the southeast corners, about 8,500 feet, and the travel time's been calculated to be over 13,000 years. And that's with data collected over 20 years at this point.

We also have a lot of data in the ground water in the area because of the nuclear testing program, a lot of data on the geology. And the modeling done for the ground water has shown very flat water table well.

MEMBER ARMIJO: You show a number of pits there. How deep are they, typically?

MR. BOEHLECKE: Typically our current practice is to dig them down to about 25 feet below grade. In the past, some have gone deeper. And for special wastes where we want to limit the radon flux to the surface we'll put those deeper as well.

This graphic shows you where in the site the facility is located. It's kind of down there to the southeast corner in an area called Frenchman Flat, as I mentioned.

We really don't have any communities that are close, the closest being Indian Springs which is about 24 miles away across the Air Force land there.

I will note too, again, not that ground water's an issue from the waste, but we do not share, we're not hydrologically connected to Las Vegas, or Indian Springs or Pahrump which are the major communities in the area.

As Roger talked about a little bit earlier, we've got some conservative bias in our assumptions. These include that all radionuclides are available for immediate release at transport.

We don't take credit for the container delaying the source term. We don't take credit for inadvertent intruders recognizing the waste. These aren't in our scenarios.

And for the member of the public scenario, we assume that there's continuously present at the 100 meters from the site, even though, as I mentioned before, there's no evidence of any long term habitation in the area.

And the last point there is we don't take credit for dilution of transport to that 100 meters. So whatever the model shows might be in the cover, any contaminants that might be in the cover, is what we look at 100 meters from the site.

Again, as Roger pointed out, it would only serve to dilute it further. And because we're in compliance already, we don't need to go through that process.

Again, conservative bias is used for compliance. The probablistic model is used to help us quantify uncertainty and reduce conservatism over the long term.

So in 2007, we used the concentration levels. And I think Roger hit on this as well. We used the concentration levels that come out of the model to help set our WAC concentration limits. That helps to protect the inadvertent intruder.

So again, we're not protecting the inadvertent intruder through compliance but setting our disposal limits using that.

Again, as I mentioned, as we move away from kind of the conservative bias and more realistic, we also looked at our resident farmer scenario being highly conservative for our specific site. Because, again, there's no resources there that you would ever have a farm. So we looked at a resident scenario with no agriculture.

This graph is a representation of the mean air pathway total affected dose for the compliance case. You'll note on the left hand side that's a log scale.

So a compliance level which is our resident light blue line there, if you can make that out, is three orders of magnitude below the performance objective, again for a non-farming resident.

MEMBER ARMIJO: Not much worse for a farming resident.

MR. BOEHLECKE: No. No, it's not. Again, for uncertainty in maintenance, kind of inform our decision making, we look at all of our model runs out to much longer times.

Here you can see the representation of the all pathways dose and the 25 millirem performance objective still below that. This is under the chronic intruder scenarios.

We look at things. For sensitivity analysis we'll look at the option of no cover versus various cover thicknesses and run the additional member of the public scenarios. And we can run these out. And I've got a slide that shows a little bit further on that we've run them out to peak impacts. It's the next slide.

It actually gives you the time for the peak impact, all in the millions of years. You can see that the pathways that don't require transport, those are the intruder pathways, are the earliest in terms of peak impact, because somebody's actually digging down to the waste. And these peak impacts are determined with 100 realizations of the model.

A little bit more on the inadvertent intruder analysis, we looked at the two scenarios that Roger described, the construction scenario where a basement is dug into the disposal unit and the acute drilling scenario where a drill crew actually drills through the waste to gain access to water, exposure occurring as they're augering for the surface casing.

Again, these scenarios, not compliant, not driving compliance, but we used them to help set our action levels in our waste acceptance criteria if you look at the concentration limit that sets the lowest level for whatever scenario that turns out to be.

Moving on to our -- I'm sorry, what was your question? Okay. Moving on to the waste acceptance program, two important aspects of that program is our radioactive waste acceptance program in general and then what we refer to as our waste acceptance review panel.

The program itself goes out and looks at all the generator facilities through an assessment program. We'll go out and visit each assessment facility to ensure that they've got processes in place to adequately characterize both the radiological and chemical component of the waste, look at their quality assurance process.

We'll look at, as well, their traceability, their training of their people and how they certify waste that is to be sent to us.

Once we're confident that a site has a

program in place to meet all our requirements, then they can submit a waste profile.

When that waste profile comes in, it's reviewed by the same guys that go out and do the facility evaluations. Or it's also reviewed by our operational people, the people that put together the PA and run the PA, nuclear safety personnel, Federal personnel.

And, as was pointed out earlier, the State of Nevada has three people that will sit on that panel as well and look at that. So the review panel will look at the waste profile, discuss it, ask the generator questions. The generator has to respond to those questions before it can move forward.

At this point, we have 24 approved generators. We may receive waste from more than 24 sites. Because some generators act as kind of middle men. They have compliance programs in place that meet our requirements. And they'll help sites that don't want to pay for that full program ship waste to us.

MS. GELLES: I think this warrants a distinction from some commercial disposal facilities' operations in that we do not have confirmatory statistical sampling at our receiver site with the exception of mixed waste verification activities which are subject to the State's regulations.

So straight low-level waste is not sampled upon receipt to confirm its acceptance. We do that quality control through this generator acceptance program that Rob just described.

CHAIRMAN RYAN: It's kind of the same function Baroque has played in the commercial site.

MS. GELLES: Thank you.

MR. BOEHLECKE: So when a waste profile comes in, the process it'll go through, again, it's very wide. This slide pretty much focuses on the PA portion, making sure it complies with the performance assessment and the disposal authorization statement.

We'll look at four questions for each of these profiles. Does the profile change the radionuclide inventory? And this is the assumed inventory at closure.

And then does it require a change to the facility design, or closure plans or the imposition of operational constraints and conditions? That might mean spacing for specific waste or burying it deeper.

We'll look at whether it alters the likelihood of a feature, event or process or significantly changes a parameter value. And we'll look at whether it requires a change to the waste acceptance criteria or the disposal authorization statement.

If the answer is yes to any of those, we'll run it through our own review disposal question process which includes primarily looking at the inventory changes.

Screening will be done. If it meets the WAC it doesn't need to go through this process if it meets the straight criteria in the WAC. But if it exceeds, we'll look at a screening process using some fractions based on the WAC action levels.

Again, if it passes here, then we don't go further. If it fails that, then we can go through our special analysis process where we put it in the model, run the model. This would be done for radon producing radionuclides and heat producing potential.

Some of the waste, one waste stream in particular we received in the past couple of years with some radiothermal electric generators which have a potential to produce heat in the soil insulating it, can cause a problem.

And so we looked at those through a special analysis. And I think I talked a little bit about that.

MEMBER ARMIJO: Are those the PU-238 sources or --

MR. BOEHLECKE: No. These were strontium

sources.

MEMBER ARMIJO: Strontium, yes.

MR. BOEHLECKE: So through that process we can impose operational conditions, again, depth and spacing.

In the case of the RTGs, we looked at spacing from each other, spacing from other waste and continue to monitor the heat that is produced by those units. We'll also look at radionuclides that may not have been analyzed in the PA when it was first set up.

Example of a special analysis, look at thorium nitrate waste that was disposed in Cell 13 a number of years ago, quite a large waste stream with several radionuclides exceeding the action levels that were in our waste acceptance criteria.

And through our special analysis process, we determined that it would be effective to limit the radon dose or radon flux at the surface by burying the waste in a bit deeper trench in a single layer with no waste on top of it.

So you've got that additional soil counteracting the radon flux at the surface. So you can see how the disposal was modeled there, the waste thickness and the total cover representing over 25 feet.

MR. SEITZ: That's an example of what happens if you get calculations that are above a standard at some time.

MEMBER ARMIJO: You just fix it with a depth or something. In this case, is a form of the thorium nitrate such that it is releasing the radon so it can diffuse out slowly? Or is it encapsulated or what?

MR. BOEHLECKE: I don't have the details on that. It was disposed of some time before me.

MEMBER ARMIJO: Just curious.

MS. GELLES: We can get the answer to that question.

MEMBER ARMIJO: I'm just curious about it, whether you want it to accumulate or just routinely release.

MR. BOEHLECKE: Diffuse out and decay by the time it reaches the surface.

MR. SEITZ: Confining it is the goal.

MR. BOEHLECKE: Our PA maintenance program includes ongoing field study, environmental monitoring where we've used the PA and CA to look at those things that we may be able to get more information on, further refine or model.

One example of that is we were able to conduct field investigations to determine how the roots actually work to bring up moisture in the distribution for burrowing animals.

We've also had a continuously running vegetative cover on a long term lysimeter. I believe it's over 20 years that that's been collecting data. We have not have water reach the bottom of that.

The annual summaries document all of the updates to the modeling, the inventory updates, the monitoring and operations of the facility and any new studies that have gone into it.

Additionally, the PA update looks at all the conditions and comments that have been previously provided by the LFRG group and how we've addressed those. So even in today's summary for this latest year, you can go back and see how we've addressed the previous comments.

MEMBER REMPE: Has there ever been any major differences between the data and the modeling, and then you've had to make changes to the modeling?

MR. BOEHLECKE: I don't know about major, but the new, you know, radionuclides we haven't looked at before. We'd certainly have to then consider those.

MR. SEITZ: I think for a site with ground water there's, I guess, I would say there tend to be differences. Because what we're trying to do with the modeling is provide a conservative bias.

So where we'll get concerned is if we start seeing concentrations that begin to approach what the model showed. And occasionally you'll get point measurements. And that actually triggers quite a process.

Anytime there's a point measurement that starts to challenge a model assumption, we'll take a closer look at that. And it could cause a need for more frequent sampling.

MS. GELLES: Yes. And I can't think of any significant differences at Nevada, with the exception of where we've introduced a new radionuclide to the inventory.

And, you know, there's some detectable presence of it, but not from a release standpoint. Because that would be different than what we had modeled before.

MR. BOEHLECKE: And our monitoring has not identified any transport at this point.

MS. GELLES: I just don't think that's happened.

MR. BOEHLECKE: And for ground water sites, you get point measurements. Mother Nature doesn't cooperate a lot of the time.

CHAIRMAN RYAN: So what do you expect in the long haul at this site? Is it a diffusion site? Is anything in your waste containers ultimately going to diffuse? Or is water close to the bottom of the disposal cell? I'm trying to just get a feel for it.

MR. BOEHLECKE: No. I mean, the modeling shows that, you know, it's going to basically remain there on --

CHAIRMAN RYAN: I'm not interested in the model. I want to physically understand the site a little bit better. What's the depth of the saturated zone from the bottom of the trench?

MR. BOEHLECKE: Over 750 feet.

CHAIRMAN RYAN: Seven hundred and fifty feet, okay. So clearly you don't have to worry about it.

(Crosstalk)

MR. BOEHLECKE: Precipitation that comes down never reaches the ground water.

CHAIRMAN RYAN: Right.

MR. BOEHLECKE: It's evaporated back out or taken up by the plants. So there is no ground water pathway, which makes it an excellent site.

CHAIRMAN RYAN: Sure. Again, I'm just to understand it.

MR. SEITZ: It's extremely depositional, isn't it?

MR. BOEHLECKE: It is in a depositional valley. It's a closed basin range area. So there's no surface water outflow. There's a dry lake bed in the middle of the valley.

CHAIRMAN RYAN: And there's the 40 inches of rain a year. So I'm envious.

MR. WALLO: Tectonic plate movement could move the site to California in about 2 billion years.

(Laughter)

MEMBER RAY: To introduce just a little more soberness here, you know, I was involved in the low-level waste siting in California for a regional site. You guys are familiar with a different geologic setting, but temporally it seems the same, a dry desert site. It's not like this but close enough.

The problem that I see is this is all very, very responsible and complete. It's the best job you could imagine.

But transferring it into the world where a low-level waste site has to be sited in a different context, I just don't see how you do it. Because you can't say many of the things that you've been saying about the responsibility that DOE will exercise over time.

CHAIRMAN RYAN: The batting average is definitely not good.

MEMBER RAY: Anyway, in theory, as you know, so to me it does very much depend on whether you're in Utah or in California what the outcome is going to be.

CHAIRMAN RYAN: Oh, sure. Illinois, Pennsylvania, North Carolina too.

MEMBER ARMIJO: Okay.

MS. GELLES: All right.

MEMBER ARMIJO: here's Savannah River, that's not a --

MS. GELLES: Yes. We're very, very close to Savannah River.

MR. BOEHLECKE: Two more slides. So again, we have used research and development to do some looking through our model.

And we're able to optimize our cover when the facility first went through an authorization statement. They assumed a four meter cover.

Looking at using the model and the inputs over the years, we were able to optimize that and show that a two and a half meter cover still meets the performance objective, and there's very little additional dose. And that extra meter and half would cost a significant amount.

And final cover decisions will be made at the time of closure. But we're able to show that right now a two and a half meter cover would make a lot more sense.

Again, the PA revision is driven by a magnitude and significance of changes.

And final slide, just a kind of summary, again, the natural and engineered barriers, and the fact that it's sparsely populated, make it an excellent site for low-level waste disposal.

The WAC compliance, again, going into our defense in depth principles, aid to help protect inadvertent intruders.

The site assessment, PA and CA, again, makes up one part of the whole system to look at defense in depth strategy, and our maintenance program that allows for continual improvement and refinement of the model through the iterative process and taking into account whatever you may have learned over the course of the previous year.

MS. GELLES: Okay. So to transition to Savannah Site, another DOE site that has multiple low-level waste disposal facilities within it, Sherri's going to give us a presentation on a subset of those, but a couple of really significant differences, different hydrology, different mission purpose.

Because the facilities she's going to talk about are accepting only waste streams that are part of the liquid waste system from Savannah River.

Whereas what Rob was describing, particularly his daily use of the PA, had everything to do with the fact that he's receiving waste from 24 approved generator sites. And there's great heterogeneity amongst those waste streams, so same DOE system, same DOE defense in depth concepts, but applied very differently.

Are you with us, Sherri?

MS. ROSS: I am. Can you hear me?

MS. GELLES: We sure can.

MS. ROSS: Well, I appreciate you all making the effort to allow me to participate by phone. And please let me know if you've got any questions.

I'm going to start with Slide 2. Again the defense in depth approach here was the multiple systems in the program that provides protection to the public.

But at Savannah River site, as Christine mentioned, it is a very different site from Nevada, our site being very humid in nature, we do take credit for both natural and engineered barriers to demonstrate compliance.

And all our disposal and closure facilities do comply with performance objectives. The PA and the maintenance program supports continuous improvement and continued compliance.

And so we'll take a look at those things that we have uncertainties about in the out-year peaks and see what we know about those and run those in our maintenance program, what R and D do we want to go get, what new information do we want to know, and update our analysis.

We have a strong external stakeholder involvement here with the State, and EPA, NRC and the public. And one of the members asked a question about feedback from the public related to doses and out-year dose and risk. And I'd like to answer that question.

Our citizens advisory board, which is one of our public avenues for getting information to the public, is very concerned with the current risk associated with our waste being stored in underground aging tanks versus, you know, being real concerned about the model showing results way out in the out-years.

They want us to concentrate on the current risk versus long-term risk, so just as a feedback point from our members of the public here at Savannah River.

Going on to Slide 3, a very large site at Savannah River, 310 square miles, Federally owned and controlled land, access is controlled on to the site.

Communities are located approximately six miles from the closure and the disposal facilities which are located predominately in the center of the site. If you look at F, and H and Z, those purple areas sort of in the center of the site, those are the facilities I'll be referring to today.

All site waterways do flow to the Savannah River which forms a western boundary for the site on the southwest side. Anyway, any questions about the site in general?

MS. GELLES: You're okay.

MS. ROSS: All right, Slide 4. So compliance with the DOE order, liquid waste facilities are either disposal facilities such as Saltstone or closure facilities, the F and H Tank Farms.

And they are very different. Saltstone is designed to receive waste for disposal. And the waste is homogeniously blended in a grout form.

The tank farms are actually, the tanks are cleaned and they're emptied, they're cleaned and then they are closed with, you know, the residual source term is left there by filling the tank with reducing grout so the waste predominately under the surface areas that are contaminated is located predominately on the bottom of that tank.

All facilities have performance assessments. I've listed the major dates here for the PA revisions, 1992 and 2009 for Saltstone, F Tank Farm, 2008, revised in 2010, H Tank Farm, 2011, revised in 2012.

We do have a composite analysis on the site that covers all radioactive residues that were left on the site. That encompasses not just Saltstone and F and H Tank Farms, but our E area low-level waste disposal facilities and any other radioactive material that'll be left on site. And again, Andy had talked about some of the requirements of those.

So moving on to Slide 5, annual performance assessment maintenance plan and disposal facility summary reports are prepared to assess what have we learned, what do we need to know, what operations have occurred, and evaluate our compliance against where we stand in operations against that performance assessment.

There's also a disposal facility that does include disposal authorization, document, waste acceptance criteria, the radioactive waste management basis, closure plan and monitoring plan. And that is your typical disposal facility.

The tank farms are actually closure activities. So we are not receiving waste into the tank farms. We're closing with the residuals that are there, that only order requires Tier 1 and Tier 2 closure authorization plans. Again, we do also have a monitoring plan associated with that.

And for these three facilities I'm referring to, they are permittted by the State of South Carolina. And so they are very much involved and approve and authorize those activities as well.

We continuously ensure conditions remain as evaluated in our documents through this program of continuous improvements, your annual reviews, your maintenance plans.

I've got, on Slide 6, a detail of natural site conditions. Closure facilities range from usually within the water table to approximately 20 feet above the water table. So that's what I've got shown.

On the bottom left-hand picture there is four H Tank Farm tanks. Tanks 9, 10, 11 and 12 are actually in the water table as constructed. It was during a period of drought.

These were designed for gravity feed from the canyons. They were recognized that they might be in the water table. They were treated. And you'll see the historical water table level there depicted above the top of the tank.

So we do have four that are in the ground water. We have four other tanks in H Tank Farm that the feet are in the ground water. The other tanks are above the elevation.

On the right hand side of the slide, there's a picture of Vaults 1 and 4 at Saltstone. And you'll see the blue line depicts your average water table.

And then we do have a tan clay underneath ground water flow. And the wells are located around those units. So we do have ground water monitoring, actively has been for a long time in the F Tank Farm, and H Tank Farm and around Saltstone. But again, the disposal facilities are about 50 feet above the water table.

And we do have a lot of water, you know, rainfall. I guess I've got another slide that's covers that, yes, Slide 7. So a humid environment, about 49 inches average rainfall annually, about 16 inches infiltration rate.

We have multiple potential exposure

pathways from some of the material over time. Ground water is our predominant pathway at Savannah River. Natural soil characteristics such as the clay in the ground does provide a barrier to movement of certain contaminants. And the site has low seismic and volcanic activity.

So on Slide 8, engineered features, we do have design engineered features for the disposal enclosure facilities as part of the system performance. Examples are closure caps, the disposable cells like the vaults for the tanks or the Saltstone vault, and engineered waste forms such as the reducing grout that's used at Saltstone and used to fill the void space in the empty grouted tanks.

And you can see there sort of a depiction of the conceptual model with the multi-layer closure caps, back-filled soil around the grouted tank. You can see that the entire tank is filled with grout.

The large contamination zone is at the bottom there. There's a base mat, still monitor. There's a concrete vault on the outside of that for all waste types, undisturbed soil and, you know, vadose zone and saturation zone underneath the tank system. And all these are modeled in our model.

Going to Slide 9, conservative biases, some examples of some of the evaluations the conservatism's replaced in the model to support our decision making process.

We do evaluate compliance 100 meters from the edge of the facility. And to go show as stakeholders, we are planning for Federal ownership of the site. But we just do not take credit for more than 100 years in our performance assessment.

And even though the site also was six miles from the boundaries, and we have boundary controls, we assume we lose institutional controls and the intruder or the members of the public actually get onto the facility, at 100 meters for the public, intruders actually on top of the site.

We do use peak aquifer concentrations, although wells normally are typically not placed in the shallow aquifers. There's three aquifers around these systems.

And though we will take the highest concentration, which is normally in the upper aquifers, you know, our ground water's so shallow, and it's easy to drill here that normally wells are placed to the lower aquifer just in times of drought. They don't want the wells to go dry. But we do use the highest concentration in the upper aquifers for determining dose.

Intruder resides directly on the facility. And we also assume for like F Tank Farm has 22 tanks, three different tank types. We assume those tanks fail at the exact same time.

And Saltstone, same thing, the SGE is a similar design, all fail at the same time. That gives us is some conservatism in the contaminants moving at once.

I'll give you peak doses. Moving on to Slide 10. So modeling, include anticipated conditions, robust sensitivity and uncertainty analysis. We're doing both deterministic and probablistic analysis in our performance assessment.

We do include detailed characterization of the residual material during disposal and closure operations.

The disposal facility, we do use a waste acceptance criteria very similar to what Nevada was explaining to evaluate proposed disposed streams and ensure that those streams are going to maintain compliance with the performance assessment and is against those objectives through the controls that are established through our waste acceptance criteria.

Closure facilities, we do have an overall PA for the whole tank farm. But as we clean the specific tanks, we will go in and characterize those and, you know, actually look at the final residual material and how it was inventoried in the previous modeling or update that modeling to address any changes in the actual source term.

So Slide 11, let's give this one some numbers here. Slide 11 is a depiction of a H Tank Farm performance assessment, the base case. It's a deterministic run.

These doses, these lines are not additives. They do depict the Sector A through F, which are the colored lines on the graph, are individual locations 100 meters around the facility if you were to draw a circle around the facility. We've just depicted segments of that line by Sector A, B, C, D, E and F.

And so what we're showing here, this is 1,000 year graph. We do have multiple tanks. We have 29 tanks, three evaporators, miles of transfer lines which are all source terms that are feeding the results here.

So this is a large scale graph. And for 1,000 years not much dose is actually coming from it. We do, as depicted and described earlier, we will model to peak.

So you can see on Slide 12 the 100,000 year graph. And this, again, is a large scale. It's water pathway, again, the H Tank Farm base case deterministic run. So it includes all those source terms.

And again, it's not additive and it's the same Sector A thorough F. So you can see, you know, the doses are approaching around 100 in the out-years. Typically, you know, 10,000 years or below, even out to 25,000 years, you're below ten millirems as your average expected dose from this case and set of assumptions.

I do want to state that, you know, DHEC, and EPA and the public, you know, we describe our analysis to the public. They're all very much aware of the results in our analysis.

We'll depict both the base case and alternate sensitivity cases and the probablistic run and show that, you know, what's the doses in the short term, what are the doses in the long term.

And they're very comfortable with moving forward based on the results, even if they're showing some higher risk in the out-years.

MEMBER REMPE: So, Sherri, I've got to ask. On Slide 11, what happened between 150 and 200 years with Sector C and Sector A?

MS. ROSS: You're talking about the 100

year doses?

MEMBER REMPE: Yes, 150 to 200 years after closure.

MS. ROSS: Yes. What we've got is some transfer lines that are in the tank farms which we know are contaminated. We're not assuming that those transfer lines are grouted. Because even if we grouted them, the grout would be on the inside, and your contamination's on the pipe walls. Those pipe walls will degrade.

So that source term is also not nearly as deep. And it's going to corrode. Those are going to be one of the first release of contaminants. So what you've got is a little bit of more mobile radionuclides being released from the transfer lines when they corrode in the ground.

MR. SEITZ: It's the lines that connect the tanks to other --

MEMBER REMPE: So something happened and the dose went away between 150 and 200 years.

(Crosstalk)

MS. ROSS: Well, it's not really going away. It's just so low it's not really showing it up.

MEMBER REMPE: Okay. I just was curious. Because they're trying to sell the land.

(Laughter)

MEMBER ARMIJO: Well, you got me started. Between 550 and 650 years there was a lot of ups and downs. What happens there? Is some physical --

MS. ROSS: Well, there're different source terms. Remember we've got 29 different tanks. They're all located at different distances from the 100 meters.

You've got evaporators, you've got diversion boxes, you've got transfer lines. These have different source terms, different rads or different mobility. They travel at different rates. Also in H Tank Farm, what was I going to say --

MEMBER ARMIJO: Well, just talk about Sector E. It goes through this undulation. And what's actually physically happening? Is there --

MS. ROSS: Well, also in H Tank Farm, a couple of the tanks, the liners are failed at Time Zero. And other tanks are failing at different times. So what you've got is different rads, different source terms are being released at different points in time.

And you lay it out on a graph and this is what's occurring. But again, in the 1,000 year window, the doses are all less than one. The scale is really blown up.

MEMBER ARMIJO: Well, I understand.

MS. GELLES: But the variability for Sector F, or Sector E, is a function of where that sector is located in the tank farm in relative proximity to different types of tanks that have different release rates or different radionuclides. And we probably presume too much. So there's, how many tanks total are there in H, Sherri?

MS. ROSS: Twenty-nine tanks.

MS. GELLES: So 29 tanks which are not identical in terms of the residual material, not an identical design, not identical integrity of liners. So each one is going to perform a little bit differently in the model. And these sectors are different locations within that tank farm. There's one single PA for the entire tank farm.

MEMBER ARMIJO: So these are composites.

MS. GELLES: They are composites, thank you. I was coming to --

MS. ROSS: Yes. This is for the entire H Tank Farm, for all source terms.

MR. SEITZ: Yes. It's more than tanks.

MS. GELLES: Right, and transfer lines.

MEMBER STETKAR: I hate to ask about this, but I'm required to.

MS. ROSS: Okay.

MEMBER STETKAR: These are nice lines, little colored lines, and they go all over the place like over 100,000 years. And you say you've done a probablistic analysis.

Do you count for uncertainties? I mean, how do I interpret these lines? Are they the mean value of an uncertainty analysis? Or are they just a line?

MS. ROSS: Okay. This evaluation is the base case deterministic line. We have other lines on sensitivities and the probablistic analysis. I'm not showing those here.

MEMBER STETKAR: Okay, thank you.

MS. ROSS: They're all inside our performance assessment. We do account for uncertainty and variability.

MEMBER STETKAR: It's just I read the title on Slide 12 that says risk informed. And that always means something --

MS. GELLES: We probably should have provided a little bit more narrative context for this specific graph. But Sherri does have a few slides --

MS. ROSS: I'm going to get more into --

MS. GELLES: -- that compare.

MS. ROSS: -- out-year doses and what we

do to address this. So we're informed in making our decisions. But we haven't actually made decisions to close H Tank Farm yet. Because we're consulting with NRC actually.

But we're aware that, you know, in the 40,000 year out time frame that the doses are approaching 100 millieme. We know that's, you know, approximating the public standard. It's above 25. And we'll factor that into our decision making.

But again, we will concentrate on the risk reduction today and knowing that what in the model is causing these peaks. We want to be informed by what's causing the peaks, how high are they and what can we learn to address those uncertainties and hopefully remove any concerns associated with that.

I've got some more examples I'm going to get to in just a couple of slides. I hope to explain that, what we've done with out-year peaks associated with F Tank Farm.

So on Slide 13, ongoing compliance, we do have a rigorous unreviewed waste management question. It's the same thing as a UDQE that was previously discussed at Nevada to evaluate new information or proposed activities against unexpected conditions.

When we find something new, your KD was off or we had more waste in the tank than we thought we would, anyway, we can evaluate those through this process.

And it can result, depending on the complexity of the new information, in determining that there was no impact, that activity can continue. Or we just need to do a more detailed evaluation. Or it may result in a special analysis which is an addendum to your performance assessment where you rerun your model to provide new information.

So on Slide 14, let me get into some more detail on how we might address out your doses. And this is a 10,000 year graph. And this is graphed from our Tanks 5 and 6 special analysis. And what is showing here is the rem line, is the original F Tank Farm PA base case, all pathway base case analysis.

We also ran, in Tanks 18 and 19, special analysis, the same case with new inventory from the actual inventories. We cleaned Tanks 18 and 19.

In Tanks 5 and 6 the solid darker blue line is the exact same base case with the actual inventory after cleaning Tanks 5 and 6. So you can do a comparison there.

Again, this is a log scale. These are not additive doses and they do reflect the entire F Tank Farm, 22 tanks and ancillary equipment, source terms over a 10,000 period.

So what we did in the Tank 5 and 6 special analysis, we also did a composite sensitivity analysis to determine the impact. And that's the light blue line. And not much difference really in the 10,000 year window.

But if you go to the next slide, on Slide 15 for the 100,000 years, the exact same model run from the Tank 5 and 6 special analysis just plotted over 100,000 year window, we were looking before about the 500 millirem doses occurring around 40,000 years. And you'll see that's now dropped below ten based on the new information that we did consider.

So looking at the graph, if you will again, not an additive dose, and it does represent the whole tank farm.

The peaks are occurring around 25,000 years, that red and blue dotted line, which from tech-99 from the Type 1 tank, we have eight Type 1 tanks in F Tank Farm, and we have put a tech-99 source that we didn't think was real. But we wanted to determine where the impact was if we did leave some tech-99 in the tank farm.

And it did show that we would have a high peak, about 500 millieme. But based on the actual, tech-99 is very soluble, it's very mobile in the environment. And we do use several million gallons of water physically to clean a single tank. And so we thought the tech-99 would come out of the tank.

And we were able to confirm that with the Tank 5 and 6 cleaning and characterization data. So that peak actually goes away in the Tank 5 and 6 special analysis.

So the second large peak there around 500 in the 40,000 year window was occurring from plutonium 239. And so we had a solubility expert review with some recommendations. And so we changed solubility release numbers based on the NEA database that was fed into our Geochemist's Workbench to update the solubility numbers and the release mechanism for the radionuclides.

We also updated KDs in soil based on cement leak shape at a higher PH. Because each of these tanks range between 750 and 1.3 million gallons a piece. And we do believe that, you know, roughly a million gallons of high PH cement will affect the leaking of the rads that are located underneath that material.

So as a result we were able to address some of the uncertainties and come up with an analysis that now is predicting the doses will be less than ten millirem.

So this is an example of, you know, we are informed by the out-year doses. And we will continue to evaluate the risk in our decision making process as well as remove that uncertainty with new information as it becomes available. Any questions on Slide 15?

MR. SEITZ: Sherri, I just wanted to make one point. I think it's important to realize that there was quite a lot of time and effort spent to address those potential peaks at the long times.

MS. ROSS: They were.

MR. SEITZ: And in the end, nothing really changed. There was a refinement --

MEMBER ARMIJO: Nothing physically, but the models were --

MS. ROSS: Right.

MEMBER ARMIJO: -- refined, if you will.

MS. ROSS: Exactly.

MR. SEITZ: So it's a refinement of assumptions.

MS. ROSS: Right.

MR. WALLO: And it was not a small task though.

MEMBER ARMIJO: It was a lot of effort.

MS. ROSS: It was a lot of effort.

MR. SEITZ: And a lot of resources put into it.

MS. ROSS: Yes. We spent quite a bit of money and about six months to address this before we closed Tanks 18 and 19 and --

CHAIRMAN RYAN: Correct me if I'm wrong, but was a lot of that --

MS. ROSS: Yes. The regulatory agency, the EPA and DHAC were not concerned at all with these out-year peaks. They wanted us to go ahead and take actions.

Because again, like I said, they really do focus on the short-term risk. They're informed of the out-year risk, but they're not overly concerned. And they don't want us to wait and make closure and risk based decisions to address it.

In this case, we actually had a 18, 19 special analysis sensitivity run as well. I'm showing the five and six sensitivity state here in this slide. But we did address that before closing Tanks 18 and 19.

MS. GELLES: Sherri, there's a question. Hang on once sec.

MS. ROSS: Sure.

CHAIRMAN RYAN: It sounds like part of this was maybe some, you know, transfer lines and other kinds of hardware failures that you sort of discovered as you moved stuff around in the tank farm. Is that right?

MS. ROSS: Yes. You've got to remember there's multiple types of tanks, that each are failing at different times, they're different distances from the 100 meter. Your transfer lines are failing earlier and so your different source terms, and each radionuclides is being held up. There's multiple barriers here. But each barrier will perform differently based on the radionuclides.

CHAIRMAN RYAN: But the transfer lines, Sherri, were mostly the earlier time periods.

MS. ROSS: That's correct.

CHAIRMAN RYAN: These late time periods, it was just the modeling of the various parameters there in the tanks themselves.

MS. ROSS: That's correct. And what we had done eventually, basically, is we had turned the plutonium, we had made it soluble. And it really doesn't ever become soluble. We just wanted to know what it would do in the out-years. So we fixed that with the sensitivity analysis.

CHAIRMAN RYAN: Thank you.

MS. GELLES: All right, girl, bring us home on PA maintenance.

MS. ROSS: Okay. So on Slide 16, I've just got some pictures here of ongoing science work that we've done to support our PA and special analysis.

So up on the top hand left corner is a technetium column test being done at PNNL. And on the bottom left hand column is some field activities and a lysimeter that actually is exposed to rainwater. That's being done through our National lab here on site.

In the field in the center of the graph is a mockup core drill that's going to support our Saltstone disposal unit activities. Top right is Clemson University research on technetium. It's a batch experiment ongoing.

And then in the bottom right is, at the National lab, an oven that can control both exterior temperature and humidity to support our Saltstone disposal activities as well.

But what I'm trying to portray here is that we do have ongoing R and D research to try to find out additional information that's important to the performance of our facility so that we can roll that back into, you know, additional modeling or the next PA update if we need to, so just some examples there.

So the PA and maintenance program, Slide 17, is evaluating update on an annual basis to look at what our available funding is and what's the priority. And sometimes we may have to push off things for another year.

But again, we're addressing out-year, you know, risk. We think we can wait a little bit to address that. But we do have a program to identify that.

Annual summaries are conducted on the disposal facility document, the actual operations, any science work that's been done and monitoring. We do annual monitoring of immediate conditions to see are we seeing something different than we anticipated.

So in summary, on Slide 18, you know, special analysis of performance, key information becomes available and performance assessments are revised on a periodic basis.

But they're entirely being driven by the magnitude and the significance of the changes in the model system. So we won't do a PA revision if we don't need to. But based on the annual reviews, if we find out some new information, we're concerned with maybe the impact, then we'll go ahead and run a new PA or special analysis.

And that's pretty much it. So any questions?

CHAIRMAN RYAN: That was a very thorough

review. Thank you.

MS. GELLES: Thank you, Sherri.

MS. ROSS: Thank you.

MS. GELLES: Thank you for your patience with our very long presentation.

MALE PARTICIPANT: No, it was very interesting.

CHAIRMAN RYAN: No, it's all very interesting. I appreciate it. Shall we go around? Let's see. Well, any questions or comments?

MEMBER BALLINGER: Not really. I thought it was great, very, very, very thorough. This is excellent.

CHAIRMAN RYAN: Good.

MS. GELLES: Thank you.

CHAIRMAN RYAN: Harold?

MEMBER RAY: Well, I've already said, but I think I want to underscore it again, agreeing with what Ron has said and also the fact that what's being described here is comprehensive. And I can't see any way that it could be improved. Transferring it into our world is what I find daunting for a whole variety of reasons that I won't go into.

CHAIRMAN RYAN: Oh, gloveboxes aren't exactly in the reactor scheme of things.

MEMBER RAY: Well, I'm more dealing in the process environment and the fact that you have, we're talking about something prospective instead of Savannah River which is retrospective.

And we're talking about setting up rules that are enforceable and can be met by proponents with some confidence that they're not going to get stuck after three years with a failed enterprise like I went through.

And that's just the difficulty I am struggling with. Nevertheless, this is good information. And hopefully we can make some application of it to the environment that we're concerned with.

The last thing I'll say, and then I'll quit, is also I think that the perspective here is, although we saw the charts going way out in time, and I do mean way out in time, I don't know that we can replicate those for the things that we're having to address with the same certainty that we need, or with the degree of certainty that we need in order to be successful in licensing a low-level waste site in the public arena. I'm done.

MEMBER SKILLMAN: Thank you for a very comprehensive briefing. I just want to make three points.

I have a good buddy who worked for Dr. Ray, Dixie Lee Ray. And Dr. Ray had a piece of copper wire about so long on her desk. My buddy said what is that? And she said, well, that's the speed of light in one nanosecond.

And light is about 300 million meters a second. And if you divide by a billion, you get a piece of wire about that long, but the point is a practical application.

We've been kicking this 10,000 year versus 1,000 year around for months now. And I've been trying to get to a place in my mind where a number makes sense.

The Magna Carta was presented in about in 1250 AD. That's about the first time a stone was laid for the cathedral in Cologne. So there's a document that is actually part of our law today and a building that you can visit tomorrow if you were to fly to Cologne.

There's evidence of a period of control, a structure, something that we can see and put our hand on that's 750 years old. It makes sense. So I think maybe 1,000 years is something that is supportable.

Because there is evidence that men and women have been able to maintain a chain of custody, or an oversight or some collaborative effort to keep that thing in tact. So I've kind of come to a point where

I think this 700, 800 years is probably a pretty good number. And it certainly beats 10,000. Thank you.

MS. GELLES: Thank you.

CHAIRMAN RYAN: Thank you. Steve?

MEMBER SCHULTZ: I want to echo that I really appreciate the presentations today. They were very well done and provided us a lot of information.

For me it was extremely thought provoking, especially as we've already heard from members of the committee, the far reaching process of thinking that is looking at that long time horizon and trying to put it in perspective with regard to our current knowledge, past knowledge and what our future knowledge might be about not only what ought to be done but also what the metrics might be and how they might change. It's very thought provoking. Thank you.

CHAIRMAN RYAN: Thanks, Steve. Joy?

MEMBER REMPE: I think my colleagues have said it better than me, but I also learned a lot from the discussion today. And I'd especially like to say that I appreciated the emphasis on how the metrics have changed over the years in looking at the future.

I have a question though. I agree that the 10,000 year is difficult to be showing. Why do you even go beyond and show plots that are even beyond 10,000 years when we all agree that it's not worth doing. And doesn't that just cause you heartburn? And what would happen if you suddenly would quit showing those types of graphs in your annual reports and --

MR. SEITZ: Let's let Sherri --

CHAIRMAN RYAN: Sherri, do you want to answer why you're showing plots out beyond 10,000 years?

MS. ROSS: Sure, sure. We do, actually. We do want to be informed. We want to know what's causing the peaks. When would the peaks happen and why? What assumptions went into the model that's causing that peak?

So what barrier is failing that's causing those peaks. And how high are they? Can we redesign the barrier? Is it some feature of the barrier that's very important? Is it one isotope?

So it informs our design, and our disposal operations and our closure activities so that we can take actions if necessary.

MS. GELLES: So since our policy is to, period of compliance is 1,000 years, but then evaluate and model out to peak impacts.

To curtail that by any point cut off, whether it was 15,000, 10,000, you know, 12,500, would suggest that we have somehow decided that everything after that is not relevant.

And as long as those peak impacts don't need to be mitigated for purposes of demonstrating compliance, but can be used to inform and improve our ability to comply, it's still useful information.

Does it raise questions that we have to answer? Absolutely. But we hope that the gain of it in terms of additional information that helps us engineer our system outweighs the pain of having to explain it to people.

MEMBER REMPE: I can appreciate it, although I heard discussion. We spent a lot of money on something rather --

MALE PARTICIPANT: A concern.

MEMBER REMPE: -- and so sometimes it, yes, it sounds like you have a good perspective on it. But it's just something --

MEMBER ARMIJO: And it might be, you know, what I got out of it is you got smarter. But physically nothing changed. And if the analysis hadn't been done at all, nature would behave pretty much like your more final analysis, and there'd be no problem anyway.

CHAIRMAN RYAN: I think I can provide some insights that might really nail it down. I mean, she talked about different radionuclides being important at different times. And she got some insights that were qualitative rather than analytic, I think.

MEMBER ARMIJO: Nothing wrong with being smart. I have nothing against it. But it's expensive. And in a commercial low-level waste site, does it really add much to require that on a --

CHAIRMAN RYAN: The only difference is she --

MEMBER ARMIJO: -- something that doesn't have the Treasury of the United States behind it.

MEMBER STETKAR: In this case, you know, I think the observation was nothing, in an engineering sense, changed.

On the other hand, there could have been an analysis of a different facility where perhaps, and again in Harold's term, a prospective analysis rather than a retrospective analysis where perhaps, you know, subtle changes in the difference of a design or difference in the burial depth, you might learn something.

And I think that's a little bit of what I heard Sherri saying, what I hear the whole group saying.

MEMBER ARMIJO: I think in the case of the DOE, they handle such a variety of complex waste compared to what I would expect in a civil or a commercial, but

I don't know.

CHAIRMAN RYAN: You might be surprised.

MEMBER ARMIJO: There might be more payoff --

CHAIRMAN RYAN: I think the broad spectrum of users that use a commercial low-level waste site is fairly substantial, everything from veterinary hospitals to you name it. I mean, there's all kinds of different waste streams.

So it's probably not as comprehensive a set of streams as the Savannah River site, of course. But it's not one or two either.

MEMBER ARMIJO: Yes. But, you know, the thing that's, from a regulatory standpoint, if we were requiring similar type of in depth analysis, very expensive analyses for low-level waste sites, commercial, I just wonder if that's the right way to spend our resources.

MEMBER RAY: But, Sam, it's not just the cost of the analysis. What I'm suggesting is the analysis has to be agreed upon not only by us but all the other parties to the decision.

And therefore, you know, you can say well, we ought to do it maybe. It only costs this much, do it. But then it becomes now, all right, what do the results mean? Does everybody agree with it? Is it another basis for controversy?

That's where I think DOE largely, I know they have internal controversy, but in a forum that we have to deal in, I'm more concerned about putting things like that on the table than I am the cost of getting them on the table. Because how do you then get them resolved? You can't, is what it boils down to. That's all.

MEMBER BALLINGER: Now I have a question. Can I have a question?

CHAIRMAN RYAN: No, you can't.

(Laughter)

MEMBER STETKAR: You'll get over this in awhile.

MEMBER BALLINGER: In your interaction with the public, what spun the public up the most, the long-term analysis and they were worried about that or the short-term?

MS. GELLES: Are you asking that of Sherri?

MEMBER BALLINGER: Yes.

MS. GELLES: Because she's got a very specific experience.

MEMBER BALLINGER: Because you had a lot of public interaction. So where did the public get exercise?

MS. ROSS: The public is much more concerned with the short term. And their concern is it's going leak before I empty them and close them. But they want me to get on with it.

MS. GELLES: Right. Until you can, that prolonged analysis, you know, perturbs our ability to progress and empty the tanks. And they get very concerned.

MR. SEITZ: No. They're more concerned with delay than with assessment.

MS. ROSS: They'd rather me not spend a lot of money on R and D on those out-year, you know, 30,000 year doses. They'd rather me spend the money emptying, and cleaning and closing tanks.

MEMBER BALLINGER: So they're smarter than we are, is what you're saying.

MEMBER REMPE: It sounds like your public's pretty good.

(Laughter)

MS. ROSS: They think that I'm trying to be open and having, you know, a well rounded program.

MEMBER RAY: If we all could only live in South Carolina it would be, the world would be much better.

CHAIRMAN RYAN: Okay, any other questions?

(Off microphone discussion)

CHAIRMAN RYAN: Anything else?

MEMBER REMPE: No more, thank you though.

CHAIRMAN RYAN: Okay. I guess I'll make one comment considering a ran a program for 20 years that did the same kind of stuff.

Ground water is a very difficult thing to figure out. It takes lots of samples, lots of wells. What's a geologist's only desire, one more core please, just one more. Fifty feet right here, I'm good. I'll be done. And a week later on, two more.

So it's a never ending process of discovery. But it's also a good one. Because you can get an awful lot of good information that can help you over time, and I mean over decades, of improving your processes and improving your facility so it does what you want it to do as opposed to what it is going to do if you don't pay attention.

So that's just, I think you've got a very good program. And it sounds like you've got the right folks involved with it. So congratulations on that. That sounded great.

MS. GELLES: Thank you. We're privileged

to have a lot of talent at the labs and at the sites.

CHAIRMAN RYAN: Absolutely. So thank you. And with that, are there any other comments from our --

MEMBER ARMIJO: I would just like to add my thanks to DOE in bringing a good, excellent, terrific package. I can use that a lot to address the issues that are a concern to me as a, you know, period of compliance and as well as the intruder assessment type, what it actually is. It's not nearly as bad as what I thought it might be. So you cleared a lot of things up for me. So I really very much appreciate your work.

CHAIRMAN RYAN: And the whole program, I mean, the entire, you know, effort for 435, sorry, 435.1 and your presentations there were great. We got a lot of insights that'll help us in formulating views for the commission here.

So we really appreciate your time and the effort you put into making our presentations very high quality. And you've responded to every question. And I think you're batting 1,000.

MS. GELLES: That was our goal. We're very glad to be helpful. And thanks again for giving us so much of your time.

CHAIRMAN RYAN: Oh, absolutely. Thank

you. With that, we're adjourned. Oh, yes? I'm sorry?

MR. WIDMAYER: You have to ask for public comments.

CHAIRMAN RYAN: Are there any public comments or speakers on the phone that would like to make a comment? Is the bridge line open?

(Off microphone discussion)

MR. WIDMAYER: It's the usual delay for opening the bridge line.

CHAIRMAN RYAN: Okay. Well, nothing like tradition.

(Off microphone discussion)

CHAIRMAN RYAN: We are on the record now.

(Off microphone discussion)

MEMBER ARMIJO: Well as long as we're waiting, I'll add a little anecdote about 1,000 years being about the right number.

I was in Salamanca, Spain, and they have a nuclear fuel factory over there. And they told me about this. Go visit the cathedrals. And I said, well, which ones should we visit? I don't have a lot of time.

He said, well, they're right across the street from one another. One is the old cathedral, one's the new cathedral. I said, okay, which one should I visit? Well, first you should start with the new cathedral which was built in 1400. And then go see the old cathedral. That was built in 1100.

And I did. And they're both looking really good. So I think Dick's right. At about a 1,000 years things are sensible. Going beyond that it's just nonsense. So calculate all you want.

MEMBER RAY: Well, you can go to Egypt and things get a little longer there.

MEMBER ARMIJO: Well, yes, Egypt.

MEMBER RAY: The Roman aqueducts are still around. And they still feed the water --

MEMBER ARMIJO: The aqueducts.

MEMBER RAY: -- and the Roman roads.

MEMBER ARMIJO: But we've got to be realistic about where we spend our money. And in fact, I think you're probably making the right decision.

MEMBER RAY: Well, it's the uncertainty that becomes more and more problematic with time, that's the greater concern to me than, as I said already, than it is the cost. I think the cost of the analysis is something that's debatable. But the uncertainty is --

MEMBER ARMIJO: It's not real, even after you spent the money, you can argue --

MEMBER RAY: What do you have?

CHAIRMAN RYAN: You want to say something, Derek?

MR. WIDMAYER: I was going to open a can of worms. So you want to tell us about uranium 233 in Nevada? No?

MS. GELLES: On the record?

(Crosstalk)

CHAIRMAN RYAN: We're on the record.

MR. TOTES: Opportunity for public comment.

CHAIRMAN RYAN: Yes.

MS. CHALMERS: Yes, I'm on the line.

MALE PARTCIPANT: Oh, Hi, Bill. Are they not hearing us?

CHAIRMAN RYAN: We hear you.

MALE PARTICIPANT: No, they're not.

CHAIRMAN RYAN: We are.

MALE PARTICIPANT: I'll call Roger tonight.

CHAIRMAN RYAN: No, no, no, no. We can hear you well.

(Crosstalk)

CHAIRMAN RYAN: Hold on, one at a time. The gentleman first.

MR. TOTES: There're a couple of us. Are you asking for public comment now?

CHAIRMAN RYAN: Yes, we are.

MR. TOTES: Oh, very good. We weren't sure what was going on. My name's John Totes with Neptune and Company. I just had a couple comments here.

One is to the gentleman who had been doing low-level waste work in California. I didn't catch your name. But you had the comment that all this work with DOE is very interesting and wonderful. But it wouldn't translate well to the public sector.

I think that your point was that it would be very expensive. And I would agree that it, having written performance assessments for both DOE and for private entities that are regulated by NRC, I would agree that it could be expensive.

But the stakes are very high in both cases. And defensability is very important for all types of regulators. So I just wanted to add that comment.

And one for Sherri Ross with the Savannah River DOE office. I was surprised to hear that stakeholders in Savannah River care very much more about the present than about the future.

And I'm interested to know what that says about this whole conversation of how far into the future we are supposed to protect people. Apparently it's something that might vary from site to site. I'm curious about any responses to those comments.

MR. WALLO: I think the answer to Sherri's, but the issue was people are more concerned about risk reduction than risk assessment. You know, if you have a choice whether you want to reduce risk or assess risk, the choice is let's reduce it first and worry about assessing it later.

And so that's the point. Again, it's the issue of how much to spend on modeling versus getting the job done.

MR. TOTES: Okay. I can appreciate that. It seems that if one, there's a possibility or a danger there that one might be short sighted and reduce current risk while increasing future risk.

MR. WALLO: Again, that's part of the issue we're trying to raise, is that you don't want to develop requirements or regulations that force you not to reduce risk while you're analyzing time periods that are of questionable value.

Clearly, you want to do a complete enough analysis to make a good decision. And that's the issue. That's where you have to ground the issue, is where can you make a good decision.

CHAIRMAN RYAN: We had one other speaker or one other call that wanted to ask a question.

MR. LEWIS: Go ahead and ask your question.

CHAIRMAN RYAN: I'm sorry.

MR. LEWIS: There's a speaker on by the name of Ruth. I was telling her to go ahead of me. My name's Marvin Lewis. I have a question.

CHAIRMAN RYAN: Okay. Ruth? Do you want Ruth to go first? Where's Ruth?

MR. LEWIS: If she's still on.

MS. CHALMERS: Right here. I've been here all along.

CHAIRMAN RYAN: Well, great. What's your question, Ruth?

MS. CHALMERS: Well, I heard a lot of talking. And there's so much that was said that is in conflict with known evidence that I couldn't begin to cover it all, even if you gave me two hours.

But what I am the most concerned about is the statements that were made about the public, the members of the public and concerned people.

I realize that they were generalizations and they didn't specifically address them to me, who's been studying this for 45 years. But I just felt, well, some of it had to do with the laughter. I mean, like it was a game and that you could find the answer. You could find the answer to nuclear radiation, man-made nuclear radiation, that somehow or other there was a way to accept this and to find it was acceptable to expose people to that.

And I feel a terrible sadness to think that people who I'm sure feel that they are doing the right thing. And yet what is the outcome of this? What has been the outcome? What will continue to be the outcome? What is this going to do to our children and our grandchildren?

Because the basic thing comes back to there's no safe exposure to radiation, man-made radiation, any kind of radiation. I just am overwhelmed.

CHAIRMAN RYAN: Well, we appreciate you taking the time to call and let us know your thoughts. Thank you.

MR. LEWIS: This is Marvin Lewis.

CHAIRMAN RYAN: Yes, Marvin.

MR. LEWIS: All right. Well, here is my point. You want it cut off at 1,000 or 10,000. And my point is this.

Recently discovered is the science of epigenetics, E-P-I genetics. And EPI genetics skips generations. It may skip even more.

The problem there is will the load radiation be cumulative over generations until we wind up the entire human race up against the wall until our evolution stops.

Now that is backed up. It's already happened in reverse in the pre-Cambrian explosion of light where suddenly over the millennia. But then soon after that four more filers, soon after that a few hundred million years, you have human beings walking around on another error. But --

MS. CHALMERS: Well, this is Ruth Chalmers again.

CHAIRMAN RYAN: Ruth, excuse me, Ruth, I'm sorry. You're interrupting the other speaker. He's giving his comments now.

MR. LEWIS: I'm sorry, Ruth. There is a history in the geology, in the anthropology and whatever. Now we have a science called epigenetics. I'll show you danger is allowing increased amounts of radiation into our biosphere over the ages. And we have in NRC litigation of this up by the various NGOs, and have --

CHAIRMAN RYAN: Thank you for your comment.

MR. LEWIS: -- administrative law judges of the NRC. But what I'm saying is what we should be looking at is epigenetics and asking the question as we add radiation eventually cause more, the end of the human race. Thank you.

CHAIRMAN RYAN: Well, thank you very much. We appreciate the comments. And are there any additional speakers who would like to make a comment?

MS. CHALMERS: Well, it's Ruth. I was --

CHAIRMAN RYAN: Ruth, Ruth, I'm sorry, Ruth. We're going to ask for other speakers first. You had a turn. So I want to make sure there's --

MS. CHALMERS: Oh, okay.

CHAIRMAN RYAN: -- there's nobody else who wants to speak. Is there anybody else that would like to speak?

Ruth, we're 20 minutes over our allotted time here in the room. So we're going to take one short comment from you and then we'll close the line.

MS. CHALMERS: All right. I wanted people to be aware that there is a proposal to transport weapons grade uranium, enriched uranium, highly enriched uranium, on our highways.

And it's in a liquid form. And it's never been transported before. And it's going to go to the Savannah River plant. And the woman that gave the talk on the Savannah River plant didn't mention the fact that that's where it's headed.

And what's interesting too is it's being kept secret. And even though it's on the newspapers, in the newspapers in Canada, it's not in the newspapers in this country. I think there've been maybe two articles.

CHAIRMAN RYAN: Well, again. We thank you for your comment. And with that, we're going to have to close the bridge line, because we are well over our allotted meeting time. So we appreciate you being with us. And thank you for your comments.

MS. CHALMERS: Thank you, bye.

CHAIRMAN RYAN: All right. Bye now. Why don't we close the bridge line please. Okay, with that, any other business or are we good?

I want to thank everybody. You really gave very thorough presentations and information to us. It's been very helpful to have your colleagues at a distance and yourselves here. And we really appreciate the time and effort you put in to have this great conversation with us. So thank you all very much. We appreciate it.

MS. GELLES: Thank you very much.

(Multiple thank yous)

CHAIRMAN RYAN: All right. With that, we're adjourned.

(Whereupon, the meeting in the above-entitled matter was concluded at 5:20 p.m.)

DOE Regulatory Approach for Near-Surface Disposal of Radioactive Waste

Christine Gelles, DOE Office of Environmental Management
Roger Seitz, Savannah River National Laboratory
Andrew Wallo III, DOE Office of Health, Safety and Security

November 19, 2013

Introduction and Background

Christine Gelles
Associate Deputy Assistant Secretary
Waste Management
DOE Office of Environmental Management

Purpose

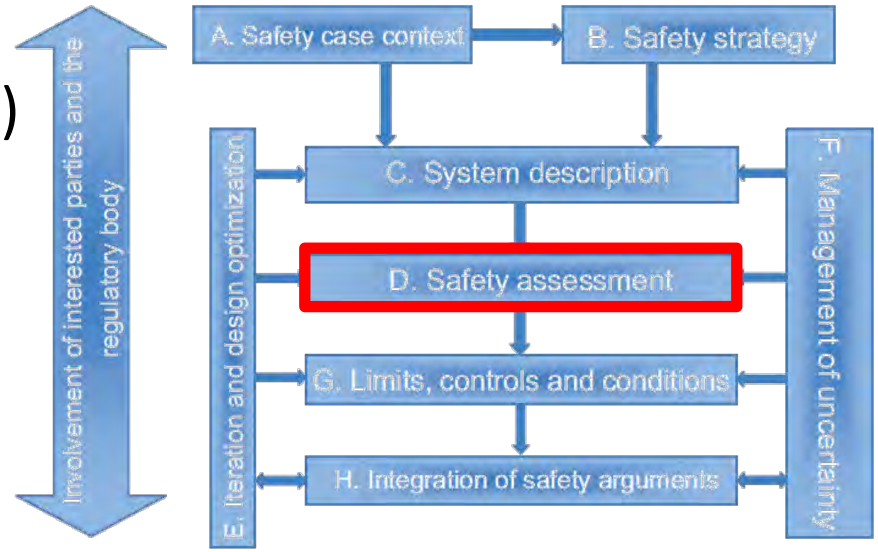
- Provide an overview of DOE's integrated protection systems approach to near-surface disposal
- Highlight the use of defense-in-depth and role of performance assessment (PA) as one of many inputs for risk informed decision-making
- Describe the emphasis on consistency with promulgated requirements
- Summarize considerations for a few key topics:
  - Use of 1,000 year time frame for quantitative compliance followed by a transition to a more risk-informed interpretation recognizing increasing speculation and uncertainties for later times
  - Inadvertent intruders considered in the context of optimization, not a performance objective
  - Radon considered separately from the all pathways objective

Agenda

Introduction and Background	Christine Gelles DOE Office of Environmental Management
Regulatory Approach	Roger Seitz Savannah River National Laboratory
History and Implementation	Andrew Wallo III DOE Office of Health, Safety and Security
Site-Specific Implementation	Robert Boehlecke DOE Nevada Field Office Sherri Ross DOE Savannah River Operations Office

DOE System of Regulations for Near-Surface Disposal

- Integrated approach to safety using defense-in-depth principles (similar to Safety Case)
- Performance Assessments (PAs) are one part of the integrated approach
- Consistency with other regulations for near-surface disposal and consideration of international recommendations
- Risk-Informed, Performance-Based for more than 25 yr



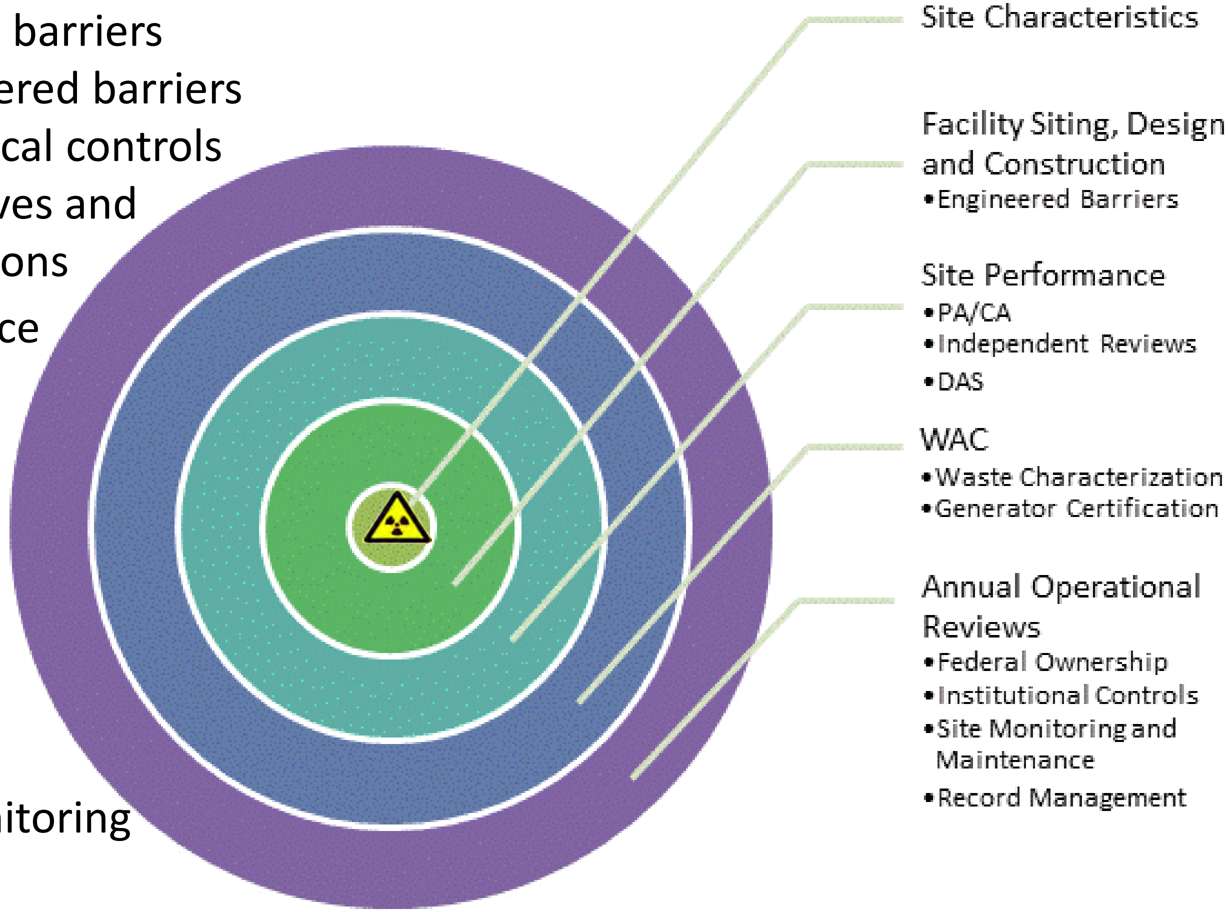
IAEA Safety Case Concept

DOE System of Regulations for Near-Surface Disposal (PA)

- PAs provide reasonable expectation that DOE disposal facilities will not exceed quantitative performance objectives and support decision-making for design, operations and closure
- A two-tiered approach to time frames is used with no specific cutoff
  - 1,000 years - calculated doses are compared to quantitative dose constraints for compliance
  - Longer-term calculations consider peak impacts to support risk-informed decision-making in the context of increasing uncertainties

Defense-in-Depth

- Integrated, total systems approach to safety
  - Site characteristics which provide geologic and hydrologic barriers
  - Facility design – Engineered barriers
  - Administrative & technical controls
- Conservative bias in objectives and assumptions for PA calculations
- Site-specific waste acceptance criteria and rigorous waste generator certification
- Federal ownership and necessary buffer zones until site can be released
- Commitment to continuous improvement with PA maintenance, including monitoring
- Permanent maintenance of records



Regulatory Approach

Roger Seitz
Sr. Advisory Scientist
Environmental Management Directorate
Savannah River National Laboratory

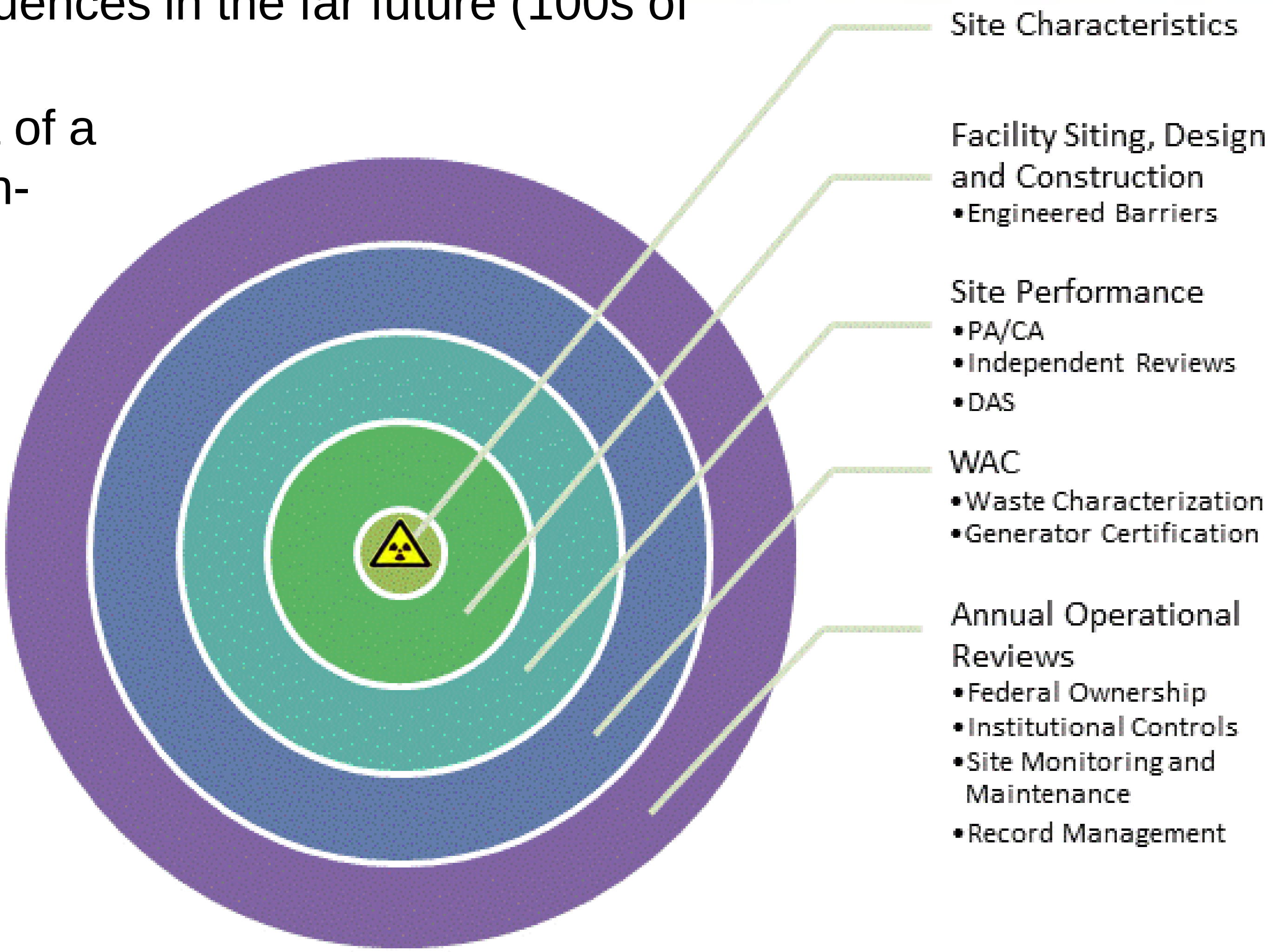
Introduction

DOE has successfully implemented an integrated protection system for near surface disposal for more than 25 years:

- DOE Radioactive Waste Management Basis (RWMB) is similar to the IAEA Safety Case approach - PA is one of many contributors to risk-informed decision-making
- Defense-in-depth and total systems perspective
- Maintaining consistency with other promulgated Federal requirements for near-surface disposal
- Considering recommendations from International organizations

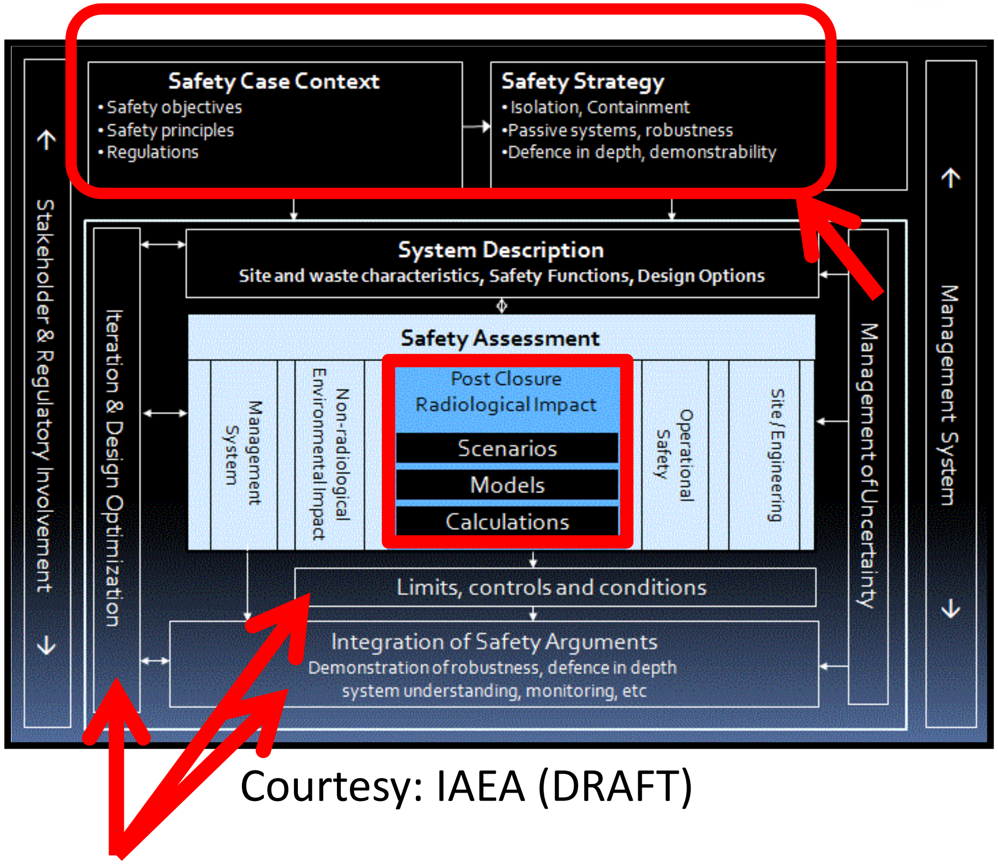
Defense-in-Depth

- Approach goes to extraordinary lengths to consider potential consequences in the far future (100s of years or more)
- PAs are one part of a robust defense-in-depth approach for safety
- Multiple levels of safety factors (e.g., dose constraints, conservative bias, inadvertent intrusion)



IAEA Safety Case

- Captures the integrated approach to safety
- Effective means to take credit for supporting activities used to build confidence
- Highlights links among modeling, design and waste acceptance criteria
- Addresses management of uncertainties throughout process (e.g., testing, R&D, monitoring – "Maintenance")
- DOE RWMB is consistent with this approach



Courtesy: IAEA (DRAFT)

DOE Performance Assessment

Site and facility-specific PAs have been formally required since 1988:

- Risk-informed, performance-based
- Emphasis on reasonable expectation of meeting objectives
- Graded and iterative process
- Implementation has been continuously refined

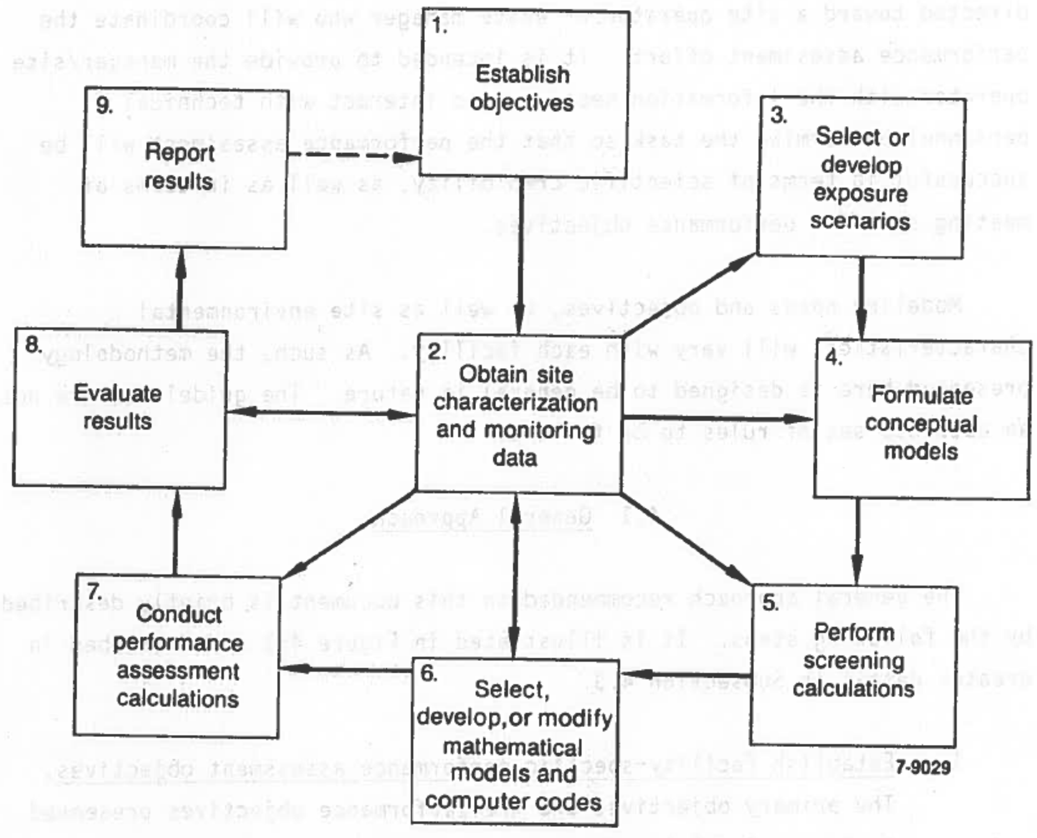


Figure 4-1. Performance assessment process.

Initial concept for graded and iterative approach (DOE LLW PA Guidance - Case and Otis, 1988)

Time of Compliance for Near-Surface Disposal

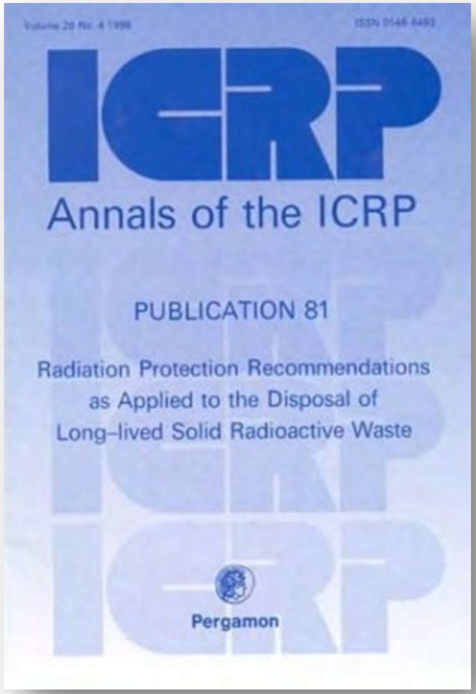
- 1,000 year time of compliance based on multiple factors:
  - Consistency with approaches used in DOE Order 458.1 and in existing promulgated NRC and EPA rules addressing near-surface disposal (e.g., 10 CFR Part 20.2002, 10 CFR Part 40 (40 CFR 192), RCRA Subtitle C),
  - Role of PA as only one contributor to the overall safety basis,
  - Decreasing relevance/usefulness of increasingly speculative/uncertain information in the far future when used for decision-making
  - Considerations related to intergenerational equity, and
  - Recommendations from the ICRP, IAEA
- Not a cutoff to calculations - must address potential peaks
  - 1,000 years marks a transition from quantitative compliance with performance objectives to use of results in a more risk-informing role for decision-making

Perspectives on 1,000 yr Time of Compliance

- ICRP position regarding the use of dose and risk as measures of health detriment (several hundreds of years)
- IAEA position on calculations for extended times for surface and near-surface disposal
- Consideration of deterministic and probabilistic (risk) views of consequences at longer times of compliance (e.g., event probabilities)

International Perspectives (ICRP)

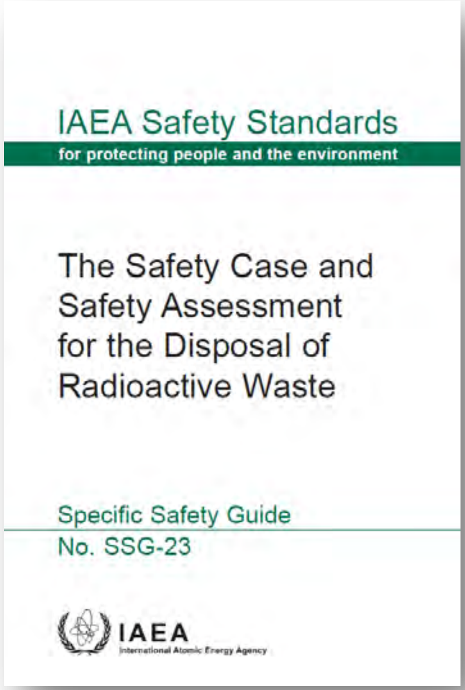
- ICRP Publication 81 (addresses near-surface and geologic disposal)
  - *“Doses and risks, as measures of health detriment, cannot be forecast with any certainty for periods beyond around several hundreds of years into the future”*
  - *“To evaluate the performance of waste disposal systems over long time scales, one approach is the consideration of quantitative estimates of dose or risk on the order of 1000 to 10,000 years.”*



International Perspectives (IAEA)

IAEA Safety Guide SSG-23

– *"For above surface disposal facilities (e.g. for waste from mining), the uncertainties in modelling results will already be substantial when considering periods of several hundred years, and quantitative estimates may become meaningless already beyond a period of a thousand years. For engineered near surface disposal facilities, which are subject to processes that may affect their integrity (e.g. erosion, human intrusion) to a lesser degree or with a smaller probability, modelling periods of a few thousand years may still be reasonable."*



Note: IAEA's Safety Standards are not legally binding on Member States but may be adopted by them, at their discretion, for use in national regulations in respect of their own activities.

International Perspectives – United Kingdom

- Difficult to directly compare "compliance" times from other countries because of differing assumptions
- Low-Level Waste Repository in the United Kingdom
  - Constraint applies through closure, risk guidance level applied later
  - Probabilities can be applied for exposure scenarios for prospective calculations
  - Generally up to thousands of years considered - Reference case considered erosion of facility at 1000 years and 10,000 yr considered for a delayed erosion case

2011 Environmental Safety Case

PA Considerations

Performance Assessment Definition (DRAFT)

An iterative process involving site-specific, prospective modeling evaluations with two primary objectives:

- *to demonstrate whether reasonable expectation of compliance with quantitative performance objectives can be demonstrated; and,*
- *to identify critical data, facility design, and model development needs for defensible, cost-effective, and risk-informed decisions and to develop and maintain operating limits (e.g., waste acceptance criteria).*

(after NCRP 2005, *Performance Assessment of Near-Surface Facilities for Disposal of Radioactive Waste)*

Defense-in-Depth - PA Context

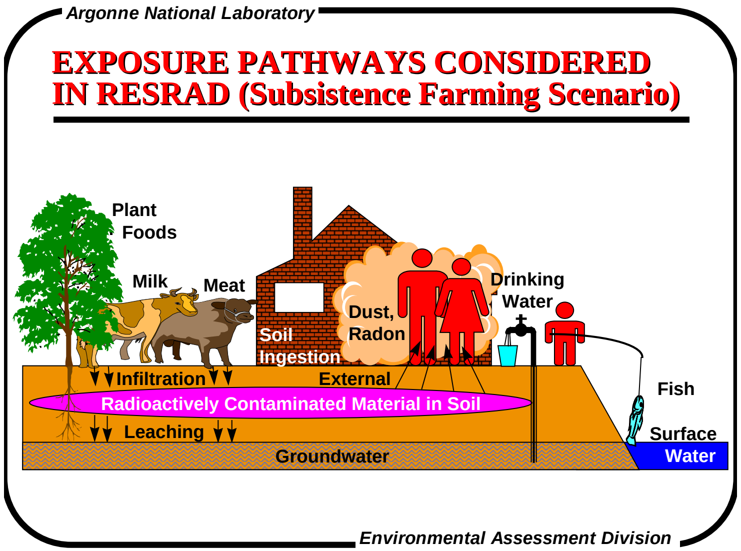
Compliance decisions are made in the context of multiple layers of safety factors, for example:

- 0.25 mSv/yr (25 mrem/yr) is 25 times less than the average annual dose received in the United States (6.3 mSv/yr, NCRP) and a factor of 4 less than the dose limit of 1 mSv/yr
- Assumed that all memory of the facility will be lost (DOE commitments, land use agreements, etc. will be ineffective at some time)
- Future residents will not test well water or be able to recognize that contamination is present underground
- General intent for conservative bias in PA approach (e.g., “highly exposed individuals”, barriers or processes are not credited in calculations in lieu of defending their performance)

Exposure Scenarios in Context

Stylized constructs representing more highly exposed individuals (probability of 1) used as a basis for compliance

- Resident drills a well for water use at location and time of peak
- Resident farmer habits (e.g., beef/milk cows, garden for consumption)
- Other scenarios specific to a site
- Intruder digs basement and drills well, immediately following loss of institutional controls

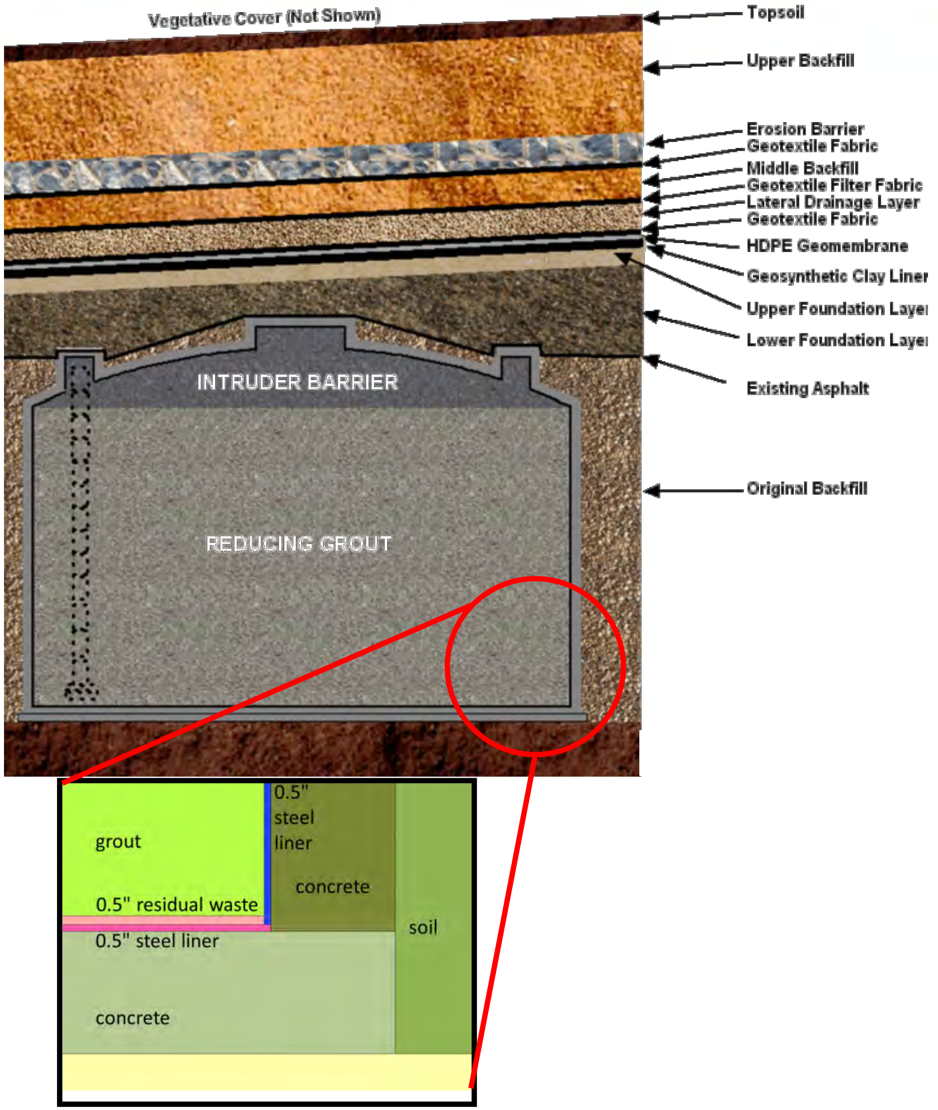


Approach for development of scenarios

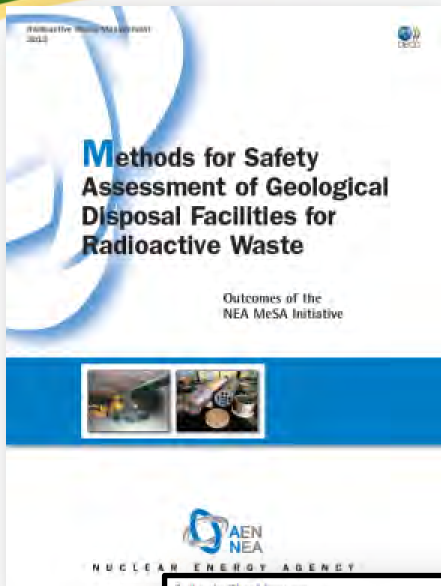
Conceptual Model Focus - Start with initial description of the system and its evolution and refine as needed in areas critical to the decision

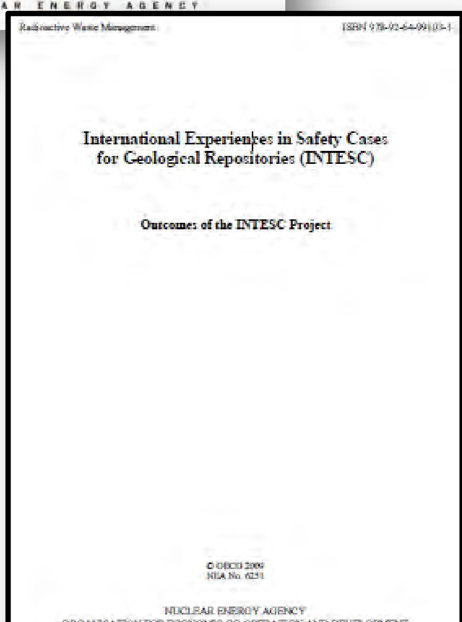
Systems Approach - Consider behavior of individual features in the context of overall system performance rather than independently (refinement of details is made within context of importance for system performance)

Safety Function Perspective – Understanding of roles and functions of "barriers" within total system and addressing potential failure mechanisms for key barriers (FEPs lists can provide insights)



Approach for development of scenarios (NEA)





Practical implementation has emphasized "top-down, bottom-up" rather than a FEPs based development approach.

> ***"In all programmes, the starting point for the identification of safety-relevant phenomena and uncertainties is the development of a detailed description of the initial state of the system and its subsequent evolution. This description provides the basis for a main scenario, also termed normal evolution, base or reference scenario."***

> ***"FEP lists or FEP databases … have evolved (at least in more advanced programmes) to become mainly a tool for checking completeness in a system (and scenario) description that has been derived earlier or using other methods. "***

Managing Uncertainties – PA Maintenance

- Recognize that waste disposal decisions must be made under uncertainty
  - Increasing use of probabilistic modeling to quantify sensitivity and uncertainty
- Initially focused on addressing changes to waste, waste form, etc. and new information
- Approach evolved to a broader confidence building context:
  - Demonstrations & field studies
  - Monitoring
  - Unreviewed Disposal Question Evaluations (e.g., design, container, waste form or inventory changes)

Sharing of Information - Community of Practice

- DOE-EM sponsored organization to share assessment experience
- Mission
  - Reduce regulatory and technical risks related to PA implementation
  - Foster continuous improvement in the quality, credibility, consistency, and efficiency of DOE's PA and risk-based decision-making
  - Maintain enduring performance and risk assessment capability and knowledge base
- Sponsored technical exchanges, workshops and technical support

Regulatory Background and History

Andrew Wallo III
DOE Office of Health, Safety and Security
Deputy Director, Office of Environmental Protection, Sustainability Support and Corporate Safety Analysis

Atomic Energy Act - Regulatory Authority

Establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission* may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property.

* In this context "Commission" refers to the Atomic Energy Commission.

DOE's Regulation of Radioactive Materials and Waste Disposal

- Self-regulation does not mean everyone gets to do whatever they want
- Responsibilities and authorities under the Atomic Energy Act implemented through Directives and Orders
- Requirement to protect members of the public from all sources of radiation, not to exceed 100 mrem/yr
- Seek consistency with existing promulgated Federal requirements
- Strive for internal consistency in Regulations and Directives (DOE O 458.1 and 10 CFR Part 835 establish protection requirements and DOE O 435.1 implements the requirements for waste management)

DOE Order 458.1 – Radiation Protection

Purpose: To establish requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of the DOE pursuant to the Atomic Energy Act of 1954, as amended.

Establishes Public Dose Limit from all sources and pathways: 100 mrem/yr total effective dose, excepting dose from (25 mrem/yr dose constraint for DOE activities):

- Radon and decay products in air
- Medical exposures
- Background radiation
- Occupational exposure

Also, must meet applicable ALARA process requirements.

DOE Order 458.1 (Cont.)

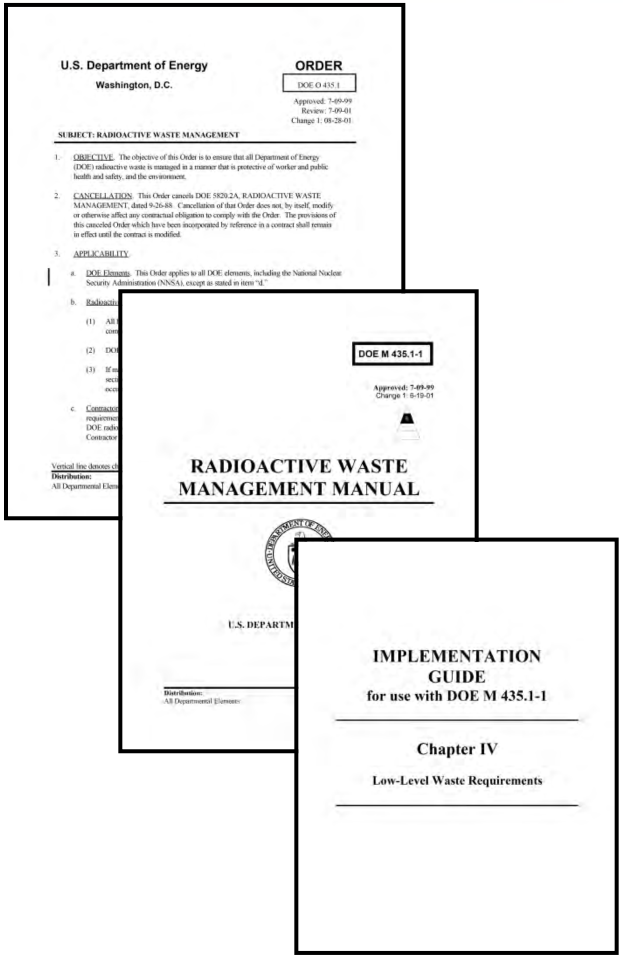
- Radon is controlled separately from the all pathways objective consistent with 40 CFR Part 61 and other requirements.
- Describes the approach for demonstrating compliance with the dose limit (representative person or MEI, use of DOE approved dose coefficients and a 25 mrem in a year dose constraint).
- Includes specific requirement that DOE property cannot be released from DOE control until the approved authorized limits are met (applies to waste disposal facilities).

History of DOE Regulation of Radioactive Waste Management

- DOE Order 5820.2A, *Radioactive Waste Management*, issued September 1988 (PA formally introduced)
- After a few years of implementation, the DNFSB provided Recommendation 94-2 that identified areas for improvement
- DNFSB 94-2 recommended DOE to conduct a complex-wide review
- The Complex-Wide Review identified 6 complex-wide vulnerabilities which echoed DNFSB findings (May 1996) and these were used as input to revision of the directive (DOE Order 435.1 development)

Development of DOE Order 435.1 (Current)

- Began process in September 1996
- Four teams of Headquarters and Field staff
  - High Level Waste
  - Transuranic Waste
  - Low Level Waste/Mixed Low Level Waste
  - General Requirements
- Structured process of workshops and steps to incorporate input from the DOE Complex
- Package included Order, Manual, Guidance, Technical Basis, and training program



DOE Order 435.1 – Radioactive Waste Management

Objective: Ensure that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment. DOE Manual 435.1-1 includes the specific requirements.

- Effective implementation date July 2000
- Established DOE HQ/Site responsibilities including establishment of a Low-Level Waste Disposal Facility Federal Review Group (LFRG) to provide independent assessments of PAs and their maintenance complex wide
- Established Performance Objective and Requirements governing disposal actions
- Required Composite Analysis to assess cumulative impacts of the disposal system and other DOE activities (planning tool)

Low-Level Waste Disposal Facility Federal Review Group

LFRG comprises representatives from each site office with a disposal site and specific HQ organizations

Roles and Responsibilities

- Develop and conduct formal review processes
- Review compliance documentation submitted by sites in support of disposal authorization statements
- Track and report preparation of compliance documentation
- Provide LFRG recommendations to senior managers
- Prepare disposal authorization statements for disposal facilities
- Monitor maintenance activities
- Conduct other reviews and assessments as directed by senior management (e.g., waste determinations and transuranic waste disposal performance assessments)

Current Performance Objectives

Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives:

All Pathways

- Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

Note: Separate treatment of radon is consistent with 40 CFR Part 190.10, 40 CFR Part 61 (subpart H), 40 CFR Part 61.192 (subpart Q), and 10 CFR Part 40 (Appendix A, criterion 6))

Performance Objectives (cont.)

Air

- Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny. (Consistent with NESHAPS dose limits)

Radon in Air

- Release of radon shall be less than an average flux of 20 pCi/m^2/s (0.74 Bq/m^2/s) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/l (0.0185 Bq/l) of air may be applied at the boundary of the facility. (Consistent other promulgated rules, see previous slide)

ALARA – maintain releases as low as reasonably achievable

Demonstrating Compliance with Performance Objectives

Performance Assessment will:

- Assess for compliance with dose limit for 1000 year period after closure and to risk inform decisions and evaluate model performance for periods >1000 years
- Average living habits for members of the critical group (more highly exposed individuals)
- Point of compliance is 100 meters from disposal facility boundary unless other point is justified
- Evaluate reasonably foreseeable natural processes that may disrupt disposal system
- Evaluate sensitivity and uncertainty
- Apply ALARA process to determine if releases are as low as reasonably achievable

Time of Compliance

History of Time of Compliance

Support Decision making process:

- Internal Consistency
  - Property control and release requirements
  - 435.1 working groups
- External Consistency
  - EPA, NRC requirements
  - OMB risk assessment recommendations (E.O.12866, Circular A-94 and A-4, and memo M-12-06)
  - NAS recommendations (NAS, 1990; NAS 1995)

Not a science but science policy & public administration issue (resource allocation and intergenerational equity and support good decisions):

- Contracted National Academy of Public Administration to review intergenerational issues

NAS Recommendations

- NAS 1990: *"[A] scientifically sound objective of geological modeling is learning over time, how to achieve the long-term isolation of radioactive waste. That is a profoundly different objective from predicting the detailed structure and behavior of a site…it is the latter use to which models have been put. The Board believes that this is scientifically unsound."*

NAS Recommendations

NAS 1995:

- *"[W]e believe that there is no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value."*

- *"[W]e note that although the selection of a time period of applicability has scientific elements, it also has policy aspects that we have not addressed." "Another … issue is intergenerational equity."*

- Recommended peak dose or a million years

NAPA Study

***Deciding for the Future: Balancing Risks, Costs, and Benefits Fairly Across Generations*, June 1997**

- Exhaustive literature survey
- Stakeholder workshop
- Expert panel

NAPA Study Recommendations

- **Trustee Principle** - Every generation has obligations as trustee to protect the interests of future generations.
- **Sustainability Principle** - No generation should deprive future generations of the opportunity for a quality of life comparable to its own.
- **Chain of Obligation Principle** - 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. (rolling present)
- **Precautionary Principle** - Actions that pose a realistic threat of <u>irreversible harm or catastrophic consequences</u> should not be pursued unless there is some compelling countervailing need to benefit either current or future generations.

NAPA Study

- Near term considered to be 2 or 4 generations. Distant future – 500 or 1,000 years.
- "Future impacts should be weighted differently from impacts on the present generation."
- "[I]t is inappropriate to use traditional economic discounting formulas over long time periods …"
- "Consideration of the needs of the future does not entitle anyone to impose an injustice on the present generation. In general, the literature related to intergenerational equity clearly opposes making trade-offs favoring the future that fail to meet crucial obligations to present generations, or that impose an injustice on the present."

NAPA Principles Application

- Time of compliance is not simply a matter of science but a public administration issue that needs to be selected to support good decisions
- It is question of intergenerational equity and resource allocation
- The goal should be to expend current resources to maximize benefit to current and future generations

Limitations and Considerations

- Dose limits based on current assessment of risk and needs
- Activities that generate waste are beneficial to both the current and future generations
- Future state of society and technology will change significantly over the next 100, let alone thousands of years
- Uncertainty in calculations is very large beyond a few hundred years

Times Change

Time Period	Event/Activity
Approx 10,000 years ago	Glacial period ending. Hunting Mammoths
1862	Internal Combustion Engine
1903	Wright brothers
1969	Man on moon

Top 3 Causes of Death

1900	Pneumonia, Tuberculosis, Diarrhea (Cancer # 8)
2001	Heart disease, Cancer, Cerebrovascular (Pneumonia #9, TB .02% of all, Diarrhea not listed)

Costs of Excessive Time of Compliance

- Not just added PA computer run time
- Additional site characterization and research to defend increasingly speculative assumptions for longer times
- Schedule delays
- Extended licensing hearings
- Litigation
- Cancelation of projects
- Cost of elaborate barriers

Invest in risk assessment or risk reduction ?

Additional Requirements (not Performance Objectives)

Water Resources

- For purposes of establishing limits on radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts to water resources.

Inadvertent Intruders

- For purposes of establishing limits on the concentration of radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts calculated for a hypothetical person assumed to inadvertently intrude for a temporary period into the low-level waste disposal facility (discussed in more detail later).

Documentation Required for a LLW Disposal Facility

An Integrated & Iterative Regulatory Framework

Performance Assessment (PA)
Assessment of LLW disposal facility performance used to establish radionuclide disposal limits

Composite Analysis (CA)
End state, public dose projection of the cumulative interaction of all radioactive sources anticipated to remain at the site and interact with the LLW disposal facilities

PA & CA Review and Approval
- LFRG Review and Approval and DOE-HQ Approval
- Ensure technical quality of assessments and compliance with performance measures.

Disposal Authorization Statement (DAS)
- LFRG and DOE-HQ review of PA/CA Maintenance, Closure, and Monitoring Plans
- Specifies radionuclide disposal limits
- Specifies conditions on design, construction, operations, monitoring, maintenance, and closure

Closure Plan

PA/CA Maintenance Plan

Monitoring Plan

Annual Reviews

All together this forms the Facility Radioactive Waste Management Basis

Annual Summaries

Annual summaries routinely document activities that are relevant for the disposal facility, for example:

- Disposal volumes and inventories relative to projections
- Status of PA/CA maintenance activities
- UDQEs and any unforeseen circumstances
- Summary of demonstrations and field/laboratory studies
- Monitoring results with comparisons to model results
- General conclusions about the continued adequacy of the assumptions for the PA and CA

Update to DOE Order 435.1

Future Developments - Update to DOE Order 435.1

- Complex-Wide Review initiated late 2008
  - More than 10 years since first Complex-Wide Review (1996)
  - 10 years experience implementing DOE Order 435.1
  - First step to evaluate needs for DOE Order 435.1 update
- Final Complex-Wide Review Report was published
- DOE Order 435.1 Update is nearly complete in draft form
  - Order, Technical Standard and Guide are being prepared
  - Will include a public review and comment period

Updates

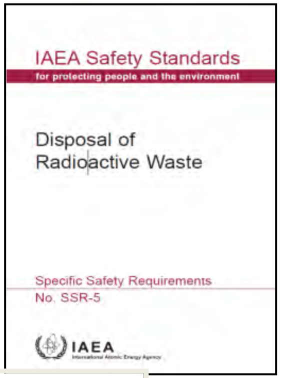
- Technical Standard being developed to replace format and content guides and other informal guidance, for example
  - Disposal Authorizations,
  - Contents for PA report, CA report, monitoring report, closure plan,
  - LFRG review process,
  - Unreviewed disposal question process.
- Specific requirements to provide the ability to use probabilistic results to compare with objectives
- Specific provisions to address Waste Incidental to Reprocessing and Tank Closure

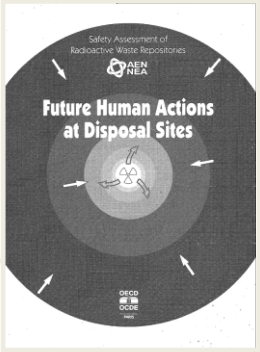
Inadvertent Intrusion

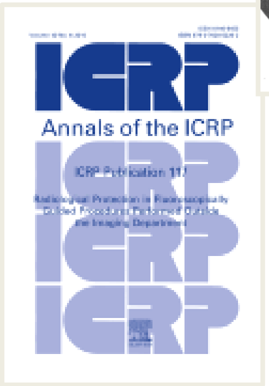
Inadvertent Intrusion

IAEA, ICRP and OECD/NEA

- Consider inadvertent intruder, not advertent intruder
- Striving to reduce potential for and/or consequences of intrusion
- Intrusion considered in the context of intervention and optimization, not as a dose constraint or objective
- Limited stylized scenarios, current habits
- Optimize waste acceptance, design, etc.



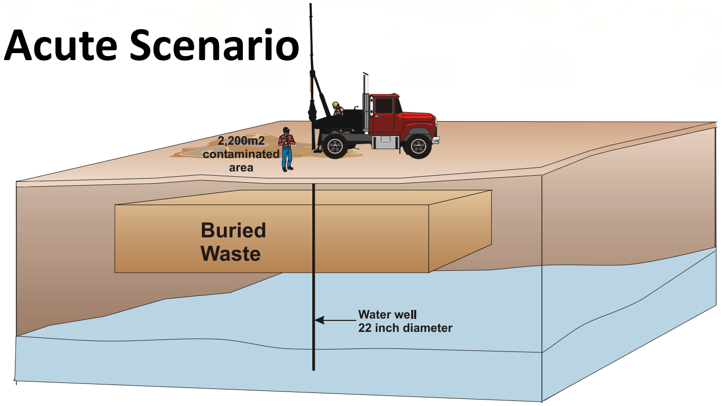




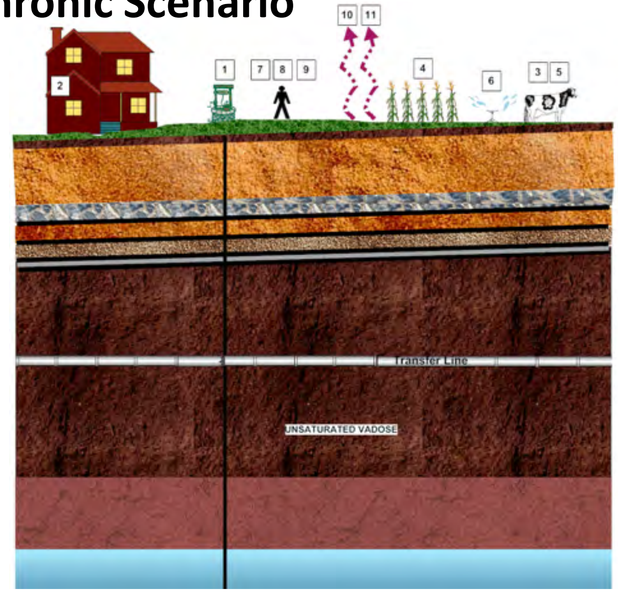
Inadvertent Intrusion (DOE)

- Assess the potential consequences in the case of a temporary loss of institutional controls (hypothetical)
- Typically assumed to occur immediately following loss of institutional controls (e.g., complete loss of memory of site, land use/deed restrictions not effective)
- Active institutional control assumed to only last for 100 years, in spite of DOE requirements to maintain controls
- Stylized scenarios similar to basis for Part 61 typically used

Acute Scenario



Chronic Scenario



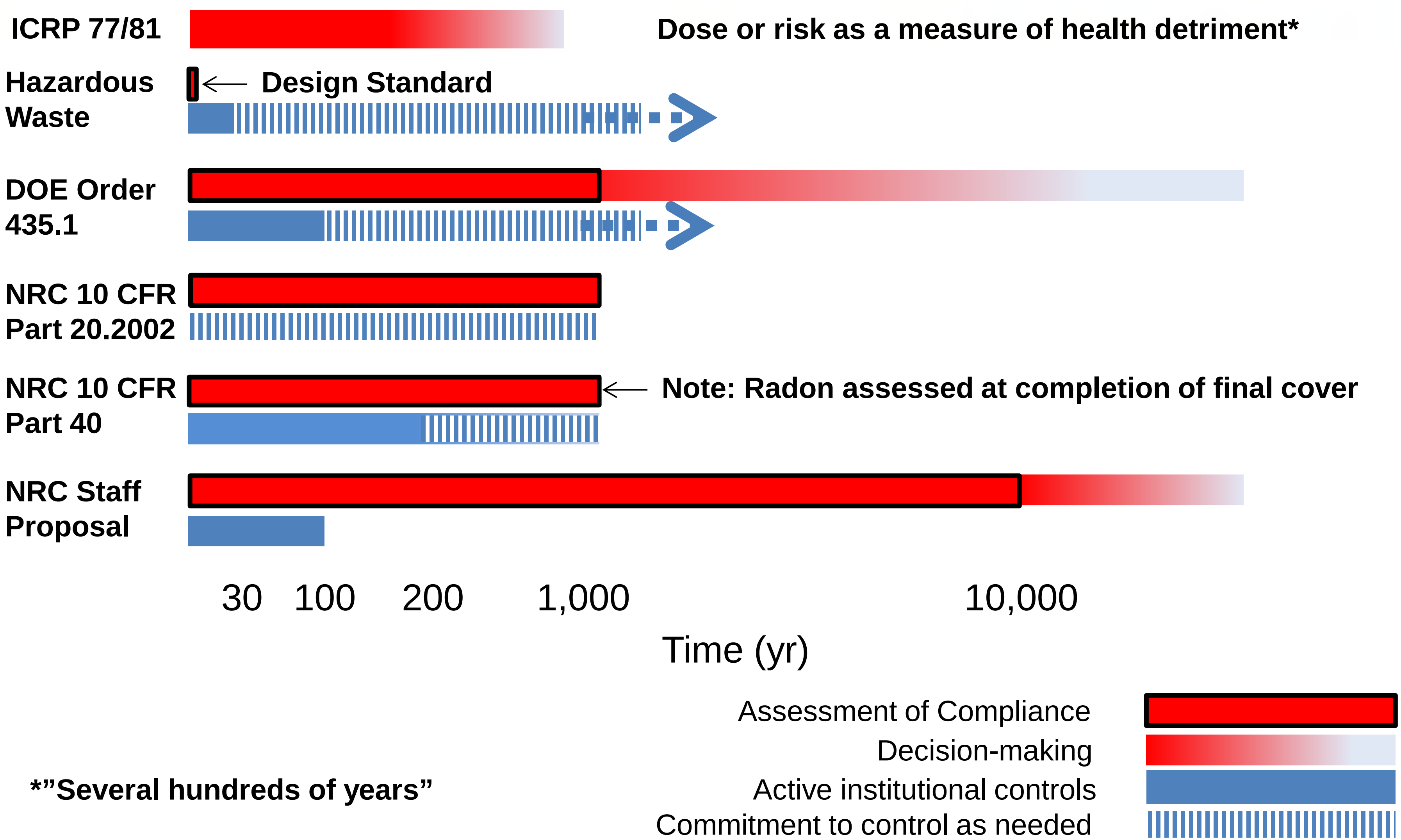
Inadvertent Intrusion (DOE Cont.)

- Results are addressed in the context of establishing waste acceptance criteria and improving facility design, but not considered a performance objective - consistent with
  - EPA feedback on 10 CFR Part 61 rulemaking that intrusion should not be a performance objective
  - International recommendations that intrusion is considered from the perspective of optimization rather than as a performance objective

Two criteria are considered

- Acute (e.g., basement excavation, well drilling) exposures are compared with 500 mrem consistent with basis for Part 61
- Chronic (e.g., residential) exposures are compared with 100 mrem/yr which is more restrictive than basis for Part 61, but does not include doses from groundwater use

Regulatory Time Frames for Near-Surface Disposal



Conclusions

- DOE has more than 25 years implementing an integrated protection systems approach to near-surface disposal
- Defense-in-depth approach is applied with a number of safety factors inherently built into the process
- PAs are viewed as one of many inputs to the RWMB and for risk informed decision-making
- Regulatory approach is to seek consistency with existing promulgated requirements
- There is no specific cutoff applied to PA calculations – 1,000 years deemed appropriate for quantitative compliance followed by a transition to a more risk-informed interpretation recognizing increasing uncertainties
- Inadvertent intruders considered in the context of optimization, not a performance objective
- Radon considered separately from the all pathways objective

Backup Slides

Radon

10 CFR Part 40, Appendix A, Criterion 6 (Tailings)

"A calculation of the potential peak annual TEDE within 1000 years to the average member of the critical group that would result from applying the radium standard (not including radon) on the site must be submitted for approval." (Note: compliance with Radon flux standards are a design requirement assessed at time of emplacement of final cover)

40 CFR 61, Subpart H (NESHAPS)

Definitions (Effective Dose Equivalent) - "For the purposes of this subpart, doses caused by radon-222 and its respective decay products for after the radon is released from the facility are not included."

40 CFR 190.10 (a) – Environmental Standards for the Uranium Fuel Cycle

" The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations."

10 CFR Part 20.1101(d)

"… a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established…, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions."

1,000 years

10 CFR Part 40, Appendix A, Criterion 6 (Tailings)

"A calculation of the potential peak annual TEDE within 1000 years to the average member of the critical group that would result from applying the radium standard (not including radon) on the site must be submitted for approval." (Note: compliance with Radon flux standards are a design requirement assessed at time of emplacement of final cover)

10 CFR Part 20.1401(d)

"When calculating TEDE to the average member of the critical group the licensee shall determine the peak annual TEDE dose expected within the first 1000 years after decommissioning."

U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

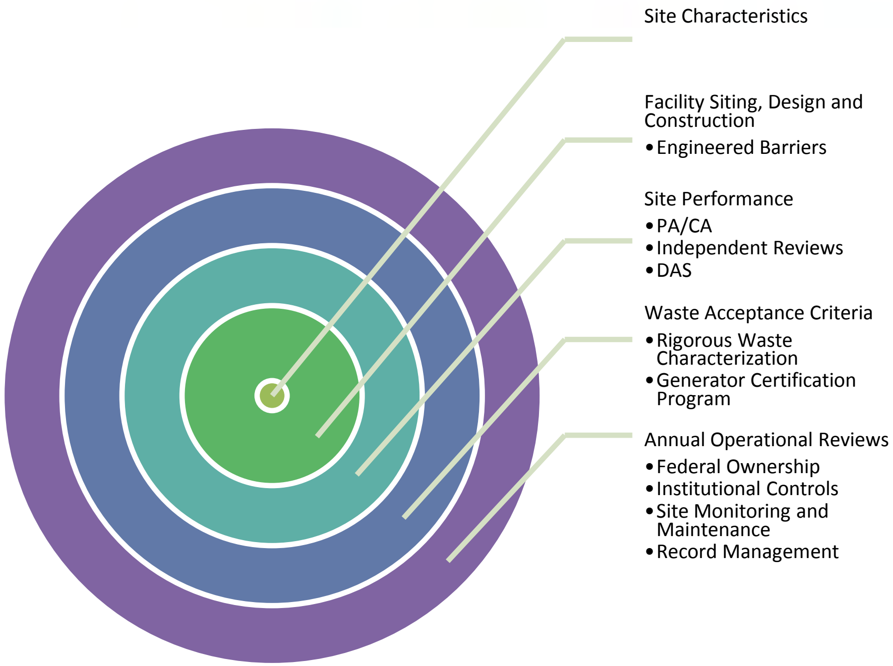
DOE Order 435.1 Implementation at the Savannah River Site

Sherri Ross
U.S. Department of Energy
Savannah River Field Office

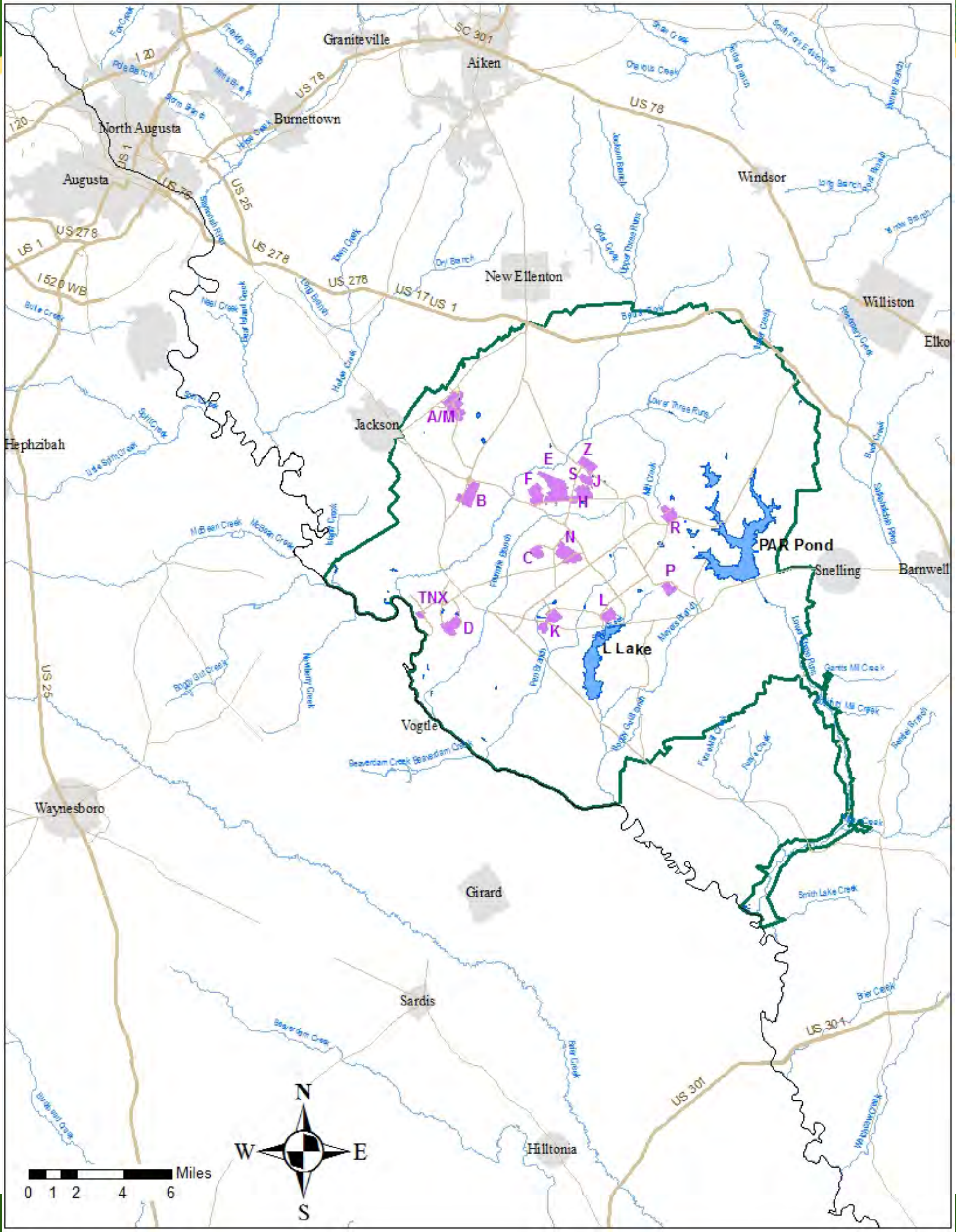
November 19, 2013

Key Points

- Both natural and engineered barriers are considered to demonstrate compliance
- All disposal and closure facilities comply with performance objectives
- Performance Assessment (PA) Maintenance program supports continuous improvement and continued compliance
- Strong external stakeholder involvement (e.g., state, EPA, NRC, public)



Overview of Savannah River Site



- 310 square miles of federally owned and controlled land
- Communities are ~6 miles from closure and disposal facilities in center of site
- Site waterways flow to the Savannah River which forms western boundary of the site

Primary DOE Order 435.1 Documents

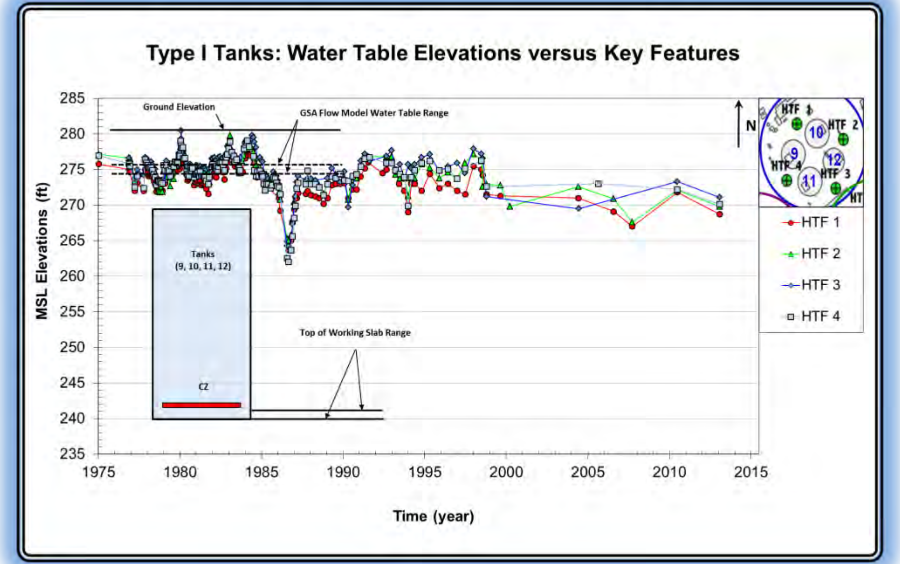
- Liquid waste facilities are either disposal facilities (i.e., Saltstone) or closure facilities (i.e., F and H Tank Farms)
- All facilities have Performance Assessments
  - Saltstone (1992, 2009)
  - F Tank Farm (2008, 2010)
  - H Tank Farm (2011, 2012)
- SRS has a Composite Analysis that covers all radioactive residues at the site (2010)

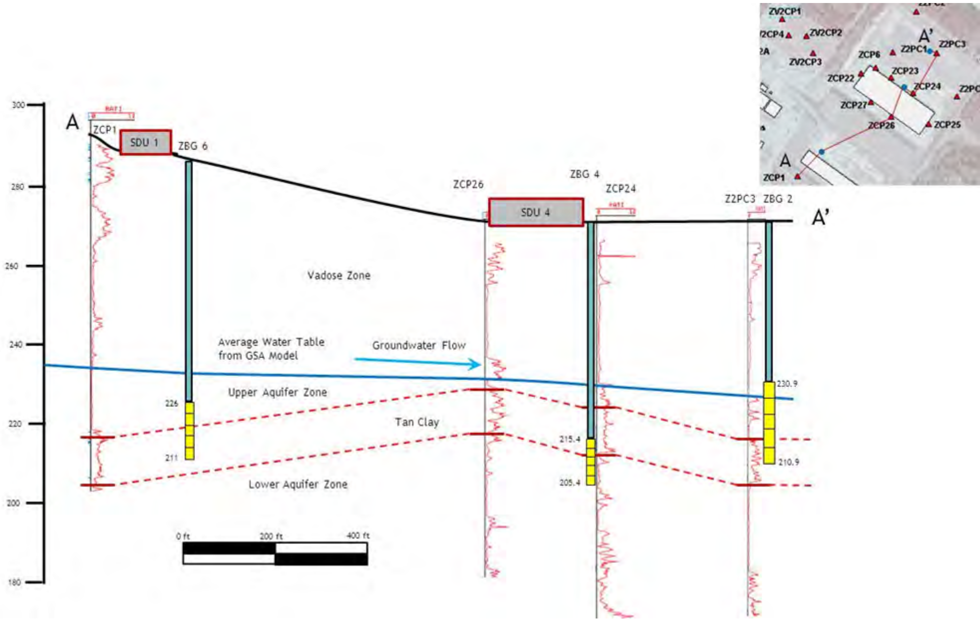
Primary DOE Order 435.1 Documents

- Annual Performance Assessment Maintenance Plan and Disposal Facility Summary report
- Saltstone Disposal Facility includes Disposal Authorization Document, Waste Acceptance Criteria, Radioactive Waste Management Basis, Closure Plan, Monitoring Plan
- Tank farms utilize Tier 1 and 2 Closure Plans
- Continuously ensure conditions remain as evaluated in documents

Natural Site Conditions

- Closure facilities range from within the groundwater to <20 feet above water table
- Disposal facilities are <50 feet above water table



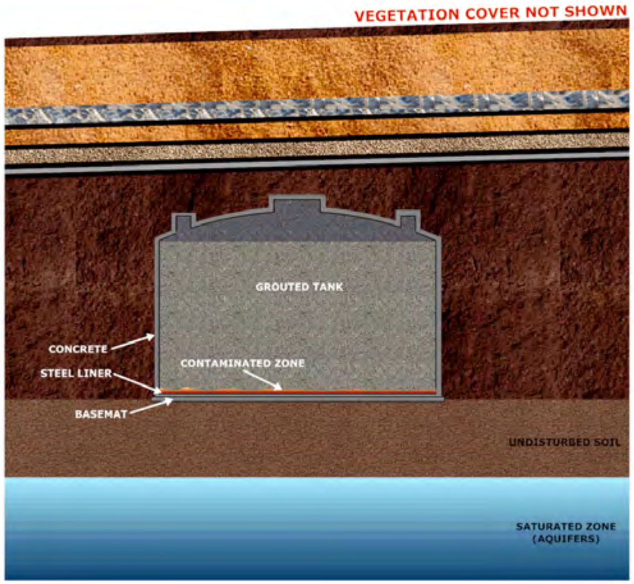


Natural Site Conditions

- Humid environment with ~49 inches average annual rainfall, ~16 inches/year average infiltration
- Multiple potential exposure pathways from residual material over time
- Natural soil characteristics (e.g., clay content) a barrier to movement of certain contaminants
- Low seismic and volcanic activity

Engineered Features

- Disposal and closure facilities incorporate multiple engineered barriers as part of the total system performance
  - Closure cap
  - Disposal cells / tank structures
  - Engineered waste form or tank fill material



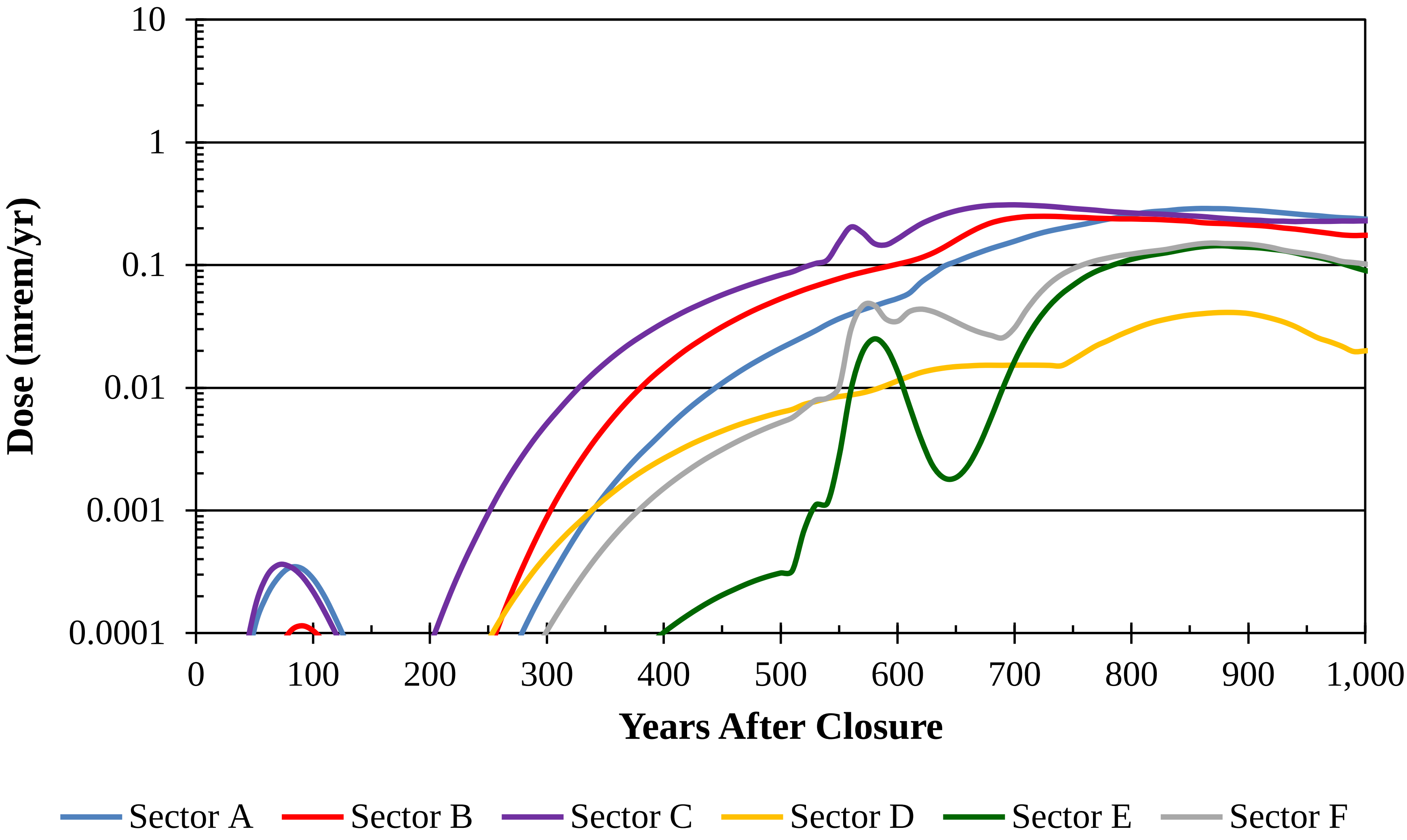
Conservative Bias (Examples)

- Evaluate compliance doses at 100 meters although plans as negotiated with stakeholders assume government control of entire site in perpetuity
- No credit for passive controls after 100 year active institutional control period
- Use peak aquifer concentration although wells not typically drilled to shallow aquifers
- Assumed intruder resides directly on facility
- Assume all similar engineered barriers fail at the same time

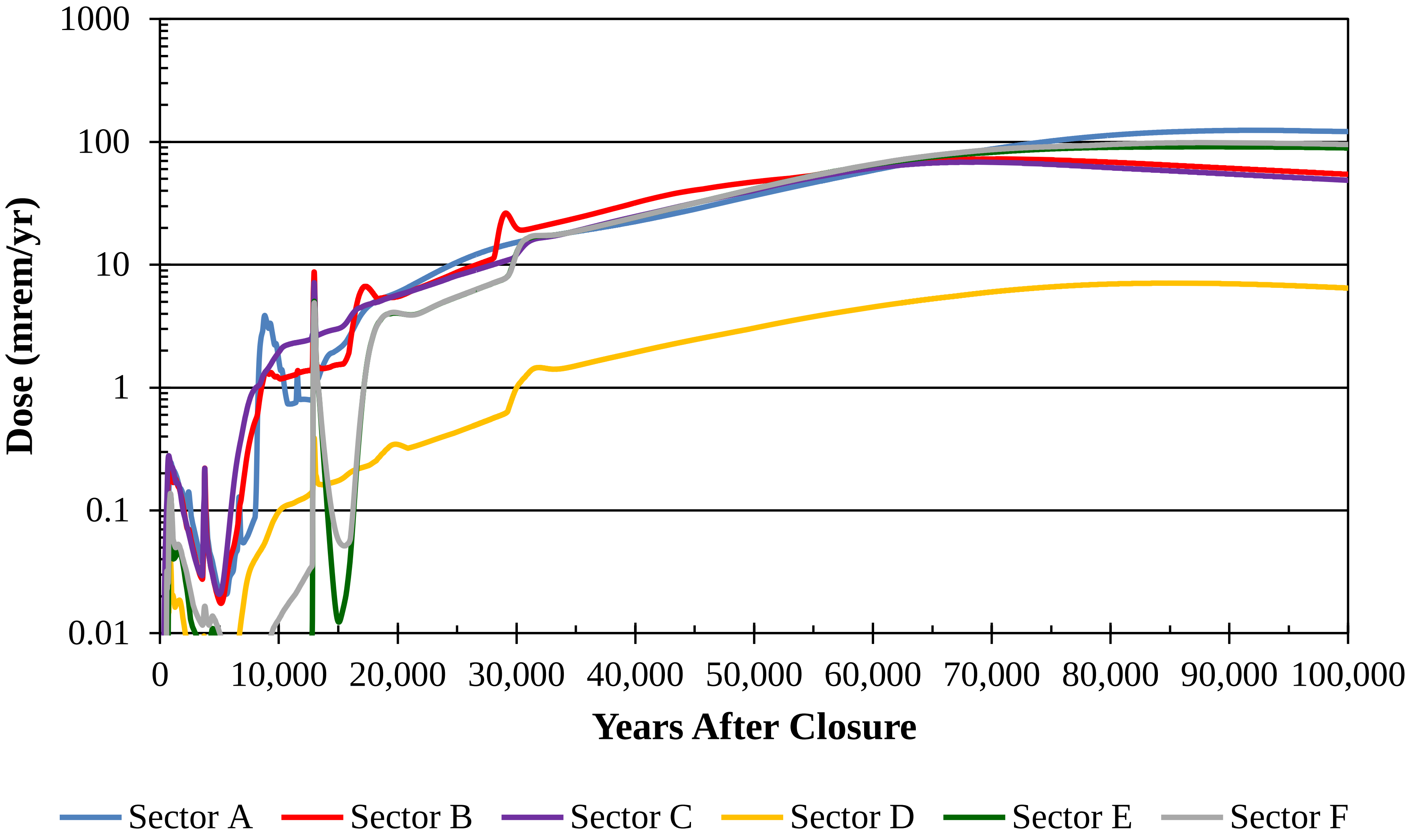
DOE Order 435.1 Compliance

- Modeling includes anticipated conditions and robust sensitivity and uncertainty analyses
- Detailed characterization of residual material during disposal or closure operations
- Disposal facility - Waste Acceptance Criteria used to evaluate proposed disposal streams
- Closure facility - final residual material characterization against anticipated inventories in modeling

DOE Order 435.1 Compliance



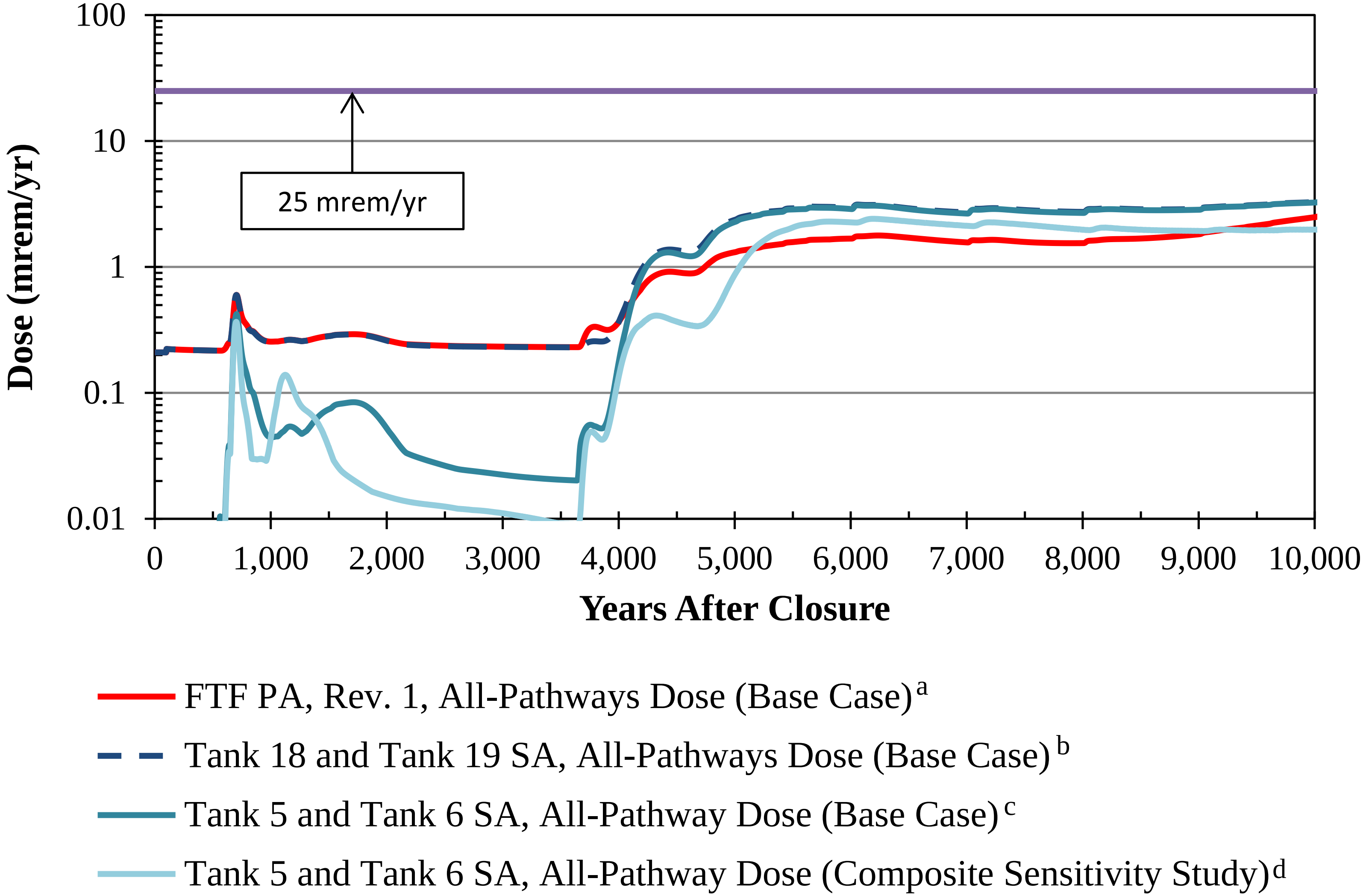
DOE Order 435.1 Risk-Informed Information



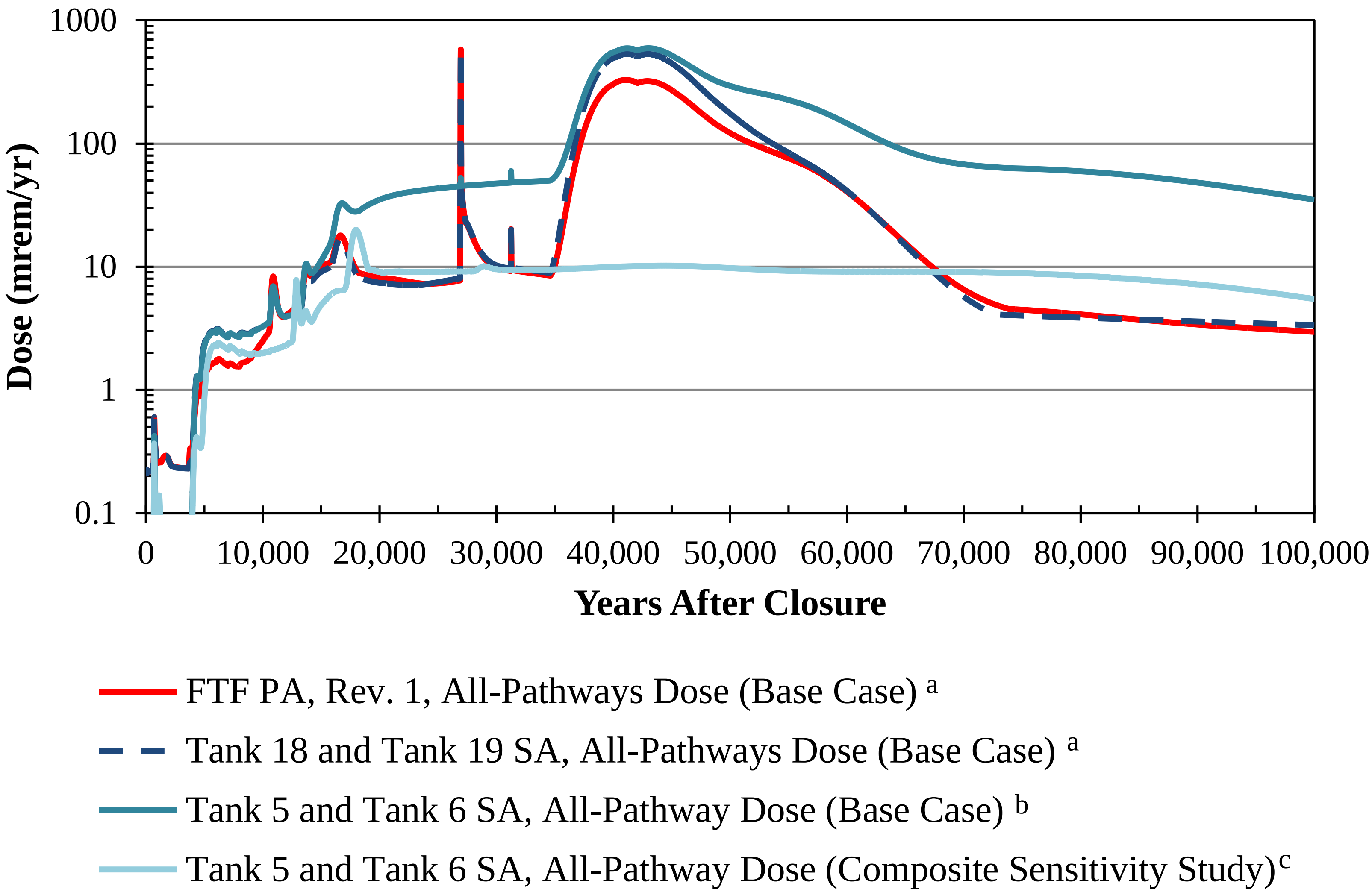
Ongoing Compliance

- Operating facilities have rigorous Unreviewed Waste Management Question (UWMQ) process to evaluate new information or proposed activities against expected conditions
- Can result in no action, UWMQ Evaluation or Special Analysis depending on nature/complexity of new information

Special Analysis Example

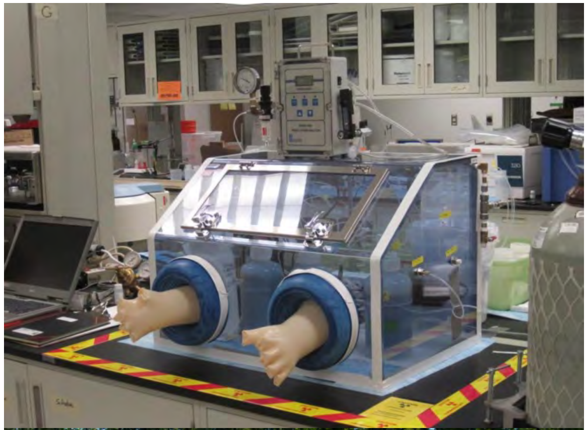


Special Analysis Example



PA Maintenance

- Ongoing science work informed by the risk significance of PA/SA sensitivity and uncertainty analyses



PA Maintenance

- PA Maintenance Program plan evaluated and updated on an annual basis
- Annual summaries conducted on disposal facility to document operations and science work in relation to establish bases
- Annual monitoring includes facility and environmental media conditions

PA Maintenance

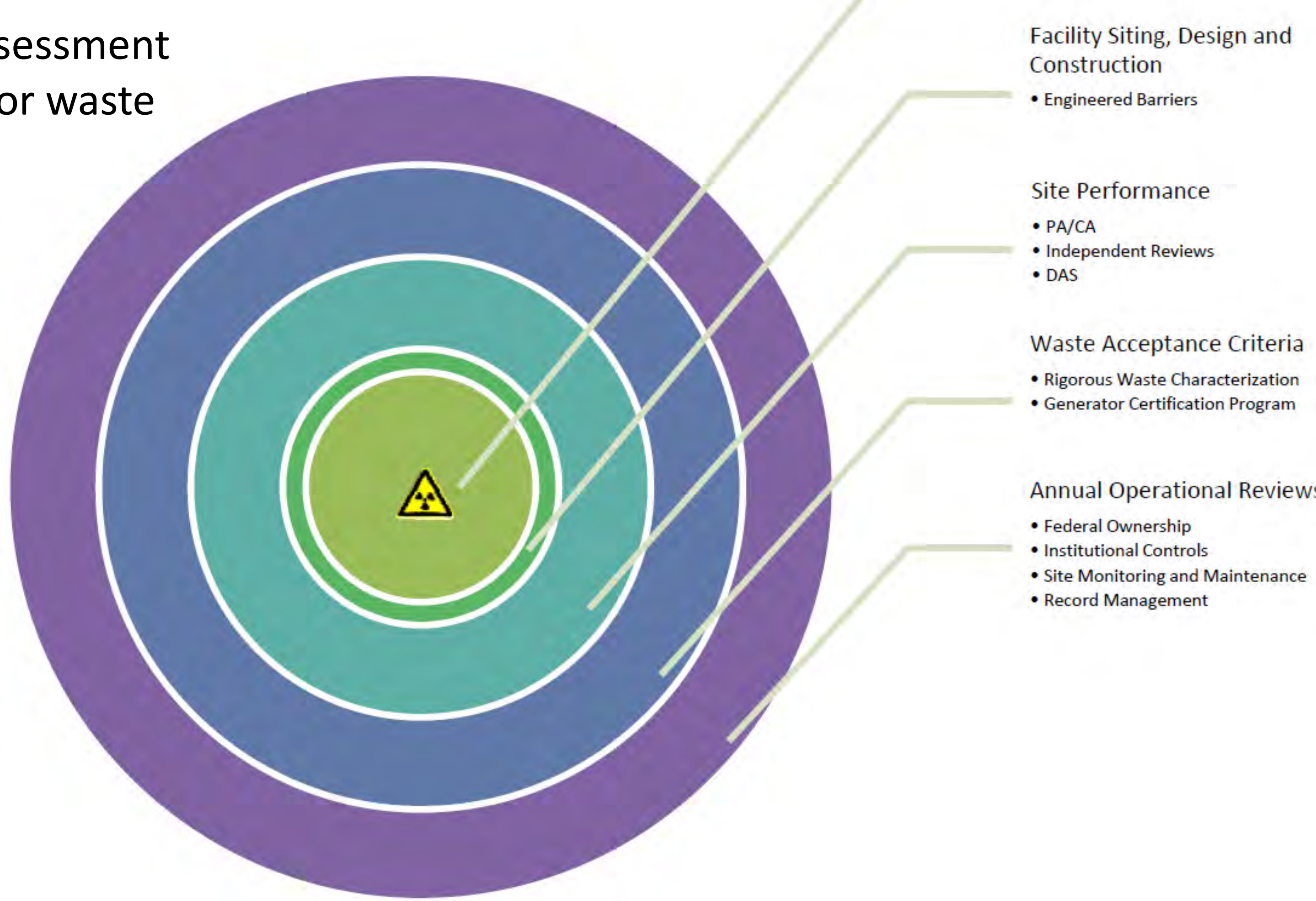
- Special Analyses performed as key science work obtained or new information available for a closure facility (e.g., final tank inventory determined)
- Performance Assessments revised on a periodic basis with timing driven by magnitude and significance of changes to modeled system

DOE Order 435.1 Implementation at the Nevada National Security Site

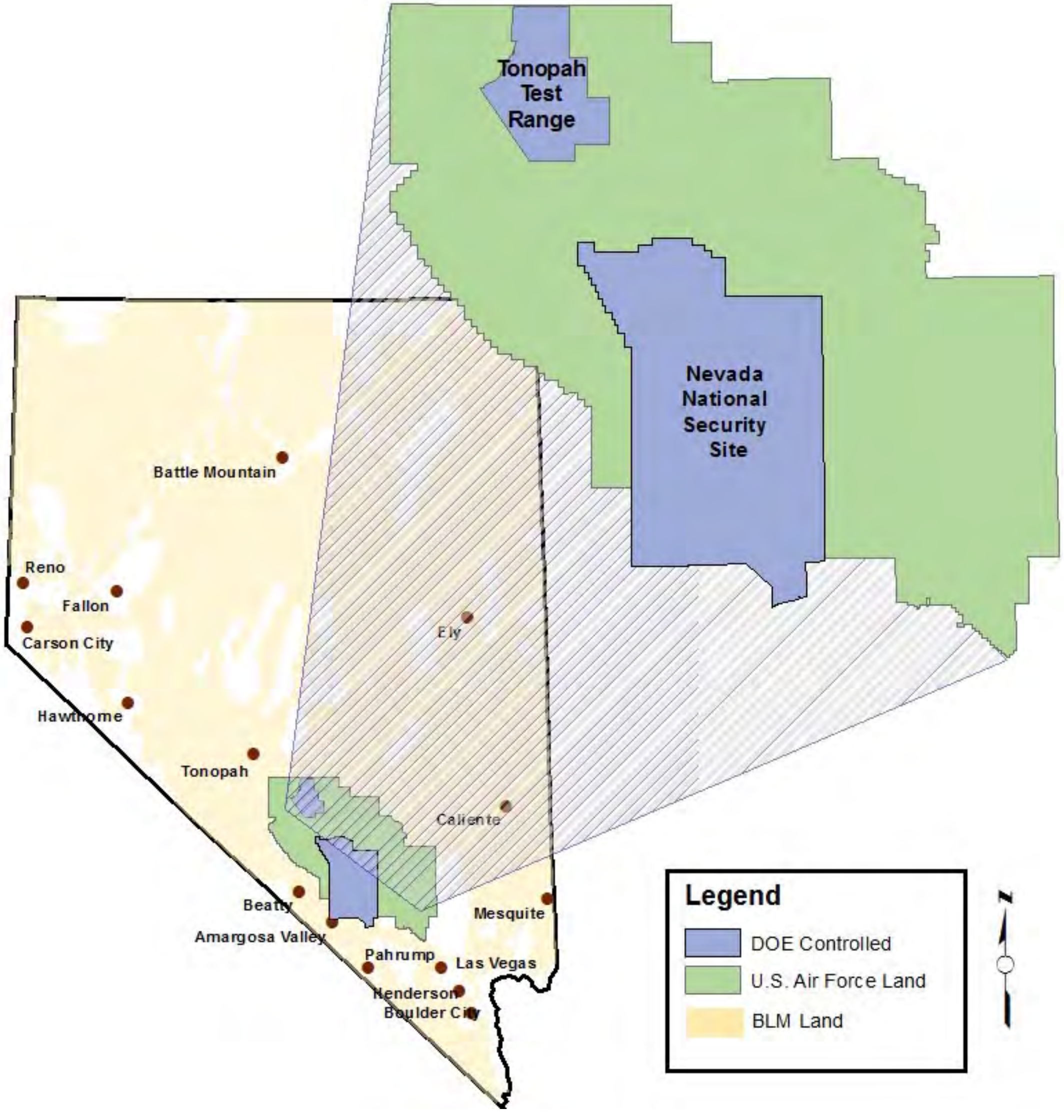
Robert Boehlecke
U.S. Department of Energy,
Nevada Field Office
November 19, 2013

Key Points

- Natural and engineered barriers are considered
- Disposal Facility complies with performance objectives
- Performance Assessment (PA) used daily for waste profile review
- PA Maintenance program allows for continuous improvement
- Strong external stakeholder involvement (e.g., state, advisory board)



Overview of Nevada National Security Site (NNSS)



- 1,360 sq. miles of federally owned and controlled land
- Surrounded by 4,500 sq. miles of federally owned and controlled Nevada Test and Training Range (NTTR)

DOE Order 435.1 Documents

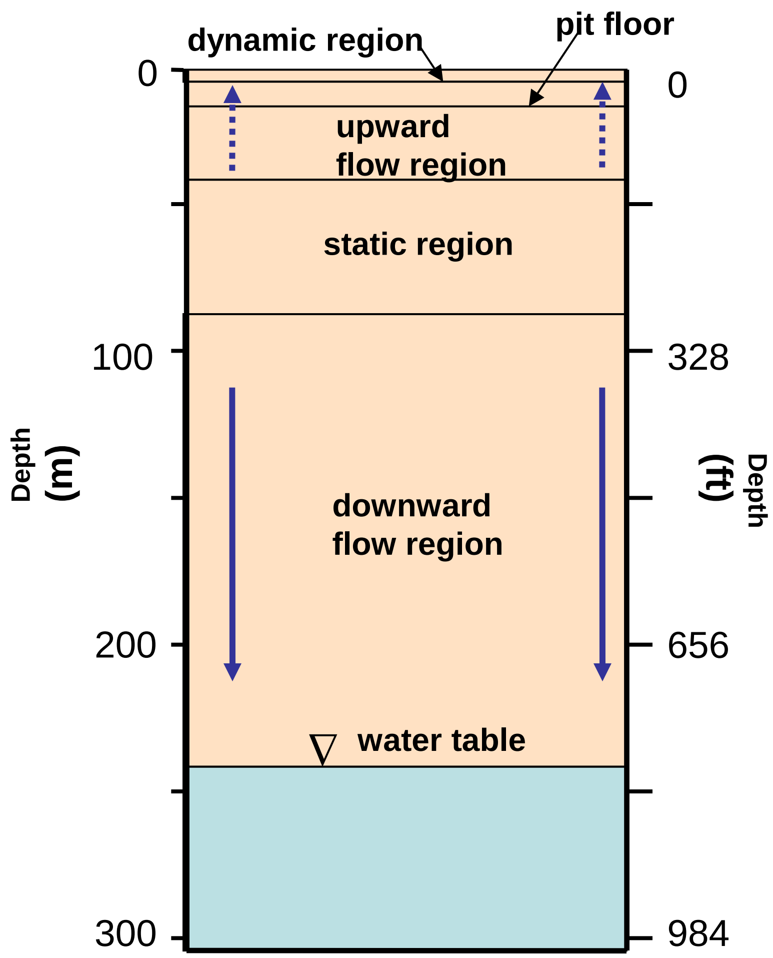
Area 5 Radioactive Waste Management Site (RWMS)

- Disposal Authorization Statement (DAS) issued in 2000, 2002, and 2007
- Radioactive Waste Management Basis (RWMB)
- PA (DOE/NV/11718-176)
  - Two addenda (DOE/NV/11718—176-ADD1;-ADD2)
- Composite Analysis (CA) (DOE/NV—594)
  - One addenda (DOE/NV—591-ADD1)

DOE Order 435.1 Documents (continued)

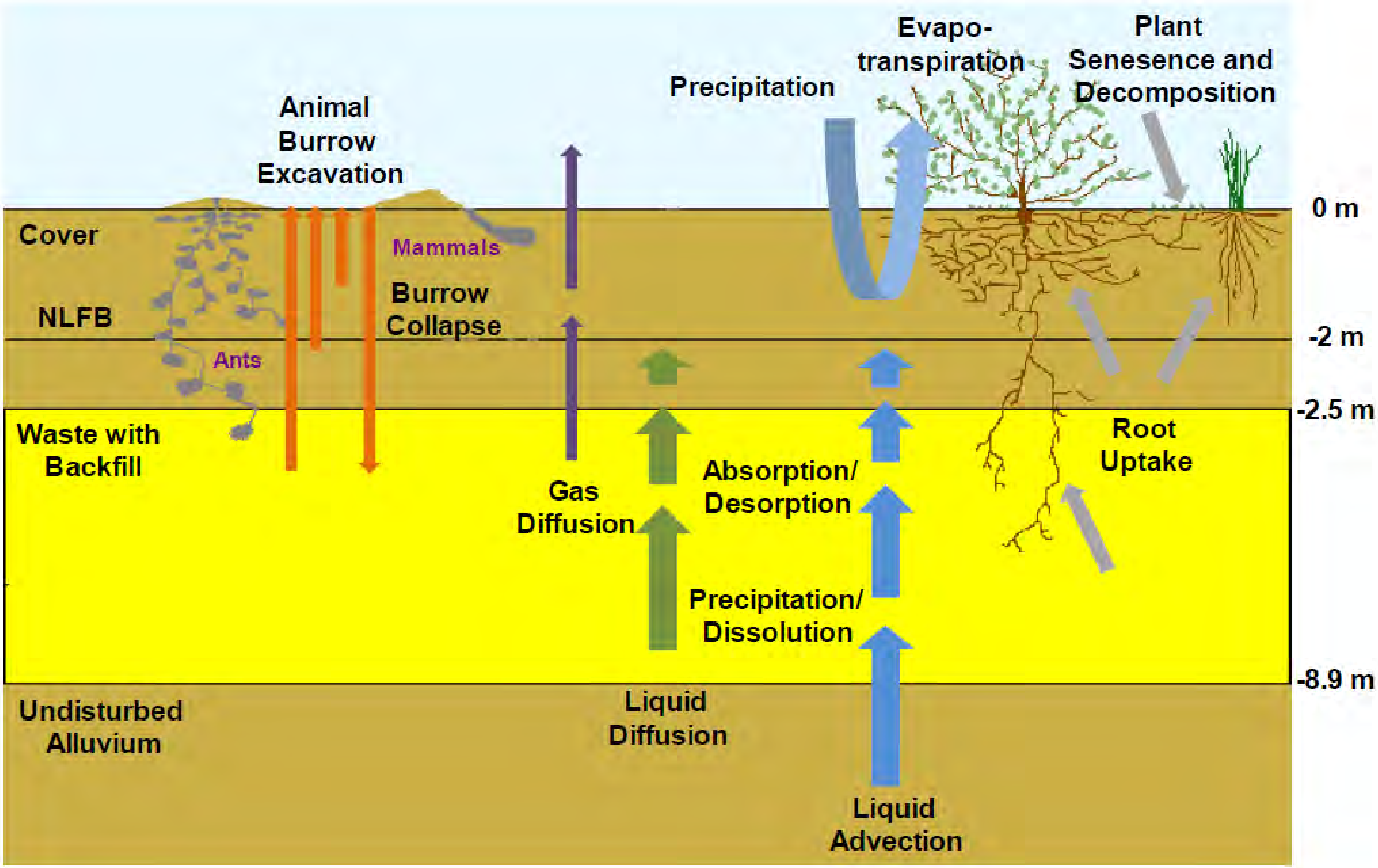
- Maintenance Plan (DOE/NV/25946—091)
- Closure Plan (DOE/NV/25946--553)
  - Includes monitoring plan
- NNSS Waste Acceptance Criteria (NNSSWAC) (DOE/NV—325-Rev.10)
- 2012 annual summary report (DOE/NV/25946—1717)

Natural Site Conditions



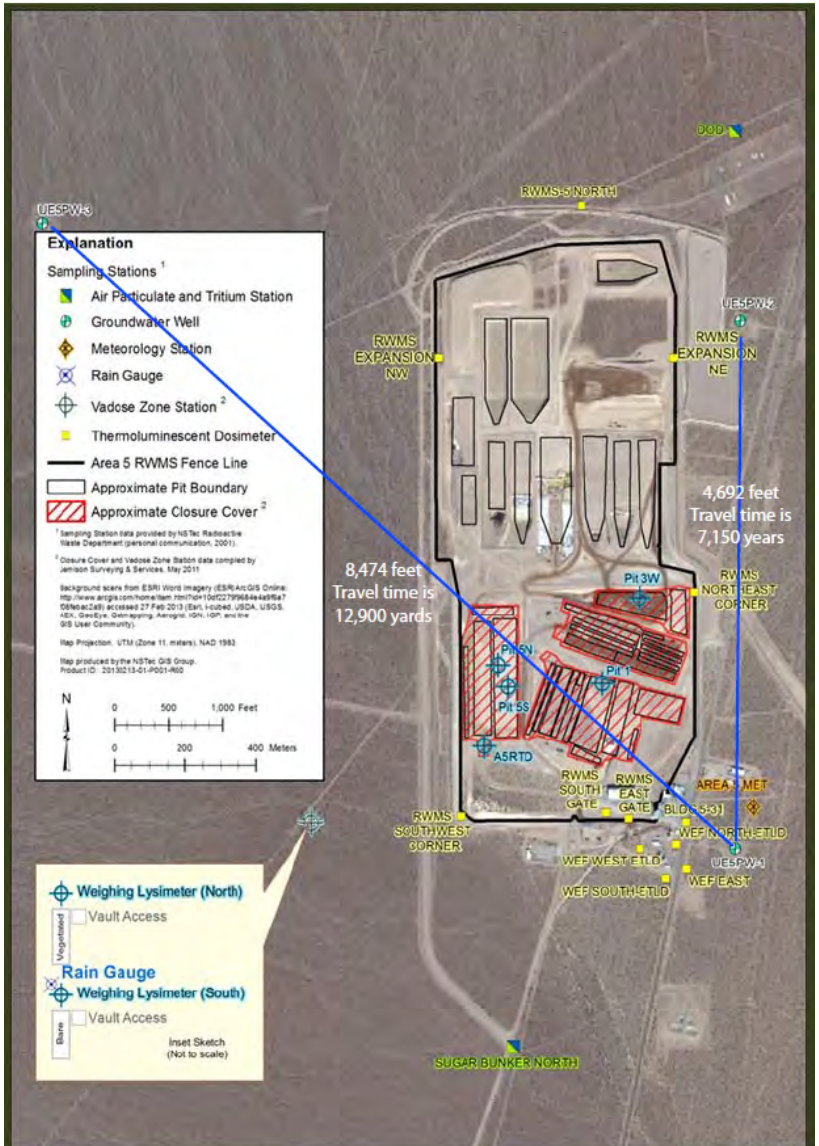
- Located >700 feet above groundwater
- ~5 inches average annual rainfall
- High potential evaporation rates (x12 rainfall)
- No groundwater pathway
- Drying unsaturated zone with upward water and vapor flow
  - 35 m
- Limited pathways from buried waste to surface
- Low seismic and volcanic activity

Natural Site Conditions (continued)



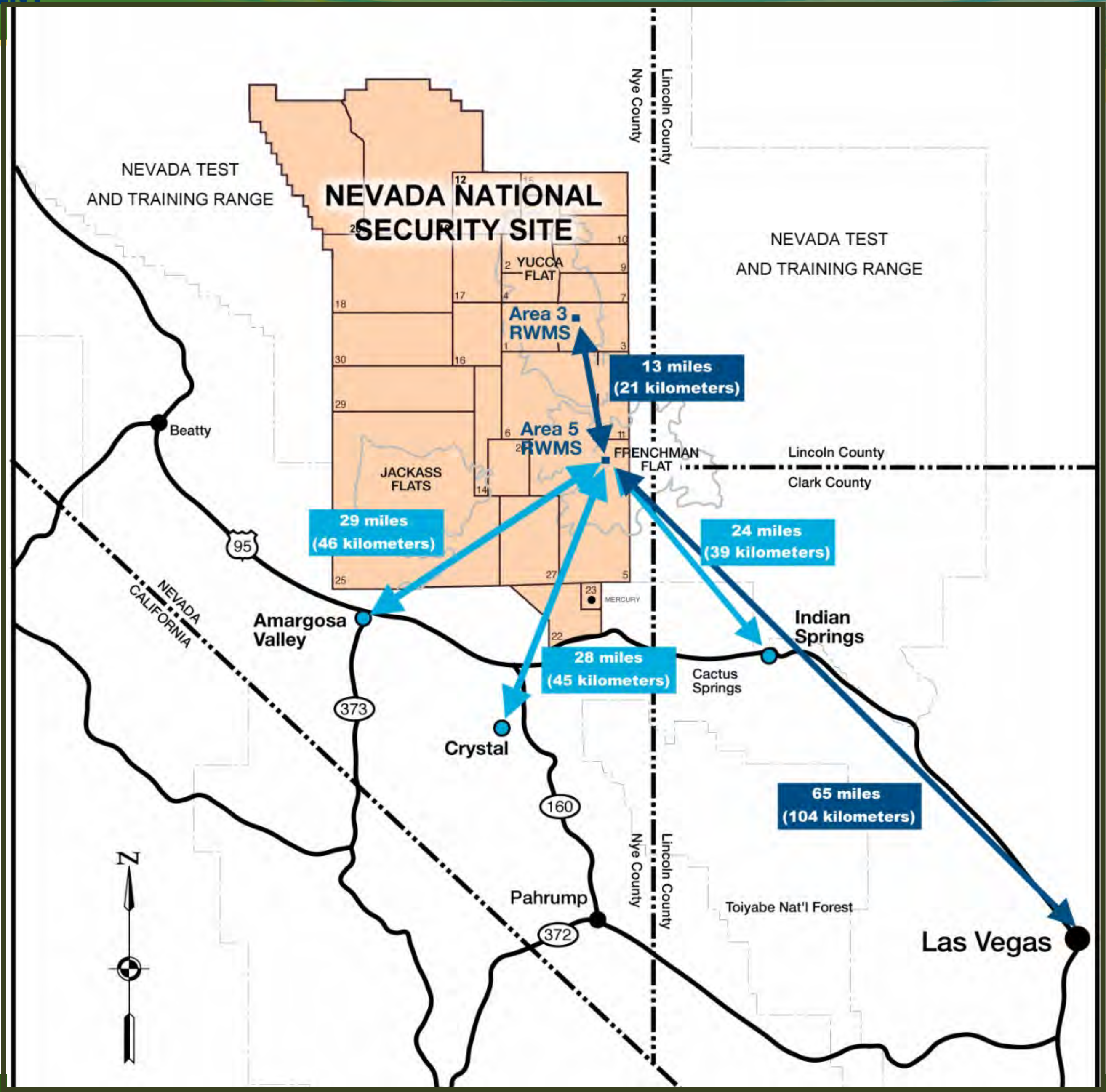
No groundwater pathway

RWMS Characteristics



- 740 acres, 184 in use
- Nuclear testing conducted nearby
- NNSA ownership of disposal site in perpetuity
- No attractive resources
  - Water, fertile soils

Distance to Communities



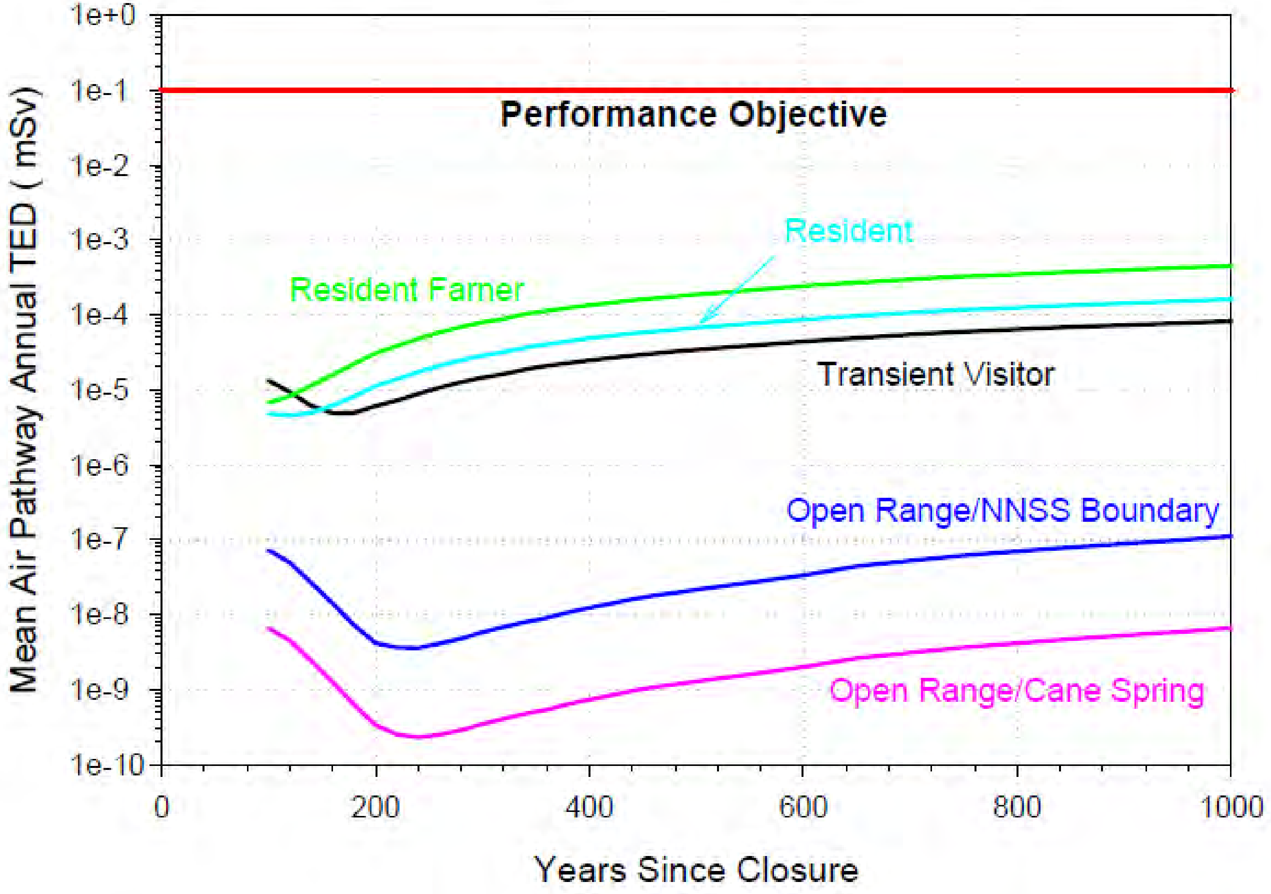
Conservative Bias/Assumptions

- Radionuclides available for immediate release and transport
  - Waste forms and containers do not delay source term release
- Inadvertent intruders do not recognize waste at any time
- Resident continuously present 100 m from the RWMS boundary
  - No evidence of any permanent or long-term presence of humans in Frenchman Flat
- Member of public 100 m from the RWMS boundary exposed to soil concentrations estimated for the disposal unit covers
  - No dilution during transport from the disposal site cover to the residence

Conservative Bias/Assumptions

- Conservative bias is used for the compliance
- Probabilistic model used to quantify uncertainty and reduce conservatism for cost effective management of facility lifecycle
  - 2007 NNSSWAC concentration action levels based on probabilistic model results
  - Resident farmer highly conservative for NNSS, moved to resident with no agriculture for compliance

Compliance



Member of Public Air Pathway results

TED – Total Effective Dose

Uncertainty/Maintenance

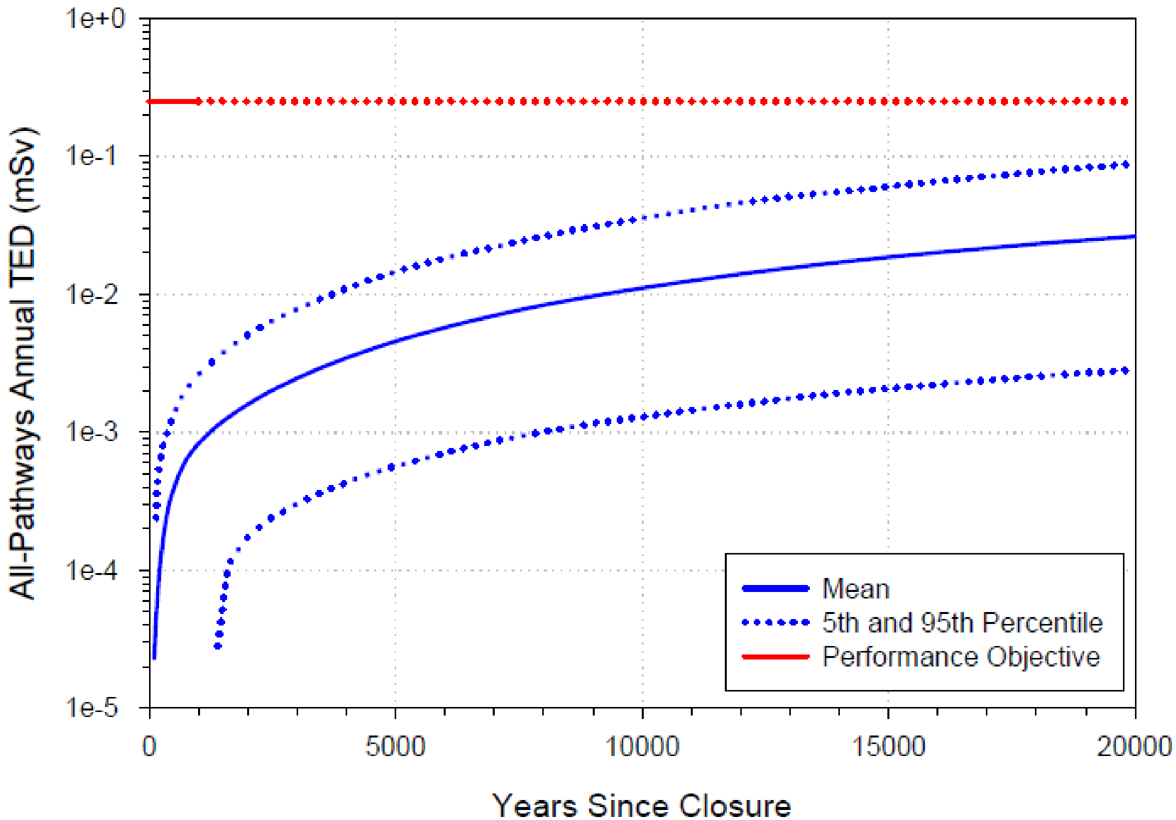


Figure 1. Area 5 RWMS all-pathways annual TED to a resident estimated by the A5 RWMS v4.114 GoldSim model.

- Uncertainty analyses include
  - Chronic intruder scenarios
  - No cover vs. various cover thickness
  - Additional member of public (MOP) scenarios
  - Out year model runs (20,000, 60,000 years)

Qualitative Peak Information

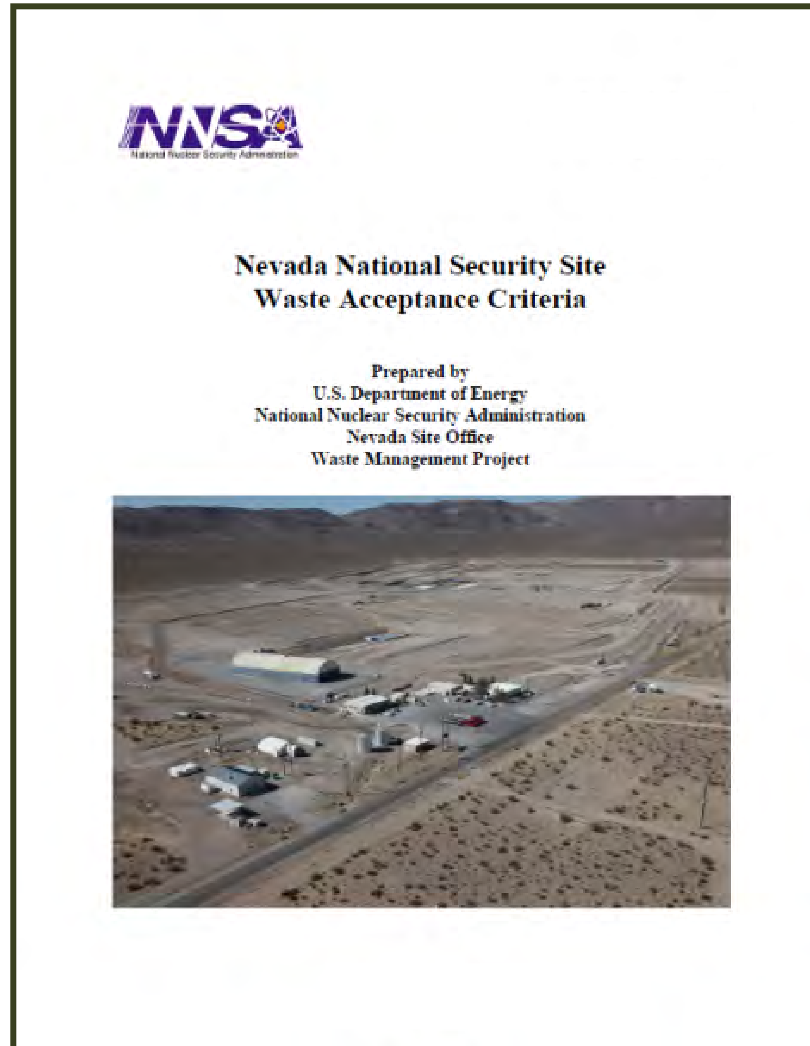
Performance Objective	Scenario	Time of Maximum (years)
Air Pathway	Resident	3.1E6
All-Pathways	Resident	3.3E6
^{222}Rn Flux Density	NA	2.0E6
Acute Intruder	Acute Drilling	2.4E6
Acute Intruder	Acute Construction	1.8E6

Inadvertent Intruder Analyses

- Construction scenario estimates the dose to construction workers building a home with a basement on a disposal unit
- Acute drilling scenario estimates dose to a drill crew drilling a water well through a disposal unit
  - Exposure to contaminated drill cuttings occurs while auguring a surface casing for the well
- Used to set radionuclide action levels in NNSSWAC

Radioactive Waste Acceptance Program (RWAP)

- Waste Acceptance Review Panel reviews every waste profile (WP) submitted for disposal
- Members: DOE/State of Nevada/site operations/RWAP/performance assessment/nuclear safety/criticality
- Generator facility audits and mixed waste stream verification
- 24 approved off-site generators


NNSA

Nevada National Security Site
Waste Acceptance Criteria

Prepared by
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Waste Management Project

PA Review of Waste Profiles

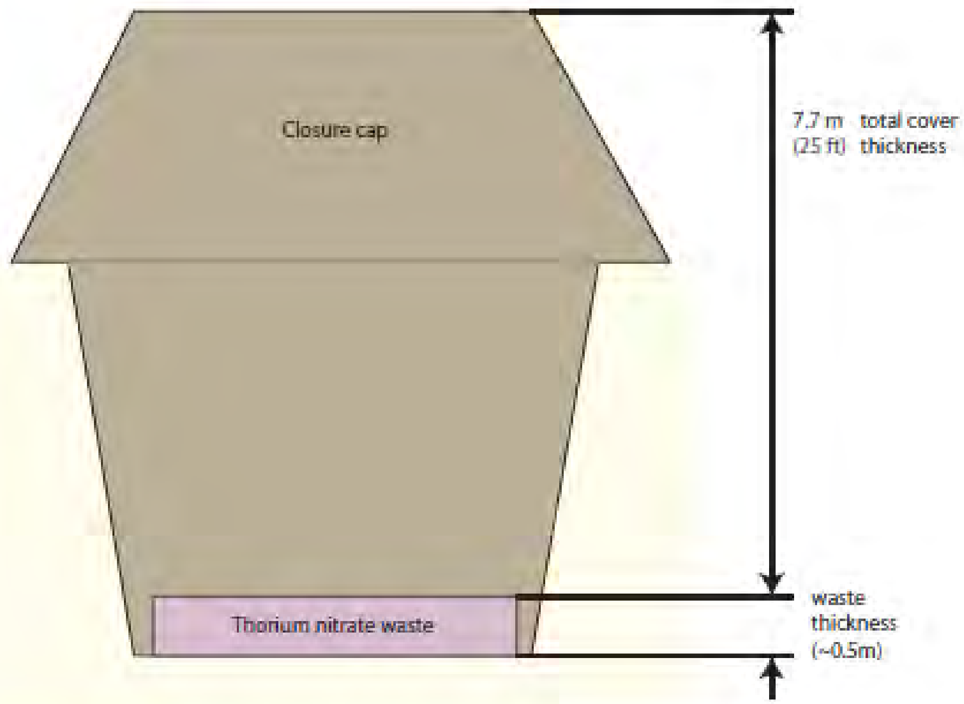
- Review for potential change to PA and DAS
  - Changes radionuclide inventory
  - Requires a change in facility design or closure plans; or the imposition of operational constraints or conditions
  - Alters the likelihood of a feature, event, or process; or significantly change a parameter value
  - Requires a change in waste acceptance criteria, the performance assessment or disposal authorization statement
- If yes to any, enter unreviewed disposal question (UDQ)

Unreviewed Disposal Question Process

- Inventory changes
  - Screening using sum of fractions based on WAC action levels
    - If pass no further action, if fail then special analysis
- Special Analysis
  - PA and process modeling (e.g. radon producing radionuclides, heat-producing potential)
  - Impose operational conditions (depth, spacing)
  - Radionuclides not analyzed in PA

Special Analysis Example

- Thorium Nitrate in Cell 13
- 11,600 cubic meters (m3)
- Ra-226, Th-230, Th-232 exceed WAC action levels
- Buried in deeper trench (25 feet) in a single layer
- No other waste placed above



PA Maintenance

- Ongoing field study and environmental monitoring based on PA/CA sensitivity and uncertainty analyses
  - Field Investigations determined proper distribution for burrowing animals and plant root depths
  - Vegetative cover based on long-term lysimeter
- Annual summaries document review of modeling and inventory updates, monitoring, and operations
- Monitoring includes facility and environmental media conditions

Iterative Process/Continued Improvement

- Research and Development
  - ALARA cover optimization
- PA revision driven by magnitude and significance of changes

Summary

- Area 5 RWMS incorporates
  - Natural and engineered barriers based on sparsely populated arid disposal site
  - WAC compliance
  - Site assessments (PA/CA)
  - Maintenance program to ensure the facility is protective of the worker and public health and safety, and the environment