



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

May 31, 2012

MEMORANDUM TO: ACRS Members

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

SUBJECT: CERTIFICATION OF THE MINUTES FOR THE MEETING OF  
THE RADIATION PROTECTION AND NUCLEAR MATERIALS  
SUBCOMMITTEE, October 4, 2011 – ROCKVILLE, MARYLAND

The minutes of the subject meeting have been certified on May 31, 2012,  
as the official record of the proceedings for that meeting. A copy of the certified minutes  
is attached.

Attachment: Certified Minutes

cc: ACRS Staff Engineers  
J. Flack  
H. Nourbakhsh



**ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
RADIATION PROTECTION AND NUCLEAR MATERIALS  
SUBCOMMITTEE MEETING MINUTES  
October 4, 2011  
Rockville, MD**

**INTRODUCTION**

The Advisory Committee on Reactor Safeguards (ACRS) Subcommittee on Radiation Protection and Nuclear Materials met on October 4, 2011, at 11545 Rockville Pike, Rockville, MD, in Room T2-B3. The meeting was convened at 2:00 pm and adjourned at 4:12 pm.

**ATTENDEES**

**ACRS**

M. Ryan, Chairman  
S. Armijo, Member  
S. Abdel-Khalik, Member  
D. Bley, Member  
J. Sieber, Member  
D. Widmayer, ACRS Staff

**NRC Staff and Contractors**

D. Persinko, FSME/DWMEP  
G. Suber, FSME/DWMEP  
J. Kennedy, FSME,/DWMEP  
J. Shaffner, FSME/DWMEP  
R. Jervey, RES/DE

D. Lowman, FSME/DWMEP  
M. Heath, FSME/DWMEP  
C. Ridge, FSME/DWMEP  
M. George, FSMW/DWMEP  
J. Cochran, Sandia National Laboratory

**Others**

L. Suttora, DOE  
T. Magette, Energy Solutions  
S. Meyer, PWC

D. Schulthiese, EPA  
B. Dornsife, WCS  
C. Miller, PG&E

## SUMMARY OF MEETING – REFERENCES TO TRANSCRIPT

The purpose of the meeting was to review and discuss the proposed revisions to the *Branch Technical Position (BTP) on Concentration Averaging and Encapsulation* for low-level radioactive waste (LLW). The presentation slides and handouts used during the meeting are attached to the transcript.

<b>Subject Covered</b>	<b>Transcript Pages</b>	<b>Slides</b>
Dr. Michael Ryan introduced the Subcommittee Meeting.	4	None
M. Heath, Project Manager for the revision of the BTP in DWMEP in FSME introduced the subjects to be discussed at the meeting, and introduced the NRC staff and contractor presenters. He then briefly introduced the contents of the BTP and its relationship with 10 CFR Part 61, and some history on the first version of the BTP and how the NRC staff got to needing this revision 1. In the course of this presentation, the subject of the inadvertent intruder was discussed, how it is characterized in the regulation and BTP and whether that is risk-informed or not, and the construct of the scenarios used in developing Part 61.	4 - 24	123 - 135
Dr. C. Ridge, Senior Performance Analyst in FSME, presented a discussion of the homogeneity guidance included in the BTP revision. Subjects specifically covered in this discussion included the elimination of the “Factor of 10” constraint on mixture inputs, the difference in exposure scenarios used in the intruder scenarios in developing the guidance, the need for homogeneity to prevent “hot spots,” the use of this modeling to augment the concentration tables in Part 61, and the methods provided in the guidance to meet the homogeneity requirements.	24 - 62	136 - 145
Dr. J. Cochran, contractor from the Sandia National Laboratory, provided a discussion of how to classify a mixture of LLW according to the guidance, encapsulation of sealed sources, and the alternative approach section of the guidance. Discussed were: the higher limits in the guidance for several sealed sources, the sealed source carry away scenario used for developing the encapsulation guidance, and the use of 10 meter depth to allow a change in the scenario in the alternative approaches section of the guidance.	62 - 112	146 - 176
D. Persinko, DWMEP Deputy Director, provided a brief description of the next steps in the process for publishing the BTP for public comment.	113 - 114	None
Mr. C. Miller from Pacific Gas and Electric provided some added comments on items discussed earlier on the encapsulation guidance.	114 - 120	None
Dr. Ryan closed the Subcommittee Meeting with some summary remarks. He also encouraged attendees to send written comments to the staff on the BTP revision when it	120 - 121	None

gets published for comment so the staff has the benefit of their insights as it moves to finalize the guidance.		
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### ***Significant Items Discussed***

Significant discussions were held on the following subjects, where public comments received by staff and discussed indicated great interest in the rule requirement from stakeholders, or where Subcommittee members had many questions or expressed some concern about the rule language or staff's explanations and discussions:

- 1) Intruder Scenario used for Basis of Guidance for Encapsulation – Members expressed a great deal of concern throughout the meeting about the scenario used for the encapsulation guidance in which a potential inadvertent intruder discovers and carries away a formerly encapsulated sealed source. Many aspects of this were discussed. Most of the issues members expressed concern that the arbitrary nature of the assumptions drives the scenario much too close to what they consider to be an “unrealistic” scenario as opposed to a bounding or “conservative” case. Many aspects of this remain troubling to the members, including no specific guidance for depth of burial, no accounting for longer time frames for the scenario to occur (i.e., has to be at 500 years in accordance with the regulation's requirements), and no accounting for large sums of money that could be used for longer times of control, or that government-recordkeeping would prevent this type of occurrence.

### **ACTIONS**

The staff agreed to provide the Full Committee with a presentation on the materials presented to the Subcommittee at the December 2011 Full Committee meeting. It is expected that the Full Committee would write a Letter Report on the matters discussed.

### **DOCUMENTS PROVIDED TO THE SUBCOMMITTEE**

1. U.S. NRC, “*Draft Branch Technical Position on Concentration Averaging and Encapsulation,*” Revision 1 (and Appendices) (ML112061191)
2. U.S. NRC, “*Technical Position on Radioactive Waste Classification,*” May 11, 1983 (ML033630755).
3. U.S. NRC, “*Final Branch Technical Position on Concentration Averaging and Encapsulation,*” January 17, 1995 (ML033630732)
4. U.S. NRC, “*Blending of Low-Level Radioactive Waste,*” SECY-10-0043, April 7, 2010 (ML090410246)

Official Transcript of Proceedings  
NUCLEAR REGULATORY COMMISSION

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Radiation Protection and Nuclear Materials

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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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SUBCOMMITTEE ON RADIATION PROTECTION

AND NUCLEAR MATERIALS

+ + + + +

TUESDAY

OCTOBER 4, 2011

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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 8:30 a.m., Michael  
Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman

SAID ABDEL-KHALIK

DENNIS C. BLEY \*

J. SAM ARMIJO

JOHN D. SIEBER

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CONSULTANTS TO THE SUBCOMMITTEE PRESENT:

JOHN FLACK

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

MAURICE HEATH

CHRISTIANNE RIDGE

DREW PERSINKO

ALSO PRESENT:

JOHN COCHRAN

CLINT MILLER \*

\* Present via telephone

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

1:58 p.m.

CHAIR RYAN: (presiding) The meeting will now come to order, please.

This is a meeting of the Radiation Protection Nuclear Materials Subcommittee. Today we are gathered to hear a review of the Branch Technical Position on Concentration Averaging and Encapsulation.

Maurice, are you going to lead us off?

MR. HEATH: Yes, I will.

CHAIR RYAN: All right. Thanks. Maybe you could introduce the speakers today and cover a little bit of an intro. That would be helpful.

MR. HEATH: Okay. Thank you.

First, I would like to thank you for giving us the opportunity to bring you a brief today on the revisions to the Draft Branch Technical Position on Concentration Averaging and Encapsulation.

Today myself will be giving the introduction. Then I will turn it over to Dr. Christianne Ridge. She will be going over the homogeneity guidance. And Mr. John Cochran from Sandia National Lab, who has been working with us in this effort, he will go over the other technical points in the presentation.

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1 CHAIR RYAN: Thank you.

2 MR. HEATH: Now before we get started, we  
3 can kind of put things in context. We believe that  
4 the draft that we are going to present to you is  
5 significantly improved from the 1995 version. We  
6 believe that it is going to help potentially improve  
7 the waste management and disposal practices. It  
8 implements the Commission's direction to risk-  
9 inform/performance-base the agency's blending  
10 position. It provides for disposal rather than  
11 indefinite storage of additional sealed sources that  
12 currently are classified A, B, and C, which could be  
13 prohibited by disposal facility licenses that  
14 reference the existing BTP.

15 And also, we believe it is better  
16 organized and it is more transparent in the technical  
17 bases that have been developed. It will help  
18 stakeholders to understand the position and provide  
19 more meaningful comments as we go through this effort  
20 to revise the BTP.

21 So far, we have had some feedback from the  
22 draft BTP. A number of stakeholders have said it is  
23 more clear, that it is a better read. We have also  
24 got some feedback from DOE, the NNSA, the National  
25 Nuclear Security Agency, who manages thousands of

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1 commercially-sealed sources which have been collected  
2 from licensees. And they have strongly supported the  
3 changes and believe that some of the changes with the  
4 sealed-source position will help alleviate some of the  
5 stranded sources that are out there today.

6 CHAIR RYAN: Have you received written  
7 communication about those views?

8 MR. HEATH: No, we haven't. We are not  
9 going to put the draft out for formal public comment  
10 until after the ACRS full Committee, and we need to  
11 write the letter after the full Committee meeting.

12 CHAIR RYAN: Okay.

13 MR. HEATH: Then we want to put the  
14 document out for our formal comment period. So, so  
15 far, these are comments that they have told us from  
16 being at conferences and that sort of thing, that they  
17 have said, given us those feedbacks.

18 CHAIR RYAN: You might take a note, John,  
19 to consider inviting DOE to the full Committee meeting  
20 to hear their views directly --

21 CONSULTANT FLACK: Yes. Yes.

22 CHAIR RYAN: -- if they manage a large  
23 number of these sealed sources.

24 Thank you.

25 MR. HEATH: Now, as we just stated, we

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1 will be back in December for the full Committee. At  
2 that time, we hope to have more comments from  
3 stakeholders and the public. Because on October 20th,  
4 we will have a public meeting out in Albuquerque, New  
5 Mexico.

6 At that meeting, we will be discussing the  
7 draft BTP and there will be various stakeholders. We  
8 have Agreement State regulators that have said they  
9 will be attending. So, we hope to get more feedback.  
10 So, in December, we will be able to come back and give  
11 you more feedback on what we have heard so far, these  
12 changes.

13 CHAIR RYAN: Maurice, I guess at this  
14 point -- correct me if I am wrong -- it is my  
15 understanding that the NRC will not directly regulate  
16 anything that is covered by this BTP; that right now  
17 at least the situation is that only Agreement States  
18 will be the responsible regulatory authority for  
19 licensees under this guidance. Is that correct?

20 MR. HEATH: That is correct. And this is  
21 guidance. And we make that a point, that this is  
22 guidance for the Agreement States. They will be the  
23 ones that are enacting that with their licensees, yes.

24 CHAIR RYAN: Thank you.

25 MR. HEATH: Now one thing before I get

1 into the presentation. I want to stress that we are  
2 still in the process, obviously, of revising. So, we  
3 are open to take comments of any type. We really want  
4 to hear the comments that you have for us today.

5 CHAIR RYAN: Okay.

6 MR. HEATH: So, that is going forward.

7 All right.

8 CHAIR RYAN: I think you have control of  
9 the -- (referring to the visual presentation).

10 MR. HEATH: Okay.

11 CHAIR RYAN: Okay. Yes. Okay. Great.

12 MR. HEATH: I will do a brief  
13 introduction, kind of what the BTP is. Then, I will  
14 do a little kind of a background. And then, the last  
15 thing, I want to make the distinction between the  
16 site-specific analysis and the BTP because we  
17 understand that there has been --

18 CHAIR RYAN: You might just want to move  
19 off that a little bit. There you go.

20 MR. HEATH: We understand that you had  
21 quite a few presentations on the site-specific  
22 analysis. We just want to make sure that we draw the  
23 difference between the two.

24 And the next slide, like I said, Dr. Ridge  
25 will be covering/demonstrating homogeneity and

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1 classifying homogeneous waste, and John Cochran will  
2 be covering the classifying of mix, make sure of  
3 individual items, encapsulation of sealed sources, and  
4 our alternative approaches.

5           What is the BTP? The BTP is the guidance  
6 document for waste generators and processors that help  
7 in classifying waste for disposal under Part 61. And  
8 it also provides a method for averaging and  
9 classifying radionuclide concentrations in waste over  
10 a volume or mass of waste package. And one note that  
11 we want to make is an important aspect is the BTP is  
12 widely used in the industry from power plants to other  
13 generators and processors and, also, like we said  
14 earlier, Agreement State regulators as well.

15           Now Part 61, in Subpart C are contained  
16 like four performance objectives. Now any disposal  
17 facility has to follow these four performance  
18 objectives and they have to be met when disposing of  
19 low-level waste.

20           Now how that applies to BTP today is that  
21 BTP, the basis of the averaging provision of BTP is to  
22 protect the inadvertent intrusion, which is contained  
23 in 61.42. Now the way to accomplish that protection  
24 from an inadvertent intrusion is with the waste  
25 classification in 61.55. That's the Tables 1 and 2.

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1 That defines the class of waste, either A, B, or C.

2 And in the regulation, the provision that  
3 actually states in the regulation for averaging is  
4 61.55(a)(8), which allows for concentration averaging  
5 in determining waste class.

6 Now the last bullet is 10 CFR Part 20,  
7 Appendix G. And what this regulation is, it is  
8 really the uniform manifest, the manifest that  
9 accompanies the waste. The main thing that it gives  
10 on this manifest, when you are ready to ship your  
11 waste, the manifest gives you container description  
12 and identify of the waste. It also has a  
13 classification that you make when you are shipping for  
14 disposal.

15 This is Table 2 that is out of the  
16 regulations. What I just want to emphasize on this  
17 slide is just that, when we are talking for the table  
18 and the concentrations, we are talking curies per  
19 cubic meter. That is the one thing. And the BTP  
20 tells how to average the waste classification, so that  
21 you can meet the 61.55 table, as you see above, and to  
22 protect the inadvertent intruder.

23 CHAIR RYAN: What radionuclides are in  
24 play after, say, a 300-year life for a low-level waste  
25 site for an institutional control period?

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1 MR. COCHRAN: Some that might surprise you  
2 with a moderate half-life of cesium and strontium are  
3 still there. Your transuranics are going to be there.  
4 For example, niobium-94 is going to be there.

5 CHAIR RYAN: Yes, 300 years strontium and  
6 cesium are pretty well done.

7 MR. COCHRAN: Unless they begin as a  
8 concentrated sealed source. We will talk about that  
9 in a second.

10 CHAIR RYAN: Okay. I will be curious to  
11 hear what you have to say about it. I get uranium, a  
12 little bit of some of the longer-lived irradiated  
13 hardware metals, but I come up with five radionuclides  
14 that might be around after 300 years. I'll share that  
15 with you when you get to your list.

16 MR. COCHRAN: Okay.

17 MR. HEATH: All right. Now I am going to  
18 just give you a little brief background on kind of how  
19 we got to this point today. Back in 2007, the staff  
20 performed a strategic assessment on NRC's low-level  
21 waste program. Out of that assessment, we identified  
22 revising the BTP has a high priority. And also, in  
23 that assessment we said that we would risk-  
24 inform/performance-base the positions contained in  
25 that BTP.

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1                   Now, a little later, blending of low-level  
2 waste was on the table, and it became a topic. And  
3 so, we developed a SECY paper, a blending SECY paper,  
4 that was sent to the Commission. Now, during this  
5 effort, the BTP was put on hold until we could work  
6 out the issue of blending.

7                   Now the SRM from the Commission on  
8 blending came down, and the Commission agreed with  
9 Option 2 in that blending paper, which said that we  
10 would risk-inform the blending position in the BTP.  
11 The staff also thought that we would risk-  
12 inform/performance-base the entire BTP as well, as we  
13 identified in our strategy assessment in 2007.

14                   This slide is just to show the definition  
15 of risk-informed/performance-based, and this was a  
16 definition that came out of NRC's strategic plan,  
17 NUREG-1614.

18                   This next slide is just to show how it  
19 relates to the BTP. When we say "risk-informed", we  
20 are talking guidance linked to limiting doses to  
21 inadvertent intruder. We are talking reasonably  
22 foreseeable scenarios and evaluated consequences to  
23 the intruder.

24                   And when we say "performance-based", we  
25 have two major things we are talking about, measurable

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1 parameters, concentrations of radionuclides, and we  
2 are talking about an additional thing that we provide,  
3 which is additional flexibility. That is in our  
4 alternative approaches section in the BTP.

5 CONSULTANT FLACK: Can I ask a question on  
6 that, Mike?

7 CHAIR RYAN: Please do.

8 CONSULTANT FLACK: Yes, on the inadvertent  
9 intruder, when you say you use risk-informed, do you  
10 try to quantify the probability of the intruder  
11 entering into the vicinity? I mean, how do you do  
12 that?

13 MS. RIDGE: No, we haven't done that.

14 CONSULTANT FLACK: So, it is not risk-  
15 informed? That part is not risk-informed?

16 MEMBER ARMIJO: That is strictly  
17 deterministic, right? Somebody decides there will be  
18 an intruder?

19 MR. COCHRAN: It is not a probabilistic  
20 risk assessment, but rather risk-informed.

21 CHAIR RYAN: So, what does it mean if it  
22 is not probabilistic? How is it risk-informed? What  
23 is your metric to risk in that setting?

24 MR. COCHRAN: The regulation requires us  
25 to protect the intruder.

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1 CHAIR RYAN: The inadvertent intruder?

2 MR. COCHRAN: The inadvertent intruder.

3 Thanks for the clarification because the regulation  
4 requires us to protect the inadvertent human intruder.

5 And in the development of Part 61, the NRC  
6 used reasonably foreseeable, yet conservative exposure  
7 scenarios, set limits on the concentrations of  
8 radionuclides that could be disposed of in the near  
9 surface. Okay? So, they used reasonably foreseeable,  
10 circumstances that we all believe might occur.

11 CHAIR RYAN: I wouldn't say "we all".

12 (Laughter.)

13 Some might.

14 MR. COCHRAN: But some might.

15 CHAIR RYAN: That is the whole point,  
16 though. There is no way to come to agreement  
17 analytically on one view versus another view in terms  
18 of its being risk-informed. That's the problem.

19 MR. COCHRAN: That's true. But science,  
20 I mean, others have wrestled with this in high-level  
21 waste, spent fuel. There is no scientific way to  
22 determine the probability of some future exposure  
23 scenario.

24 MEMBER ARMIJO: That is why it is pretty  
25 subjective.

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1 MR. COCHRAN: And so, that's why it is  
2 subjective.

3 MEMBER ARMIJO: Right.

4 MR. COCHRAN: And that's why the  
5 regulatory authority needs to set the basis. If you  
6 leave it to the Agreement States and the licensees,  
7 the licensees' view of the future is there won't be  
8 any intrusion. Stakeholders may say there could be  
9 terribly extensive intrusions. Somebody could build  
10 a school here, for example. And there is no way to  
11 resolve between the two perspectives.

12 The NRC chose 25 years ago, and we  
13 followed in their footsteps, to set reasonably  
14 foreseeable, yet conservative, exposure scenarios to  
15 then determine what is safe in your service disposal.

16 CHAIR RYAN: And how to interpret those  
17 concepts are all in the eye of the beholder. There is  
18 nothing analytic about it, in my view.

19 MR. COCHRAN: I hope that at a high level  
20 that concept is fairly agreeable. We should select  
21 reasonably foreseeable, yet conservative scenarios.  
22 The details are absolutely in the eye of the beholder.

23 CHAIR RYAN: So, the concept is also in  
24 the eye of the beholder and what they mold out of it?

25 MR. COCHRAN: The fine line is in the eye

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1 of the beholder. We hope that the concept is  
2 agreeable, that the regulation says we need to protect  
3 the intruder. The NRC chose 25 years ago that we were  
4 going to use reasonably foreseeable, yet conservative,  
5 exposure scenarios.

6 CHAIR RYAN: Well, I would have to say  
7 that I hear the words, but they all sound horribly  
8 qualitative -- and I mean "horribly" in the way you  
9 would think. It is not tenable to have something that  
10 is not commonly interpretable by all that use it. And  
11 my experience is it has been very widely interpreted  
12 for a long time.

13 MEMBER ARMIJO: Yes, and for what period  
14 of time? We get into that issue of how far into the  
15 future do you have to protect these intruders. We got  
16 into that a couple of meetings ago.

17 CHAIR RYAN: Even a simpler question of,  
18 when does an inadvertent intruder become an advertent  
19 intruder?

20 MS. RIDGE: If we could just return to the  
21 original question for just a moment, though, I am not  
22 sure -- and if I could amplify what John said -- I am  
23 not sure I would say it is fair to say it is not risk-  
24 informed at all. Because whenever you make a choice  
25 about what scenarios to consider, and I agree with you

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1 it's subjective, and that possibly could be improved,  
2 although I think that would be an extremely difficult  
3 technical problem when you start looking into the  
4 future.

5 But I don't think it is fair to say it is  
6 not risk-informed, because whenever you choose a  
7 scenario, you are making a risk decision. You are  
8 saying, for example, if the waste is buried in the  
9 first few meters, we consider that someone could put  
10 a dwelling on the site. If it is deeper than that, we  
11 are making a decision that we are not considering that  
12 scenario. That is not quantitative, but that is risk-  
13 informed.

14 Someone could come and build a very deep  
15 basement for a very large structure, and we are making  
16 a risk decision that we think that that is  
17 sufficiently improbable, although we haven't been able  
18 to quantify it, that we are not considering that.

19 So, I would agree with you that work could  
20 be done to improve the quantification, but I don't  
21 think I would agree that we can say that these aren't  
22 risk-informed at all. Because whenever you choose a  
23 scenario, you are implicitly making a risk decision.

24 CHAIR RYAN: In a qualitative way. That's  
25 the point, is that it is not quantifiable; it is

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1 qualitative. And that is where I think it falls a  
2 little short, but I think we understand.

3 MEMBER ARMIJO: Yes, but the dilemma  
4 starts with the regulation, which says protect  
5 inadvertent intruder for any and all. I think those  
6 words are in there, which is literally something that  
7 you can't do really. So, you are making some  
8 judgments on how to limit that.

9 And our problem is, you know, judgment is  
10 being used. Our definition of risk is different than  
11 -- we use it with a capital "R"; at least that is what  
12 the PRA guys do. So, these are judgments that are  
13 made and, to a certain extent, are deterministic.  
14 People can discuss it forever and still not agree.

15 But the inadvertent intruder issue drives  
16 the answer. It seems to me that these conclusions and  
17 everything is driven by that issue of protecting this  
18 inadvertent intruder. And that is the problem, where  
19 the real thing is to protect people, in your term, who  
20 are working at the site.

21 So, I have a philosophical problem with  
22 protecting somebody thousands of years in the future  
23 compared to people who are here today.

24 MR. COCHRAN: If you look at the  
25 development of the Part 61 regulation and, in

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1 particular, limiting the concentration of the nuclides  
2 in the near surface, in that development they divided  
3 the waste into Class A, Class B, and Class C.

4 And the assumption was that Class A waste  
5 would be waste that we would only need to isolate from  
6 the inadvertent human intruder for 100 years, and the  
7 standards would be pretty easy to implement.

8 B waste, they limited the concentrations  
9 such that at 300 years you could have the inadvertent  
10 human intrusion, as envisioned in the draft and Final  
11 EIS, and the intruder would be protected at 300.

12 Class C, the intruder is protected to 500  
13 years.

14 And then greater than Class C, typically  
15 is inappropriate for near surface. And the intruder  
16 would not be protected, even if they inadvertently  
17 entered the landfill at year 501.

18 So, there may be some mixing of the site-  
19 specific assessment rulemaking with the tables that  
20 are in Part 61.

21 MEMBER ARMIJO: Okay, there probably is.  
22 There probably is some confusion.

23 MR. COCHRAN: Those tables that are in 61  
24 that set the Class A, the Class B, and the Class C  
25 limits, those are all set up. In Class A, the curie

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1 limits are pretty low, and that waste will be safe for  
2 inadvertent human intrusion, as described through the  
3 draft and Final EIS, the rulemaking process, safe at  
4 100 years; B at 300; C at 500.

5 CHAIR RYAN: That's the part I don't  
6 understand. How can something be safe at 100 years,  
7 something else doesn't become safe for 300 years, and  
8 it is all buried the same way and we are talking about  
9 the same level of intrusion? Intrusion is binary. It  
10 either happens or it doesn't.

11 Let me get back to my point earlier.

12 MR. COCHRAN: It's the concentrations that  
13 provide the safety.

14 CHAIR RYAN: Ah, so, I mean, we have got  
15 3,000, I'm sorry, 5,247 curies of uranium-238. That  
16 is what is in one disposal site right now. It is  
17 obviously not decayed.

18 Carbon-14, 3,380 or so curies. I-129, 9  
19 curies. Tech-99, 117 curies. You know, they have  
20 kind of taken cesium and strontium off the list  
21 because they are 10 times the half-life and  
22 essentially gone.

23 So, I don't understand what we are  
24 protecting the inadvertent intruder from. By the way,  
25 the uranium, the carbon, the iodine, and technetium

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1 are very well-distributed in lots of different waste.  
2 Yet, they are still classified based on their  
3 quantity.

4 MR. COCHRAN: It is the specific activity  
5 that is really --

6 CHAIR RYAN: Of the radionuclide itself,  
7 not necessarily in the waste form, right?

8 MR. COCHRAN: Of the waste form that the  
9 intruder sees. They don't see the entire inventory in  
10 a landfill.

11 CHAIR RYAN: Right. But, I mean, the  
12 point is that this is distributed over millions of  
13 cubic feet of material. I am still struggling with  
14 it, and honestly so. I am not trying to be critical  
15 of what you are talking about, but there is very  
16 little activity left after 300 years, and we are  
17 putting a huge burden on inadvertent intrusion control  
18 and response. So, I just offer you that thought to  
19 think about when you make your comments.

20 MR. COCHRAN: I certainly appreciate your  
21 concerns. And hopefully, as we talk through some of  
22 the exposure scenarios, and we have more meaningful  
23 discussion, there is quite a bit of material yet to  
24 cover.

25 CHAIR RYAN: Okay. Fire away.

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1 MR. HEATH: All right. This slide just  
2 represents the major changes, a comparison to show, it  
3 gives you what was in the 1995 BTP and what was  
4 revised. We are going to cover all of these in our  
5 presentation. Like I said earlier, Dr. Ridge will  
6 cover the homogeneity, the removal of the factor-of-10  
7 constraint for blending of waste, and then John will  
8 take care of the technical issues with the sealed  
9 source, for instance, the factor of two. And we will  
10 get into that during the presentation.

11 The last thing I want to go over is just  
12 to make the distinction, because we have already had  
13 some talk about the difference between site-specific  
14 analysis rulemaking and the BTP. Now they both deal  
15 with intruder protection, but the primary user for the  
16 site-specific analysis is the disposal facility, and  
17 the primary user for the BTP are the generators and  
18 the processors.

19 And one of the other major distinctions is  
20 the site-specific analysis rulemaking, the purpose if  
21 regulation, so adding an additional measure, where the  
22 BTP is just guidance that is not a requirement.

23 CHAIR RYAN: How do you think they will  
24 match up or become aligned? I mean, the bottom line  
25 is a site-specific rulemaking, it is a regulation. It

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1 is going to end up with a license that has license  
2 requirements that most likely are going to require the  
3 BTP to be used. So, it, in effect, carries the weight  
4 of regulation. I don't see the distinction in  
5 splitting the two apart and saying one is guidance and  
6 one is regulation.

7 MS. RIDGE: Well, I think the BTP is  
8 fairly clear in providing alternatives that John will  
9 discuss in more detail. But it explains, tries to  
10 explain fairly clearly, this is one way of showing  
11 that you have concentration-averaged appropriately.  
12 There are other considerations, and it describes other  
13 considerations.

14 CHAIR RYAN: It wouldn't surprise me to  
15 see a license condition at a new site that says, "Thou  
16 shalt follow the BTP," period.

17 MS. RIDGE: But if it does, the BTP itself  
18 provides for alternative consideration.

19 CHAIR RYAN: In this way. I mean it will  
20 be very specific, I would guess. I think whatever  
21 variability exists in the BTP will be taken out by  
22 licensing. That's my guess.

23 MR. COCHRAN: Well, to amplify what  
24 Christianne just said, the new BTP -- and I'll talk  
25 about this -- the alternative approaches really give

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1 both the Agreement States and the licensees a lot of  
2 room for using site-specific factors to deviate from  
3 the guidance. You are not deviating from the  
4 regulation at this point. You are just deviating from  
5 the guidance. And the BTP, this revised BTP tries to  
6 make it a lot easier to do that.

7 CHAIR RYAN: Okay.

8 MR. COCHRAN: So, that is fairly different  
9 than having something in some of the regulation and  
10 wanting to deviate from the regulation.

11 CHAIR RYAN: Uh-hum.

12 MR. HEATH: Now, also, when we have our  
13 public meeting and the state regulators are there, we  
14 are hoping that we get comments like that from the  
15 state regulators. And then, if we do, we will  
16 definitely bring that back in time to the full  
17 Committee.

18 CHAIR RYAN: Thank you.

19 MR. HEATH: Okay. Now I will turn it over  
20 to Dr. Ridge for the homogeneity guidance.

21 MS. RIDGE: Well, thank you again for your  
22 time. And I just wanted to reiterate we are looking  
23 forward to your comments on this draft guidance.

24 Next slide.

25 This is a slide that, actually, the next

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1 slide is a slide you have seen before. This slide  
2 just describes the waste types that are addressed in  
3 the BTP. I am only going to talk about one of them.  
4 I am only talking about homogeneous waste. John is  
5 going to talk about the remaining waste types.

6 CHAIR RYAN: Okay.

7 MS. RIDGE: Before we go on, I do want to  
8 make a couple of general points about homogeneous  
9 materials. These are wastes that I am sure you are  
10 mostly familiar with, but like ion-exchange resins,  
11 soils, ash, among other things, that are flowable,  
12 miscible, and, in part, for that reason, are assumed  
13 to be well-mixed, if an intruder were to encounter  
14 these wastes.

15 There are other wastes, for instance,  
16 solidified liquid, maybe not as miscible when an  
17 intruder brings them up, but uniform when disposed.  
18 And so, that is also regarded as a homogeneous waste.

19 Containerized dry active waste also  
20 regarded as a homogeneous waste, not so much because  
21 it is homogeneous when it is disposed, but because  
22 after 100 years it is assumed to degrade to a point  
23 that it will be miscible if intruded upon. So, these  
24 are items, generally, that we are assuming, if someone  
25 were to exhume, they would be mixed during that

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1 process. And those are things we are regarding as  
2 homogeneous wastes.

3 Most low-level waste by volume is  
4 homogeneous waste. And homogeneous waste is the waste  
5 that is easiest to apply concentration averaging to.  
6 Essentially, you can divide the curies in the  
7 container by the volume or the mass, whichever is  
8 appropriate according to the tables, and that is the  
9 end of the process and you have a number. You do not  
10 need to apply any of the additional constraints that  
11 are recommended in the guidance for these other waste  
12 types. So, there is an interest in demonstrating that  
13 a waste is homogeneous because it does affect how  
14 complex the concentration averaging is.

15 Next slide.

16 This slide you have seen before. Maurice  
17 presented this. These are the topics we are going to  
18 address today, and I just wanted to point out I'm only  
19 going to be talking about the first, demonstrating  
20 homogeneity and classifying homogeneous waste.

21 CHAIR RYAN: You are missing all the fun  
22 on 2 and 3 and 4.

23 (Laughter.)

24 MEMBER ARMIJO: Well, I just want to ask  
25 a question.

1 MS. RIDGE: Sure.

2 MEMBER ARMIJO: Are there types of waste  
3 that someone might consider as homogeneous that others  
4 would say, "Oh, no, that can't be homogeneous."? It  
5 is in these issues, areas where people have big  
6 disagreements and --

7 MS. RIDGE: That is a very good question.

8 MEMBER ARMIJO: It always happens. You  
9 know, you think you have made a clear definition, and  
10 there is always this middle transition zone where it  
11 might be or might not be.

12 MS. RIDGE: Absolutely. And the guidance  
13 I think tries to address that.

14 MEMBER ARMIJO: Okay.

15 MS. RIDGE: The first subtopic I am going  
16 to talk about within the homogeneity guidance is  
17 homogeneous waste types. And this is extremely  
18 similar to what is in the 1995 BTP.

19 Essentially, in the 1995 BTP there are  
20 certain waste types that are designated as being  
21 homogeneous. And with a very small change, we kept  
22 that from the 1995 BTP, and those waste types are  
23 listed.

24 Those waste types specifically, and I  
25 mentioned some of them earlier, are assumed to be

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1 homogeneous, and we are not proposing to apply any  
2 test to show that those waste types are homogeneous.  
3 I mentioned earlier ion-exchange resins --

4 MEMBER ARMIJO: Soils.

5 MS. RIDGE: -- ash, soils, dry active  
6 waste in containers, solidified liquids, absorbed  
7 liquids. And these waste types are, as I said,  
8 assumed to be homogeneous. And I am going to talk  
9 about that in a little more detail, but we are not  
10 changing the 1995 guidance on these topics.

11 CHAIR RYAN: Just one other, is there a  
12 placeholder for a new waste form that could be  
13 homogeneous based on these criteria? I am thinking of  
14 reverse osmosis waste, for example, you know, that has  
15 no residence. It is just an RO-type process. So,  
16 there are some processes out there where you get a  
17 homogeneous waste that is not on that list. How are  
18 you going to deal with that.

19 MS. RIDGE: Right. That is a very good  
20 point. And we would certainly consider putting a  
21 placeholder to make other waste streams designated.

22 The next part of the guidance on my next  
23 bullet addresses one specific waste type and a  
24 recommended approach for demonstrating that that waste  
25 type is homogeneous.

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1           And so, there is a process that we will  
2 talk about --

3           CHAIR RYAN: Okay.

4           MS. RIDGE: -- for showing that other  
5 waste types are homogeneous. That is not precisely  
6 the same thing as saying, forevermore, this waste type  
7 will be designated as one of the designated  
8 homogeneous waste types. And that is certainly  
9 something we could consider. But the guidance does  
10 address looking at a specific waste and showing  
11 whether or not you would consider it homogeneous.

12          CHAIR RYAN: Okay.

13          MS. RIDGE: And the next thing I will  
14 touch on briefly is classifying these homogeneous  
15 wastes.

16                 Now the reason we developed those  
17 homogeneity guidance, there are four primary reasons.  
18 One is that the 1995 BTP included what was known as a  
19 factor-of-10 constraint on inputs to a waste mixture.  
20 And what that said was that you can mix these flowable  
21 waste types and classify based on the mixture if the  
22 inputs will be within a factor of 10 of what the  
23 average will be after you mix them.

24                 So, you have the average after you mix  
25 them, and the ingredients to that mixture have to be

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1 within a factor of 10. Essentially, it prevented  
2 mixing things across classes because you couldn't mix  
3 things that had concentrations that were too  
4 different.

5 Now this is not a very performance-based  
6 way to look at things because you are looking at the  
7 inputs to a process rather than the output. And so,  
8 one of the changes in the proposed draft BTP is that  
9 it eliminates this factor-of-10 constraint on inputs  
10 to a waste mixture, and instead, looks only at the end  
11 of the process and not the inputs to a process.

12 Now eliminating that constraint does  
13 introduce a small concern for the safety of the  
14 inadvertent intruder. And I am going to talk about  
15 that in more detail on my next slide.

16 But, essentially, if you are not limiting  
17 the inputs, you have no more control over what is in  
18 that container unless you look at the outputs. And  
19 that is what we want to do with the homogeneity  
20 guidance.

21 Now the next reason for introducing this  
22 homogeneity guidance is a stakeholder concern. And I  
23 know that you are all familiar with the blending  
24 issue, of an industry proposal to blend wastes that  
25 have concentrations that would be greater than Class

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1 A concentrations with waste that has concentrations  
2 that would be lower than Class A concentrations, to in  
3 the end come up with a Class A mixture.

4 And if in the end that waste has  
5 concentrations that meet the tables, that is a Class  
6 A waste. But there is a stakeholder concern, knowing  
7 that more concentrated wastes have gone in, and not  
8 knowing how well those wastes are blended. And so,  
9 the BTP proposes criteria for looking at the output of  
10 that process that would show that the waste is  
11 essentially sufficiently blended, and that you do have  
12 Class A waste and not --

13 CHAIR RYAN: We are kind of touching on an  
14 area where I think it is real important to understand  
15 there are two different kinds of intrusion into the  
16 waste. And the part you are talking about now to me  
17 is the fractional release from the inventory to a  
18 vector that can expose humans.

19 So, let's say it contaminates groundwater,  
20 just as an example. It is not the inventory that  
21 matters, unless you drill through it. I would argue  
22 that --

23 MS. RIDGE: Drilling through it is  
24 specifically one of the concerns.

25 CHAIR RYAN: But let's just leave that one

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1 just aside for a minute.

2 MS. RIDGE: Sure.

3 CHAIR RYAN: A fractional release from the  
4 inventory to environmental media is really a little  
5 bit different than how is it mixed, because the  
6 inventory is what drives the fractional release. If  
7 I have one curie of cobalt in a concentrated source,  
8 that is a lot different than if I have 100 curies of  
9 cobalt on an ion-exchange resin or 1 curie of cobalt  
10 on an ion-exchange resin.

11 So, I am trying to just think about those  
12 kinds of variables as well. So, maybe you can touch  
13 on, you know, when I have concentrated materials  
14 versus non-concentrated. I am not in favor of the  
15 factor-of-10 rule, but it is not the inventories so  
16 much in the subsets, components of a waste mix that  
17 trouble me. It is the fractional release from the  
18 entire inventory that really sort of sets the stage  
19 for an impact analysis for me.

20 MS. RIDGE: And I would agree, the  
21 fractional release from the inventory is, I want to  
22 say critical, but it is more than critical. It is the  
23 whole story for someone who is offsite. And for  
24 someone who is offsite, you are looking at the  
25 fractional release from the inventory.

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1 For someone who is onsite and intruding  
2 into the waste, then concentration can matter.

3 The third point --

4 CHAIR RYAN: With direct exposure, but not  
5 with putting a well down.

6 MS. RIDGE: Right. Right. I would agree  
7 with you on that.

8 CHAIR RYAN: Only when you dig it up and  
9 get next to it, whatever that means.

10 MS. RIDGE: Precisely. Precisely.

11 CHAIR RYAN: Okay.

12 MS. RIDGE: The next reason for creating  
13 some homogeneity guidance is to be consistent with an  
14 increased emphasis on site-specific scenarios that we  
15 have talked about a little bit with the site-specific  
16 analysis, which is a separate but related effort.

17 And finally, the staff was directed by the  
18 Commission to create some guidance around waste  
19 homogeneity, and specifically directed to consider  
20 waste homogeneity in the context of intrusion  
21 scenarios. And that was in the SRM we received in  
22 response to the paper on blending.

23 CONSULTANT FLACK: So, if I could just ask  
24 a question on that, the blending is actually to reduce  
25 the risk to an inadvertent intruder? Is that what is

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1       happening here? I mean, is that why you would want to  
2       blend, so that you don't have an inadvertent intruder  
3       hit one of these concentrated areas. So, it is more  
4       like a defense-in-depth than it is a risk. I mean,  
5       you are applying some form of defense-in-depth against  
6       that scenario, right?

7                   MS. RIDGE: If we don't drop the factor-  
8       of-10 constraint that is in the 1995 BTP, you can't  
9       blend waste.

10                   CONSULTANT FLACK: Okay. That's a  
11       process.

12                   MS. RIDGE: Right.

13                   CONSULTANT FLACK: But the reason for  
14       doing it, other than the process piece --

15                   MS. RIDGE: The reason for doing it is to  
16       define a disposal pathway for B&C waste.

17                   CONSULTANT FLACK: So, it is the process  
18       that is driving it? You have to get rid of the waste  
19       somehow, right? So, it is not the risk at all.

20                   CHAIR RYAN: John, let me try an approach.  
21       I think, to me -- and correct me I am wrong or you  
22       don't agree -- I think, to me, it is to try to get  
23       disposed waste below the blue house and the red corn,  
24       the red soil corn.

25                   (Laughter.)

1 CONSULTANT FLACK: Oh, okay.

2 CHAIR RYAN: That it is more uniformly-  
3 handleable in an exposure scenario. I am just trying  
4 to get the words that help people understand what  
5 exactly is --

6 MS. RIDGE: Blending is driven by the  
7 tables right now.

8 CHAIR RYAN: Never mind right now.

9 MS. RIDGE: Okay.

10 CHAIR RYAN: Where are you heading? If  
11 the factor-of-10 rule goes away, do we end up with  
12 more homogeneous waste that I can better describe,  
13 once disposed, or not? That is really a key question  
14 to me.

15 MS. RIDGE: If the factor-of-10 rule goes  
16 away, then you will have created more waste that is  
17 Class A, but at the higher end of Class A.

18 CHAIR RYAN: There's nothing magic about  
19 that high end of Class A?

20 MS. RIDGE: No.

21 CHAIR RYAN: It is more uniform.  
22 Therefore, it is more kind of understandable in the  
23 context of the performance assessment?

24 MS. RIDGE: It should be more uniform, and  
25 that is part of what the homogeneity guidance was

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1 created to address, is how uniform is it. Because  
2 without the homogeneity guidance, there is no reason  
3 to assume it would be more uniform. That is what the  
4 promise is, but there is no guidance around that. You  
5 could put something in a barrel and not mix it and  
6 call that blending. Now that isn't what anyone said  
7 their intention is, but that you could do. And so,  
8 the homogeneity guidance is really to address that  
9 issue, to say how uniform is that going to be.

10 I'm not sure I 100 percent agree that  
11 there's nothing special about the top end of Class A  
12 because the different waste classes are subject to  
13 different disposal requirements. And so, what you are  
14 doing is you are moving some waste that would have  
15 been disposed of as Class B with those requirements  
16 around. It will now be blended so that it is Class A  
17 waste and is, quite probably, more uniform. It is  
18 more dilute, and therefore, for those reasons, lowers  
19 the risk to an intruder. But it will be disposed of  
20 under different disposal conditions.

21 And so, whether it is good or bad for an  
22 intruder is entirely up to how it is implemented. I  
23 don't think it is inherently good or bad for an  
24 intruder. That part is up to the implementation.

25 CHAIR RYAN: I think on the blending part

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1 I understand and appreciate what you are saying. The  
2 hard part, though, is not the blending aspect. It is  
3 the fact the probability of intrusion is what? That  
4 is where it falls apart because it becomes automatic  
5 that that is a real case, and there is no reason to  
6 accept that or believe that. Depth-of-burial and  
7 other kinds of burials could impact that probability.

8 MR. COCHRAN: Let me add another factor to  
9 try to answer your question, John. It is very  
10 practical.

11 Right now, in America that is a disposal  
12 facility that can take Class A waste, the least active  
13 waste, from all 50 states. But if you are generating  
14 B and C, the higher-activity waste, and you are one of  
15 36 states, there is no disposal facility that can take  
16 it. But if you blended it with a lot of low-activity  
17 A, so that your B and C ion-exchange resins become A  
18 when blended, then you have got a disposal pathway.  
19 So, there is a very practical driver behind this.

20 CONSULTANT FLACK: Yes, okay.

21 MR. COCHRAN: Does that make sense that  
22 right now --

23 CONSULTANT FLACK: Well, yes, it does. I  
24 am trying to look at it from a societal risk  
25 perspective, if there is any change here to the human

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1 population, the risk that it's being exposed to.

2 We keep coming back to the intruder's  
3 risk, but in this case you are talking about a  
4 societal risk. Now you have large quantities that  
5 could expose many people, and now you want to put it  
6 into places that get away from that situation. And  
7 that changes the risk profile.

8 But now you are left with an intruder  
9 profile, which is the last one that you look at to  
10 make sure, inadvertently, it doesn't get hit. So, I  
11 am trying to keep these two separate in my mind, the  
12 societal from the intruder.

13 But, anyway, thank you. That helps a  
14 little bit.

15 CHAIR RYAN: Okay. Go ahead.

16 MS. RIDGE: I would agree that this is a  
17 consequence analysis, and maybe that helps. So, we  
18 acknowledge that this is a consequence analysis for  
19 the intruder.

20 The probability of intrusion was  
21 considered only subjectively and --

22 CHAIR RYAN: Well, so far, the low-level  
23 waste is zero. The actual probability is zero. All  
24 right, yes.

25 MS. RIDGE: And it remains to be seen, I

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1 think, what happens after the waste sites are closed  
2 for 100 years.

3 CHAIR RYAN: We'll see.

4 MS. RIDGE: We'll see. We'll see.

5 MEMBER ARMIJO: Yes, that's where we get  
6 into what is society like, will we have a government,  
7 will we be a bunch of transients wandering around  
8 looking for a home. You know, when you get into such  
9 a subjective arena, it is not engineering anymore.

10 MS. RIDGE: Fortunately, I think you will  
11 see that we are talking about a shorter timeframe than  
12 you may have had in recent discussions on other --

13 MEMBER ARMIJO: Yes, the last one I was in  
14 was 20,000 years. So, 300 years, I can say, hey, we  
15 might still have a country then.

16 CHAIR RYAN: Well, the good thing is there  
17 will only be five radionuclides left.

18 MEMBER ARMIJO: Yes, but, well, 300 years,  
19 I can deal with that. I mean it is 20,000 years that  
20 got me.

21 MS. RIDGE: The first thing I want to  
22 point out on this slide is that I am not proposing  
23 that someone exhuming a small amount of waste is at a  
24 greater risk than someone exhuming a large amount of  
25 waste. And I want to be very clear on that.

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1 I am not at all proposing that someone  
2 drilling a well is somehow at a greater risk than  
3 someone building a dwelling and exhuming the amount of  
4 waste that you would exhume to build a dwelling. That  
5 is the scenario that was considered for the Part 61  
6 intrusion analysis.

7 So, what I am showing here on the left is  
8 the Part 61 intrusion analysis and then contrasting  
9 that with an alternate conceptual model of a  
10 hypothetical intrusion scenario that drives the  
11 homogeneity guidance.

12 All I am suggesting is that, if you are  
13 looking at waste homogeneity, you have to consider, if  
14 your concern is how well waste is mixed, then someone  
15 exhuming a small amount of waste is going to see  
16 hotspots more than someone exhuming a large amount of  
17 waste. Someone who builds a dwelling and exhumes a  
18 large amount of soil is going to mix that waste, and  
19 to whatever extent they don't mix, by moving around  
20 the property, they are going to average their own  
21 exposure to that waste. Someone who exhumes a very  
22 small amount of waste could hit hotspots in that  
23 waste.

24 And so, I am not proposing that someone  
25 exhuming a small amount of waste is at greater risk.

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1 All I am proposing is that, when specifically you are  
2 trying to develop homogeneity guidance, you need to  
3 look at someone exhuming a small amount of waste.

4 Now there are a few things I want to point  
5 out the differences here. Part 61 assumed that the  
6 waste was fairly shallow; someone did put a house in  
7 the waste. It also assumed that the waste, when it  
8 was emplaced, by chance, was mixed. It was  
9 randomized. And so, you were not going to pull up in  
10 the size of a basement of a house a great deal of  
11 waste that was all dominated by the same radionuclide,  
12 was all at the limit, because this waste was all going  
13 to be randomly-placed. And that was an assumption in  
14 that analysis and it is built into some of the numbers  
15 in those tables.

16 Now when looking at the homogeneity  
17 guidance, we considered a few things. One is that  
18 waste typically is actually disposed of more deeply  
19 than was assumed in the development of Part 61. Right  
20 there, that limits the scenarios.

21 CHAIR RYAN: Should we move on to your  
22 next slides or do you want to stay on this figure?  
23 You're talking from your upcoming slides? It's up to  
24 you.

25 MS. RIDGE: Well, I was still talking to

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1 this.

2 CHAIR RYAN: Okay. All right. That's  
3 fine. All right.

4 MS. RIDGE: I'm almost finished with this  
5 slide.

6 And so, we, for those reasons, looked at  
7 a well-drilling scenario.

8 We can move on to the next one.

9 Okay. Now, as I mentioned, homogeneous  
10 waste types are those waste types that are assumed to  
11 be homogeneous in the context of intrusion. The list  
12 that is in the BTP is listed here. No additional test  
13 is proposed for designated waste types. For these  
14 waste types right now that are treated as homogeneous  
15 waste, they are assumed to be equally-mixed, as we  
16 discussed. In some cases, they are assumed to become  
17 easily mixed.

18 And the only thing we are proposing is  
19 that, if you are a waste classifier, so a generator or  
20 a processor, and you are surveying the waste for some  
21 other reason, for instance, for transportation, if you  
22 develop information that shows that the waste is not  
23 homogeneous, that you would consider that and ignore  
24 it.

25 And specifically, what I mean by not

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1 homogeneous is the crux of the guidance, which is that  
2 no cubic foot of the waste should be more than 10  
3 times the class limit. And I will talk more about  
4 that on the next slide.

5 CHAIR RYAN: So, you are going back to the  
6 factor of 10 that you just took away?

7 MS. RIDGE: The factor of 10 is moving  
8 from the inputs to the output, which is a different  
9 thing. Because if it is on the inputs, it limits what  
10 types of processing you can do.

11 CHAIR RYAN: Yes, I see your point.

12 MS. RIDGE: Next slide.

13 CHAIR RYAN: Is that how you take away the  
14 fact that, without that kind of a rule, that there  
15 could be very wide variability interpreting those  
16 criteria that are on slide 20?

17 MS. RIDGE: Yes.

18 CHAIR RYAN: I mean, I could see different  
19 Agreement States having different views of that,  
20 coming out of the box, for the different systems.

21 Okay. Thanks.

22 MS. RIDGE: So, this guidance was based on  
23 the --

24 CHAIR RYAN: Sorry, Christianne, just one  
25 more question.

1 MS. RIDGE: Yes.

2 CHAIR RYAN: Why a factor of 10? Why not  
3 20? Why not 30 or 5?

4 MS. RIDGE: Well, you anticipated my next  
5 statement. The guidance is based on the scenario that  
6 I just showed you two slides ago. So, it could have  
7 been that we developed guidance around a factor of 20.  
8 The factor of 10 is consistent with how we currently  
9 do mathematical averaging. And it is a number that  
10 corresponds, when you look at the scenario, the well-  
11 drilling scenario I just showed you, the factor of 10,  
12 the amount of waste you would have to exhume  
13 corresponds to an amount of waste that is detectable  
14 essentially. If you went to a factor of 20, the  
15 volume that that would correspond to would be smaller,  
16 and it becomes more difficult to detect that and do  
17 surveys around that number.

18 So, we are on this point very much  
19 interested in the comments we are going to get from  
20 stakeholders on the factor of 10 and the cubic foot.  
21 It may be that regulation around a factor of 20 at a  
22 smaller volume is both protective and more  
23 implementable. It may be that a guidance that is  
24 around a smaller factor, but a larger volume, is  
25 protective, yet implementable. And that is something

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1 specifically that we are really looking forward to  
2 stakeholder comments on.

3 But the factor and the volume that it  
4 corresponds to in that scenario are obviously linked.  
5 And essentially, the details of the scenario are  
6 described in the Appendix B of the BTP. But,  
7 essentially, that is a volume and a factor for  
8 exhuming Class A waste at 100 years or Class A at 500  
9 years, that gives an intruder risk at half the limit.

10 Half the limit was used because, if you  
11 put in a well, you are exhuming other waste as well.  
12 And so, that subjective allowance was given. So, that  
13 is where those numbers come from.

14 CHAIR RYAN: One thing the factor of 10 or  
15 20, or some other number, it really depends on what  
16 radionuclides you happen to be dealing with. Because  
17 some of those radionuclides, as you well know, as I am  
18 sure everybody does, the dose conversion factors per  
19 unit of activity can be very different. So, that  
20 factor you derive is very specific to the dose  
21 conversion factors for those radionuclides, right?

22 MS. RIDGE: Don't lose sight that there is  
23 a great deal of mixing that is already assumed. So,  
24 we are looking at a dose conversion factor for someone  
25 exposed to a plane source after this has been mixed

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1 into the soil for someone consuming crops. So, it is  
2 not quite the same problem as looking at sealed  
3 sources.

4 CHAIR RYAN: Well, let's say I take  
5 carbon-14, which has essentially no dose rate.

6 MS. RIDGE: Right. And this guidance is  
7 based on the most limiting radionuclide. Now for  
8 Class C --

9 CHAIR RYAN: Ah, so it is bounded by the  
10 most conservative radionuclide from this standpoint?  
11 That's deterministic.

12 MS. RIDGE: Yes.

13 CHAIR RYAN: I mean, it kind of takes away  
14 from the operator of a site the ability to judge what  
15 he has instead of what is a limiting case.

16 MS. RIDGE: And I think that if your waste  
17 weren't one of those limiting radionuclides, certainly  
18 a case could be made for using a different homogeneity  
19 guidance.

20 CHAIR RYAN: Yes. That might be something  
21 to think about adding --

22 MS. RIDGE: And that may be something we  
23 should specifically list.

24 CHAIR RYAN: -- as an alternative.

25 MS. RIDGE: I think that that makes a lot

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1 of sense.

2 CHAIR RYAN: Yes. Okay.

3 MS. RIDGE: I think that that makes a lot  
4 of sense.

5 CHAIR RYAN: You know, anytime you build  
6 a construct of any of these kinds of types that we  
7 have talked about a couple, it would be really helpful  
8 to have, and if you have different radionuclides or a  
9 different set of circumstances where you want to  
10 propose an alternative, it is the structure of that  
11 alternative that you need to follow.

12 MS. RIDGE: And we did -- and John will  
13 talk more to that.

14 CHAIR RYAN: Okay.

15 MS. RIDGE: We did list several of those.  
16 This is another one that I think makes a lot of sense.

17 CHAIR RYAN: Okay.

18 MEMBER ARMIJO: How does somebody go about  
19 demonstrating that he meets your homogeneity  
20 requirement? Let's say you have got tons of resin,  
21 and they come from different batches from his site.  
22 The resins were generated when there were a lot of  
23 field failures and there's a lot more stuff in  
24 there --

25 MS. RIDGE: Right.

1                   MEMBER ARMIJO: -- than resins that come  
2 from a normal operation, a clean plant. And he wants  
3 to mix them. So, he puts them in some sort of a  
4 blender.

5                   What does he have to do to demonstrate  
6 that he has met the 1 cubic foot with some fractions  
7 greater than 10? How do you actually go about that?  
8 What is expected?

9                   MS. RIDGE: We are imaging that in most  
10 cases, and it comes something to that point in the  
11 second bullet, but we are imagining that in most cases  
12 the test would be applied to the mixing apparatus. In  
13 plants, for instance, I think there is typically a  
14 recirculation loop on resin tanks. In a blending  
15 apparatus, it may be a completely different  
16 construction.

17                   But, essentially, we are envisioning that  
18 a lot of this could be done through surveys, that  
19 there are some scaling factors that could be made, so  
20 that you can do this through surveys. I think the  
21 number of samples you would have to take would be  
22 certainly burdensome if you were trying to show that  
23 there are no cubic feet that --

24                   MEMBER ARMIJO: Yes, that's what I was  
25 trying to get at. How do you prove that?

1 MS. RIDGE: That sampling would be  
2 impossible. But we are making an assumption at this  
3 point that, for most waste streams, there is some  
4 scaling factor that could be made, so that this could  
5 be done through surveys. And then, for instance, if  
6 waste were moving by in a recirculation loop, you  
7 could just look at the flow rate --

8 MEMBER ARMIJO: Yes.

9 MS. RIDGE: -- and say, well, you know --

10 MEMBER ARMIJO: If it is amenable to  
11 blending, why it's --

12 MS. RIDGE: -- if there blips to this  
13 number for this amount of time, that would correspond  
14 to a cubic foot; you're okay.

15 MEMBER ARMIJO: Okay.

16 MS. RIDGE: You know, this also could be  
17 applied to individual containers. But if we are  
18 talking about intentional blending during processing,  
19 we are assuming that this would be applied to the  
20 process, and then that demonstration that the process  
21 is creating homogeneous waste would remain until there  
22 was some change in the process or some significant  
23 change in the inputs.

24 Now, I mean, the simple matter is, if you  
25 did have enough knowledge of your inputs to say it

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1 already met a factor of 10, then none of this would be  
2 necessary. So, we are assuming that, you know, if you  
3 are talking about blending wastes, that the inputs  
4 differ by a factor of 10, then you have to look at the  
5 outputs.

6 MEMBER ARMIJO: Right.

7 MS. RIDGE: Obviously, if you have enough  
8 information about the waste streams to say that they  
9 already are within a factor of 10, then this is  
10 unnecessary.

11 But if you are talking about blending  
12 waste to have more different concentrations, then we  
13 are assuming in most cases this would be applied to  
14 the process itself. It could also be applied to  
15 individual waste containers, although it seems like  
16 that would be more difficult. But maybe it wouldn't.  
17 Certainly, we could get comments on that as well.

18 Next slide.

19 This is my last substantive slide. We  
20 really need to let John talk because he has most of  
21 this information.

22 But I did want to mention that we also  
23 included some guidance on the classification of  
24 homogeneous waste. This would not necessarily be  
25 limited to intentional blending during processing, but

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1 it was intentional blending during processing that  
2 made us think about guidance for waste that is very  
3 near a classification limit.

4 Now this guidance hasn't been quantified  
5 in NRC guidance previously. But guidance about more  
6 rigorous consideration of the uncertainties for waste  
7 that is near a classification limit is consistent with  
8 the 1983 Branch Technical Position on Waste  
9 Classification. That Branch Technical Position  
10 indicates that, if you have a process where a small  
11 change in the process could change the waste  
12 classification, then you need to more rigorously  
13 account for uncertainties in the process.

14 And so, we provided some guidance. Our  
15 proposed guidance is that the sum of fractions should  
16 be less than one minus the standard error. So,  
17 essentially, the mean sum of fractions, you look at  
18 the standard error around that, and you want to clear  
19 the bar where you are within a sum of fractions,  
20 you're within a standard error of your waste  
21 classification limit.

22 Now, if you are considering a once-filled  
23 test because you are only concerned about being below  
24 the classification limit, and you gather enough  
25 samples and you make some assumptions about your

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1 waste, the number being, the error being random, then  
2 that corresponds to approximately an 85 percent  
3 confidence interval. That selection is subjective,  
4 and we will certainly get comments on that. But that  
5 is the proposed guidance.

6 CHAIR RYAN: Why did you pick that one?

7 MS. RIDGE: I think I just thought it was  
8 subjective.

9 (Laughter.)

10 CHAIR RYAN: Why not some other number?  
11 Okay, it's a starting place. I'll take it as a  
12 starting place.

13 MS. RIDGE: This is a starting place.  
14 This is a starting place, and we are going to get  
15 comments on this.

16 CHAIR RYAN: Okay.

17 MS. RIDGE: And essentially, we are just  
18 asking folks to rigorously consider these  
19 uncertainties.

20 MEMBER ABDEL-KHALIK: How do you assure  
21 compliance with that third bullet?

22 MS. RIDGE: We don't mean to assure  
23 compliance because this is guidance. But what we  
24 would ask folks to do is to look at the spatial  
25 variability, which we anticipate would be a source of

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1 uncertainty, and to look at the mean of the readings  
2 they have for the spatial variability. We would ask  
3 them to look at the uncertainty in scaling factors,  
4 which we think would also be another factor.

5 Now there may be other factors that  
6 contribute significant uncertainties. These are the  
7 two we thought would be most significant.

8 And we would ask, if you are near the sum  
9 of fractions of 1, that we would see, what is the  
10 variability in your scaling factors? What is your  
11 spatial variability? And then, propagate those  
12 errors.

13 MEMBER ABDEL-KHALIK: And the length scale  
14 or the volume scale of 1 cubic foot, what is the basis  
15 for that?

16 MS. RIDGE: That, the 1 cubic foot, is  
17 sort of part and parcel of looking at 10 times the  
18 class limit. If you have a cubic foot that is 10  
19 times the class limit and you exhume that when you are  
20 digging a well and spread it on the surface, for your  
21 most limiting radionuclides -- and Dr. Ryan made a  
22 good point --

23 CHAIR RYAN: Bounding analysis.

24 MS. RIDGE: Right. Dr. Ryan made a good  
25 point about us looking at only the most limiting

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1 radionuclides. Then that gets you to an intruder dose  
2 of 250 millirem per year.

3 Now there are assumptions built in there  
4 about how deep the well is, how much you spread the  
5 drill cuttings, how large of a garden you have. There  
6 are certainly assumptions built into that.

7 We looked at those probabilistically. So,  
8 we considered our range of well depths, a range of  
9 cutting areas, a range of garden sizes.

10 CHAIR RYAN: How do those match up --

11 MS. RIDGE: But that is how those two  
12 things, the cubic foot comes with the 10 times the  
13 limit.

14 CHAIR RYAN: I am sure, John, you have  
15 done this, but if you take a look at those kinds of  
16 parameters that are existing in closed low-level waste  
17 sites, how does it match up to what you assumed?

18 MS. RIDGE: At closed low-level waste  
19 sites?

20 CHAIR RYAN: Yes. Or operating ones.

21 MS. RIDGE: I am unaware of intruders  
22 having drilled wells --

23 CHAIR RYAN: Well, I mean, the depth of  
24 wells and all those other kinds of parameters that are  
25 known.

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1 MS. RIDGE: You mean in the regional  
2 areas?

3 CHAIR RYAN: Yes.

4 MS. RIDGE: I don't know.

5 CHAIR RYAN: I mean, I would think you  
6 would want to get some anchor to say that this within  
7 reason --

8 MS. RIDGE: Right.

9 CHAIR RYAN: -- within the world of low-  
10 level waste sites, federal and commercial, in the U.S.

11 MS. RIDGE: The numbers, the ranges that  
12 we used were related to the original Part 61 analysis.

13 CHAIR RYAN: That's ancient history.

14 MS. RIDGE: And that could be updated.

15 CHAIR RYAN: I don't think that is  
16 reflective of probably the range of reality for those  
17 kinds of parameters. I think it would be instructive  
18 at least. You know, maybe it confirms where you are;  
19 I don't know. But I would try to get some sense of  
20 what is the depth, the real depth, of wells in that  
21 distribution for monitoring and other parameters that  
22 feed into your analysis to say, are we on home plate  
23 or are we way out in left field somewhere in the  
24 corner? I think that is a useful thing to think  
25 about.

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1 Thank you.

2 MEMBER SIEBER: Have you ever done an  
3 analysis where you presume that the waste packager was  
4 trying to get rid of some hot stuff and goes to the  
5 limits on all this?

6 (Laughter.)

7 And how that impacts the waste package  
8 after it has been disposed of?

9 For example, there is a fair amount of  
10 variability here, you know, the factor of 10 and all  
11 of that. I think every radcon manager sometime in his  
12 career has ended up with a hot pistol you would like  
13 to get rid of without paying a million dollars to do  
14 it, you know.

15 Have you taken a look at the regulations  
16 from that standpoint?

17 MR. COCHRAN: The classification limits,  
18 we talk about Table A, Table B, and Table C.

19 MEMBER SIEBER: Right, Class A, right.

20 MR. COCHRAN: The way those were developed  
21 was the NRC, through the rulemaking process, developed  
22 some reasonably foreseeable, yet conservative,  
23 exposure scenarios. Like someone might inadvertently  
24 construct a basement into where the waste was buried  
25 and not recognize it. Or if they did recognize it,

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1 they would back away after six hours. Two different  
2 exposure scenarios.

3 And in the scenario where the waste is not  
4 recognizable, it is fairly homogeneous, it is mixed  
5 in, soil and ask, they construct the basement and then  
6 some of the cuttings go in a garden, and then in the  
7 garden they eat some of the vegetables.

8 And the dose limit for the inadvertent  
9 human intruder is 500 millirem. They, then, back-  
10 calculated the concentration of each of the nuclides  
11 that would give you 500 millirem. So, those standards  
12 were set to give 500 millirem, the dose standard for  
13 the intruder, for each of the nuclides. Then, we used  
14 something called sum of fractions to account for  
15 having multiple nuclides in a disposal cell.

16 Now, unfortunately, the story is a little  
17 bit more complicated than that. I don't want to go  
18 into it. But the simple story is, they were back-  
19 calculated. These specific activity limits, like  
20 4,600 curies per cubic meter, were back-calculated to  
21 give the intruder 500 millirem. So, they were set at  
22 the dose limit, the maximum dose limit.

23 And the story is a little more  
24 complicated, and unless we really want to tell a  
25 complicated story, I would like to leave it at that.

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1 MS. RIDGE: Well, I would like to leave  
2 it. I don't want to go into it. I know we don't have  
3 a lot of time. But I think we do need to point out  
4 that factors were applied to those numbers after that  
5 to account for various objective considerations. And  
6 so, the numbers that are in the table don't right now  
7 correspond to an intruder in these scenarios getting  
8 500 millirem, because factors were applied after that.  
9 And I think we can leave it at that.

10 But I want to point out that you can't  
11 just take those numbers right now and get to 500  
12 millirem. You get to a number higher than 500  
13 millirem.

14 CHAIR RYAN: Tell me if you don't agree,  
15 but I think it is a fair observation that this is not  
16 risk-informed; it is really deterministic.

17 MS. RIDGE: Which part?

18 CHAIR RYAN: That does calculation you  
19 just described. I don't think it is very risk-  
20 informed. I think it is very deterministic and based  
21 on the assumptions that you make. And one analyst  
22 could very easily make other assumptions and come up  
23 with a very different number, up or down.

24 MR. COCHRAN: The point that I would add  
25 to that --

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1 CHAIR RYAN: Do you agree or disagree? Am  
2 I wrong or?

3 MR. COCHRAN: Well, let me just add my  
4 point and then we can --

5 CHAIR RYAN: All right. All right.

6 MR. COCHRAN: My point is that the NRC, in  
7 developing these standards, held eight or ten regional  
8 meetings, a draft EIS, a Final EIS, a rulemaking  
9 process, public meetings. And so, these what appear  
10 to be subjective exposure scenarios were developed  
11 with the public input.

12 So, one could say, to some degree, these  
13 represent the level of protectiveness that the society  
14 has selected.

15 CHAIR RYAN: That's all fine, but that is  
16 not what I am asking about. I am asking about the  
17 technical correctness of what the assumptions are  
18 compared to what reality is. That is a whole separate  
19 issue.

20 MR. COCHRAN: I mean, they are risk-  
21 informed into the --

22 CHAIR RYAN: And I think -- go ahead.

23 MR. COCHRAN: They are there to protect  
24 the inadvertent human intruder, should the intruder  
25 inadvertently dig into the waste.

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1 CHAIR RYAN: I mean, are we guaranteed  
2 that that goal is accomplished? I just don't see why  
3 or how one can conclude that it will meet that goal  
4 because there is lots of variability in all the  
5 assumptions that went into that scenario.

6 MR. COCHRAN: You can't anticipate all.

7 CHAIR RYAN: So, there is no certainty  
8 that that is too much or enough? Or too little?

9 MR. COCHRAN: Again, through the  
10 rulemaking process --

11 CHAIR RYAN: I understand there's been  
12 lots of comment, but that can be either technical or  
13 non-technical and a wide range of views in that. So,  
14 I mean, that is one factor to take into account, but  
15 that is not the analytical process to me.

16 MR. COCHRAN: Well, as we have discussed,  
17 there is no way of actually assigning a probability to  
18 any future scenario.

19 CHAIR RYAN: Wow! It cannot be risk-  
20 informed then. It cannot get the "how likely is it?"

21 MR. COCHRAN: Well, it is risk-informed in  
22 that it is protective of the inadvertent human  
23 intruder. Remember, this is not probabilistic risk  
24 assessment. We sound a little like a broken record to  
25 each other.

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1 CHAIR RYAN: Okay.

2 MR. COCHRAN: But this risk-informed, not  
3 probabilistic risk assessment.

4 CHAIR RYAN: Oh, I don't disagree.

5 Okay, go ahead.

6 CONSULTANT FLACK: It sounds more like  
7 defense-in-depth.

8 MEMBER ARMIJO: Yes.

9 CONSULTANT FLACK: Not risk. But you are  
10 saying I am going to defense against this.

11 MR. COCHRAN: Yes, should this occur.

12 CONSULTANT FLACK: It's defense-in-depth.  
13 I don't see the risk here because risk is probability  
14 times consequences. Without the probability, I don't  
15 know what the risk is. I mean, we could talk about  
16 consequences all day long and try to protect. Okay.  
17 So, we don't know, so we are going to put in defense-  
18 in-depth, period, end of story.

19 But I am just trying to understand, you  
20 know, maybe deep inside everybody they have  
21 likelihoods of these scenarios. But I don't know what  
22 they are at this point now.

23 MR. COCHRAN: Yes, and deep inside we  
24 might have different gut feelings about --

25 CONSULTANT FLACK: Might have a different

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1 probability.

2 MR. COCHRAN: And pretty soon in my  
3 presentation, I will present one to you.

4 (Laughter.)

5 And get your gut response to it.

6 MS. RIDGE: I think we need to let John  
7 get to that.

8 This is a quick table of some of the main  
9 changes to the BTP and the ones that I have talked  
10 about. I don't want to belabor this. The only thing  
11 I want to point out is that the second one I have  
12 highlighted is in the 1995 BTP there was an exception  
13 to the factor-of-10 rule. We eliminated that  
14 exception, but only because we eliminated the factor-  
15 of-10 rule. So, that is somewhat clear.

16 I think we can go on and let John speak.

17 MR. COCHRAN: Good afternoon.

18 CHAIR RYAN: Good afternoon, John.

19 MR. COCHRAN: Next slide.

20 So, I am going to review three elements of  
21 the guidance and the technical basis for those three  
22 elements.

23 One is how to classify a mixture of  
24 individual items in a container: the activated  
25 metals, contaminated materials, or cartridge filters.

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1           The other is the BTP's position on  
2 encapsulation of sealed reactive sources and like  
3 materials.

4           The third is alternative approaches.

5           I am going to review these in reverse  
6 order because they build on each other.

7           Next slide.

8           And let me go sort of off-course for just  
9 a second. The BTP is about classifying waste under  
10 Part 61. If we had another hour, it would be great to  
11 talk about Part 61 because this is guidance for using  
12 Part 61.

13           And I see the look on your faces. You  
14 want to understand this, but it is a little tough.

15           CHAIR RYAN: John, we may take you up on  
16 that in a little bit.

17           (Laughter.)

18           MR. COCHRAN: I would actually like to do  
19 that.

20           CHAIR RYAN: Very good.

21           MR. COCHRAN: I would like to do that  
22 sometime.

23           CHAIR RYAN: Yes, we will plan on it.

24           MR. COCHRAN: And we could probably  
25 disagree on some of the bases, but that is okay. I

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1 think it would be very meaningful for the group here  
2 because the BTP is about classifying waste using Part  
3 61. Anyway, that is off-course.

4 So, let me talk about alternative  
5 approaches first. And if you have had a chance to  
6 look in the revised draft of the BTP, you will see  
7 there is alternative approaches and alternative  
8 provisions. And so, let me separate the two.

9 Alternative provisions, that is in the  
10 1995 BTP. What it says in a nutshell is, if you would  
11 like to deviate from the BTP's guidance, you should do  
12 it by seeking a deviation from the regulation. Well,  
13 that's a pretty high bar to set.

14 So, in the revised draft of the BTP, if  
15 you look under alternative provisions, it says there  
16 may be some circumstances where you need a deviation  
17 from the regulation. If you need a deviation from the  
18 regulation, seek a deviation from the regulation. If,  
19 though, you need a deviation from just the guidance,  
20 then that is what alternative approach is about.

21 Alternative approaches are new to the BTP.

22 Next slide.

23 And really, they represent a new  
24 philosophy in implementing the BTP. Where the BTP  
25 sets broadly applicable look-up values, and that gives

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1 us a uniform level of safety for the implementing  
2 Agreement States, then the alternative approaches  
3 provides the licensees in the Agreement States with  
4 specific NRC guidance on factors to consider when  
5 deviating from the guidance. So, this is new to the  
6 BTP.

7 Uniform threshold, easy to use. Look it  
8 up in the book. Then, if you need to deviate,  
9 alternative provisions provide both the licensees and  
10 the Agreement States with things to consider when  
11 deviating.

12 So, let me give you a quick example, and  
13 I hope we don't get distracted. Let's say I'm a  
14 licensee. I've got a 20-curie sealed radioactive  
15 source here, cesium-137 source, and I've got a 200-  
16 curie one.

17 Kind of hollow (referring to visual aids).  
18 I'd better do it like that.

19 (Laughter.)

20 I have tried to send them back to the  
21 manufacturer. He won't take them. I have tried to  
22 recycle them. You can't recycle them. I need to  
23 dispose of them.

24 So, I look to Part 61, and this 20 curies,  
25 let's say it is in a cubic inch. The BTP for

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1 cesium-137 gives everything in curies per cubic meter.  
2 So, I scale this 20 curies in a cubic inch up to  
3 curies in a cubic meter. I have got a terrible  
4 problem. This is like 3 million curies now per cubic  
5 meter. So, I've got a problem.

6 I go to the BTP. The BTP says I can  
7 encapsulate this in concrete and average over the  
8 encapsulating media. And it even has a specific table  
9 in here for cesium-137. And so, I have got a disposal  
10 pathway for the 20 curies.

11 Now the 200 curies is too big. I don't  
12 have a disposal pathway yet. I go to the alternative  
13 provisions, I'm sorry, alternative approaches. And I  
14 see in alternative approaches that for sealed sources,  
15 if I am able to bury them deeper than 10 meters, and  
16 in a source housing that would be very difficult for  
17 the intruder open, that might be acceptable.

18 Okay. So, now I have a basis for seeking  
19 deviations from the guidance. And the basis that I  
20 see as a generator is the same basis that the  
21 Agreement States see. Okay.

22 So, I have got easy-to-use lookup values.  
23 Where I exceed those values, I have got the  
24 alternative approaches.

25 So, what we are doing is we are --

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1           MEMBER BLEY: The alternative approaches  
2 it sounds like are not automatically acceptable. It  
3 is a suggestion that can be brought forward.

4           CHAIR RYAN: Dennis, if you could maybe  
5 get a little closer to your microphone? We are having  
6 a little trouble hearing you.

7           I'm sorry, this is Dennis Bley, a Member  
8 of the Subcommittee and the ACRS on the phone,  
9 B-L-E-Y.

10          Go ahead, Dennis.

11          MEMBER BLEY: Yes, I just said it sounds  
12 as if the alternative approaches, then, are not  
13 acceptable at face value, but offer a way, an  
14 alternative, that people can come back and propose to  
15 you.

16          MR. COCHRAN: That is correct. That is  
17 correct. It's not automatic. If it were automatic,  
18 it would be in the guidance, right?

19          Next slide.

20          So, I have just talked a little bit about  
21 encapsulation. So, let me go through the  
22 encapsulation policy.

23          Next slide.

24          And if you are not familiar with  
25 encapsulation, it is the process of surrounding a

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1 radioactive item, like a sealed source, with a binding  
2 matrix, like concrete, in a container, where the  
3 radioactivity remains in the dimensions of the  
4 original item.

5 And we encapsulate things for several  
6 reasons. One, to meet stability requirements.  
7 Another is to provide worker protection in the  
8 disposal facility. And a third is that the BTP allows  
9 one to average the curies over the encapsulating  
10 media. Okay. So, maybe the 20 curies are here, but  
11 I can average it over the volume of the encapsulating  
12 media.

13 So, a lot of good reasons to encapsulate.  
14 As you can imagine, I think you brought up, in fact,  
15 that this could be abused.

16 MEMBER SIEBER: Yes, sure.

17 MR. COCHRAN: Right? Someone could  
18 encapsulate over the volume of a small house or  
19 something to get rid of waste that otherwise would be  
20 unacceptable for near surface disposal.

21 MEMBER SIEBER: If it will fit on a truck.

22 MR. COCHRAN: Yes.

23 Next slide.

24 Let me review, first, the 1995 BTP  
25 guidance. It sets limits on encapsulation. It sets

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1 a limit on the maximum volume. That limit is .2 cubic  
2 meters, basically, a 55-gallon drum worth.

3 And then, if you have got a non-gamma  
4 source, a strontium-90 source, the maximum curie limit  
5 is that limit that would meet the Class C limits when  
6 averaged over the encapsulating volume. So, it is  
7 basically the number of curies that you could have in  
8 .2 cubic meters or the number of curies you could have  
9 in a 55-gallon drum.

10 CHAIR RYAN: What's the largest drum I can  
11 use? How about an 80-gallon drum? How about 150?  
12 Maybe a 300-cubic-foot? Why are we picking one  
13 particular container?

14 MR. COCHRAN: No, no, no, no.

15 CHAIR RYAN: Okay, John, I know you have  
16 thought through all this.

17 (Laughter.)

18 MR. COCHRAN: First, I am reviewing the  
19 1995 guidance. Okay?

20 CHAIR RYAN: Okay, but -- all right.

21 MEMBER ARMIJO: So, that may go by the  
22 wayside.

23 MR. COCHRAN: And then, finally, there are  
24 curie limits for the gamma emitters as well.

25 Next slide.

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1           Now those curie limits for the gamma  
2 emitters were set based on an intruder exposure  
3 scenario that is in the back of the 1995 BTP. You can  
4 go look it up.

5           And a part of that scenario envisions that  
6 the intruder would be exposed to an encapsulated  
7 source 1 meter away or 2,360 hours. Okay? Sort of  
8 a little --

9           MEMBER ARMIJO: Pretty specific.

10          MR. COCHRAN: Pretty specific, and maybe  
11 doesn't seem reasonable to us today that the intruder  
12 would be 1 meter away from an encapsulated sealed  
13 source for 2,360 hours. And so, staff set about  
14 developing what we hope is a more reasonable scenario.

15          But, based on that exposure scenario, in  
16 the 1995 BTP there are limits for disposal through  
17 encapsulation of gamma-emitting sealed sources. I am  
18 not going to go through the limits except to point to  
19 cesium at the Class C limit, 30 curies. So, that is  
20 the largest cesium source that could be encapsulated  
21 under the 1995 BTP.

22          Next slide.

23          So, now I am going to talk about the  
24 revised draft of the BTP. The maximum encapsulating  
25 volume remains at .2 cubic meters with the opportunity

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1 to implement alternative approaches. And for the non-  
2 gammas, also unchanged, it would be the Class C limit  
3 when the non-gamma source is averaged over the  
4 encapsulating volume.

5 CHAIR RYAN: I peeked ahead, and I saw no  
6 change, but there actually is an alternative for  
7 change on the first bullet, the alternative method,  
8 right? Did I understand that right? In fact, the  
9 maximum volume is still .2?

10 MR. COCHRAN: It is, that's correct, the  
11 difference being alternative approaches now.

12 CHAIR RYAN: Okay.

13 MR. COCHRAN: But the maximum volume is  
14 still .2.

15 Now for the gamma-emitting curie limits,  
16 the staff wasn't sure that this exposure, 1 meter,  
17 2,360 hours, seemed reasonable. And staff set about  
18 developing a different exposure scenario.

19 Next slide.

20 CHAIR RYAN: Just to pick on the .2 meters  
21 a little bit, I am curious, why not .3 or .4?

22 MR. WIDMAYER: Mike, I think it is based,  
23 if I am not mistaken, on the fact that a concrete-  
24 filled, 55-gallon drum is reasonable to --

25 CHAIR RYAN: I know, but why not an 80-

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1 gallon drum, or some other size drum?

2 MR. WIDMAYER: Well, because it wasn't  
3 reasonable to be moving that gigantic barrel around  
4 with concrete in it.

5 CHAIR RYAN: It's not that heavy.

6 I'm just curious. I know it is a standard  
7 drum that is used in standard shipments, but if a  
8 small change could accommodate a waste and still meet  
9 the criteria, I don't see why there isn't an  
10 alternative to do that.

11 MR. COCHRAN: And now there will be if we  
12 implement the alternative.

13 CHAIR RYAN: Okay.

14 MR. COCHRAN: I mean the new BTP.

15 CHAIR RYAN: With a little bit more  
16 specificity, you know, you can use a different size  
17 drum, you can look at alternatives. I think the more  
18 specific you are, the better off it will be.

19 MR. COCHRAN: We are fairly specific. I  
20 don't know if you have had a chance to look at look  
21 alternative approaches for encapsulation, but it is  
22 fairly specific about things you can do.

23 CHAIR RYAN: Okay. Thank you.

24 MR. COCHRAN: So, the next six slides are  
25 on developing the new exposure scenario. We call it

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1 the gamma-emitting, sealed-source, carry-away  
2 scenario.

3 And in developing the scenario, we  
4 reviewed accidents with sealed radioactive sources.  
5 And it is our understanding that accidents with sealed  
6 sources were one of the drivers for the development of  
7 the BTP to begin with.

8 Part 61 envisioned one of two things.  
9 Either the waste would be homogeneous, they wouldn't  
10 recognize the hazard, they might build a basement in  
11 it or a garden in it, or the waste would be  
12 recognizable and they would back away.

13 But with these small sealed sources, the  
14 concern was that maybe these sealed sources might  
15 survive, but the hazard wouldn't be recognized. So,  
16 it was in between the two.

17 We can go to the next slide. I'll get to  
18 it a little bit later. I've got a point I want to  
19 make.

20 So, we reviewed sealed-source accidents.  
21 These are three. We reviewed about five of them.  
22 These were all prominent accidents.

23 There was one in Egypt we also reviewed.  
24 There was one in Morocco. That one killed eight  
25 people.

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1 I'm not going to talk to them except the  
2 one in Goiania. That was the most interesting. In  
3 1987, in Brazil, there was a semi-closed medical  
4 clinic. A couple of people entered the clinic with a  
5 wheelbarrow. They went to a cancer-treating machine,  
6 a teletherapy machine, pulled the head off, put it in  
7 the wheelbarrow, took it to a scrap metal dealer,  
8 disassembled it.

9 And in the center of the head, they found  
10 a stainless steel capsule in the very middle of it.  
11 That seemed pretty interesting to them, and they cut  
12 it open. And when they cut it open, they exposed the  
13 cesium chloride powder that was in it. They didn't  
14 recognize the hazard. It didn't smell bad. It didn't  
15 look bad. It didn't produce heat. They didn't  
16 recognize the hazard whatsoever.

17 And, in fact, in low light, this powder  
18 kind of glowed a bluish glow. It seemed like magic  
19 powder.

20 It got spread around. In the end, four  
21 people died, including a little girl. It spread  
22 throughout the city because it was a dispersible  
23 powder. It took several years to clean up.

24 So, this is a real instance with a sealed  
25 source.

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1 CHAIR RYAN: I think that is clearly a  
2 tragedy. There's no question about it. But it is a  
3 leap to get from an abandoned source as opposed to a  
4 disposed source that is licensed, and how you can make  
5 kind of direct comparisons. I mean, sure, there will  
6 probably be other events in the world where materials  
7 are abandoned and fall into ill use, as you describe.  
8 But I'm at a loss to try to get to the reach where  
9 this is the same kind of consideration or should drive  
10 the consideration for properly and licensed disposed  
11 low-level waste.

12 MR. COCHRAN: Next slide. Maybe I will  
13 address your concerns.

14 So, looking across the accidents, there  
15 were a number of common elements: loss of regulatory  
16 control. In every case, the source fell out of  
17 regulatory control, whether it was the radiographer  
18 who lost his radiography source, his radium source,  
19 and didn't report it to the authorities, or a medical  
20 clinic that had been closed, or a teletherapy machine  
21 that ended up in a storeroom somewhere.

22 The victims were engaged in normal  
23 activities: a farmer in Egypt, scrap metal dealers  
24 and soldiers in Georgia.

25 The hazard was unrecognizable in every

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1 case. There was nothing to tell them that there was  
2 gamma radiation here. Their sense failed them.

3 Most of the accidents resulted in  
4 fatalities, adults and children.

5 And when viewed broadly, these are all  
6 unlikely. I mean, there are millions of sealed-source  
7 applications in a year and only a few big accidents  
8 like this. So, they are unlikely --

9 MEMBER ARMIJO: But those were all surface  
10 or near-surface --

11 MR. COCHRAN: Yes, yes.

12 MEMBER ARMIJO: -- situations. And you  
13 see something that small. Why isn't the best solution  
14 just simply drilling a hole, keeping it small, maybe  
15 putting it in some capsule, and getting it out of the  
16 way? The probability of finding it diminishes  
17 tremendously by something pretty straightforward.  
18 Drill a well, not a well, but a hole. It seems to me  
19 like that is amenable to analysis, just this  
20 probability of encountering it. Where it is near  
21 surface, you start getting into a human activity,  
22 which these are all normal and common activities.

23 MR. COCHRAN: Yes. The probability of  
24 someone inadvertently drilling into a source or  
25 finding a source that is buried in subsurface isn't

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1 actually knowable because you don't know if societal  
2 practices will stay the same for hundreds of thousands  
3 of years or change or technological knowledge --

4 MEMBER ARMIJO: John, I don't know if  
5 there's thousands of those little disks --

6 MR. COCHRAN: Millions, actually.

7 MEMBER ARMIJO: -- or millions of them,  
8 but let's say you were in a big disposal site and you  
9 decided, okay, in this big disposal site we are going  
10 to allow deep burial, seal them properly, whatever,  
11 whether it is in concrete or a smaller capsule. But  
12 a small thing is harder to find than something that is  
13 uniformly distributed or millions of them.

14 So, is that part of what your process --  
15 would you permit that? Would you give credit for  
16 that? The probability of finding those things in a  
17 big site is really small.

18 MR. COCHRAN: It is an argument to bring  
19 to bear, but I don't think it is a sole decider  
20 because you just don't know what the future will  
21 bring.

22 Let me proceed because, again, I have got  
23 six slides on this exposure scenario. Maybe I will be  
24 able to answer some of your questions.

25 MEMBER ARMIJO: Okay.

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1 MR. COCHRAN: Next slide.

2 So, the scenario that is proposed is not  
3 real. We don't know that this is going to happen or  
4 not. Rather, it is a stylized scenario used to ensure  
5 that the intruder wouldn't see an inordinately high  
6 dose, should intrusion occur. We are just being  
7 protective.

8 CHAIR RYAN: You know, I understand your  
9 comment. You think that you feel that is protective.  
10 But is it necessary to be that protective based on the  
11 fact that there is no real risk insight into the  
12 scenario? I mean, I understand the surface examples.  
13 They are all tragedies. There's no doubt about that  
14 in anybody's mind.

15 But we now have a situation where we have  
16 got a source, just like the ones in front of you, the  
17 quarter and the piece of tin. And that is now in a  
18 55-gallon drum buried 40 feet down below a concrete  
19 barrier, below a multilayered cap, maybe even a sign  
20 that is put on the top of the cap that says,  
21 "Radioactive material. Do not dig."

22 And we need to somehow recognize that  
23 there are many opportunities for that intruder to  
24 become aware. And by the way, it is pretty tough to  
25 get through, as you well know, a foot of reinforced

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1 concrete without some very serious equipment.

2 So, I find the example a little bit  
3 poorly-informed about the more reasonable set of  
4 circumstances that are likely to be found in any low-  
5 level waste site in the United States.

6 MR. COCHRAN: Let me proceed through  
7 the --

8 CHAIR RYAN: Sure.

9 MR. COCHRAN: -- description of the  
10 scenario, so you understand the basis. Why don't we  
11 take a look at accidents to see the circumstances of  
12 accidents? What we are proposing isn't real, but,  
13 rather, stylized, to protect the intruder, should  
14 intrusion occur. Let me go ahead and develop the  
15 scenario that was then used.

16 So, we are now 500 years in the future.  
17 There is an old low-level waste landfill. There has  
18 been a loss of control, recognition, and knowledge of  
19 the landfill.

20 Inside the landfill, the containers and  
21 the wastes have decayed, rotted away. Even the  
22 concrete has gotten kind of rotten over 500 years.

23 However, the stainless steel radioactive  
24 source has remained intact. Stainless steel is very  
25 decay-resistant.

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1 Next slide.

2 MEMBER ARMIJO: I'm sorry, John, would you  
3 go back?

4 Is this thing in this concrete?

5 MR. COCHRAN: It began as an encapsulated  
6 sealed source.

7 MEMBER ARMIJO: And it was put in -- okay.  
8 So, it is stainless steel with this concrete in a  
9 barrel.

10 MR. COCHRAN: That's correct.

11 CHAIR RYAN: And maybe, just maybe, a  
12 stainless steel drum instead of a carbon steel, which  
13 is what you assumed.

14 MEMBER ARMIJO: It depends on what you  
15 bury it in.

16 CHAIR RYAN: Yes.

17 MEMBER ARMIJO: Stainless steel is, if it  
18 goes anaerobic, it is not that good.

19 MR. COCHRAN: And certainly, there are  
20 arguments about concrete should last thousands of  
21 years. Then, there are others who take a look at  
22 Crystal River in Florida and find that concrete maybe  
23 only lasts tens of years. There are a lot of  
24 arguments that could be made.

25 CHAIR RYAN: Again, I think that is where,

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1 without trying to criticize or come up with an answer,  
2 it is really very site-specific.

3 MR. COCHRAN: It is --

4 CHAIR RYAN: The stylized approach may  
5 work at one place or some small number, but probably  
6 is not going to be useful at all. And I am just  
7 offering the suggestion that, if somebody comes up  
8 with a site-specific alternative to your stylized  
9 scenario, that that be allowed.

10 MR. COCHRAN: Okay, and the alternative  
11 approaches do.

12 CHAIR RYAN: I mean very explicitly in  
13 what you need to do and how you need to do it, so they  
14 get the guidance they need.

15 MR. COCHRAN: We even give very explicit  
16 guidance.

17 CHAIR RYAN: Okay. All right.

18 MR. COCHRAN: We really do -- if you have  
19 not had a chance to look ahead in the draft revised  
20 BTP.

21 Next slide.

22 After loss of knowledge, control,  
23 recognition, there is a public works project, maybe a  
24 regional pipeline, trenches through the landfill. The  
25 crew putting in the pipeline, they notice things are

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1 a little bit different, but they are behind schedule.  
2 The foreman urges them on.

3 Later, an individual -- maybe somebody out  
4 for a walk, maybe it is a worker -- finds a small  
5 source. It's small. It's old. It's interesting.  
6 And there is no indication of a hazard. It's just a  
7 piece of metal.

8 Next slide.

9 MR. WIDMAYER: Hey, John, before you  
10 leave --

11 MR. COCHRAN: Yes, sir?

12 MR. WIDMAYER: Where did this scenario  
13 come from in the context of Part 61?

14 MR. COCHRAN: This is not in 61. So, this  
15 is a scenario that is presented in the BTP that is,  
16 then, a basis for the encapsulation policy for gamma-  
17 emitting sources.

18 MR. WIDMAYER: So, I kind of don't  
19 understand. I mean, what --

20 MR. COCHRAN: Yes, it supplements Part 61.  
21 So, in 61, the developers envisioned one of two things  
22 happening.

23 MR. WIDMAYER: And this wasn't one of  
24 them.

25 MR. COCHRAN: That is correct.

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1 MR. WIDMAYER: So, I am just kind of  
2 trying to understand where it came from.

3 MEMBER ARMIJO: So, it is introducing a  
4 new scenario.

5 MR. COCHRAN: That's correct.

6 MEMBER ARMIJO: Okay.

7 MR. COCHRAN: And it was driven, we  
8 understand from staff, that it was driven by the  
9 sealed-source accidents. And the staff said, "Boy, we  
10 didn't think about that in putting 61 together, that  
11 some of these small items might survive and also be  
12 unrecognized."

13 So, in developing 61, they envisioned that  
14 somebody would dig into a bunch of drums or waste and  
15 say, "Boy, this looks like a waste disposal site here.  
16 I'd better back away and investigate."

17 But, rather, there might be just a lot of  
18 soil, like you see in this photograph here, a lot of  
19 soil, and in it might be some little pieces of metal  
20 that might survive and still be dangerous.

21 MEMBER ARMIJO: But, so far, that still  
22 looks like a near-surface excavation, right?

23 CHAIR RYAN: Yes, that's 25 feet tops,  
24 that arm on it.

25 MR. COCHRAN: Something like that, yes.

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1 CHAIR RYAN: So, I mean, they are not  
2 going to get to too much waste.

3 MR. COCHRAN: And let me just jump ahead.  
4 In the alternative approaches, one of the suggestions  
5 is that sources buried deeper than 10 meters might not  
6 be accessible, and it might be safe to bury larger  
7 sources. So, I am just going to jump ahead and tell  
8 you something that is in the alternative approaches.

9 So, the individual -- maybe it's a worker,  
10 maybe it's somebody out for a walk -- finds this  
11 interesting, old piece of metal in the soil, brings it  
12 home. It goes on a curio shelf.

13 And coming home, it is in their coat  
14 pocket for maybe four hours on the way home. It ends  
15 up on the curio shelf, where it is 2 meters from their  
16 couch where they sit maybe an hour a day.

17 And I would just point out on this curio  
18 shelf the majority of what is here are actually small,  
19 old pieces of metal. There's about 15 old pieces of  
20 metal on this curio shelf.

21 CHAIR RYAN: Staged for this presentation  
22 and photograph?

23 (Laughter.)

24 MEMBER ARMIJO: Well, this is your normal  
25 curio shelf, right? One of which is a cesium source,

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1 right?

2 MR. COCHRAN: And actually, it is my curio  
3 shelf. I am one of these guys who picks up small,  
4 interesting pieces of metal and arrowheads and rocks.

5 MS. RIDGE: I, however, have been cured of  
6 that practice.

7 (Laughter.)

8 MR. COCHRAN: Oh, you're not going to do  
9 that anymore?

10 MS. RIDGE: After this discussion, I'm not  
11 going to pick up little pieces of metal.

12 (Laughter.)

13 MR. WIDMAYER: After this, the digging  
14 scenario?

15 MS. RIDGE: Yes.

16 MR. COCHRAN: Next slide.

17 So, we then did a dose analysis to take a  
18 look at how big the source could be before the  
19 intruder saw 500 millirem. So, the exposure is in the  
20 pocket for four hours, coat pocket for four hours,  
21 then on a curio shelf five hours per week, 2 meters  
22 away.

23 And this may talk to your earlier point,  
24 Mike. It was surprising. Five hundred years, that's  
25 16 half-lives. We found that the source has to be

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1 limited to 130 curies at the time of disposal to keep  
2 the dose under 500 millirem at 500 years.

3 So, the old rule of thumb may be good for  
4 dispersed radionuclides, but for concentrated  
5 radionuclides the rule of thumb doesn't hold up  
6 anymore.

7 MEMBER ARMIJO: But why wouldn't that be  
8 dependent on the depth of burial? A hundred and  
9 thirty was for 25 feet, a much larger number for 100  
10 feet? It doesn't seem like it's --

11 MR. COCHRAN: In essence, we do as you  
12 recommend. Okay?

13 MEMBER ARMIJO: Okay.

14 MR. COCHRAN: Remember, philosophically,  
15 the BTP says it is generic, easy-to-use, lookup  
16 guidance for everybody.

17 MEMBER ARMIJO: Right. If it doesn't  
18 bother you, just do it that way.

19 MR. COCHRAN: That's right. And if you  
20 can meet the standards, be done. However, if you want  
21 to use the alternative approaches, here's some of our  
22 guidance.

23 And the guidance for sealed sources  
24 specifically calls out burial at depth greater than 10  
25 meters might invalidate that exposure scenario because

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1 it would have to be a really deep trench to dig --

2 CHAIR RYAN: Well, it could be a borehole,  
3 too. I mean, there's lots of ways to do it. I would  
4 hope the guidance would be a little more explicit  
5 about how to look at alternative cases.

6 MR. COCHRAN: I mean, the guidance calls  
7 out 10 meters, and if it were disposed of in a long-  
8 lived source device, maybe titanium shielding, a blood  
9 irradiator with lead shielding, the intruder, even if  
10 it were excavated, can't put that in his pocket.

11 And it turns out that this exposure  
12 scenario, it's the in-the-pocket that mattered.

13 CHAIR RYAN: Sure. Of course.

14 MR. COCHRAN: On the shelf 2 meters away,  
15 a minor contributor.

16 CHAIR RYAN: He could swallow it, too, I  
17 guess.

18 MR. COCHRAN: Pardon?

19 CHAIR RYAN: He could swallow it, too.

20 (Laughter.)

21 MR. WIDMAYER: But that makes him an  
22 advertent intruder.

23 (Laughter.)

24 CHAIR RYAN: Yes, it does.

25 That is a longstanding question for me.

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1 When is an advertent intruder --

2 MEMBER ABDEL-KHALIK: It is the  
3 normalization point. What would the result be if,  
4 instead of 500 years, it was 300 years?

5 MR. COCHRAN: I can answer the question.  
6 So, if you look at the table here, let's look at  
7 cesium. So, the Class C limit, the exposure was 500  
8 years. And we have gone from 30 curies to 130 curies.  
9 The Class B limit, we did the calculation at 300  
10 years. So, it is just under 1 curie at time of  
11 disposal. It will still give you 500 millirem at 10  
12 half-lives.

13 Next slide.

14 MEMBER ABDEL-KHALIK: It just seems like  
15 it is all very arbitrary.

16 MEMBER ARMIJO: Yes, and I think it drives  
17 certain behaviors that may just not be practical or  
18 forces you; .72 curies, you know, I don't know how  
19 many sources -- that little thing the size of a  
20 quarter, what is the curie content in that thing?

21 MR. COCHRAN: You could certainly have  
22 tens of curies here of cesium chloride.

23 MEMBER ARMIJO: Right. So, where would  
24 somebody who wanted to meet the 300-year limit, would  
25 he have to actually chop that thing up and put it into

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1 smaller capsules, which doesn't sound like a good  
2 idea?

3 MR. COCHRAN: That is not a good idea with  
4 cesium chloride.

5 MEMBER ARMIJO: Yes, yes.

6 MR. COCHRAN: It turns out that most  
7 disposal facilities that are licensed for B are  
8 licensed for C. And so, you would be able to do the  
9 500 years.

10 MEMBER ARMIJO: They would do the 500  
11 years. And if they had lots of those little quarter-  
12 sized things that they needed to get rid of -- I am  
13 still trying to get to the point of a practical  
14 solution that still is safe. Is the depth of burial  
15 your solution? The obvious solution, that they have  
16 got a big site and they know as long as you don't get  
17 into the water table, and all that other related  
18 stuff, the accessibility just disappears.

19 MR. COCHRAN: Depth of barrel until you  
20 reach the greater than Class C limit. Then you need  
21 to shift regimes, if you will, and maybe not even  
22 dispose of it in the near surface at all.

23 The regulation defines near surface as 30  
24 meters. That is near surface defined in the  
25 regulation.

1           So, we have got a new scenario basis.  
2           And, in turn, it was based on a reasonably  
3           foreseeable, and yet conservative, exposure scenario.  
4           Using the new scenario, we have got higher curie  
5           limits than what have existed since 1995, and we have  
6           got a transparent basis for using alternative  
7           approaches.

8           Because we understand the scenario that  
9           was used to develop the 130-curie limit, and so, as  
10          you have just said, the scenario assumes trenching  
11          goes through it. So, if I can go a lot deeper,  
12          greater than 10 meters, for example --

13                  MEMBER ARMIJO: It doesn't apply.

14                  MR. COCHRAN: -- it has probably  
15          invalidated the scenario.

16                  Next slide.

17                  MEMBER ABDEL-KHALIK: I mean, the fact  
18          that this is just totally arbitrary doesn't seem to  
19          bother you at all.

20                  MR. COCHRAN: I have worked in this arena  
21          about 15 years. It might have seemed arbitrary 15  
22          years ago, and it doesn't anymore. I mean, I  
23          understand the concept.

24                  I also came out of a probabilistic risk  
25          assessment world, working on the disposal of

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1 transuranic waste. I did that for about a decade.  
2 And we do features, events, and processes, right, full  
3 FEPs analysis, come up with probability-weighted  
4 scenarios, but for inadvertent human intrusion.

5 MEMBER ABDEL-KHALIK: Could you just  
6 conceptually explain to me, why would a hypothetical  
7 intrusion scenario depend on the waste classification?

8 MR. COCHRAN: We took them independent.  
9 So, that scenario that you saw, we applied it to A, B,  
10 and C waste forms. I'm not sure I understand.

11 MS. RIDGE: I think I understand the  
12 question. It depends because the time of intrusion  
13 that you consider is different for different classes  
14 of waste.

15 MEMBER ABDEL-KHALIK: Right. Why would  
16 that be the --

17 MS. RIDGE: Because Class C waste is  
18 required to be disposed of with an intruder barrier  
19 that would prevent someone from intruding for 500  
20 years. So, when we look at Class C, we assume,  
21 because the regulation requires it, that that intruder  
22 barrier is in place.

23 CHAIR RYAN: Just a point there, if I may,  
24 Christianne.

25 MS. RIDGE: Yes.

1 CHAIR RYAN: I think the intruder barrier  
2 is viewed to be doing different things to different  
3 practitioners. The intruder barrier to me is  
4 something that tells an intruder this is not Mother  
5 Nature; you are getting into something you probably  
6 ought to think about.

7 Is it the one that keeps him from getting  
8 a dose? Well, I'm not sure that is exactly right. If  
9 it is a reinforced concrete pad over a disposal cell  
10 that is -- pick a number -- 12 inches thick and has  
11 rebar in it, it is going to take an awful lot of work  
12 to get past it.

13 Somewhere in that process of attacking  
14 barriers has to make an inadvertent intruder recognize  
15 this is not Mother Nature.

16 MS. RIDGE: And that is assumed to be true  
17 for the first 500 years. And so, I think we are in  
18 agreement for 500 years.

19 CHAIR RYAN: Well, I mean, if we cut it  
20 off at 500 years plus one day, it is a different  
21 story. That I have a little trouble with because that  
22 could be true in some environments, not true in  
23 others.

24 MR. COCHRAN: The regulations almost have  
25 to work that way. You have got to draw some bright

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1 line, even though there is variability --

2 CHAIR RYAN: Well, that is not exactly  
3 true, either. We don't draw that bright line in a lot  
4 of areas in radiation protection.

5 MR. COCHRAN: Take speed limits, for  
6 example.

7 CHAIR RYAN: I don't want to go off into  
8 speed limits. Let's stick to our subject.

9 MR. COCHRAN: I like speed limits.

10 (Laughter.)

11 No, just kidding.

12 MEMBER SIEBER: He's from South Carolina.

13 CHAIR RYAN: I just find it a little -- I  
14 don't want to say "arbitrary" because I don't mean it  
15 is arbitrary. You have been very thoughtful in what  
16 you have done. But it is certainly deterministic, in  
17 my view.

18 MEMBER ARMIJO: And it is, and I don't  
19 have a problem with deterministic approaches if they  
20 make sense and you can use it as an engineer. You can  
21 say, okay, I can meet that criterion by doing this and  
22 this, and it is acceptable.

23 But it seems like that is more fruitful  
24 and less argumentative than getting into these things  
25 of what a hypothetical intruder will do 500 years in

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1 the future. And that is just for your Branch  
2 Technical Position, but other guys are going to try to  
3 apply, foresee what that person might do 20,000 years  
4 into the future, and that totally is bizarre.

5 So, it just seems like that inadvertent  
6 intruder thing is mucking-up a straightforward  
7 engineering judgment approach. These numbers may turn  
8 out to be the best numbers in the world. I don't have  
9 a problem with it. But it seems like we are going  
10 through this artificial process. It really just  
11 doesn't satisfy me.

12 MR. COCHRAN: If you could know the  
13 future, then you could put in the protective measures.

14 MEMBER ARMIJO: I don't need to know the  
15 future. I just need to know how dangerous this thing  
16 is, how small it is, and how I can make as  
17 inaccessible as possible. And I really don't think  
18 that one or two people 20,000 years into the future  
19 that might dig up something, it is beyond our  
20 responsibility to protect them. Okay? That's my  
21 personal opinion. And I don't think we are even in a  
22 position to do that.

23 If you just say, "Hey, look, we're going  
24 to bury these things and set limits so that, no matter  
25 how anybody got to them, they wouldn't get more than

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1 this level of exposure," and that's it. Forget the  
2 scenarios.

3 MR. COCHRAN: We have to have a scenario  
4 to set the limit.

5 MS. RIDGE: Well, I think that is  
6 essentially what we have done.

7 MEMBER ARMIJO: I don't know. I don't  
8 know. I'm a metallurgist, so I'm not a health  
9 radiation protection guy. But it just seems that this  
10 is a very difficult thing to understand.

11 MS. RIDGE: But I want to understand your  
12 point. I want to understand your point a little  
13 better because I am not sure exactly how that differs.

14 MEMBER ARMIJO: I may not have made a good  
15 point. So, that may be it.

16 MS. RIDGE: I mean, if you are willing to  
17 elaborate, when you say that, I believe you said you  
18 wanted to say, well, you're comfortable saying we just  
19 want to say, if someone is exposed to this, are we  
20 being protective, and let's not go through the  
21 artificial process of hypothesizing intruder  
22 scenarios. I don't know if I am paraphrasing you  
23 accurately, but that is what I heard.

24 And I am not sure I understand that  
25 because, when you say you want to be protective, if

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1 the person is doing what? If the person is exposed --

2 MEMBER ARMIJO: Only if he is doing  
3 normal, common activities. Okay? I will tell you  
4 where I saw this first that kind of struck me as  
5 strange.

6 In the Yucca Mountain analysis work,  
7 granted, that is spent-fuel, high-level waste, there  
8 were scenarios that I saw in some of the DOE  
9 documentation where somebody decides to put a drill  
10 right on top of the mountain, drill through a thousand  
11 feet of mountain, drill through a titanium drip  
12 shield, drill through an Alloy 22 container, drill  
13 through the stainless steel container, drill into the  
14 fuel, and then everything is released and it  
15 eventually all turns to rubble and contaminates the  
16 environment.

17 To me, that was so artificial -- I can  
18 show you the documents -- that I just lost total  
19 confidence in that analysis, so arbitrary, so  
20 unrealistic. And I see elements of that in low-level  
21 waste, which I just think it would be more practical  
22 to say, for cesium sources, if you want to get rid of  
23 a lot of it, you have got to bury it very deep, and  
24 this is the amount of maximum curies that you can  
25 bury. And that could just be a table.

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1 MS. RIDGE: How would you arrive at that  
2 maximum amount?

3 MEMBER ARMIJO: I don't know how to do  
4 that, Christianne. I am just saying that is my kind  
5 of thinking.

6 And for stuff that is Class A stuff,  
7 blending and all these other things that you can do,  
8 it is not harmful.

9 MR. WIDMAYER: Presumably, it wouldn't be  
10 an inadvertent intruder scenario if you buried it  
11 deep, right?

12 MS. RIDGE: Right.

13 MR. WIDMAYER: Well, then, something else,  
14 some other scenario creates your limit then.

15 CHAIR RYAN: I kind of take out of this,  
16 because we could talk about inadvertent versus  
17 advertent intrusion for a long time --

18 MR. WIDMAYER: Yes.

19 CHAIR RYAN: -- much past the schedule for  
20 this meeting. I think if we just maybe take away the  
21 note that we are going to think about it, and  
22 hopefully you will think a little bit more about it,  
23 too, and we can take it up at a future meeting.

24 Somewhere along the line, I think Derek  
25 said it well. An inadvertent intruder is advertent --

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1 and I'm not sure that is the same scenario. You know,  
2 if somebody decides they are going to set up a drill  
3 rig and drill 200 feet and do a borehole exploration,  
4 or whatever kind of really serious intrusion thing you  
5 want to do, I don't know how you stop that.

6 But, at some point, it is different than  
7 an inadvertent intrusion, where somebody accidentally  
8 intersects the waste in some way that results in  
9 exposure.

10 MS. RIDGE: To my mind, it is advertent if  
11 they know that there is a hazard there. It is  
12 inadvertent if you don't recognize the hazard. And to  
13 me, that is the difference.

14 CHAIR RYAN: But barriers to the waste  
15 create the opportunity to recognize this is something  
16 unique and different. And so, I guess I would offer  
17 you thought I think where we are stuck, or where I am  
18 stuck, is that at some point an inadvertent intruder  
19 becomes an advertent intruder.

20 MS. RIDGE: Class A waste --

21 CHAIR RYAN: So, a junkyard picker who  
22 picks up a source, to me, is a whole different ball  
23 game. And I did notice that all of your examples were  
24 from countries that might be viewed to be less  
25 sophisticated than what the average person that picked

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1 up those sources might be in terms of radioactive  
2 material and all the rest. So, I think it is  
3 important to have scenarios that guide us that are a  
4 little bit more realistic of what might happen at a  
5 well-engineered, well-operated, well-closed, funded by  
6 a closure fund that has got tens and hundreds of  
7 millions of dollars in it, with this ongoing  
8 monitoring and maintenance for at least 100 years,  
9 maybe longer, and certainly money to do that,  
10 different from somebody that scavenged. We need to  
11 come up with a little bit more realistic scenario to  
12 get as to what intrusion really might be like.

13 CONSULTANT FLACK: But if I could follow  
14 up on that a little bit, the more difficult you make  
15 it, the more difficult it is to get rid of, the more  
16 likely it is to end up with these other scenarios  
17 where they just don't want to be bothered getting rid  
18 of it because it is too difficult. And then, you  
19 increase the likelihood that it could be picked up,  
20 like these earlier scenarios, on the surface and  
21 expose a lot of people to this risk but not knowing  
22 it.

23 So, if you look at the holistic risk  
24 picture, right, the more you want to protect one, the  
25 more likely you end up exposing someone else to it.

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1 So, I think there has to be a balance there somewhere.

2 MR. COCHRAN: And to reiterate what was  
3 said a couple of times, the limit that has been in  
4 place since 1995 is 30 curies. Now it is 130 curies  
5 and alternative approaches which didn't exist in the  
6 old BTP.

7 CONSULTANT FLACK: Right. So, it is  
8 trying to find that balance, is basically what you are  
9 saying.

10 MS. RIDGE: Moving in that direction,  
11 certainly.

12 MR. COCHRAN: Well, we've shifted.

13 CONSULTANT FLACK: Yes, it is just a  
14 matter of finding it, yes.

15 MR. COCHRAN: I know it is frustrating to  
16 you all. We are required to protect the inadvertent  
17 human intruder.

18 MEMBER ARMIJO: I know. You are  
19 constrained by the regulation. And I have read it,  
20 and it is so inclusive, "any and all", any inadvertent  
21 intruder for all, potential. It's ridiculous.

22 CHAIR RYAN: Well, I think what is the  
23 interesting part of all this discussion is that, while  
24 the rule and the regulation wording may not change,  
25 the way we are interpreting it has without changing

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1 the rule. So, maybe that is something to think about.  
2 I will think about it for sure. Maybe that is a  
3 construct that needs to be better explained  
4 fundamentally in the regulation.

5 MEMBER ARMIJO: The problem starts with  
6 the rule, the language in the rule.

7 CHAIR RYAN: I don't know.

8 MS. RIDGE: I would also like to point out  
9 that Class A waste is not required to be disposed of  
10 with an intruder barrier. So, when we talk about  
11 someone becoming an inadvertent intruder because  
12 surely they recognized the risk when they hit the  
13 reinforced concrete, that is not a requirement of the  
14 rule for Class A waste.

15 So, at least for that part of the  
16 discussion, I do think it is plausible that someone  
17 comes in, performing normal activities, building a  
18 dwelling, putting in a well, and they don't recognize  
19 the risk. It depends on where you are in the country,  
20 how common it is to drill into hard materials. And  
21 there are parts of the country where people blast  
22 water wells free of caliche. And certainly there are  
23 site-specific factors to be considered.

24 But I think that we should remember that  
25 we are not always, in some cases we are talking about

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1 places that would be reinforced with concrete,  
2 reinforced intruder barriers. But some of this waste  
3 isn't subject to that requirement. And so, we are  
4 trying to postulate scenarios that are based on  
5 activities that people perform today.

6 CHAIR RYAN: I think we have had a good  
7 discussion on this point --

8 MS. RIDGE: Yes, we have.

9 CHAIR RYAN: -- and I don't want to  
10 shortchange from the rest of your slides, which there  
11 are a few.

12 MR. COCHRAN: We're all but done. We're  
13 in the wrap-up, actually.

14 CHAIR RYAN: Okay.

15 CHAIR RYAN: Oh, we're not. Oh, my  
16 goodness. We have got to talk about a mixture --

17 (Laughter.)

18 CHAIR RYAN: I didn't think you were.

19 MS. RIDGE: Or we could skip that part.

20 (Laughter.)

21 MR. COCHRAN: Okay. So sorry. So, just  
22 the other half of my presentation I forgot about.

23 (Laughter.)

24 Okay. So, guidance on how to classify a  
25 mixture of individual items. So, what's this about?

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1 Let's say I have got a drum, and in the drum I have  
2 got pieces of activated metal, different sizes,  
3 different curie contents. I want to know how to  
4 classify the mixture together inside the drum.

5 So, first, let me review what is in the  
6 1995 BTP guidance. It actually offers separate  
7 guidance, depending on whether you got activated metal  
8 or contaminated materials or cartridge filters. Yet,  
9 the guidance is really similar. And one of the things  
10 we did in the revised BTP was just consolidate it.

11 The 1995 BTP and the revised, both define  
12 a couple of terms of art. One is primary gamma-  
13 emitters. These are cobalt-60, niobium-94,  
14 cesium-137. And if you look in the waste tables,  
15 Table 1 and Table 2, these are the only gamma-emitters  
16 that are there.

17 And then, also, the non-gamma-emitters,  
18 and those are defined in the BTP as well. You can  
19 read the list.

20 Next slide.

21 Still reviewing the 1995 BTP guidance,  
22 what it says is that you can classify this mixture of  
23 pieces based on the piece in the mixture with the  
24 highest classification. They call this a conservative  
25 classification. I just find the one in there that has

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1 got the highest classification, I apply it to the  
2 entire container, and I'm done.

3 Or you can also average across all the  
4 pieces, as long as you eliminate the hotspots. And  
5 there are two tests to eliminate gamma hotspots and  
6 two tests to eliminate non-gamma hotspots.

7 So, for the gamma hotspots, if it is very  
8 small, less than 1/100th of a cubic foot, and exceeds  
9 the Table A values for gamma-emitters, it should be  
10 taken out and managed separately because it is sealed-  
11 source-like.

12 There is a factor of 1.5 rule for the  
13 gamma-emitters. And what it says in the old BTP was  
14 that, for each of the primary gamma-emitters -- let's  
15 take cobalt or cesium, let's use cesium, actually --  
16 the concentration of cesium in any individual piece  
17 can't be more than a factor of 1.5 times the average  
18 for cesium in the entire mixture. And it prevents  
19 deviations about the average.

20 Then, non-gamma hotspots, the non-gamma-  
21 emitters that are greater than Table B values should  
22 be removed and managed separately. And there is a  
23 factor-of-10 rule for the non-gammas. It is like the  
24 factor of 1.5, only it is for the non-gammas, and it  
25 is a factor of 10. So, the non-gammas in any

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1 individual piece can't be more than 10 times the  
2 average of that non-gamma nuclide.

3 Next slide.

4 So, this is the revised guidance for  
5 classifying mixture of individual items. It looks the  
6 same, but it is not. You do have the same general two  
7 choices to make early on. You can do the conservative  
8 classification or you can average across the mixture,  
9 curies divided by volume of the pieces.

10 There are still four tests, two for the  
11 gamma-emitters and two for the non-gamma-emitters.  
12 However, for the gamma-emitters, the Table A values  
13 have changed. I will go over those in a second. The  
14 factor of 1.5 rule is now a factor-of-2 rule, and it  
15 is interpreted differently.

16 For the non-gammas, the Table B is  
17 unchanged. And for the non-gammas, the factor-of-10  
18 rule is still the factor-of-10 rule but interpreted  
19 differently. So, let me go through each of those real  
20 quick.

21 Next slide.

22 So, this test is to remove from the  
23 mixture items that are sealed-source-like. If any  
24 item in the mixture is less than 1/100th of a cubic  
25 foot and exceeds the Table A values, it needs to be

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1 pulled out and managed separately. Table A has been  
2 updated, and this is the same table as used for  
3 encapsulation of sealed source gamma-emitting. So,  
4 there is consistency between the encapsulation policy  
5 and the policy for disposing of items in a mixture.

6 Next slide.

7 At this point, let me go back and point  
8 out real quickly, for cobalt there is no limit because  
9 cobalt really does decay. It is a five-year half-  
10 life. It decays away pretty quickly. So, at 300  
11 years, we ran the analysis with a Nordion irradiator  
12 pin, 14,000 curies in a single pin, 300 years it is  
13 still benign. It is still benign.

14 Next slide.

15 The factor-of-2 rule, this is based on a  
16 new exposure scenario. I'm sorry to say that to you.  
17 Based on a new exposure scenario that is very similar  
18 to the gamma-emitting, sealed-source, carry-away  
19 scenario except now the scenario involves larger  
20 pieces of activated metal.

21 And I've got some slides in the backup.  
22 We can go over that scenario, if there is time later.

23 Next slide.

24 Let me just go to the results. We started  
25 this with niobium-94, and we applied it to the others.

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1 But the analysis demonstrates the need to protect the  
2 intruder from larger pieces of activated metal.

3 MEMBER ABDEL-KHALIK: Where did the 1.5  
4 original multiplier come from?

5 MR. COCHRAN: It is described in the back  
6 of the 1995 BTP. It is a very brief description. It  
7 says that, should an intruder dig up pieces of  
8 activated metal in the landfill, and those pieces be  
9 reconfigured as a disk on the surface 3 meters in  
10 diameter, the dose would be 6 millirem per hour to the  
11 intruder at 1-meter distance. Therefore, a factor of  
12 1.5.

13 So, at least in our revised draft BTP, if  
14 you read it, you will see that it is a lot clearer to  
15 understand and you could reproduce the calculations.  
16 But that is where it comes from. So, it is briefly  
17 described in a few sentences in the back of the 1995  
18 BTP.

19 MEMBER ABDEL-KHALIK: But it is just  
20 another hypothetical scenario?

21 MR. COCHRAN: It is. It is.

22 So, what we found, looking at niobium-94  
23 in activated metal was you have got to hold the  
24 concentration to less than two times the  
25 classification limit, keep the intruder dose under 500

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1 millirem at 500 years, under the conditions described  
2 in the intruder scenario.

3 Next slide.

4 And I hope the next slide explains maybe  
5 the significant differences between the existing and  
6 the proposed.

7 CHAIR RYAN: John, just one quick question  
8 on that previous slide. I am going to ask it out of  
9 ignorance. How much niobium-94 is around in sealed  
10 sources?

11 MR. COCHRAN: Almost none. It is going to  
12 be in your activated metal.

13 CHAIR RYAN: Okay.

14 MR. COCHRAN: So, that table you saw -- go  
15 back, a couple more.

16 The niobium-94 is really here because we  
17 used the same table for pieces of activated metal as  
18 well as sealed sources.

19 CHAIR RYAN: Okay. All right. I  
20 understand now. Thanks.

21 MEMBER ARMIJO: Inactivated metal is the  
22 niobium? I mean, in stainless steel, is it chromium  
23 or what? Steel?

24 MR. COCHRAN: Yes, stainless.

25 MEMBER ARMIJO: Okay.

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1 MR. COCHRAN: So, let's just look at the  
2 lower left. And what you see graphically -- it could  
3 be for any nuclide -- is the Class A, B, and C limits.  
4 And the bar represents the average for all the pieces  
5 in a mixture. So, in this case, the average is  
6 between the Class B and the Class C limit.

7 And you see the old factor of 1.5 is  
8 applied about the average. Okay? For niobium or  
9 cesium, you've got an average value. That is the bar.  
10 And then, for that nuclide, like cesium, it can't be  
11 more than 1.5 times above or below the average. So,  
12 that is the old one.

13 The new one, we have got the same mixture.  
14 You see the average is going to be in the same  
15 location. But what we found in doing the intruder  
16 exposure scenario analysis was you needed to keep the  
17 piece with the highest activity, no more than two  
18 times the Class C limit, to hold the intruder dose  
19 below 500 millirem.

20 Okay. Next slide.

21 So, there is a factor-of-10 rule for the  
22 non-gammas. It is really quite a bit like the factor-  
23 of-1.5 or the factor-of-2 rule in the other.

24 The old one was linked to the average.  
25 The new one is linked to the classification limit.

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1           So, for each non-gamma nuclide, the  
2 concentration in an individual piece can't be more  
3 than 10 times the classification limit, as opposed to  
4 10 times the average for that nuclide in the mixture  
5 of all the pieces.

6           Next slide.

7           So, in summarizing the revised BTP  
8 guidance for classifying a mixture of items, a mixture  
9 of pieces of activated metal, for example, you have a  
10 new Table A with higher gamma limits, a new factor of  
11 2 which is linked to intruder exposure. There is no  
12 lower limit for the factor-of-2 rule like there was in  
13 the factor of 1.5. And it is linked to the  
14 classification limit, not to the average in the  
15 mixture.

16           We have also got a new factor-of-10 rule;  
17 basically, the same story. The factor of 10 linked to  
18 the classification limit and not the average in the  
19 mixture.

20           Next slide.

21           Now I am going to summarize the three  
22 topics that I have covered here.

23           Alternative approaches represents a new  
24 philosophy. The BTP provides uniform threshold or  
25 level of safety, easy-to-use, lookup guidance.

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1           And then, through the alternative  
2 approaches, it gives guidance to the Agreement States  
3 and licensees on how they might deviate from the  
4 guidance.

5           Encapsulation, we have got a new scenario  
6 basis. We are not using the 2,360 hours of exposure  
7 anymore, but, rather, the gamma source carry-away  
8 scenario with the pipeline construction. This new  
9 scenario gives us new, higher curie limits, which  
10 means that more stranded sources can be disposed of  
11 with the new, higher curie limits. And we have also  
12 got a transparent basis for implementing the  
13 alternative approaches.

14           So, you understand the scenario basis, we  
15 gave you the 130-curie limit, and then you can now  
16 demonstrate why that scenario wouldn't be reasonable  
17 for your setting. Maybe deeper disposal or disposal  
18 in a sealed-source device where they couldn't take the  
19 source out.

20           Next slide.

21           This is just a summary slide on all the  
22 major changes to the BTP.

23           I don't know, Maurice, if you want to go  
24 through them.

25           MR. HEATH: No. Well, these are all the

1 ones that actually we have been talking about.

2 CHAIR RYAN: I don't think we need to read  
3 through them, unless anybody wants to look at them.  
4 We all have them here, and they are part of the record  
5 as well.

6 MEMBER ARMIJO: Okay.

7 CHAIR RYAN: But before we take questions,  
8 let me do something for the record. The Members in  
9 attendance today are Sam Armijo, Dennis Bley via  
10 telephone, Jack Sieber, and Said Abdel-Khalik. The  
11 Chairman is here as well.

12 Thank you very much. I'm sorry. I should  
13 have done that earlier.

14 Derek Widmayer is the Designated Federal  
15 Official for the meeting as well.

16 Thank you.

17 MR. WIDMAYER: You were supposed to that  
18 earlier, too.

19 CHAIR RYAN: I was.

20 (Laughter.)

21 Better late than never. It's on the  
22 record.

23 Any further questions?

24 Sam?

25 MEMBER ARMIJO: No, I have no questions.

1 CHAIR RYAN: Well, I am sure this is the  
2 first conversation we will have on this topic; I am  
3 looking forward to followup, but I think we have a lot  
4 to digest.

5 I'm sorry. No, he pointed to you like I  
6 was not paying attention.

7 MR. WIDMAYER: He wanted to make a comment  
8 potentially. He is on the agenda.

9 CHAIR RYAN: Oh, I'm sorry. Yes.

10 But we have a lot to do.

11 And, yes, I'm sorry. Drew, there you are.  
12 Path forward. Sorry, sir. My mistake. I can't see  
13 you behind Derek.

14 (Laughter.)

15 MR. PERSINKO: I just wanted you to finish  
16 your closing remarks there.

17 CHAIR RYAN: I was getting ready, but go  
18 ahead.

19 MR. PERSINKO: No, I just want to talk  
20 about path forward. Our plan for path forward was to  
21 brief the full Committee in December and then go out  
22 for public comment with the BTP in January, after we  
23 discuss with the full Committee.

24 We are also planning to have a public  
25 meeting on October 20th to discuss the BTP in

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1 Albuquerque, and that is prior to going out for the  
2 official public comment. But we got it scheduled and  
3 on the agenda already.

4 CHAIR RYAN: So, we will have to work out  
5 having a letter at that meeting for you. So, I'm sure  
6 we will.

7 Thank you, Drew. I appreciate that  
8 schedule.

9 And just to be sure now, I understand you  
10 are going out in January to the public?

11 MR. PERSINKO: That's the plan.

12 CHAIR RYAN: Yes, that's the plan. Okay.  
13 Great.

14 Any other comments from Members? We're  
15 all set?

16 (No response.)

17 Anybody else? Any of the members from the  
18 audience?

19 (No response.)

20 Anybody on the phone, the bridge line,  
21 that would like to make a comment?

22 MR. MILLER: Can you hear me?

23 CHAIR RYAN: Yes.

24 MR. MILLER: I guess a couple of  
25 historical items.

1 CHAIR RYAN: Could you tell us who you  
2 are, please?

3 MR. MILLER: Clint Miller.

4 CHAIR RYAN: Okay.

5 MR. MILLER: Pacific Gas and Electric. I  
6 am the radwaste engineer at the Diablo Canyon Power  
7 Plant.

8 CHAIR RYAN: Okay.

9 MR. MILLER: There was a question about  
10 where the 1 cubic foot kind of came from as a  
11 potential hot item, and would that be a problem if  
12 somebody tried to hide that in other material.  
13 Historically, the 1 cubic foot is a default value for  
14 the size of a cartridge filter, which could be highly  
15 radioactive from a Pressurized Water Reactor.

16 In practice, it is very hard to hide  
17 anything over 1 r per hour in a shipping container of  
18 material that could be disposed of at lower cost, like  
19 rad trash. Because you are shipping in unshielded  
20 containers, you can't have the container over 1 r per  
21 hour unless you are in a closed van. So, that  
22 obviates that aspect. So, that is where the 1 cubic  
23 foot comes from.

24 Also, I appreciate the comments about  
25 encapsulation and why is there a criteria on the size

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1 of the container. Not so much for encapsulation of  
2 sources, but for encapsulations of filters and other  
3 objects, those very objects are often over 1 r per  
4 hour that we are trying to package and disposition  
5 appropriately. Encapsulation is often a path to be  
6 used.

7 And the NRC previously had received and  
8 approved the encapsulation of multiple filters in  
9 larger containers, much larger than a drum. And the  
10 key thing is, instead of having a size of a container,  
11 just go to waste-to-binder ratio. The 1 cubic foot is  
12 the size of a filter. There was a practical process  
13 of putting one cartridge filter in one 55-gallon drum.  
14 That is a 1-to-7 ratio or about a 14 percent waste-to-  
15 binder ratio for encapsulation of objects and  
16 cartridge filters.

17 We would appreciate it if that limit was  
18 not on a container for encapsulation of size, but,  
19 rather, just a waste-to-binder ratio. Anything over  
20 14 percent loading in container of encapsulated  
21 mixtures, that should be seen as not diluting the  
22 waste and actually providing a more secure package for  
23 the environment.

24 CHAIR RYAN: Thank you. That is very  
25 helpful.

1           Just so I think everybody understands,  
2           there are two things in play, I believe, from your  
3           comments. One is how you meet disposal requirements,  
4           but you mentioned a couple of examples where it is not  
5           only disposal, it is transportation.

6           MR. MILLER: Correct.

7           CHAIR RYAN: So, you are mixing and  
8           matching, not mixing and matching, but you are trying  
9           to resolve two problems that are happening to you  
10          simultaneously. It has to be a legal transport unit,  
11          and then it has to be a legal disposal package. And  
12          sometimes those work well, and sometimes you have to  
13          work hard to make sure they are aligned. Is that  
14          correct?

15          MR. MILLER: Correct. One of your  
16          Committee Members, you know, "What's going to control  
17          someone or limit someone from trying to put something  
18          very highly radioactive into lower-activity material?"  
19          And the practical matter is the transportation limits  
20          are there.

21          MEMBER SIEBER: Yes, but there is  
22          shielding that you can put over, PICs, for example, to  
23          ship it.

24          MR. MILLER: But when you do that, but  
25          once you do that, sir, then you have already bought

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1 the price for the shipping cask. And that is looking  
2 at \$5,000 to \$50,000. So, once you are going to  
3 mobilize the cask to your site, you put everything you  
4 can into that high-activity shipment and make your  
5 most out of your money. You put all the hot stuff  
6 together.

7 CHAIR RYAN: I think that is a very  
8 important point, that there are practical  
9 transportation issues that licensees, particularly  
10 power plants with higher-activity materials in larger  
11 quantities, have to do to optimize their performance.

12 I guess I would think about that, if you  
13 have any written comments you would like to send in to  
14 the Committee on points that would be helpful for us  
15 to hear on what are your challenges as you see them  
16 under the BTP, I would welcome any input from the  
17 public on that point.

18 But I think you hit on an important point,  
19 that we, I think, have to be careful to make sure that  
20 whatever version of the new BTP ends up as the final  
21 also accommodates and recognizes these kinds of  
22 tradeoffs between the transportation requirements and  
23 disposal requirements and processing requirements,  
24 which is another dimension of all this. What is my  
25 limit of a process to make the waste acceptable to

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1 transport and disposal?

2 So, I would encourage you to send in  
3 written comments, if you would care to do so.

4 MR. MILLER: Yes, we are bundling those  
5 with NEI's and EPRI's comments to the NRC.

6 CHAIR RYAN: Great. We will look forward  
7 to having them. Thank you very much.

8 MR. MILLER: Appreciate it.

9 CHAIR RYAN: Is there anybody else on the  
10 phone that would like to make a comment?

11 (No response.)

12 MR. COCHRAN: Clint makes a good point.  
13 I mean, I have talked a lot about sealed sources  
14 because they are important. But you might encapsulate  
15 small pieces of activated metal or cartridge filters,  
16 as Clint just noted.

17 MR. MILLER: And oftentimes, high-activity  
18 valves are cut out of the plant, hot objects.

19 CHAIR RYAN: I think it is fair to say  
20 that sometimes the transportation requirements and  
21 disposal requirements drive the operational  
22 considerations for how to get those kinds of things  
23 done.

24 Any other comments? Is there anybody else  
25 on the bridge line that would like to make a comment?

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1 (No response.)

2 Any final comments from our panelists?  
3 Maurice or Christianne or John?

4 MR. HEATH: I do have just one quick item.  
5 You mentioned it earlier, about the alternative  
6 approaches and having it well-explained and thought-  
7 out. And I just wanted to mention, as John said, it  
8 is actually in the BTP, in the revised. So, what we  
9 will do next time in the full Committee is we will  
10 just lay that out in the presentation, so you will  
11 understand. Because, like John said, there are  
12 provisions for having a different media for disposal,  
13 you know, if you wanted different shielding, titanium.  
14 Those things are in the BTP. We just might not have  
15 brought them across so they are explicitly known in  
16 this presentation, and we will do so in the full  
17 Committee.

18 CHAIR RYAN: Yes. Thank you. I think  
19 that will be helpful for the full Committee, to hear  
20 some of the insights you have relied on to end up with  
21 the revisions that you have made.

22 MR. HEATH: Okay.

23 CHAIR RYAN: That would be very helpful.  
24 Christianne, anything else?

25 MS. RIDGE: No, thank you.

1 CHAIR RYAN: No? John? No?

2 MR. COCHRAN: It was a pleasure to be  
3 here.

4 CHAIR RYAN: As always, it was a pleasure  
5 to have you here.

6 And I want to compliment the staff and the  
7 rest of the team in radioactive waste management.  
8 They have done a lot of hard work trying to evaluate  
9 and divine and improve a document that is now quite  
10 old and has a lot of history behind it.

11 So, we will look forward to hearing  
12 further about it and then offering you our comments in  
13 a letter. But I want to appreciate your hard work and  
14 your talent that you have applied to this job. Thank  
15 you all very much.

16 MS. RIDGE: Thank you.

17 MR. COCHRAN: Thank you.

18 CHAIR RYAN: With that, hearing no other  
19 comments, we will adjourn the meeting.

20 Thank you very much.

21 (Whereupon, at 4:12 p.m., the meeting was  
22 adjourned.)

23

24

25

# **Advisory Committee on Reactor Safeguards**

## **Review of Draft Branch Technical Position on Concentration Averaging and Encapsulation**

**Maurice Heath, Project Manager**  
**Dr. Christianne Ridge, Sr. Systems Performance Analyst**  
**John Cochran, Sandia National Laboratory**

**October 4, 2011**



# Outline

- **Introduction**
- **Technical Bases for Homogeneity Guidance**
- **Technical Bases for Alternative Approaches, Encapsulation, and Classifying Mixture of Items**
- **Summary**



# Topics Addressed

- 1. Demonstrating homogeneity and classifying homogeneous waste**
- 2. Classifying mixture of individual items:**
  - a. activated metals, or**
  - b. contaminated materials, or**
  - c. cartridge filters**
- 3. Encapsulation of sealed sources & other LLRW**
- 4. Alternative Approaches**



# Introduction

**Maurice Heath**  
**Project Manager**  
**October 4, 2011**



# What is the BTP

- **Guidance document for waste generators and processors**
  - **classifying waste for disposal under 10 CFR Part 61**
  - **provides a method for averaging and classifying radionuclide concentrations in waste over a volume or mass of waste package**
  - **widely used by generators, processors and agreement state regulators**



# 10 CFR 61 Subpart C - Performance Objectives

- **Protection of the general population from releases of radioactivity.**
- **Protection of individuals from inadvertent intrusion**
- **Protection of individuals during operations**
- **Stability of the disposal site after closure**



# 10 CFR Part 61 Requirements Applicable to BTP

- **§ 61.42, “Protection of individuals from inadvertent intrusion”**
  
- **§ 61.55, “Waste classification”**
  - **Tables 1 and 2 – define Class A, B, and C waste**
  - **§ 61.55(a)(8)**
    - ✓ **Allows for concentration averaging in determining waste class**
  
- **10 CFR Part 20, Appendix G**



# Waste Classification Table 2

## 10 CFR 61.55

Radionuclide	Concentration, Ci/m <sup>3</sup>		
	Col. 1 (Class A limit)	Col. 2 (Class B limit)	Col. 3 (Class C limit)
Total of all radionuclides with < 5 yr half-life	700	n/a	n/a
H-3	40	n/a	n/a
Co-60	700	n/a	n/a
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

If concentration does not exceed column 1, waste is Class A. If concentration is > col. 1 and < col. 2, waste is Class B. If concentration is > col. 2 and < col. 3, waste is Class C. If > col. 3, waste is not acceptable for near-surface disposal

# Background

- **Low-Level Waste Strategic Assessment, October 2007**
  - Revisions to CA BTP – high priority
  - Risk-informed, performance-based
  
- **Blending of LLW and SECY paper— CA BTP on hold**
  
- **SRM-SECY-10-0043**
  - **Risk-inform blending position in BTP**



# Risk-Informed, Performance-Based

## ➤ Risk-Informed:

- Decision making approach that uses risk insights, engineering judgment, safety limits, and other factors.
- For establishing requirements that focus on issues commensurate with their importance to public health and safety

## ➤ Performance-based:

- Performance and results as the primary bases for decisionmaking

- Performance-based regulations have these attributes, among others:

1. measurable, calculable or objectively observable parameters exist or can be developed to monitor performance;
2. objective, criteria exist or can be developed to assess performance;
3. licensees have flexibility to determine how to meet the established performance criteria in ways that will encourage and reward improved outcomes



# Risk-Informed, Performance-Based

## ➤ Risk-informed

- Guidance linked to limiting doses to inadvertent intruder
- Protection of inadvertent intruder 1 of 4 objectives of Part 61
- Reasonably foreseeable scenarios
- Evaluated consequences to intruder (500 mrem dose limit)

## ➤ Performance-based

- Measurable parameters (concentrations of radionuclides)
- Additional flexibility provided in revised version for alternative approaches, as long as intruder protection is maintained



# Major Changes to 1995 BTP

Revised BTP	1995 BTP	Reason for change
Removed factor of 10 constraint for blending of wastes	Blended wastes subject to factor of 10 constraint	Consistent with Commission blending SRM
Removed exceptions for blending of homogeneous wastes (resins, e.g.)	No constraints on blending if operational efficiency or worker dose reductions in play	Consistent with Commission blending SRM
Changed the Cs-137 sealed source limit from 30 Ci to 130 Ci, and Class B Co-60 limit from 700 Ci to no limit, based on new scenario.	30 Ci limit on Cs-137 sources, 700 Ci limit on Class B Co-60 sources.	1995 scenario unnecessarily conservative, creates orphan waste, esp. for DOE/NNSA
Consolidated sections addressing activated metals, contaminated materials, and cartridge filters into one	Three sections for each of these wastes, with virtually same technical positions	Improved readability and organization
Factor of 2 in place of 1.5 and factor applies to class limit, not average of mixture	Factor of 1.5 applied to variation around <i>average</i> concentration of mixture.	Uniformity (factor of 1.5) has no direct relationship to risk, especially when a mixture is uniform but well below the class limit. Tying factor to class limit gives risk connection. Two is a reasonable limit, staff believes
Factor of 10 tied to class limit, not average of mixture	Factor of 10 for non-primary gamma emitters tied to average of mixture	Same as above, first part
Added test for homogeneity for mixing similar homogeneous waste types	No test required	Need to ensure intruder protection, well drilling scenario
Added "Alternatives approaches" section and gives examples.	61.58 had to be invoked for alternative approaches, a high threshold	61.58 is for alternative to regulations, not guidance. Effect was to discourage use (only 1X in 16 years)
Revised and clarified technical bases in Appendix	Has technical basis for sealed source scenarios, but difficult to understand	Greater transparency, more realistic scenarios

\*\*\* Additional changes were made but they were not as significant

# Site-Specific Analysis Rulemaking and BTP

<b>Activity</b>	<b>Intruder Protection ?</b>	<b>Primary user</b>	<b>Purpose</b>
Site-specific analysis rulemaking	Yes	Disposal facility	Regulation
Concentration Averaging BTP	Yes	Generators and processors	Guidance



# **Technical Basis for Homogeneity Guidance in the Branch Technical Position on Concentration Averaging and Encapsulation**

**Dr. Christianne Ridge  
Sr. Systems Performance Analyst  
October 4, 2011**



# Waste Types

- 
- Homogeneous materials
  - Activated metals
  - Cartridge filters
  - Contaminated materials
  - Sealed sources



# Topics Addressed



- 1. Demonstrating homogeneity and classifying homogeneous waste**
- 2. Classifying mixture of individual items:**
  - a. activated metals, or
  - b. contaminated materials, or
  - c. cartridge filters
- 3. Encapsulation of sealed sources & other LLRW**
- 4. Alternative Approaches**



# Homogeneity Guidance Topics

- **Homogeneous Waste Types**
- **Intentional Blending During Waste Processing (i.e., “large-scale” blending)**
- **Classification of Homogeneous Waste**

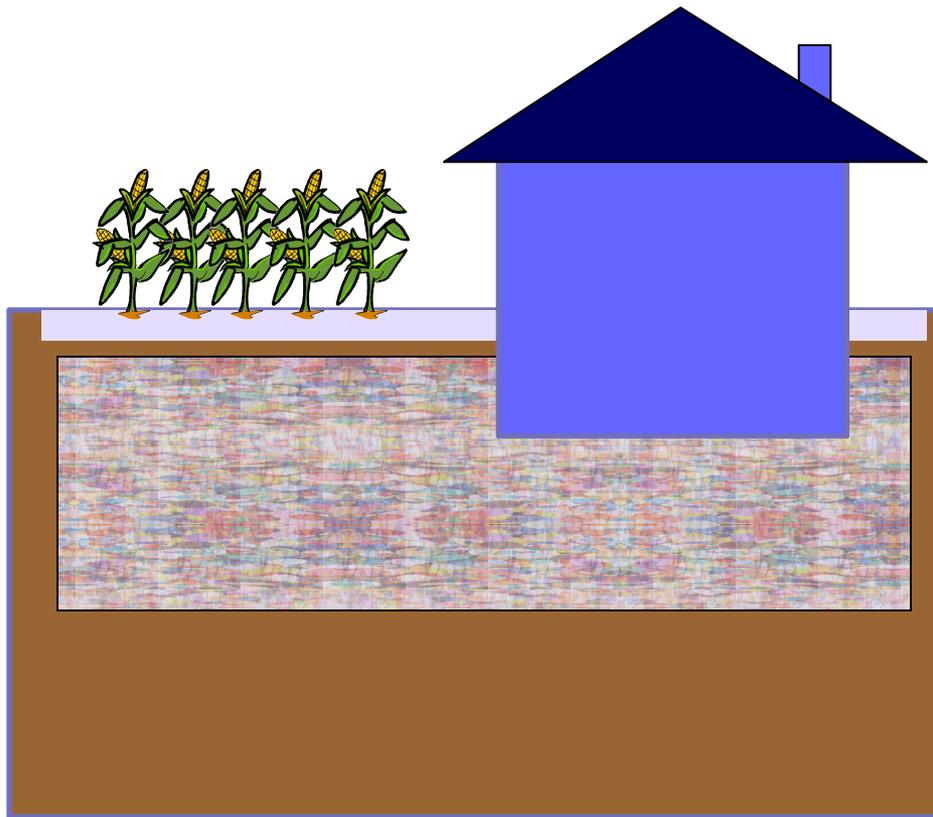


# Reasons for Homogeneity Guidance

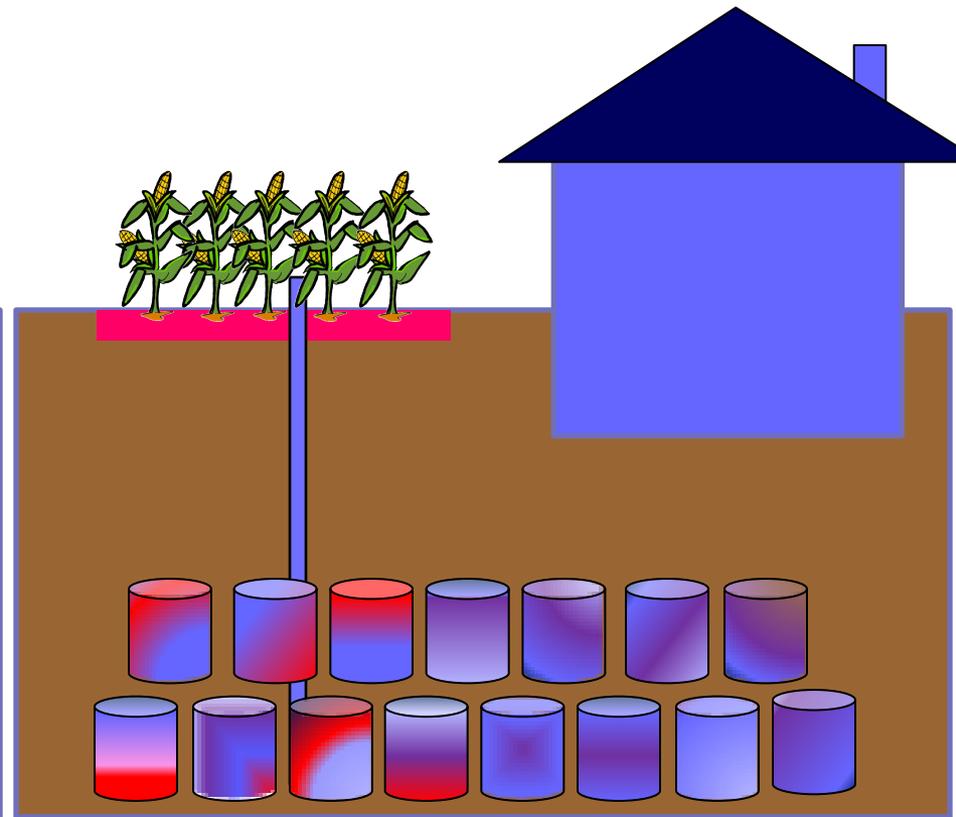
- **Elimination of “factor of 10” constraint on inputs to a waste mixture**
- **Stakeholder concern**
- **Increased consideration of site-specific scenarios**
- **Commission direction (SRM-SECY-10-0043)**



# Alternate Conceptual Models



Part 61 Intrusion  
Analysis



Hypothetical Intrusion Scenario

# Homogeneous Waste Types

- **Specific waste streams assumed to be homogeneous in the context of intrusion**
  - **Solidified or absorbed liquid, spent ion-exchange resins, filter media, evaporator bottom concentrates, ash, contaminated soil, and containerized dry active waste**
  
- **No homogeneity test proposed for designated homogeneous waste types**
  - **These wastes are homogeneous or easily mixed, or waste is expected to become easily mixed after 100 years**
  - **Waste classifiers advised to consider existing information**



# Intentional Blending During Waste Processing

- **Guidance based on dose to resident after a well is drilled on site**
- **Processors either demonstrate that process creates homogeneous waste or apply test to individual containers**
- **Homogeneous waste should not contain any pocket of waste larger than 1 cubic foot with a sum of fractions greater than 10**



# Classification of Homogeneous Waste

- **More rigorous consideration of uncertainties recommended for waste with a sum of fractions close to 1**
  - **Consistent with 1983 Branch Technical Position**
- **Main sources of uncertainty expected to be**
  - **Spatial variability in radionuclide concentrations**
  - **Uncertainty in scaling factors**
- **Proposed Guidance: Sum of fractions should be less than 1 minus its standard error**



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Revised and clarified technical bases in Appendix	Has technical basis for sealed source scenarios, but difficult to understand	Greater transparency, more realistic scenarios

# **Technical Basis for Alternative Approaches, Encapsulation and Classifying Mixture of Individual Items in the Branch Technical Position on Concentration Averaging and Encapsulation**

**John R. Cochran  
Sandia National Laboratories  
October 4, 2011**



# Topics Addressed

1. **Demonstrating homogeneity and classifying homogeneous waste**
- ➔ 2. **Classifying mixture of individual items:**
  - a. **activated metals, or**
  - b. **contaminated materials, or**
  - c. **cartridge filters**
- ➔ 3. **Encapsulation of sealed sources & other LLRW**
- ➔ 4. **Alternative Approaches**



# Roadmap

1. **Demonstrating homogeneity and classifying homogeneous waste**
2. **Classifying mixture of individual items:**
  - a. **activated metals, or**
  - b. **contaminated materials, or**
  - c. **cartridge filters**
3. **Encapsulation of sealed sources & other LLRW**
-  4. **Alternative Approaches**



# Alternative Approaches and Alternative Provisions

## ➤ Alternative Provisions

- 1995 BTP - deviation from BTP guidance via deviation from Part 61 regulation (61.58), high bar for deviating from guidance
- Revised draft BTP – Alternative Provisions restricted to deviations from Part 61 regulation

## ➤ Alternative Approaches

- new section in BTP
- deviations from BTP



# Alternative Approaches

- **New philosophy:**
  - **BTP provides broadly applicable “look up” guidance & sets uniform level safety for implementing Agreement States**
  - **Alternative Approaches provides Licensees / Agreement States with *specific NRC guidance* on factors to consider in submitting / approving alternative guidance**
- **Example Alternative Approaches – BTP sets maximum curie limits gamma-emitters that can be encapsulated, and AA states that larger curie sources might be safe, if buried > 10 m deep in long-lived source device**
- **Provides intruder protection, with flexibility**



# Roadmap

1. **Demonstrating homogeneity and classifying homogeneous waste**
2. **Classifying mixture individual items:**
  - a. **activated metals, or**
  - b. **contaminated materials, or**
  - c. **cartridge filters**
-  3. **Encapsulation of sealed sources & other LLRW**
4. **Alternative Approaches**



# Encapsulation of Sealed Sources and Other LLRW

- **What is encapsulation:** Surround radioactive item (sealed source) in a binding matrix, in a container, where radioactivity remains in original dimensions
- **Why it is good:** waste form stability, worker protection, for classification average curies over entire volume or mass
- **BTP sets limits on encapsulation to prevent use of extreme measures**



# 1995 Guidance: Encapsulation of Sealed Sources and Other LLRW

- **Max. encapsulating volume or mass 0.2 m<sup>3</sup> or 500 kg**
- **Max. curie non-gammas: Class C limit when averaged across encapsulating media**
- **Max. curie gamma-emitters: based on exposure scenario in BTP**



# 1995 Gamma Curie Limits for Encapsulated Items

- 1995 curie limits for gamma emitters based on intruder exposure scenario in 1995 BTP
- Limits based on scenario where intruder is exposed for 2,360 hours to encapsulated source 1 m from intruder

Nuclide	For Waste Classified as Class A or B	For Waste Classified as Class C
Co-60	700 Ci	no limit
Nb-94	1 mCi	1 mCi
Cs-137/Ba-137m	3 mCi	30 Ci



# Revised Draft Guidance: Encapsulation of Sealed Sources and Other LLRW

- **Maximum encapsulating volume or mass 0.2 m<sup>3</sup> or 500 kg - No Change**
- **Maximum non-gammas: Class C limit when averaged across of 0.2 m<sup>3</sup> encapsulating package - No Change**
- **Maximum gamma-emitter curie limits: new exposure scenario, with higher curie limits**
- **Alternative Approaches also available**

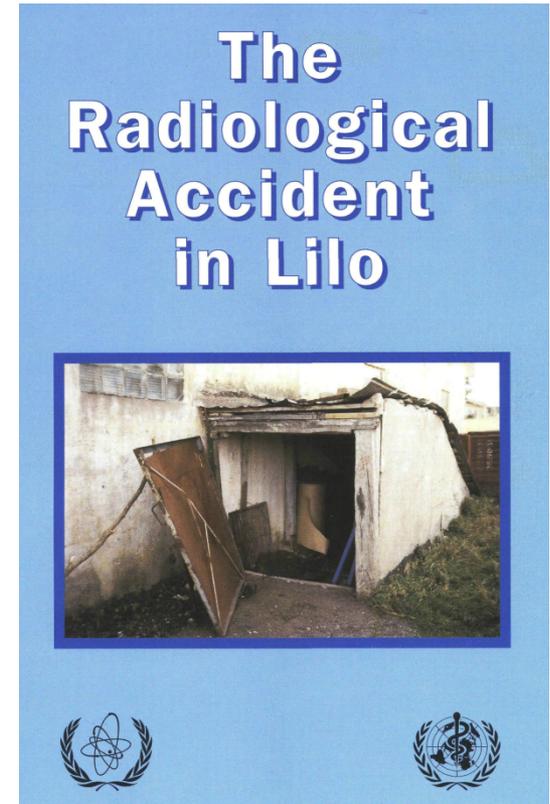
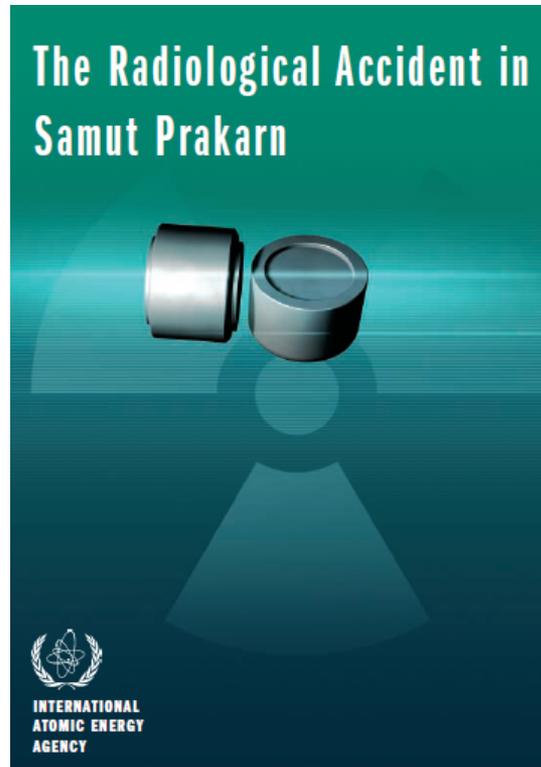
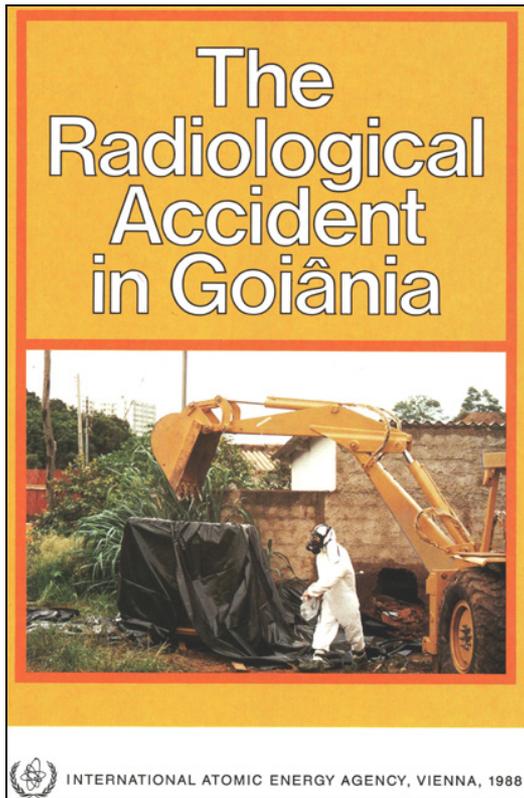


# Development of Gamma-Emitting Sealed Source Carry-Away Scenario

- **Accidents were a factor in developing new intruder sealed source scenario**
- **Considered sealed radioactive source accidents for inadvertent intruder discover of sealed radioactive source**
- **Developed “reasonably foreseeable, yet conservative” scenario**



# Reviewed Sealed Source Accidents



# Reviewed Sealed Source Accidents

- **Common elements**
  - **Loss of regulatory control**
  - **Victims engaged in normal activities**
  - **Radiological hazard not recognizable**
  - **Many accidents resulted in fatalities (adults and children)**
  - **Unlikely, but severe consequences**
  
- **Many factors were considered in developing sealed source exposure scenario**



# **Gamma-Emitting Sealed Source Carry-Away Scenario**

- **Not real, but stylized scenario used to ensure the intruder does not receive an inordinately high dose, should intrusion occur**
- **Scenario basics:**
  - **500 years after LLRW landfill closure, loss of control, recognition, knowledge**
  - **Containers / wastes / encapsulating media decayed**
  - **Stainless steel Cs-137 sealed radioactive source survived**





- **Public works project, regional pipeline, trench through landfill**
- **Crew notices soil different, foreman urges crew keep working**
- **Individual finds sealed source: small, old, interesting**
- **No indication of a hazard**





- Individual takes home, 4 hours in coat pocket
- Curios shelf, 2 meters couch, 5 hours per week



# Results of Gamma-Emitting Sealed Source Carry-Away Scenario

- Analysis demonstrates need to protect intruder from small, highly-radioactive items
- Cs-137 sealed source  $\leq 130$  Ci at disposal, dose intruder  $\leq 500$  mrem at 500 years

Nuclide	Waste Classified as Class A	Waste Classified as Class B	Waste Classified as Class C
Co-60	140 Ci	No Limit.	No limit.
Nb-94	1 mCi	1 mCi	1 mCi
Cs-137/Ba- 137m	7.2 mCi	0.72 Ci	<b>130 Ci</b>



# Summary: Revised Draft Encapsulation Guidance

- **New scenario basis**
- **Reasonably foreseeable, yet conservative**
- **Higher curie limits – more stranded sources can be disposed**
- **Transparent basis for using Alternative Approaches**



# Roadmap

1. **Demonstrating homogeneity and classifying homogeneous waste**
-  2. **Classifying mixture of individual items:**
  - a. **activated metals, or**
  - b. **contaminated materials, or**
  - c. **cartridge filters**
3. **Encapsulation of sealed sources & other LLRW**
4. **Alternative Approaches**



# 1995 Guidance: Classifying Mixture Items

- **Mixture items: activated metals, or contaminated materials or cartridge filters *in single container***
- **Separate, but very similar guidance, for each waste type**
- **BTP defines “primary gamma emitters:” Co-60, Nb-94, and Cs-137/Ba-137m**
- **BTP also defines non-gammas emitters: H-3, C-14, Ni-59, Ni-63, and alpha-emitting TRU half-life > 5 years (except Pu-241 and Cm-242)**



# 1995 Guidance: Classifying Mixture Items

- A. Classify mixture using class. piece w/ highest class,  
or**
- B. Classify based on average of mixture, if hot spots are removed:**

**Gamma hot spots:**

- 1. Pieces  $< 0.01 \text{ ft}^3$  and  $>$  Table A gamma emitters**
- 2. Factor 1.5 rule for pieces gamma emitters**

**Non-gamma hot spots:**

- 1. Pieces  $>$  Table B for non-gamma pieces, any size**
- 2. Factor 10 rule for non-gamma pieces**



# Revised Draft Guidance: Classifying Mixture Items

- A. No change - Classify mixture using class. piece w/ highest class, **or**
- B. No change - Classify based on average of mixture, if:
1. Change - Pieces  $< 0.01 \text{ ft}^3$  and  $> \textit{Table A gamma emitters}$
  2. Change - Factor 2 rule for pieces gamma emitters
  3. Pieces  $> \textit{Table B}$  for non-gamma pieces, any size
  4. Change - Factor 10 rule for non-gamma pieces



# Revised Draft Guidance: Table A Updated

1. Pieces  $< 0.01 \text{ ft}^3$  and  $>$  Table A gamma emitters
  - Updated Table A, which matches encapsulation values

Nuclide	Waste Classified as Class A	Waste Classified as Class B	Waste Classified as Class C
Co-60	140 Ci	No Limit.	No limit.
Nb-94	1 mCi	1 mCi	1 mCi
Cs-137/Ba- 137m	7.2 mCi	0.72 Ci	130 Ci



# Revised Draft Guidance: Factor 2 Rule

## 2. Factor 2 Rule for pieces gamma emitters

- **New Rule is based on new exposure scenario, that is similar to Gamma-Emitting Sealed Source Carry-Away Scenario used to set the encapsulation limits for gamma emitters and the Table A limits**



# Results of Gamma-Emitting Larger Items Carry-Away Scenario

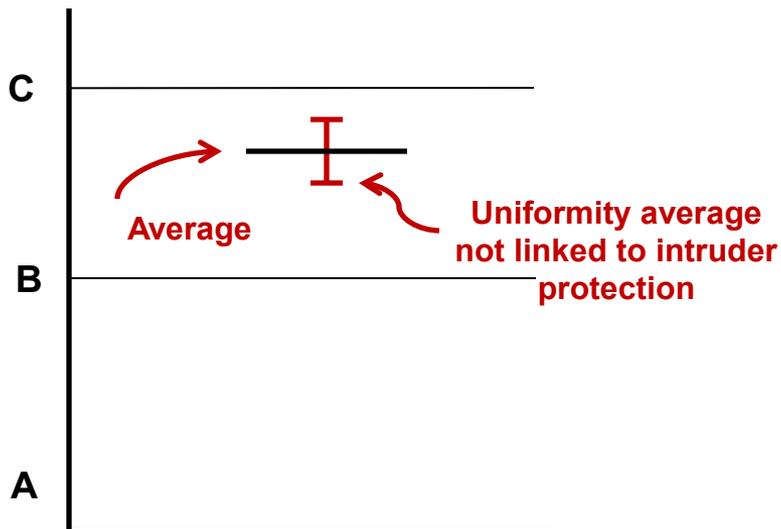
- Analysis demonstrates need to protect intruder from larger pieces of activated metal
- Nb-94 (Co-60 & Cs-137) activity  $\leq 2 \times$  Class limit, dose intruder  $\leq 500$  mrem at 500 years (Factor 2 Rule)



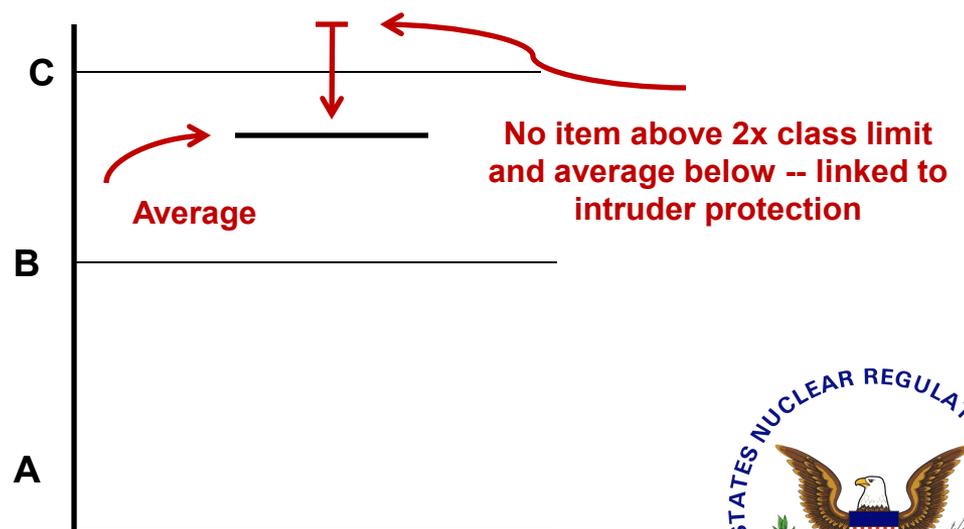
# Revised Draft Guidance: Factor of 2 vs Factor of 1.5

- Current, concentrations of individual nuclides, in individual items  $< 1.5 \times$  of respective average of each nuclide in mixture
- Proposed, concentration in individual items  $< 2 \times$  of the class limit for that nuclide

Factor of 1.5



Factor of 2



# Revised Draft Guidance: Factor 10 Rule

## 4. Factor 10 rule for non-gamma pieces

- Proposed Factor 10 Rule similar to proposed Factor 2
- Current Factor 10 relative to *average of each non-gamma nuclide in mixture*
- Proposed, Factor 10 Rule relative to *class limit for that nuclide*



# Summary: Revised Draft Guidance Classifying Mixture Items

- **New Table A – higher limits gamma**
- **Factor 2 Rule gammas**
  - **New intruder scenario**
  - **No lower limit**
  - **Linked to class limit, not average of mixture**
- **Factor 10 Rule non-gammas**
  - **No lower limit**
  - **Linked to class limit, not average of mixture**



# Summary: Alternative Approaches and Encapsulation

## ➤ Alternative Approaches

- New philosophy
- BTP provides “look up” guidance, uniform level safety
- AA provides specific guidance for deviations

## ➤ Encapsulation:

- New scenario basis for gamma-emitter curie limits
- Higher curie limits – more stranded sources disposed
- Transparent basis for using Alternative Approaches



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Thank You

