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UNITED STATES NUCLEAR REGULATORY COMMISSION'S  
ADVISORY COMMITTEE ON NUCLEAR WASTE

April 18, 2006

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This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

169th MEETING

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TUESDAY,

APRIL 18, 2006

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The Advisory Committee met at 10:00 a.m.  
at Nuclear Regulatory Commission Headquarters, in room  
T2B1 of Two White Flint North, Rockville, Maryland,  
DR. MICHAEL T. RYAN, Chairman, presiding.

MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman  
ALLEN G. CROFF, Vice Chairman  
JAMES H. CLARKE, Member  
WILLIAM J. HINZE, Member  
RUTH F. WEINER, Member

ACNW STAFF PRESENT:

JOHN T. LARKINS, Executive Director, ACNW/ACRS Staff  
NEIL M. COLEMAN, Designated Federal Official  
LATIF HAMDAN, ACNW Staff

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

(10:03 a.m.)

CHAIRMAN RYAN: Good morning. If I could ask the meeting to come to order, please?

As you can see, we are not in our usual accommodations. We are happy to report the upgrade is proceeding well. And if all goes well, we'll be ready for our meeting next month in the revised room.

We've got new audiovisual equipment and other features that will make presentations even more fabulous than they have been, much thanks to Theron and his team for getting us down the road and making all of these intermediate accommodations the last couple of months. Without Theron's able help, we would be talking to each other without being on the record. And we would have a real mess.

So thank you, Theron. We appreciate your help.

MR. BROWN: Thank you.

CHAIRMAN RYAN: Let me read the opening statement. The meeting will come to order. This is the first day of the 169th meeting of the Advisory Committee on Nuclear Waste. My name is Michael Ryan, Chairman of the ACNW. The other members of the Committee present are Vice Chair Allen Croff, Ruth

1 Weiner, James Clarke, and William Hinze.

2 During today's meeting, the Committee will  
3 be briefed by a Purdue faculty member on the  
4 methodology of accelerated mass spectrometry, will be  
5 updated by representatives from the Department of  
6 Energy on the status of chlorine-36 validation studies  
7 at Yucca Mountain, and be briefed by the  
8 representatives of the National Academy of Sciences in  
9 their recent report titled "Going the Distance to Safe  
10 Transport of Spent Nuclear Fuel and High-Level Waste  
11 in the United States."

12 We will also be briefed by representatives  
13 from the Office of Nuclear Material Safety and  
14 Safeguards on the staff proposed rulemaking to  
15 implement section 651 of the Energy Policy Act of  
16 2005, to include certain naturally occurring or  
17 accelerator-produced radioactive materials in NRC's  
18 regulations for byproduct material.

19 Finally, we will discuss proposed letters  
20 and reports the Committee has prepared from earlier  
21 meetings.

22 Neil Coleman is the designated federal  
23 official for today's session. This meeting is being  
24 conducted in accordance with the provisions of the  
25 Federal Advisory Committee Act. We have received no

1 written comments or requests for time to make oral  
2 statements from members of the public regarding  
3 today's sessions. Should anyone wish to address the  
4 Committee, please make your wishes known to one of the  
5 Committee staff.

6 It is requested that the speakers use the  
7 only microphone for this session, which will be in one  
8 of the two seats at the end of the table, a bit  
9 inconvenient perhaps but that way we'll have you on  
10 the record.

11 So if you want to ask a question, please  
12 come up, use one of the chairs, and we'll be able to  
13 hear you. And you can identify yourself and hopefully  
14 have you speak with sufficient clarity and volume so  
15 you can be readily heard. It is also requested if you  
16 have cell phones or pagers, you kindly turn them off.

17 With that introduction, I think we're okay  
18 on the record. Okay. Everything is working fine.  
19 I've given the recorder a map of who we are. So we  
20 don't need to identify ourselves because we don't have  
21 our name tags and all of that stuff, as we would in  
22 the normal room, but he has the road map. So he knows  
23 who we are. And we will go from there.

24 So without further ado, today's agenda is  
25 being led by Professor Hinze. So without further ado,

1 I will turn it over to Professor Hinze. Thank you.

2 MEMBER HINZE: Thank you, Chairman Ryan.

3 As you have stated, we have two briefings  
4 this morning on the AMS spectrometry studies of  
5 chlorine-36, which have played such an important role  
6 in understanding the temporal processes at Yucca  
7 Mountain.

8 Our first presenter -- and I would ask  
9 David to come up and sit at the table here -- is  
10 Professor David Elmore, professor of physics at Purdue  
11 University.

12 David is appropriately the godfather of,  
13 at least the father of, AMS and chlorine-36. He was  
14 the senior author of the *Nature* paper back in the '70s  
15 which kicked this whole type of study off and has  
16 continued in those studies since that time.

17 He came to Purdue in the early '90s to  
18 organize and direct the PRIME lab, which hands the  
19 cosmogenic isotope measurements for Purdue University  
20 as well as external sources, including those from  
21 Yucca Mountain to the Department of Energy.

22 Dr. Elmore will be, as Chairman Ryan has  
23 pointed out, David Elmore will be, discussing with us  
24 the measurement of chlorine-36 with the AMS technique  
25 and be discussing the uncertainties that are involved

1 with those measurements and the many advances that the  
2 PRIME lab has underway to improve the measurement of  
3 chlorine-36 by AMS.

4 With that, I will turn it over to you,  
5 David. We welcome you here, and we look forward to  
6 this. It's been a topic of a lot of ad hoc discussion  
7 among the Committee. So we'll be interested to hear  
8 what you have to say.

9 DR. ELMORE: Thank you, Bill.

10 Let me start by saying that we developed  
11 accelerator mass spectrometry, chlorine-36, back in  
12 the late '70s. And the technique really hasn't  
13 changed very much.

14 We have been measuring samples. I  
15 measured June Fabryka-Martin's Master's thesis and  
16 thesis samples back in the early '80s. And what I am  
17 going to describe today is really pretty much the same  
18 thing. We have improved on some of the things, like  
19 the amount of beam we get out of the samples, but  
20 otherwise what we are doing is what you are going to  
21 hear about today.

22 Another thing I should mention, Mark  
23 Caffee, who measured some of these samples at  
24 Livermore, is now the director of our lab. So I work  
25 together with Mark.

1           Okay. So I am going to describe AMS, talk  
2 about the problems and challenges, the data analysis  
3 that we use for the samples, checks and balances.

4           Okay. Next. All right. The way  
5 accelerator mass spectrometry works, we form a  
6 negative ion in the ion source from a small sample,  
7 about pinhead size amount, of silver chloride. And so  
8 there is, of course, a lot of chemistry that comes  
9 before the AMS measurement. I'm not going to say too  
10 much about that.

11           So the negative ion comes out of the ion  
12 source. It's bent by a 90-degree injector magnet,  
13 which sorts to the mass. The different masses bend  
14 different amounts. We're selecting mass 36.

15           The negative ion is accelerated to the  
16 positive terminal, the tandem, which can run up to  
17 eight million volts. And then there is a stripper in  
18 the middle that removes electrons. So now we have a  
19 positive ion, accelerates again to ground, the other  
20 end. So we call it a tandem accelerator.

21           Then following that, there are two more  
22 large magnets, a velocity selector, an electrostatic  
23 analyzer. And these all, again, select the mass. And  
24 our limit of detection is one part in  $10^{15}$ . Okay? I  
25 tell our eighth grade tours that if we fill up our

1 football stadium at Purdue with sand all the way up to  
2 the top, it will hold about  $10^{15}$  grains of sand.

3 So we're counting these chlorine-36 atoms,  
4 which has nothing to do with the fact that they are  
5 radioactive. Okay? We're counting them directly and  
6 one at a time in this detector at the end of the beam  
7 line. And so all of these magnets get rid of the  
8 interferences; in particular, the stable chlorine  
9 isotopes.

10 So what we measure is an isotope ratio.  
11 And so we inject both the stable in the radioactive  
12 isotopes by changing this magnet here to select the  
13 three isotopes. The stable chlorine-35 and 37 are  
14 measured right after this magnet here. So we go back  
15 and forth. We spend about a minute counting the atoms  
16 of the chlorine-36, and then we measure the beam  
17 current of the chlorine-35 and 37.

18 Okay. Next, please. Here is inside the  
19 accelerator. It is a 40-foot-long accelerator. The  
20 whole beam line is about 200 feet long. And this  
21 shows we're in there doing maintenance.

22 Okay. Next. All right. There are two  
23 things I want to convey here. One is the basic  
24 technique is really pretty simple. We're counting  
25 atoms. We're using magnets to get rid of things, but

1 the apparatus itself is very complex.

2 This is the ion source. We developed this  
3 at Purdue, lots of vacuum pumps and power supplies and  
4 racks and beam line components, lenses, and beam  
5 profile monitors and the ion sources here. The sample  
6 changer moves the sample up through a tube here into  
7 a rod and goes down into the vacuum. Each sample goes  
8 into the vacuum one at a time.

9 We built this ion source at Purdue. It's  
10 one of the best in the world at doing this. There are  
11 only maybe six or eight places in the world that can  
12 measure chlorine-36, two in the United States: one at  
13 Purdue and one at Lawrence Livermore National Lab.

14 Okay. Next. This is another part inside  
15 the ion source. The primary cesium beam is ionized on  
16 a very hot ionizer here. The negative ions then go  
17 through the hole into the accelerator.

18 Okay. Next. All right. So I wanted to  
19 say just a few things about sampling. I am a  
20 physicist. I do the AMS. I don't do too much of the  
21 chemistry and very little collecting of samples.

22 Some of the problems and challenges.  
23 Well, there are many sources of chlorine-36. We have  
24 the meteoric produced from spallation of argon in the  
25 atmosphere. We have spallation of potassium and

1 calcium on the surface of the Earth. And then we have  
2 activation of chlorine-35 subsurface. And then on top  
3 of all of that, we have the bomb-produced chlorine-36.

4 So there are lots of different sources.  
5 And when you measure chlorine-36, each atom, of  
6 course, you don't know where it came from. Possible  
7 problems in collecting samples, you know, one little  
8 bead of sweat from your forehead would swamp the  
9 chlorine in the rock. So, of course, you have to be  
10 very careful with chlorine. You know, if you live  
11 along a seacoast, just the chlorine in the air can be  
12 a problem.

13 Okay. If you're looking for one of the  
14 lower-level chlorine-36 sources, then you have a  
15 problem with contamination from the bomb pulse, which  
16 is orders of magnitude higher from the 1950s  
17 above-ground tests.

18 The *in situ* produced chlorine-36, that's  
19 produced in the rocks on the surface. And then the  
20 weathering of the rocks, that can get in the  
21 groundwater. That may be somewhat higher than the  
22 meteoric chlorine-36. And, of course, reactor  
23 material, since chlorine is a common contaminant in  
24 reactors, the chlorine-36 cross-section to make  
25 chlorine-36 from neutrons is so high that there is

1 going to be chlorine-36 in any reactor materials and  
2 in, for example, groundwater around nuclear  
3 facilities.

4 If the sample is really small, I don't  
5 know if this is being done with samples from Yucca  
6 Mountain, but we would add carrier, which would mean  
7 we would add just the stable chlorine isotopes to give  
8 us more sample. And when you do that, you have to be  
9 careful about equilibration of that carrier with the  
10 natural chloride.

11 With chlorine, that is not really a  
12 problem, though. And something we do is add separated  
13 isotope chlorine-35, one of the two stable isotopes.  
14 And that tells us the amount of natural chloride that  
15 was in the sample when we add the carrier. And that  
16 is kind of a trick we use that is working very well.

17 Okay. Next, please. All right. As far  
18 as the measurement goes, I haven't measured. Our  
19 biggest interference problem with chlorine-36 is  
20 sulfur-36. This is an isobar. It's a rare sulfur  
21 isotope. And if the chemistry is good, we can reduce  
22 it enough in the sample so we can then distinguish it  
23 in our detector at the end of the beam line since as  
24 the same mass, it gets around all of those magnets.

25 And so this is an interference. The

1 sample preparation is really the key in removing the  
2 sulfur. And it has to be done right. Sample loading,  
3 which we do at Purdue, we have to be careful we don't  
4 introduce dust and things that would have sulfur in  
5 them.

6 And then, finally, once we sputter through  
7 a small sample, our cathode, which is our sample  
8 holder, will have sulfur in it. And so a small  
9 sample, often we have sulfur problems just because we  
10 consume the sample quickly and we get all of this  
11 sulfur from the holder.

12 Okay. So that is a challenge to separate  
13 the chlorine-36 from the sulfur-36. Another challenge  
14 is keeping 30 power supplies to determine the beam  
15 going through this complex accelerator.

16 If any one of those shifts a little bit,  
17 then it's going to change the result and we're going  
18 to get the wrong number. Okay? But, in particular,  
19 the terminal of the accelerator, we need to hold that  
20 constant to a part in 1,000. And if it drifts a  
21 little bit, again, we get the wrong result.

22 In order to account for these kinds of  
23 problems, we measure standards pretty often. These  
24 are samples with a known amount of chlorine-36 in  
25 them. And so we can correct for loss in the beam

1 line.

2 There always will be some chlorine-36  
3 loss. So we need that standard in order to normalize.

4 MEMBER HINZE: Where do you get the  
5 standards? And how are they set up?

6 DR. ELMORE: The standards come from NIST  
7 originally, but they have to be diluted down. And  
8 each lab does that independently, but we share  
9 standards with each other. So we make sure our  
10 standards agree with others. And so that hasn't been  
11 a problem with chlorine. And so --

12 MEMBER CLARKE: If I can follow up on  
13 that? The lowest point on the calibration curve is  
14 supposed to be close to the protection, whenever  
15 possible. That's an awfully low concentration you're  
16 detecting.

17 DR. ELMORE: Yes. And I skipped over the  
18 blanks here. Okay. So we also measure samples with  
19 no chlorine-36 in them. And then that tells us what  
20 our background level is. And that's right. A lot of  
21 our samples are down near the background.

22 So the blank correction becomes more  
23 important than the standard correction. And the  
24 standard correction is more important to get high  
25 precision on the higher-level ones. And so we're

1 doing both of those.

2 CHAIRMAN RYAN: At this point, you are  
3 talking about kind of inside the laboratory divisions?

4 DR. ELMORE: Right.

5 CHAIRMAN RYAN: You're not talking about  
6 things like field blanks and other kinds of  
7 variability that creep in from the taking it out and  
8 --

9 DR. ELMORE: That's right. And I --

10 CHAIRMAN RYAN: -- all the way up through?

11 DR. ELMORE: Yes. I have another slide --

12 CHAIRMAN RYAN: Okay.

13 DR. ELMORE: -- that is going to address  
14 that a little bit. In terms of our beam lines, we  
15 know we're losing some chlorine-36. So the standard,  
16 we do a correction for that routinely.

17 Okay. Next. Okay. This is kind of our  
18 normal procedure for measuring samples. We measure  
19 the iso ratio of chlorine-36 to the stabilized  
20 isotopes three or four times. So we're going back and  
21 forth between the isotopes. So we're essentially  
22 measuring that ratio three or four times.

23 We measure, as I said earlier, both the  
24 chlorine-35 and 37 after the accelerator and make sure  
25 that we're getting the natural value for that.

1           And this is really something that helps a  
2           lot for chlorine-36.    The radioisotope is midway  
3           between the two stable isotopes.   So if there are any  
4           mass-dependent problems in the accelerator, we see  
5           that right away in a change in stable isotope ratio.

6           Then we put each sample into the ion  
7           source two to five times.   So we're measuring the  
8           sample 20 times total.   Okay.   So we identify random  
9           sources of errors when we do this.

10          Okay.   We measure the standard pretty  
11          often, every three to five unknown samples.   And we  
12          measure the blank every 10 to 20 samples.   So we're  
13          keeping good watch on all of this.

14          Now, the blank here again is the  
15          laboratory blank.   A chemistry blank, which I'm yet to  
16          have another slide on, is submitted by the submitter.  
17          And that tells us what chlorine-36 contamination we  
18          might have in the chemical preparation.

19          So when I say we measured two to five  
20          times, as soon as we get better than about five  
21          percent precision, we stop.   So we don't measure them  
22          all five times.   In fact, we might get a three percent  
23          measurement after two times.

24          So uncertainties generally range three to  
25          five percent on samples that don't have any problems.

1 And I'll later show some examples of samples that did  
2 have problems.

3 Okay. Next, please. Okay. Here is the  
4 statistical data analysis. And this we do as we  
5 collect the data. We're continually updating the  
6 statistics. So when we're finished measuring a  
7 sample, we really know what the uncertainty is.

8 Okay. We have internal errors and  
9 external errors. The internal errors come from the  
10 actual measurement directly. And the main one, the  
11 counting statistics, we need 400 counts to get the  
12 square root of 400. Twenty is five percent. So to  
13 get five percent precision, we need to count 400  
14 atoms. Generally we're counting a lot more than that.

15 And then if the beam current changes with  
16 time, we can put in an internal error for that. And  
17 then we combine using standard statistical techniques  
18 the errors to get an overall internal error.

19 Now, the external error comes from  
20 measuring the sample many times. And this is computed  
21 from the standard deviation. And also we measure the  
22 standards in blanks. And we fold in errors from  
23 those.

24 And so at each step in the process, we  
25 compute a weighted average of all of the measurements.

1 And we take the larger of these internal and external  
2 errors. That's a conservative approach and actually  
3 overestimates the uncertainties.

4 So after the first few cycles, the three  
5 or four cycles, we get the error from the standard  
6 deviation. And that then goes in as an internal error  
7 at the next level.

8 So when we measure the sample two to five  
9 times, that error is used up here. And again we take  
10 the larger of the internal and external error. So  
11 this is happening many times and very well accounts  
12 for any random errors.

13 Say one of those power supplies or the  
14 terminals drifted during a measurement. Then that  
15 measurement would be different from all of the others.  
16 Okay? And that would make the standard deviation  
17 higher. And then the final result would have a larger  
18 error.

19 And by measuring the standards from the  
20 blanks, those correct for any systematic errors there  
21 might be.

22 CHAIRMAN RYAN: Could you give us rough  
23 numbers on what those three look like? I mean, is the  
24 blank error typically two percent, ten percent? You  
25 know, the standard --

1 DR. ELMORE: Well, it depends. A sample  
2 that is a low-level sample, say, 10 times  $10^{-15}$ , --

3 CHAIRMAN RYAN: Yes.

4 DR. ELMORE: -- if our blank is running 2  
5 times  $10^{-15}$ , we will subtract the blank. And that will  
6 give us 8 times  $10^{-15}$ , but we put a plus or minus 100  
7 percent on the blank. So we'll subtract two plus or  
8 minus two. Okay? And so that will put a 20 percent  
9 error on our number.

10 CHAIRMAN RYAN: Where's that?

11 DR. ELMORE: Right there. And so --

12 CHAIRMAN RYAN: That doesn't include the  
13 others.

14 DR. ELMORE: Right. And then all of the  
15 others will get combined and larger. So the large  
16 submitter always dominates from that equation.

17 CHAIRMAN RYAN: Right.

18 DR. ELMORE: I know I have gone through  
19 this quickly, and it's hard to see what is happening,  
20 but I do have some data, which I am going to show you  
21 in a minute, that includes some of all of these  
22 effects, like the problems with low samples where  
23 there is a blank problem with samples that have high  
24 sulfur and that kind of thing. We will see some  
25 actual data in a minute here.

1           Okay. Next. All right. Now, these, the  
2 checks and balances, are the responsibility of the  
3 person submitting samples to us. And in this case,  
4 the Yucca Mountain samples are all of the chemistries  
5 performed outside of our lab. If we were doing them  
6 in our lab, which is a possibility, we're doing the  
7 chemistry, we would certainly do all of these things.

8           Okay. First of all, the chemistry needs  
9 to be done well so the sulfur content is low because  
10 that is our main interference problem. And we need to  
11 have sufficient samples. If samples are much smaller  
12 than a milligram, it's best to add carrier to them to  
13 bring them up to a milligram because we're not going  
14 to get a good measurement for a sample that is much  
15 less than a milligram of chloride.

16           The submitter needs to check his reagents  
17 because there might be chlorine-36 in any of the  
18 reagents used in the chemistry. And so the user needs  
19 to take some dead chloride, which, you know, usually  
20 reagent chloride is good enough, and run it through  
21 the same chemistry. And that will tell us if there is  
22 any contamination in the chemistry.

23           We need to see multiple samples from each  
24 location. Okay? Then if that bead of sweat happens  
25 to get in one of them, it probably isn't going to get

1 in all of them. And, of course, there can be sampling  
2 problems, I mean, variations in the rock, for example,  
3 that might cause trouble when you're leaching out the  
4 chlorine.

5 Multiple collection dates is a good idea.  
6 Just things change with time. Possible contamination  
7 can change with time. Okay. Then we invite blind  
8 repeat splits of the sample.

9 Two samples, we don't know this, but they  
10 are supposed to be the same. They are submitted to  
11 us. We would run them both as independently, as  
12 unknowns. And we like to see samples submitted in  
13 different runs. We run chlorine-36 every 2 months or  
14 so. And we can measure the same sample the next time.  
15 And it's a good idea to different to different AMS  
16 labs as well.

17 What I was going to say is some of our  
18 users have a big rock or, in particular, I am thinking  
19 of a guy that sends us meteorite, samples from  
20 meteorites. He has one meteorite. Every run he takes  
21 a little sample from that same meteorite and reruns it  
22 every time. And he knows before we do if there are  
23 any problems. He says, "Hey, my meteorite didn't come  
24 out right that run." Of course, that doesn't happen  
25 much, but it can happen.

1 MEMBER CLARKE: Within that group of  
2 threes, the variation between the different labs, the  
3 highest?

4 DR. ELMORE: Well, unfortunately, it's the  
5 one we do least. And we don't actively send splits to  
6 other labs. We occasionally do but certainly not  
7 every run. Unfortunately, I'm not sure it's done  
8 enough, but I don't see the data. You know, I don't  
9 really know how much they're doing this. I am not  
10 supposed to know.

11 But the few times that I know about that  
12 we participated in group measurements and several  
13 other labs do the same set of samples, things have  
14 come out pretty well.

15 MEMBER CLARKE: I guess what I was getting  
16 at, is there a laboratory variation so that if you  
17 have different rooms in the same lab versus different  
18 labs?

19 DR. ELMORE: Yes. This is a very complex  
20 measurement. And there certainly can be problems.  
21 For iodine-129, which is a fair bit more complicated  
22 isotope to measure, more difficult isotope to measure,  
23 than chlorine-36, we had a problem with our standards.  
24 And we didn't realize it until we compared  
25 measurements with another lab. When the standard was

1 made, the iodine-129 was not in the equilibrium  
2 chemically with iodine. It was used for dilution.  
3 And light decomposed it.

4 So our standard was changing with time.  
5 And that really stumped us for a while.

6 CHAIRMAN RYAN: It's a bad thing.

7 DR. ELMORE: So things like that can  
8 happen. With chlorine, the chemistry is much simpler  
9 for chlorine-36. And I don't see that happening. But  
10 that is one reason we do measure samples.

11 Now, what we actively do is compare  
12 standards with other labs. They measure our standard.  
13 We measure theirs. We do that every couple of years  
14 or so. For chlorine, this hasn't turned up any  
15 problems at all. And so I think we're in good shape,  
16 Livermore being the only other lab in the United  
17 States that measures chlorine-36.

18 CHAIRMAN RYAN: Is that on a national  
19 capacity or is it just for Livermore?

20 DR. ELMORE: Yes. And there is a  
21 laboratory in Australia that we have exchanged samples  
22 with. And so yes. Now, what I'm referring to is the  
23 standards. We measure each other's standards. I  
24 don't know of people sending splits to Australia.

25 CHAIRMAN RYAN: I understand.

1 DR. ELMORE: They should be. They should  
2 be.

3 Okay. Next, please. Okay. Now I'm  
4 showing some data. This is from Jim Cizdziel. I'm  
5 not sure how to pronounce that name -- at UNLV. These  
6 are Yucca Mountain samples. And we just measured them  
7 in the last month. Okay? And it's three slides  
8 showing the data.

9 I don't know. I'm showing you this not  
10 knowing, really, anything about the sampling. Okay.  
11 So here we're finding the percent uncertainty versus  
12 the amount of chlorine-36. This is what we are  
13 measuring, the chlorine-36 to chloride ratio,  $10^{-15}$ ,  
14 where our blank is running around 1 times  $10^{-15}$ .

15 Okay. So you see most of the samples are  
16 down below about five percent precision. This is our  
17 goal. Okay. And some of these, we are going to see  
18 why they are higher on the next two slides. Some of  
19 these have poorer precision. Okay?

20 But really what I want to show on this  
21 slide is when we get down to below 100 times  $10^{-15}$ ,  
22 then our precision just because we're not getting as  
23 many counts, you know, that internal area that came  
24 from the square root of the counts. We're not getting  
25 as many.

1           And so our error creeps up here from about  
2           100 times  $10^{-15}$  down to about 10 times  $10^{-15}$ . Then  
3           below that, our blank starts being an issue. And so  
4           these ones that are right on zero, some of those,  
5           maybe most of those, are chemistry blanks. All right?  
6           I don't necessarily know --

7           CHAIRMAN RYAN: Is that why you have to  
8           have a red line that says, "Below detection"?

9           DR. ELMORE: Yes. Well, but, you see,  
10          this comes out automatically from the analysis. So  
11          the lowest ones have 100 percent uncertainty. Okay?  
12          And you're right --

13          CHAIRMAN RYAN: No. I mean, there's got  
14          to be a line on that graph that says, "Below this, we  
15          have no confidence we are reporting real numbers."

16          DR. ELMORE: Exactly. And what we do --

17          CHAIRMAN RYAN: And I don't think it's at  
18          zero.

19          DR. ELMORE: You're right. What we do, if  
20          a value of the measurement is less than about two  
21          times the uncertainty, then we say all we can do is  
22          set an upper limit. And that is what we say in our  
23          report. That is right.

24          And that number is around five. It  
25          depends on -- some run their backgrounds a little

1 better than others, but our detection limit is around  
2 3 to 5 times  $10^{-15}$ .

3 CHAIRMAN RYAN: Right.

4 DR. ELMORE: But that's much --

5 CHAIRMAN RYAN: That's the red line after  
6 that --

7 MEMBER CLARKE: There's a quantitation  
8 limit in addition to the detection limit. Usually  
9 it's some multiple of the detection limit, above which  
10 you can assign a number and below which you really do  
11 --

12 DR. ELMORE: Right.

13 MEMBER CLARKE: Do you do it that way? Do  
14 you report it in terms of --

15 DR. ELMORE: Yes. I forget the exact --  
16 I think it's actually three times our uncertainties.  
17 These uncertainties, by the way, if I haven't actually  
18 said it, are one sigma uncertainties. And so if a  
19 number is less than three times three sigma from zero,  
20 then we would consider that just an upper limit.

21 MEMBER CLARKE: Well, that is the  
22 detection limit.

23 DR. ELMORE: That is a detection limit,  
24 right. Above that, we report numbers.

25 MEMBER CLARKE: You report on --

1 DR. ELMORE: The errors --

2 MEMBER CLARKE: -- anything above the  
3 detection limit?

4 DR. ELMORE: Right. But, you know, we are  
5 reporting what the uncertainty is. So the submitter  
6 can take that to mean what they like.

7 CHAIRMAN RYAN: And this is just your  
8 measurement part? This is nothing to do with any  
9 uncertainty superimposed from any errors in the  
10 delivery to your --

11 DR. ELMORE: Exactly.

12 MEMBER HINZE: And it's an internal  
13 mixture.

14 DR. ELMORE: Yes. These are all the  
15 larger of the internal and external errors. We have  
16 not done any correction for a chemistry blank here.  
17 We have done the correction for a laboratory blank.

18 CHAIRMAN RYAN: This is what I would call  
19 the instrument error.

20 DR. ELMORE: Yes, exactly. This is the  
21 instrument error. Now, the submitter needs to submit  
22 a chemistry blank. If their chemistry blank is ten,  
23 then, you know, probably anything less than 20 or 30  
24 should be considered the limit, but that is their  
25 responsibility to set that limit.

1 CHAIRMAN RYAN: That is a really important  
2 bit of information that you're only doing one  
3 instrument part. And any errors that are reported on  
4 your instrument part don't take into account any of  
5 these other errors.

6 DR. ELMORE: That's correct.

7 CHAIRMAN RYAN: Okay. Great.

8 DR. ELMORE: That's correct.

9 CHAIRMAN RYAN: You're going to tell me  
10 why it bounces all over the map?

11 DR. ELMORE: Yes. We'll do that. What I  
12 want to impress on you is you have the instrument  
13 error. We have a good handle on it. And these ones  
14 that have larger errors, we know what the problem is.

15 And we're reporting those larger errors.  
16 But I think most of the samples that are down as five  
17 percent error range, the biggest uncertainty is in the  
18 sampling problem.

19 Well, what is the source of the  
20 chlorine-36 atoms in this rock? You know, is it bomb?  
21 Is it meteoric? And that, of course, the submitter  
22 has to work that out.

23 CHAIRMAN RYAN: Well, it's the bead of  
24 sweat, and it's the --

25 DR. ELMORE: Yes.

1 CHAIRMAN RYAN: -- you know, origin of the  
2 source and all of that, homogeneity, and homogeneity.

3 DR. ELMORE: Yes. This has nothing to do  
4 with it.

5 CHAIRMAN RYAN: I mean, it's six dozen  
6 things. My guess is, as in most instruments, the  
7 instrument is the best thing you have got.

8 DR. ELMORE: Yes.

9 CHAIRMAN RYAN: And the rest of it can be  
10 anywhere from well-controlled to magic.

11 DR. ELMORE: But this is one of the more  
12 complex of the instruments out there.

13 CHAIRMAN RYAN: You bet you.

14 DR. ELMORE: Two hundred foot beam wide  
15 with 30 power supplies. So, therefore, I'm working a  
16 little harder to show you they're doing their job.

17 CHAIRMAN RYAN: Oh, no. That's going very  
18 well, I might add. Thank you.

19 DR. ELMORE: Okay. The next one shows the  
20 uncertainty versus -- the interference rate is the  
21 sulfur-36. And so we can handle quite nicely now  
22 samples with under 10,000 or so interference rate.  
23 And, for sure, these two samples up here have a high  
24 uncertainty because of the high sulfur rate. And so  
25 we didn't do very well on measuring those.

1 CHAIRMAN RYAN: I'm struggling with care  
2 out "quite nicely" because down near the lower  
3 numbers, you have got lots of uncertainties that are  
4 --

5 DR. ELMORE: Okay.

6 CHAIRMAN RYAN: -- north of 40 percent.

7 DR. ELMORE: Right. Now, a lot of these  
8 -- see, I really need a three or four-dimensional plot  
9 here to show you, but most of these samples here, a  
10 lot of these, were the ones that had the lower ratio  
11 from the previous slide. Okay? And --

12 CHAIRMAN RYAN: So you haven't factored  
13 out just the sulfur error?

14 DR. ELMORE: Right, exactly. This is all  
15 the data. My three plots that I've got here show all  
16 of the data. You know, what you can do is you can  
17 look at this one here. It's about 61 percent error.  
18 You can find that point on the other plots if you  
19 want.

20 The point is that most of the samples have  
21 a manageable amount of sulfur. The few that don't end  
22 up with larger errors. We don't have any up here with  
23 30,000 counts per second sulfur that have a 5 percent  
24 error. That's not happening. These get a big  
25 uncertainty because of that. And mostly it's because

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1 there is a contribution towards signal from the  
2 sulfur-36. And that varies with time.

3 CHAIRMAN RYAN: So what's your criteria  
4 for sulfur when you're asking to sample? Below what?

5 DR. ELMORE: Well, it ends up being about  
6 a part per million sulfur is where we have trouble.  
7 See, unfortunately, sulfur-36 is only  $10^{-4}$  abundant.  
8 It's .01 percent of sulfur.

9 CHAIRMAN RYAN: Right.

10 DR. ELMORE: And so the part per million  
11 translates to part in  $10^{10}$  sulfur-36, but that is  
12 still five orders of magnitude above our background.  
13 We can handle that five orders of magnitude. We can  
14 handle our detector because our detector gives a  
15 different signal for sulfur and chlorine. And that  
16 lets us handle pretty well up to about 10,000 a  
17 second.

18 And so we actually subtract a background  
19 that is linear with the sulfur.

20 CHAIRMAN RYAN: Just so I'm clear, David,  
21 I want to understand these. Are there very large  
22 errors that have nothing to do with the sulfur?

23 DR. ELMORE: Yes, yes.

24 CHAIRMAN RYAN: Those two would stay in  
25 the '70s for other reasons?

1 DR. ELMORE: Exactly.

2 MEMBER HINZE: Those would be in this  
3 error rate shown?

4 DR. ELMORE: Yes. And the previous slide  
5 and the next slide show the other reasons we have.  
6 And the previous slide showed a lot of low  
7 chlorine-36. So we didn't very many counts. Those  
8 have large error because of the low amount of  
9 chlorine-36.

10 And the next slide, if we can move to  
11 that, here we now have a problem with low beam  
12 current. Okay? This is essentially the sample size.  
13 If the sample is really small, we're not going to get  
14 much beam out of it. Okay?

15 And this last batch, this is a little  
16 unusual. This last batch, we had a lot of really  
17 small samples. And the beam currents are way low.  
18 And these produced a big error down here.

19 And we can handle them. With pretty low  
20 beam currents, we can handle them. But when they get  
21 right down under 100 or a few hundred nanoamps, then  
22 there is a problem.

23 So these two over here were the high  
24 sulfur and either sulfur or low chlorine-36 content.

25 CHAIRMAN RYAN: See, when I look, I guess

1 I'm trying to find the other points in the previous  
2 graphs. I don't know how to do that. I mean, I'm  
3 looking at those two high points, and where are they  
4 in the other graph. There's nothing in the 95  
5 percent. I guess it is on the chlorine-36 one. Is  
6 that right?

7 DR. ELMORE: Yes. I think one of those  
8 points was actually off scale on one of the other --  
9 the part with the high sulfur, and it didn't show it.

10 CHAIRMAN RYAN: I'm just not tracking  
11 which one. I mean, if I look on the second sulfur, if  
12 you could back up, there's a spot right there under 40  
13 percent on the right side.

14 Is that data point supposed to show up on  
15 another graph somewhere? I don't see it.

16 DR. ELMORE: Yes. There's one point I  
17 know didn't show up on the other graph, and that's  
18 because it was off scale. And I didn't want to adjust  
19 the scale to get them all on there.

20 CHAIRMAN RYAN: It's just real hard to  
21 follow and suggest. I can't follow one or the other.

22 DR. ELMORE: Yes. But I'm not really  
23 intending you to do that.

24 CHAIRMAN RYAN: Okay.

25 DR. ELMORE: I'm just showing that --

1 CHAIRMAN RYAN: Well, you told me I could.

2 DR. ELMORE: Yes. Okay. You're right.

3 But the thing is we have the high sulfur. We have the  
4 low amounts of chlorine-36. And we have the small  
5 sample size. Those are the three things that give us  
6 large uncertainties.

7 CHAIRMAN RYAN: One thing that's not clear  
8 -- and it is I think an important part of uncertainty  
9 analysis. And let's just for the sake of the argument  
10 say that anything below 5,000 is good with regard to  
11 sulfur. Anything below -- pick a number --

12 DR. ELMORE: Okay.

13 CHAIRMAN RYAN: -- with chlorine, the  
14 chlorine ratio is okay.

15 DR. ELMORE: Okay.

16 CHAIRMAN RYAN: And anything below -- I  
17 don't know. Pick a number here, whatever you like.  
18 But what happens at these higher values is things  
19 bounce around a lot. And, you know, you would expect  
20 if you really get better as this analyte increased,  
21 then you would see it smooth out.

22 DR. ELMORE: Well, but the --

23 CHAIRMAN RYAN: Now, I see this range of  
24 high points down here as a detection limit problem.  
25 But what I don't see is that this curve doesn't get

1 smooth. This bounces all over the place from, say,  
2 250 on up to 1,500.

3 DR. ELMORE: Right.

4 CHAIRMAN RYAN: Now, I understand there  
5 are competing issues.

6 DR. ELMORE: Right.

7 CHAIRMAN RYAN: But how do I have  
8 confidence in this when I don't know what is causing  
9 this to bounce around? So, I mean, for example, if I  
10 said, what is the average uncertainty between 500 and  
11 2,000, I would take an average of those numbers.

12 DR. ELMORE: Yes. Well, as I say, I can't  
13 --

14 CHAIRMAN RYAN: That's what I propagate.

15 DR. ELMORE: I can't do a five-dimensional  
16 display on the screen.

17 CHAIRMAN RYAN: Right. Maybe I'm being  
18 unfair for that reason.

19 DR. ELMORE: Right.

20 CHAIRMAN RYAN: I'm just trying to  
21 understand it.

22 DR. ELMORE: Yes. We give the submitter  
23 the spreadsheet that has all the details of these  
24 measurements if they choose to use it. And they can  
25 then see why.

1           Every one of these is high for a reason.  
2           Okay? And looking at the spreadsheet, they can see  
3           whether it's low, chlorine-36 low, or high sulfur-36,  
4           or low beam kerner from a small sample. Those are our  
5           three big problems.

6           CHAIRMAN RYAN: On your end.

7           DR. ELMORE: On our end, right. And so  
8           the submitter can see where the problem was and --

9           CHAIRMAN RYAN: But the real secret is  
10          when they propagate the error, they've got to  
11          propagate it in a way where that error translates to  
12          the answer.

13          DR. ELMORE: Yes. I mean, it's a --

14          CHAIRMAN RYAN: It's a ratio of  
15          chlorine-36 to chlorine stable plus or minus some  
16          percentage --

17          DR. ELMORE: Right.

18          CHAIRMAN RYAN: -- accounting for all of  
19          those things and the wrong sampling error.

20          MEMBER CLARKE: Well, if you had the 20  
21          measurements, basically 20 measurements, you could  
22          come up with the uncertainty on that.

23          DR. ELMORE: Yes, exactly.

24          MEMBER CLARKE: If you come up with an  
25          uncertainty that's greater than a few percent or ten

1 percent, then you don't use those in the analysis. Is  
2 that what you would suggest?

3 DR. ELMORE: Yes. Well, that's right.  
4 And so if the submitter gets back a report that has  
5 uncertainties of 40 percent to 100 percent, those  
6 samples probably they should weed out and because  
7 there were --

8 CHAIRMAN RYAN: Oh, I would suggest just  
9 the opposite, that they be included.

10 DR. ELMORE: Okay.

11 CHAIRMAN RYAN: That's an uncertainty of  
12 the overall system that must be included. Weeding  
13 them out is a horrible thing.

14 DR. ELMORE: Well, fine. But they need to  
15 be weeded according to their uncertainties. If  
16 there's a big uncertainty, they shouldn't count it  
17 very much.

18 CHAIRMAN RYAN: No. If it's a big  
19 uncertainty, they should include it because it's a  
20 measure of system uncertainty.

21 DR. ELMORE: Okay. Well --

22 CHAIRMAN RYAN: You know, they're trying  
23 to measure an analyte in a sample and just saying,  
24 "Well, I followed the detection limit" or maybe that  
25 gives you a real, true, effective detection limit for

1 the whole process. Tossing out data is generally a  
2 bad idea.

3 DR. ELMORE: Yes. Well, we never throw  
4 away anything.

5 CHAIRMAN RYAN: Oh, I know.

6 DR. ELMORE: The submitter gets --

7 CHAIRMAN RYAN: But, I mean, just ignoring  
8 some and accepting some because the analytical work  
9 was theoretically better on some, rather than others,  
10 that's a risky slump, I think.

11 MEMBER HINZE: But the uncertainty tells  
12 you that something is wrong in the measure.

13 DR. ELMORE: Right, exactly. Now, if none  
14 of these samples --

15 MEMBER HINZE: In this whole process.

16 CHAIRMAN RYAN: Well, in the instrument  
17 part, which is what we're hearing about so far.

18 MEMBER HINZE: Yes, but it may be because  
19 you have a high sulfur that is not practically taken  
20 into account. And that's a part of the sample and  
21 sample collection and sample preparation, as I  
22 understand it.

23 DR. ELMORE: Yes. If we know what caused  
24 the uncertainty, then they don't have to worry about  
25 that coin too much if it's off where it should be.

1 Where they have to worry is if we report a five  
2 percent precision measurement and when they plot it  
3 with their other samples, one of them is way off in  
4 left field, that is when the bead of sweat got in  
5 there, something we don't have any control over. And  
6 that sample, yes, should be left there to show that  
7 there are other problems.

8 MEMBER CLARKE: I think we are making a  
9 distinction between the instrument limit, which is  
10 running the samples without any interferences or any  
11 complications, what is usually called a method  
12 detection limit, where now you're running actual  
13 samples. You've got other things going on.

14 CHAIRMAN RYAN: And the system error is  
15 obviously the combination of both. And it's only when  
16 you understand every component of system error that  
17 you really understand uncertainty.

18 MEMBER CLARKE: If I understood what you  
19 said to Mike's earlier question, you point to some of  
20 the different graphs that are all the same samples.

21 DR. ELMORE: Yes.

22 MEMBER CLARKE: So if you numbered those,  
23 you would be able to match them up.

24 DR. ELMORE: Yes, yes. Good point. We  
25 could have done that. And if anybody here would like

1 to see the spreadsheet of the raw data, you know I can  
2 provide that.

3 CHAIRMAN RYAN: That would be helpful,  
4 actually.

5 DR. ELMORE: And I think there is only one  
6 point that was off scale on this plot. I think it was  
7 -- I don't know. I'm not sure right now.

8 CHAIRMAN RYAN: It doesn't really matter.  
9 If we can get the spreadsheet, we can figure it out.

10 DR. ELMORE: Yes, exactly. Okay.

11 Then I have a couple of conclusions to  
12 make here. Okay. AMS is a complex analysis tool.  
13 And, really, it takes the physics department, where we  
14 have ten employees and to keep the thing running and  
15 two Ph.D. physicists running the accelerator. So it's  
16 a very complex tool.

17 We make a very active use of standards and  
18 blanks. We measure them a lot. That helps us  
19 identify any problems in the system. A complete error  
20 analysis usually identifies samples with problems.  
21 Okay?

22 These are problems in the measurement.  
23 And I say "usually." There are other things I didn't  
24 talk about here that can be problems, like mixing of  
25 samples and stuff. And it happens but pretty

1 infrequency. Maybe once a year we get a sample that  
2 got mixed up in the loading or something.

3 So there are other problems that don't  
4 show up here. And, you know, some of those will be  
5 showing up with the splits sent to us and other labs  
6 or just two samples sent to us. And so it's a  
7 responsibility of the user to submit multiple samples  
8 in blind split repeats.

9 I'll be glad to take any other questions.  
10 That is what I had to present.

11 MEMBER HINZE: Ruth?

12 MEMBER WEINER: Thank you for a very  
13 interesting discussion. I just have a couple of  
14 questions.

15 How does this method compare in precisions  
16 and resolves and uncertainty with if you just tried to  
17 assay chlorine-36 radiologically?

18 DR. ELMORE: Okay. The half-life of  
19 chlorine-36 is about 300,000 years.

20 MEMBER WEINER: So you get a very weak --

21 DR. ELMORE: Very weak signal. If you  
22 counted for months on one sample, if it was a large  
23 sample, you might be able to see. Davis and Schaeffer  
24 tried to do this in the '50s, actually. They  
25 predicted chlorine-36 would be produced in the

1 atmosphere. And they tried to measure it with decay  
2 counting but failed. And so that's really out of the  
3 question.

4 MEMBER WEINER: So this is, really, only  
5 the method of choice, then, --

6 DR. ELMORE: Well, let me --

7 MEMBER WEINER: -- the only method you can  
8 use?

9 DR. ELMORE: Well, let me say the  
10 standards were counted by decay counting. Okay?

11 MEMBER CLARKE: We could use ICP NMS, but  
12 according to what you told us in the beginning, this  
13 was at least 1,000 times in lower detection limit. I  
14 think that is parts per trillion pretty much.

15 DR. ELMORE: Yes.

16 MEMBER WEINER: Yes. That was my next  
17 question. What if you used ICP NMS? Could you --

18 DR. ELMORE: It would have the same  
19 problem with the sulfur. And the sulfur is about five  
20 orders of magnitude higher than our background signal.  
21 It takes the high energy.

22 I didn't mention that there are two things  
23 that you need the high energy, this big accelerator,  
24 for. One is to separate the sulfur from the chlorine.  
25 We do that from the basis of energy loss in our

1 detector. That only works with many MEV of energy.  
2 And the other is destruction of molecules. There can  
3 be other molecules of mass-36. And so these would be  
4 problems with ICP NMS.

5 MEMBER WEINER: So you really have  
6 narrowed down to a method that isolates the CL-36.  
7 And that was why you can't --

8 DR. ELMORE: That is correct.

9 MEMBER WEINER: My other question is, who  
10 supports this?

11 DR. ELMORE: The National Science  
12 Foundation Solid Earth Sciences. We have block  
13 funding from them. Most of the work we do is the *in*  
14 *situ* produced chlorine-36 and other nuclides,  
15 bromium-10, aluminum-26, in rocks on the surface of  
16 the Earth to measure exposure time of the rock so we  
17 can date volcanic eruptions, earthquakes that will  
18 expose rocks to cosmic rays, glacial marines, and  
19 landslides. That is most of our work.

20 MEMBER WEINER: When people send you  
21 samples, do they pay for the analyses or do you  
22 support that?

23 DR. ELMORE: Yes. If it's research  
24 samples with the types of research the NSF funds, then  
25 we charge half-price still. And the other half really

1 comes from our block grant.

2 And for samples such as Yucca Mountain, if  
3 that's not considered just basic research, then we  
4 charge the full price, which is about \$400 a sample.

5 MEMBER HINZE: Allen?

6 VICE CHAIRMAN CROFF: In your talking, you  
7 alluded to a number of radionuclides that you  
8 mentioned. I mean, we focused on chlorine-36 but  
9 iodine. You just mentioned some others. How long is  
10 the list of things that this will make? I mean, is it  
11 a long list or --

12 DR. ELMORE: Six.

13 VICE CHAIRMAN CROFF: Okay.

14 DR. ELMORE: There are six isotopes we  
15 measure. And we usually spend a week or two on each  
16 one. And so it takes a few months to cycle through  
17 all of them.

18 VICE CHAIRMAN CROFF: Okay. Thanks.

19 MEMBER HINZE: Dr. Ryan?

20 CHAIRMAN RYAN: Has anyone reported that  
21 you know of a complete analysis of sampling error and  
22 system error over a large, integrated number of  
23 samples?

24 DR. ELMORE: No. June Fabryka-Martin was  
25 very active in our data analysis, these samples in

1 particular. And she had a good body of data on Yucca  
2 Mountain. I don't know that she has published that,  
3 but she would be the one to do it.

4 CHAIRMAN RYAN: Yes. Well, I guess you  
5 can tell by my questions I have been struggling with  
6 understanding a few basic things. On the instrument  
7 side, which I really appreciate your insights, there  
8 is a red line. Below the red line, you don't have any  
9 confidence in an answer.

10 DR. ELMORE: Right.

11 CHAIRMAN RYAN: Wherever you want to draw  
12 it, for whatever reasons, that is --

13 DR. ELMORE: I mean, there are really  
14 three red lines --

15 CHAIRMAN RYAN: Exactly.

16 DR. ELMORE: -- shown by the three plots.

17 CHAIRMAN RYAN: So, you know, if I have a  
18 known sample, I can tell which red line I am really  
19 focused on. If I get a field sample, the weakest of  
20 the red lines; that is, the one highest up on the  
21 x-axis, is the one I have to draw.

22 So it would be interesting to try and  
23 figure out how to take field samples. And you need,  
24 you know, obviously more than three or four or six.  
25 You know, you need hundreds to really do a good job to

1 say what were the field sampling errors and then what  
2 were the instrument errors assuming some detection  
3 limits and on the other issues, which you very well  
4 discussed, and do a systematic error for all of these  
5 samples and then a systematic error for the collection  
6 of samples before you can really say or interpret  
7 these ratios.

8 I mean, everybody typically reports an  
9 instrument error when they say, "Oh, the error of a  
10 gamma spec is X percent of cobalt-60." Well, you  
11 know, that's the instrument. That's not the system  
12 error that got you to the sample that you want the  
13 analyte for and that those are typically the sampling  
14 problems dwarf the instrument problems.

15 DR. ELMORE: Yes.

16 CHAIRMAN RYAN: In almost every case I  
17 know of, that's true. So how do we put all of this  
18 together? What would your recommendation be to --

19 DR. ELMORE: I think it's true that the  
20 Yucca Mountain studies measure many samples of the  
21 same from the same source.

22 CHAIRMAN RYAN: Many? "Many" being 50?  
23 Twenty?

24 DR. ELMORE: Well, June did hundreds.

25 CHAIRMAN RYAN: Hundreds.

1 DR. ELMORE: We're sure. But, sure, I  
2 think -- well, these samples from UNLV, I think here  
3 we saw so many that were below the red line because I  
4 think they are trying new things. Okay? They're  
5 trying small samples in places where there are real  
6 low ratios.

7 CHAIRMAN RYAN: Fair enough.

8 DR. ELMORE: But I think a lot of the work  
9 June did -- there weren't so many below the red line,  
10 but, at any rate, I think even that, even this recent  
11 data, that there are certainly tens of samples that we  
12 got good measurements on. And I suspect that a lot of  
13 those are from the same site.

14 And so then you can pop those in and look  
15 at the distribution. And that distribution for sure  
16 will have a wider range than five percent.

17 CHAIRMAN RYAN: And that is the real  
18 error?

19 DR. ELMORE: That is the real error.

20 CHAIRMAN RYAN: That's what I keep  
21 reaching for --

22 DR. ELMORE: Yes.

23 CHAIRMAN RYAN: -- to get to hear much  
24 about.

25 DR. ELMORE: But I think AMS is a

1 complicated enough measurement tool that you might  
2 conclude that a lot of that error came from AMS. And  
3 I am trying to lay to rest that isn't true.

4 There certainly are problems, but when  
5 those problems occur, we can identify them. We can  
6 say, "This sample didn't get measured well because of"  
7 such and such a problem. And we do.

8 For the person who doesn't want to look at  
9 that spreadsheet, we tell them why. Whenever any  
10 sample is over five percent precision, we then why.

11 Let me say there have been studies of, for  
12 example, glacial marines, where we measure lots of  
13 boulders on the marine exposure age. And there have  
14 been cases where they all agree to within three to  
15 five percent over a field of rocks. And it's  
16 unbelievable.

17 So what I am saying is this -- and this is  
18 what we are funded for. And it works really well.  
19 And so it's possible to have a low scatter of data  
20 from field samples, but the trouble is leaching rocks,  
21 which is what we're doing mostly in Yucca Mountain,  
22 there are different sources of the chlorine-36 and  
23 different rocks or different amounts of leaching will  
24 give you different answers. And then that puts a  
25 spread in the data.

1                   CHAIRMAN RYAN: And, again, I think we are  
2 agreeing that the sampling uncertainties, you know,  
3 right from getting the sample to the chemistry on the  
4 sample and all of that, is probably a much bigger  
5 error than what you are documenting to us.

6                   DR. ELMORE: That's the bottom line from  
7 my talk.

8                   CHAIRMAN RYAN: I'm guessing that. So,  
9 you know, we're taking that away. But what we really  
10 need to understand if the interpretation of this data  
11 is valuable is, what is the real uncertainty? What is  
12 the system uncertainty?

13                   DR. ELMORE: Yes.

14                   MEMBER CLARKE: So you have helped me  
15 reshape my question. Thank you.

16                   DR. ELMORE: Well, if you haven't had Fred  
17 Phillips give a presentation here, he might be the --  
18 he's the world expert in chlorine-36 from the geology  
19 point of view and hydrology. He's a hydrologist.  
20 He's done chlorine-36 with me since day one. And Fred  
21 would give a nice presentation from that point of  
22 view, I think.

23                   CHAIRMAN RYAN: Thanks. That's a good  
24 suggestion.

25                   Jim, sorry. Thank you.

1 MEMBER CLARKE: I share Mike's concerns.  
2 I started out on the chemical side. So I'm using  
3 different words than he is, but, you know, this  
4 overall what he's calling system error and what I  
5 would call method detection limit. And I'm even a  
6 little concerned about recording above the detection  
7 limit because all the detection limit tells you is  
8 it's there. It doesn't tell you how much is there.

9 Normally there is an area of uncertainty  
10 until you get to a point where you -- you know, what  
11 you are doing is not unusual. I haven't heard  
12 anything about the detection limit.

13 Allen asked you about other radionuclides.  
14 You said there were six?

15 DR. ELMORE: Yes.

16 MEMBER CLARKE: You could theoretically  
17 tune this to anything? Is that right?

18 DR. ELMORE: Well, we measure  
19 radionuclides because they are what is rare in nature,  
20 not because they're radioactive and other isotopes.  
21 And we've tried technetium, for example. But the  
22 problem is the isobar, the equivalent of the  
23 sulfur-36. They swamp us.

24 We're building a new beam line. So we are  
25 starting to work on new isotopes, but each one is a

1 major development.

2 MEMBER CLARKE: Yes. I was just talking  
3 about the technique in general. Obviously you would  
4 have sources of interference for different  
5 radionuclides. You would have to deal with those, but  
6 in principle you could apply the standard to  
7 radionuclide. You would just have different --

8 DR. ELMORE: In principle.

9 MEMBER CLARKE: You would have different  
10 uncertainties.

11 DR. ELMORE: In practice, we have been  
12 doing this for 30 years. And we have tried lots of  
13 other ones and failed so far. But there are some that  
14 are promising we're working on.

15 MEMBER CLARKE: And how do you remove the  
16 sulfur?

17 DR. ELMORE: How do you remove the sulfur?

18 MEMBER CLARKE: Sulfur.

19 DR. ELMORE: Okay. Well, first of all, in  
20 the chemistry, by precipitating silver chloride and  
21 redissolving in ammonia, the sulfur doesn't  
22 precipitate. So you do that several times and --

23 MEMBER CLARKE: It's a chemical  
24 separation?

25 DR. ELMORE: So it's a chemical. That's

1 the first one. Then the other is the detector. The  
2 rate of energy loss in the gas in our detector for  
3 sulfur and chlorine are different because of the  
4 different atomic number. And that gives us a  
5 different signal. And this is a standard nuclear  
6 physics technique. So we need both of those to remove  
7 the sulfur.

8 MEMBER CLARKE: And that is typically done  
9 by the person sending you the sample?

10 DR. ELMORE: The chemistry.

11 MEMBER CLARKE: And there is --

12 DR. ELMORE: The first step, yes.

13 MEMBER CLARKE: Have you listed the  
14 variation?

15 DR. ELMORE: Well, for sure, some  
16 submitters are better able to remove the sulfur than  
17 others, but we're now able to handle pretty high  
18 sulfur. That 10 to 20 thousand count-per-second limit  
19 we have now used to be 2 or 3 thousand. So we have  
20 improved our measurement technique by an order of  
21 magnitude.

22 And so most samples are okay. It's not  
23 usually a problem. The ones that are a problem are  
24 where we don't work in a class 100 clean room and so  
25 we get -- one little dust particle can wipe out a

1 sample with the sulfur. So we occasionally get high  
2 sulfur ones.

3 MEMBER CLARKE: Thank you. Very  
4 interesting presentation.

5 MEMBER HINZE: The thing is, let me ask it  
6 a little differently regarding this whole system if  
7 you will. We have the sample collection. We have the  
8 chemical proliferation. And we have the actual AMS  
9 measurement.

10 I know that you are very interested and  
11 PRIME is very interested in making certain that the  
12 results of these are scientifically interesting and  
13 justifiable. But there is this potential for a  
14 disconnect between those three elements.

15 Do you hold courses in helping people to  
16 understand what your problems are in measurement so  
17 that the sample collection and the chemical  
18 preparation really keep in mind what is the end  
19 product down here in terms of actual measurement? Is  
20 that sort of thing done?

21 DR. ELMORE: We host visitors pretty  
22 often. And we're glad to share our chemical  
23 preparation procedures we have written up. We share  
24 those openly to anybody.

25 And our sample submitters learn very

1 quickly the sulfur problem, the sample size issue, and  
2 the detection limit. I mean, they learn those three  
3 pretty quickly; if not before their measurements, at  
4 least after their first batch of them.

5 So, you know, I don't think there are  
6 enough new users out there to really have a class. We  
7 would. In fact, we are planning to start doing that  
8 for the geology users for the *in situ* produced  
9 nuclides that are most of our business. We're talking  
10 about we started having a class on that, kind of a  
11 workshop.

12 I mean, there is a conference, accelerator  
13 mass spectrometry conference, every three years. And  
14 there are a lot of interactions there on discussing  
15 these problems.

16 MEMBER HINZE: One of the major problems  
17 that you have is the sulfur. And I think volcanic  
18 peroxide. I think of sulfur. There is a lot of  
19 sulfur in volcanic rocks. Do you find the  
20 uncertainties higher in measurements that are made in  
21 volcanic rocks than you do in others? Do you have any  
22 feel for this?

23 DR. ELMORE: I think there's no real  
24 correlation between the amount of sulfur in the  
25 original sample and the sulfur in the sample we run.

1 I think the chemistry is adequate.

2 The sulfur we see I think is more from  
3 blunders and that dust particle there or not doing the  
4 chemistry right. I mean, sometimes the first time the  
5 submitter sends us samples, there is sulfur in them.

6 But I think that that is not an issue,  
7 really, how much sulfur is in the original samples.

8 MEMBER HINZE: Do you have better  
9 consistency of the results when you actually do the  
10 sample preparation itself?

11 DR. ELMORE: No. Our technician can give  
12 us samples that are as high in sulfur as anybody on  
13 occasion.

14 MEMBER HINZE: Okay. We have just a few  
15 moments. I will open this up to anyone in the  
16 audience who has a question for Professor Elmore.

17 MR. HAMDAN: David, I have a question.

18 CHAIRMAN RYAN: Please come and sit at the  
19 desk and tell them who you are just because of he  
20 microphone problem.

21 MEMBER HINZE: Use the microphone.

22 CHAIRMAN RYAN: Tell us who you are, toc.

23 MR. HAMDAN: I'm Latif Hamdan with the  
24 ACNW staff.

25 David, I just wanted to ask you -- I don't

1 know if this is in the scope of your representation or  
2 not, but still you mentioned you did something for  
3 Yucca Mountain, either present there or if you have an  
4 expert opinion on the subject as to whether or not  
5 this is all that we know, Yucca Mountain, whether this  
6 method, the chlorine-36 method, is a good enough  
7 method to get you a good number for the --

8 DR. ELMORE: Yes. Well, you're asking a  
9 physics professor, not a hydrologist or a geologist.  
10 I mean, we know where the source is of the  
11 chlorine-36. The subsurface sources of chlorine-36  
12 come from decay of uranium and thorium, which produce  
13 neutrons that make chlorine-36. And we can predict  
14 how much of that there should be. And it's a pretty  
15 low number, usually less than 10 times  $10^{-15}$ . Okay?

16 So anything above  $10^{-15}$ , which is right  
17 down near our detection limit, anything higher than  
18 that must have come from the surface. Okay? Neither  
19 can be combination. That occasionally will happen,  
20 but that isn't going to usually be the problem.

21 It has to come from production in the  
22 atmosphere, production on the top meter of the Earth's  
23 surface, and production from above-ground bomb tests.

24 Those are really the three sources. And  
25 so if you're finding chlorine-36 down under, it's got

1 to come from one of those. All right?

2 And the production since it's a  
3 300,000-year half-life, the production in the  
4 atmosphere and on the surface of the Earth, that's  
5 been happening all along. And so the numbers you see  
6 that range up to about 1,000, you know, all that's  
7 telling us is the travel time from the surface to the  
8 below-ground sampling depth took less than a few  
9 half-lives, let's say less than a million years or  
10 less than half a million years.

11 Okay. But anything you see above 1,000  
12 times  $10^{-15}$  must have come from the bomb tests. And  
13 I'm not too knowledgeable about all of the work that  
14 has been done on that, but it's my opinion that if you  
15 consistently see samples above 1,000 times  $10^{-15}$  in one  
16 place, that means chlorine-36 from the bomb test,  
17 which means the last 50 years, is getting down there.  
18 So I don't know of any higher-level sources of  
19 chlorine-36.

20 And for sure, you know, if you leach more  
21 chloride out of the rock, then you're getting more of  
22 the lower-level chloride that was originally in the  
23 rock that only had chlorine-36 from the neutrons. So  
24 if you leach more, that's going to lower your numbers  
25 because you're diluting it with the old chloride.

1           So if there are any samples at all that  
2           were well above 1,000, it seems to me that has to be  
3           from transported by water in the last 50,000 years.

4           And that's my feeling from what I know  
5           about the subject. And I don't claim to be a real  
6           expert.

7           MR. HAMDAN: Yes. I was thinking just in  
8           terms of the passage of the measurements, uncertainty  
9           in the sampling and the measurement itself, how that  
10          is relevant to the passage.

11          DR. ELMORE: Yes. Well, the vast majority  
12          of our samples -- and I think this data I showed you  
13          had more with higher uncertainties than we usually  
14          have because they were special samples.

15          Most of our samples have had uncertainties  
16          at around five percent. And so, you know, if it's  
17          1,000 plus or minus 50, that's a pretty small range.  
18          And so if you are seeing some samples that are a few  
19          thousand, for sure that wasn't because of our  
20          measurement. That's --

21          CHAIRMAN RYAN: But again, that's the  
22          instrument error, which, you know, I mean, I still say  
23          that is not a measure of error of the sample.

24          DR. ELMORE: Right.

25          CHAIRMAN RYAN: It's a measure of error in

1 the instrument measurement.

2 DR. ELMORE: But how could there be errors  
3 in the sampling that give you -- if you measured a  
4 sample that was, say, 5,000 times  $10^{-15}$ , it would have  
5 to be contamination from some source of --

6 CHAIRMAN RYAN: Sure, right.

7 DR. ELMORE: -- of chlorine-36.

8 CHAIRMAN RYAN: But without systematic  
9 documentation of that, we're guessing.

10 DR. ELMORE: Yes.

11 CHAIRMAN RYAN: We're just making a guess.  
12 That's my point. You know, nobody has really taken  
13 this on as a real systematic error analysis. You have  
14 confirmed that at least.

15 DR. LARKINS: You mentioned earlier that  
16 there was some comparison of blanks for using the same  
17 technique between your lab and the Australian lab.  
18 What was the variability in the measurement of those  
19 blanks, standards?

20 DR. ELMORE: Well, both. I mean, it is  
21 appropriate to look at both standards and blanks.

22 DR. LARKINS: Yes.

23 DR. ELMORE: The standards we're now  
24 agreeing to better than five percent. In fact, I  
25 think it's one to two percent as we're agreeing on the

1 standards among the labs. And so that certainly isn't  
2 a big issue.

3 CHAIRMAN RYAN: But is that a fair test as  
4 you have been looking at the same standards now back  
5 and forth for years? What would happen if, for  
6 example, somebody gave you a split of a known sample  
7 and sent it to both of you, one that didn't agree  
8 within that two percent? It's a different question.

9 DR. ELMORE: When we measure the  
10 standards, we measure many more times. And there are  
11 higher-level samples. So we can do that to one or two  
12 percent.

13 The unknowns, you know, the best we would  
14 probably look for would be five percent. And the  
15 samples we have compared, I didn't bring any data to  
16 show you but have been on the order of five percent.  
17 So --

18 CHAIRMAN RYAN: That's the best you --

19 DR. ELMORE: So we --

20 CHAIRMAN RYAN: What is typical?

21 DR. ELMORE: Yes. Typical comparisons on  
22 chlorine-36 -- now, other nuclides, like iodine, it  
23 wouldn't be so good, but with chlorine, 5 percent  
24 agreement. Okay. But to one sigma error, you're  
25 going to have a few that might be ten percent

1 different, but five percent is I think a reasonable  
2 uncertainty to be putting on it.

3 That's one of the reasons we don't  
4 measure. We don't try to measure to better than five  
5 percent because if we measure a lot of splits with  
6 Livermore, probably on average they would agree to  
7 about five percent. Neither of us are going to try to  
8 do better than that.

9 MEMBER CLARKE: I think the other point  
10 is, what is the value of the standards, the standards  
11 made at very low ratios?

12 DR. ELMORE: We measure standards that  
13 range from about a 100 times  $10^{-15}$  up to 40,000. We  
14 have set up with, actually, a 40,000 standard, but our  
15 typical one is 8,000.

16 MEMBER CLARKE: And do you get the same  
17 precision at the low levels as you get at the high  
18 one?

19 DR. ELMORE: Yes.

20 MEMBER HINZE: Well, thank you very much,  
21 David, for an excellent presentation, very  
22 informative. You have been very helpful to us. We  
23 really do appreciate it.

24 With that, we will move directly into an  
25 update on the chlorine-36 studies of the Department of

1 Energy. Drew Coleman will be making the presentation  
2 for DOE. And, if I understand correctly, this is  
3 concerning the validation report of the DOE that is  
4 pending and that we are all looking forward to seeing.

5 DR. D. COLEMAN: Yes. Thank you for this  
6 opportunity to address the ACNW. I appreciate it. I  
7 don't like to follow up people like David with a  
8 bureaucrat, but I'll see what I can do here.

9 I'm a geological engineer by training and  
10 a geologist by experience. I'm a bureaucrat for the  
11 DOE. I'm a task manager, a saturated zone manager,  
12 university task manager, and a USGS technical monitor.

13 CHAIRMAN RYAN: Drew, if I may just --  
14 we're going to hook up some folks in who wanted to  
15 listen in. So we will just let that happen.

16 DR. D. COLEMAN: Okay.

17 CHAIRMAN RYAN: And we'll pick that right  
18 up. Sorry. We should have gotten that done ahead of  
19 time.

20 (Pause.)

21 CHAIRMAN RYAN: Good morning.

22 MR. FITZPATRICK: Good morning.

23 CHAIRMAN RYAN: Just to complete our  
24 record, could you tell us who is on the phone and who  
25 you are with, please?

1 MR. FITZPATRICK: This is Charles  
2 Fitzpatrick, Nevada.

3 CHAIRMAN RYAN: Okay.

4 MEMBER HINZE: Thank you very much,  
5 Charles.

6 CHAIRMAN RYAN: Can you hear us all right?

7 MR. FITZPATRICK: Yes, I can hear you  
8 fine.

9 CHAIRMAN RYAN: Okay. Fire away, Drew.

10 DR. D. COLEMAN: Okay. So I'm Drew  
11 Coleman. I'm from the Department of Energy. And I'm  
12 giving a presentation entitled "Update on Chlorine-36  
13 Studies."

14 Now, David talked a little bit about some  
15 of the parts of the study, but parts I'm going to talk  
16 about are what I call the USGS/Los Alamos conflicting  
17 reports portion and where that is.

18 There is also a follow-on, UCCSN  
19 cooperative agreement study, that I'll talk about.  
20 And when I talk about the USGS part, that was actually  
21 a consortium of the USGS-Lawrence Livermore with Mark  
22 Caffee, who was mentioned by David, and some ACL  
23 people. But the USGS led the study in my view.

24 And the Los Alamos part, it would be June  
25 Fabryka-Martin's early work and then some follow-on

1 work by a guy named Bob Roback that worked on that.  
2 And the UCCSN work is Jim Cizdziel as a chemist; Fred  
3 Phillips as the, I guess, chlorine-36 guru on the  
4 effort; and Jean Cline, who has done some sampling and  
5 some activities prior on the project and was sort of  
6 their sampling lead for their UCCSN effort.

7 So you folks have had a presentation on  
8 this subject. I think it's been a few years ago. And  
9 there is not really a lot to say, but I was going to  
10 go over the history just briefly and if you've got  
11 questions I guess try to answer them during the  
12 questions part.

13 In 1996, the TBM was mine in the  
14 exploratory studies facility. And systematic samples  
15 and feature-based samples, which focused on, say,  
16 faults or fractures or other kinds of features,  
17 followed the TBM in some cases right behind it, in  
18 some cases followed on maybe after a few months had  
19 gone by. But those were the systemic and  
20 feature-based samples that June did some chlorine-36  
21 measurements on and reported the early chlorine-36  
22 results.

23 The chlorine-36 testing, there had been an  
24 assertion that a layer of non-welded tuffs, the  
25 Paintbrush non-welded units or the Paintbrush Tuffs,

1 the non-welded units, provided a tin roof or some sort  
2 of a barrier to infiltration and that it was likely  
3 that no infiltration made it through those.

4 And so the bomb pulse chlorine-36 reading  
5 below those units in the repository horizon was an  
6 interesting result. Now, the word "localized" that  
7 appears in that third bullet is a key word.

8 No one asserts that there's any more than  
9 just a few localized areas where there are fast  
10 pathways, as indicated by the data that we have  
11 collected. But there were a few at the Sundance  
12 Fault, at the Drill Hole Wash Fault locations, which  
13 is where studies have sort of focused.

14 Now, the fracture mineral, we continued  
15 with the excavation through the ECRB. And people have  
16 looked at chlorine-36 in there. I think there have  
17 been a few hits.

18 So, with these bomb pulse hits, these few  
19 fast pathways, the DOE chose to fund a validation  
20 study and have another organization other than Los  
21 Alamos take a look at the results and see if they  
22 could replicate it. And that was a decision I didn't  
23 participate in, but it was a decision that was made.

24 Now, there is a typo on this last bullet.  
25 It says, "Lawrence Livermore National Laboratory was

1 funded to provide a measure of oversight." That  
2 should read, "Los Alamos" because we wanted to keep  
3 the Los Alamos, who had made the original bomb pulse  
4 report, in the study.

5 So next slide. The USGS developed this  
6 sampling methodology, and they were worried about  
7 contamination. This was long after the TBM had gone  
8 through and there had been some wall washing and  
9 things.

10 So they decided to drill core holes. And  
11 they drilled 50 core holes. They drilled 40 of them  
12 4 meters deep into the Sundance Fault area, where one  
13 of the hits had been reported, and another 10 in the  
14 Drill Hole Wash area, which was in the north ramp and  
15 wasn't so much of a repository horizon, but they  
16 drilled some there because there had been hits there  
17 also. And they focused on that.

18 Two meters, it was the furthest back in  
19 the wall to sort of minimize assertions of  
20 contamination. And they worked with Mark Caffee. And  
21 he leached those samples. And he reported very low  
22 levels, lower than any that have been reported by Los  
23 Alamos. And they started to look at his technique.

24 And he was leaching the samples. USGS got  
25 the samples and then actually just sent the samples in

1 bulk to Livermore and let them do all the work from  
2 there on. And he leached the samples by crushing them  
3 and rotating them in a drum for eight hours.

4 And when people got to looking at that,  
5 they thought that was somewhat too aggressive of a  
6 leach. He defended his original work as chlorine is  
7 hard to get out of rock. But in the end, they decided  
8 to perform some leaching studies.

9 And the USGS and Los Alamos did a lot of  
10 work to look at how leaching affected the samples and  
11 what kind of results you got and settled on a mutually  
12 agreeable path that short passive leach, for example,  
13 an hour was desirable as sort of passively genuous,  
14 short passive leach, where you just put the sample in  
15 the water and let it leach for an hour and then take  
16 the sample out and send the results in to be looked  
17 at.

18 CHAIRMAN RYAN: Just a quick question.  
19 Leaching is a surface area question. Are you talking  
20 about taking a chunk of rock and just sticking it in  
21 a leach solution?

22 DR. D. COLEMAN: Right, crushing it and  
23 sizing it maybe to die size, but I think essentially  
24 in some of Jean's work, she put whole blocks in a pct  
25 and leached them, crushed them sometimes and leached

1       them. And these I think were crushed and sized and  
2       leached but yes, pretty much just putting it in and  
3       letting it --

4                   CHAIRMAN RYAN: They were crushed, then  
5       sized and leached, though?

6                   DR. D. COLEMAN: Sized and leached, yes.  
7       And they looked at the size effects of things. And  
8       that is all described, but I will get to where that is  
9       described.

10                   So on the samples that they performed the  
11       leaching studies, the USGS leached some samples using  
12       the mutually agreed-upon technique and sent aliquots  
13       -- so that's the water, the leachate -- to Los Alamos  
14       and Livermore.

15                   Now, Los Alamos preferred to spike their  
16       own samples and precipitate their own targets and get  
17       them all ready for David to just put in his AMS,  
18       however that works, but it could be described in the  
19       process.

20                   Livermore, the USGS sent them to  
21       Livermore. And they did that same process, the  
22       spiking, the targets, and putting them in the AMS.  
23       And those two agreed on a one-to-one line on a graph  
24       when they were plotted. And that is kind of a key  
25       result.

1           It is that result that led us to be  
2           confident that the wet chemistry or the AMS part was  
3           really not the problem. They could both get the same  
4           answer from a water sample taken and sent and the wet  
5           chemistry done each according to their own AMS done  
6           that they could replicate each other's results.

7           Now, admittedly, it was a low result, but  
8           I guess for me, the -- what I am wanting to call the  
9           wet chemistry and the AMS, the part that David was  
10          talking about today. I don't believe that is where  
11          the area of disagreement is. I believe it's  
12          elsewhere.

13          But the tricky part is there was some core  
14          that June had originally done that showed a bomb pulse  
15          signature, and it was for Niche 1, which is near the  
16          Sundance Fault area, where other hits had been  
17          reported.

18          So it had some nice advantages, whether it  
19          be block samples, like June had used; it was core,  
20          like the USGS had used; it had shown a bomb pulse hit  
21          before in the Los Alamos work, and there remained a  
22          requisite two kilograms or so necessary for each site  
23          to have a split.

24          So there was a section of core remaining,  
25          maybe with some gaps in it and sort of short core

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1 lengths in a box. And they didn't just divide it in  
2 half. They took a piece for you and a piece for me,  
3 a piece for you, a piece for me until each side had  
4 half of the sample and it was roughly a kilogram,  
5 which is about the minimum you need to get a leach or  
6 you start getting those low-end values that everybody  
7 worries about. And they leached those.

8 Now, the difference between this one up  
9 here is the USGS leached both samples and then had the  
10 wet chemistry done at Los Alamos and Livermore. But  
11 down here it was LLNL leached their own and the USGS  
12 leached their own. And then the USGS sent the  
13 leachate to Livermore. And Los Alamos precipitated  
14 and then sent to Livermore.

15 And Los Alamos replicated their early  
16 result of bomb pulse. And the USGS replicated their  
17 early results of no bomb pulse. So at that point we  
18 still had a -- conflicting results is what I would  
19 term them. And we were out of sample that was  
20 suitable for testing for bomb pulse, and we were kind  
21 of at a decision point.

22 There were three years worth of work that  
23 had gone into this. The leaching protocols had been  
24 agreed upon. The GS had sort of done all they could  
25 to validate. They had used up all their validation

1 core. I had to go get new samples, and it wasn't  
2 clear to me that maybe just the taking of the samples  
3 was a problem.

4 I mean, when you're at a point like this,  
5 you've got to really think about what your next move  
6 is going to be. And what we chose to do was have them  
7 write the report up and write a joint report that  
8 represented both viewpoints.

9 CHAIRMAN RYAN: There could be one  
10 viewpoint that consolidates all of the data. And that  
11 is, if you went out and replicated these samples a  
12 number of times, you would end up with the same  
13 result. The range would be if I am reading this right  
14 244 to 8,580. Reality is somewhere in between that  
15 range.

16 DR. D. COLEMAN: Yes. The --

17 CHAIRMAN RYAN: There is a possibility  
18 that nobody did anything wrong and this is just the  
19 natural variation of what you're going to --

20 DR. D. COLEMAN: Right. There is no clear  
21 admission by me that either one is wrong or that it's  
22 necessary that either one be wrong.

23 CHAIRMAN RYAN: Right, exactly.

24 DR. D. COLEMAN: The difficulty is, you  
25 know, what samples do you go get and test. And, you

1 know, the USGS never did show an bomb pulse. Los  
2 Alamos showed it rarely but at least occasionally.

3 And, you know, another -- I mean, we could  
4 have done more work with them. Both groups were  
5 confident that they could drive it to a resolution.  
6 They didn't want to give up on it.

7 They to this day are not ready to give up  
8 on it. They would love to take over the work. But  
9 the department took a look at it and thought the best  
10 idea was to write up the results in a report that  
11 discussed the areas of agreement, the areas of  
12 conflict, discussed every facet of the work, and that  
13 both scientists would stand behind as representing  
14 their points of view, even though they were divergent  
15 a little bit.

16 I mean, at some point you're looking like  
17 you're not going to write anything up until you get an  
18 answer that you like. And that is a perception  
19 problem that you might have to deal with.

20 I mean, from this point looking back and  
21 getting ready for this presentation, I kind of  
22 relooked at my decision. And I don't really  
23 second-guess it. Now, I wasn't the only one that made  
24 the decision. There were lots of people higher up  
25 into the department than me that participated, but I

1 don't really second-guess the decision.

2 So they wrote it up. The report is  
3 entitled "Chlorine-36 Validation Study at Yucca  
4 Mountain, Nevada." It's completed all of its reviews.  
5 The last comments were being resolved. When I talked  
6 to them just before I came here, they had gotten a few  
7 more comments from the QA guys, and they were a little  
8 bit upset about that. But they're working to resolve  
9 those.

10 And the report should be available pretty  
11 shortly. Of course, I will work with Neil or somebody  
12 to get a copy of that through the public release  
13 review and to interested parties.

14 This is one summary figure that is in the  
15 report. It shows all of the work from all of the  
16 various phases in one figure. There are figures on  
17 tritium. There are figures on the overall tunnel  
18 data. There are a lot of figures. But the  
19 significant one is that little box at the very top and  
20 the one below it are probably the last results where  
21 Los Alamos validated their previous findings of bomb  
22 pulse in this vicinity.

23 And all the USGS squares are kind of below  
24 1,000, some getting up close but sort of below 1,000.  
25 And so those never showed bomb pulse from this

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1 repository horizon area. And then the yellow boxes  
2 are some earlier LLNL work in the vicinity of the  
3 Sundance Fault here.

4 So the second part of my talk was the  
5 UCCSN follow-on work. Now, I've got to correct this  
6 slide. I said, "Proposals for a follow-on study were  
7 requested," And I was talking to a guy who did that  
8 work. And he had asked me to get together a proposal  
9 from the university system.

10 And the sense I got from him at the time  
11 is that he was getting several proposals together to  
12 look at. But it turns out he was just interviewing  
13 various people to see who the real good experts were.  
14 So I would change "Proposals for a follow-on study" to  
15 sort of "Interviews of chlorine-36 community were  
16 conducted. And possibilities were passed forward,  
17 evaluated, or something like that. I just wanted to  
18 note that because I was asked by one of my researchers  
19 about proposals.

20 And the proposal I got together from the  
21 university, I just asked them to pull one together.  
22 But they had, again, Fred Phillips, who was talked  
23 about by David as one of the early experts.

24 I looked at his list of publications, and  
25 there were 90-something publications from 1970

1 something forward. And I'm wanting to say 95 percent  
2 of them had "Chlorine-36" in the title. I don't know  
3 that he was doing any of the lab work or the sampling.  
4 He was more oversight.

5 And Jean Cline, a university professor who  
6 had worked on fluid inclusions earlier, her areas of  
7 expertise were Carlin coal deposits and high  
8 temperature fluid inclusions. And she did some  
9 low-temperature fluid inclusion work for us and dined  
10 out on that for a while.

11 And then her other area of interest is  
12 sampling biases, what effects they can have on a  
13 study. And she believed that the answer was in the  
14 fractures and the sampling and the way you looked at  
15 it. And she was kind of similar to your earlier  
16 statement. I believe maybe both of them were right if  
17 you just understood what you were measuring.

18 She wanted to look at the plains, the  
19 fracture plains, making them soft, just the plain  
20 itself, where fluid would have dropped, would have  
21 traveled, and then leach that, as opposed to leaching  
22 a lot of rock that may not have seen the fluid  
23 traveling fast.

24 But, anyway, that was the study. And we  
25 funded that. Their study was entitled "Bomb Pulse

1 Chlorine-36 at the Proposed Yucca Mountain Repository  
2 Horizon: An Investigation of Previously Conflicts and  
3 Collection of New Data."

4 And in their proposal, they were going to  
5 attempt to determine the cause of the conflicting  
6 results and obtain additional data and, at least  
7 informally, they told me that they were going to try  
8 and figure out what had happened to lead to the  
9 earlier conflicting results.

10 So they were gung ho to go. And they  
11 developed their scientific investigation plans over a  
12 couple of months. And right around Christmas of 2003,  
13 we're just about to go get their samples. My safety  
14 and health arm wanted to upgrade some mine power  
15 centers and some different things in there.

16 The bottom line is we put them on hiatus  
17 for a year while we upgraded those mine power centers.  
18 When you upgraded them, workers in the underground  
19 couldn't be there because maybe you had the  
20 ventilation off or you had safety issues.

21 And so they looked at all the work that  
22 was going on and judged it as to how critical it was.  
23 And I tried to have this be critical, but it's  
24 difficult to argue against safety. And in the end, I  
25 acquiesced. And we put that study on hold.

1           Of course, you lose a little focus with  
2 your team when you are on hold for a year. But early  
3 in 2005, we started back in to try to get some samples  
4 and finished our sampling in about July of 2005. And  
5 they leached their first set of samples for  
6 chlorine-36 in August of 2005 and sent me a  
7 spreadsheet of the results. And they had some data  
8 that were just really high.

9           If you were to look at this figure back on  
10 page 7 and see the range there is 100 to 10,000 and on  
11 the spreadsheet that they gave me out of those first  
12 samples, they had some numbers that were 300,000 and  
13 some of those were the samples that were measured  
14 during the early leaching experiments -- we still had  
15 some of that material left. And they were using that.  
16 They were trying to replicate, of course, earlier  
17 results also. And so they had some really high  
18 values.

19           I was on a telecon where Fred was talking  
20 it over with them about what --

21           MEMBER HINZE: Excuse me. Who did their  
22 sample corporation? And who did their measurements?

23           DR. D. COLEMAN: I think they did their  
24 own targets and leaching. They didn't send it to you  
25 guys to --

1 DR. ELMORE: I don't know.

2 DR. D. COLEMAN: You don't know for sure?  
3 I think they did their own. I think they prepared  
4 them sort of similar to Los Alamos, did their own  
5 leaching, did their own spiking, and did their own  
6 target preparation. But they're in the process of  
7 writing up their results. I'll be able to give you an  
8 answer. I'll take that question and try to get you an  
9 answer as to who did their spike.

10 Is that what you're asking, spiking?

11 MEMBER HINZE: Who did the analysis?

12 MEMBER WEINER: I guess Livermore did.

13 DR. D. COLEMAN: Analysis, AMS were sent  
14 to PRIME.

15 MEMBER CLARKE: They were sent to PRIME?

16 DR. D. COLEMAN: Oh, yes. Yes. He  
17 mentioned Jim Cizdziel earlier as somebody -- in fact,  
18 I think the results he showed were some of their later  
19 studies.

20 Now, when these high values came, we had  
21 a telecon with Fred on it. I mean, you know, I have  
22 to be careful what I say about somebody's lab -- it's  
23 the way they make their livings -- and, you know,  
24 having a rookie make a lot of statements that are  
25 wrong about what went on in someone's lab, but the

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1 bottom line was the only thing around I think that had  
2 that kind of levels was their new standard. So  
3 something had gotten away, you know.

4 I was going to actually ask David. When  
5 you buy a standard, how hot is a standard?

6 DR. ELMORE: It can be very hot, but --

7 DR. D. COLEMAN: A standard could be  
8 300,000 parts per 10 --

9 MEMBER HINZE: Excuse me. David, would  
10 you --

11 MR. D. COLEMAN: Move to the table.

12 DR. ELMORE: Typically users preparing  
13 samples do not prepare a standard. Okay? The  
14 standard only comes from the --

15 DR. D. COLEMAN: But you buy a NIST, a  
16 bottle of --

17 DR. ELMORE: Yes. I don't know what they  
18 sell, but there is a lot of chlorine-36 around. And  
19 a problem can be if a laboratory dealt with reactor  
20 materials for any purpose; for example, neutron  
21 activation analysis.

22 Chlorine can be a volatile forms and can  
23 be around for many years before in a lab. So it's  
24 very important to do a swipe test, to prepare a blank  
25 from dust in the room and that kind of thing.

1 DR. D. COLEMAN: I think they have blanks  
2 and stuff, you know, but --

3 DR. ELMORE: But yes. Certainly there are  
4 high sources of chlorine-36 that can get into samples  
5 --

6 DR. D. COLEMAN: Right.

7 DR. ELMORE: -- without you knowing it.

8 DR. D. COLEMAN: Right. So the bottom  
9 line was they had these high values. And Fred's  
10 recommendation was that they can destroy all their  
11 glassware and move to a new lab. And they took a shot  
12 at cleaning up their lab and cleaning up their  
13 glassware, but they still didn't like the results.  
14 They've now moved to a new lab.

15 And, you know, when that happens to you,  
16 then you spend a couple of rounds of AMS time trying  
17 to convince yourself that you've got numbers that you  
18 can believe in. So you're mostly blanks then, and  
19 you're sending them in to see if your lab is good.  
20 And that is kind of a lot of what they have been doing  
21 here recently.

22 I think the AMS runs chlorine-36 something  
23 like once a quarter. Is that accurate? So the time  
24 goes slow on sampling, but they got -- their most  
25 recent results came back on March 31. And it may have

1 even been some of those that you showed, those  
2 Cizdziels or he had some other ones in not too long  
3 ago. And that is kind of where they are at.

4 And contractually when you are working  
5 with coop tasks, you get -- if we can go back? I  
6 forget exactly where I'm at now, but maybe page 10.

7 MEMBER HINZE: I think 9 is where you --

8 DR. D. COLEMAN: Yes. Nine maybe I left  
9 off. So if we're on 10, they took measures to reduce  
10 their background and prepared and tested additional  
11 blanks to verify their techniques. They're reasonably  
12 confident they got these issues resolved.

13 And they have tested some rocket soil  
14 samples. Again, the samples were analyzed by PRIME on  
15 3/31 or maybe not on 3/31, but he got the results back  
16 on 3/31. So that may be. You may want to correct  
17 that little statement.

18 And they're being reviewed. Now, he  
19 didn't want to discuss his results with me, and I  
20 didn't really want to put them up on the board here  
21 until his team had reviewed them. You know, I'm  
22 sympathetic to the researchers that --

23 CHAIRMAN RYAN: That's fair enough.

24 DR. D. COLEMAN: -- about holding onto  
25 their data until they're ready to --

1 CHAIRMAN RYAN: Fair enough.

2 DR. D. COLEMAN: -- put it out. So their  
3 study has actually concluded because contractually  
4 their study, they thought they could do this study in  
5 18 months. And, of course, we put them on that  
6 one-year hiatus. And we gave them a one-year no-cost  
7 extension, but that's all you get under the way that  
8 contracts work or even grants, as these are our  
9 cooperative agreement with the university.

10 So my discussions with them indicate they  
11 are interested in pursuing further the study, but  
12 they're writing up their results to date. And they  
13 have some 60 days from the end of the contract at  
14 March 31 to write their results up and get them QAed  
15 and get all their data into the system. And they  
16 might be able to get a few extensions for that.

17 But that is pretty much where we are  
18 there. My management or at least my immediate  
19 management is interested in pursuing the chlorine-36  
20 work with the university. I'm interested in pursuing  
21 it. I think they're interested in pursuing it.

22 But the actual work of either getting it  
23 in the annual plan or putting together a change  
24 through DOE's processes is kind of in the works right  
25 now.

1           And they have quite a few samples that  
2 remain unleached. They got a lot of samples so that  
3 they could slice off portions and test it. And  
4 they're confident that they haven't contaminated those  
5 existing samples, although when I was talking to them  
6 just the other day, they probably would want to come  
7 and get some more samples.

8           But I think I will end my talk there and  
9 try to field questions as best I can.

10           MEMBER HINZE: Well, we thank you very  
11 much, Drew, understanding the limitations of not  
12 having the report from the validation study or report  
13 from the university cooperative work.

14           DR. D. COLEMAN: Yes. Maybe one further  
15 point. I agree with you and David that the instrument  
16 is the least likely source of the big errors and the  
17 errors are elsewhere or the conflicting results.

18           I guess, although maybe characterizing  
19 clearly the errors, like the point you made, is a good  
20 one, I think our difficulties are involved in maybe  
21 the contamination or the sampling or the preparation  
22 of the samples.

23           My sense is once you get it into water and  
24 get it to them, it's really a pretty routine  
25 measurement. A lot of people use it and a lot of

1 people have confidence in my investigators taking a  
2 water sample from depth and sending it. They would  
3 have no worries. It's somewhere in the leaching and  
4 sampling and contamination world that people worry  
5 about the technique.

6 CHAIRMAN RYAN: The real secret is when we  
7 turn your sense of that into numbers.

8 DR. D. COLEMAN: Yes.

9 CHAIRMAN RYAN: That is when we will know  
10 what is right and wrong.

11 DR. D. COLEMAN: Right.

12 CHAIRMAN RYAN: I mean, I just find that  
13 your talk was interesting. Your folks are obviously  
14 qualified and have done a good job. You know, when  
15 they start this process, they end up having all sorts  
16 of headaches and problems.

17 This is not, as I think was pointed out  
18 earlier, an easy measurement to make and certainly  
19 systematic. To me, it screams out for a systematic  
20 assessment of uncertainty.

21 DR. D. COLEMAN: Yes.

22 MEMBER HINZE: Let's make certain we have  
23 all the questions asked. Dr. Clarke?

24 MEMBER CLARKE: Thank you, Drew.

25 Can we go to slide 5? I'd like to go

1 through this slide, maybe the next one for two  
2 reasons: one, to make sure that I understand it; and,  
3 two, I think that will give us an opportunity as we go  
4 through the slide to point out the possible sources of  
5 error.

6 So, as I understand it, one core is  
7 reached. There were two cores. One core was reached,  
8 and that leachate was sweat.

9 DR. D. COLEMAN: Well, I'm wanting to say  
10 cores as sort of plural here. Core would be any one  
11 of the sets of core from the 40 bore holes.

12 MEMBER CLARKE: No, no. What I am saying  
13 is that the U.S. leached samples from the validation  
14 core and they split the leachate.

15 DR. D. COLEMAN: Okay.

16 MEMBER CLARKE: Well, you know, if there  
17 were two cores, then that's a source.

18 DR. D. COLEMAN: All right. You have the  
19 same core.

20 MEMBER CLARKE: If there was one core and  
21 they split the leachate, I would think splitting the  
22 leachate would be -- I don't think I would be too  
23 upset about that.

24 DR. D. COLEMAN: Yes.

25 MEMBER CLARKE: But now they go to

1 different groups. And those groups process the  
2 sample, I guess, to remove the interferences that  
3 David mentioned.

4 DR. D. COLEMAN: The spiking, the  
5 precipitation of the target. And it's just the  
6 process that these kinds of AMS guys use. Maybe you  
7 can weigh in on it. I don't know.

8 MEMBER CLARKE: No. Here I think we're  
9 getting into some real possibilities for variation.

10 DR. D. COLEMAN: Okay.

11 MEMBER CLARKE: So I would put a circle  
12 around that second bullet.

13 Then the results of the two generally  
14 agree. Now, is that the range of all of the data or  
15 is that the range of the disagreement?

16 DR. D. COLEMAN: They had a graph. And  
17 I'm not as good at Powerpoint presentations as I would  
18 like to be, but this would be USGS and Los Alamos.  
19 And they had a one-to-one line. And those samples  
20 just lay right on it from that using, one, their  
21 technique; and, the other, his technique. And they  
22 were all low. They were in the range of 250 to 500,  
23 but they had a really nice one-to-one line fit there.

24 MEMBER CLARKE: Then the other point I  
25 guess I would make is that these samples went to the

1 same lab. Is that right?

2 DR. D. COLEMAN: The same AMS lab?

3 MEMBER CLARKE: Yes.

4 DR. D. COLEMAN: Yes. I think they both  
5 went to --

6 MEMBER CLARKE: Livermore.

7 DR. D. COLEMAN: -- Livermore at that  
8 time.

9 MEMBER CLARKE: So you've got --

10 DR. D. COLEMAN: Los Alamos didn't use  
11 them a lot. And the USGS purposely used Livermore.  
12 But then toward the end, I mean, Caffee had been at  
13 Livermore. And then he went to PRIME, and that sort  
14 of confused the whole --

15 MEMBER CLARKE: Let's just stick with this  
16 slide.

17 DR. D. COLEMAN: All right.

18 MEMBER CLARKE: Okay? Because we have  
19 identified that there was one core. So we're not into  
20 variation between core to core. We do know that they  
21 processed the samples perhaps differently at different  
22 locations. That could be a major source of  
23 disagreement.

24 DR. D. COLEMAN: Well, they got the  
25 one-to-one fit, though, on those.

1 MEMBER CLARKE: Well, but, you know,  
2 again, we're looking at variation of the data.

3 DR. D. COLEMAN: Yes.

4 MEMBER CLARKE: And then if they went to  
5 the same lab and there is no inter-lab variation,  
6 there is just intra-lab variation, in other words,  
7 these samples would have been at variations times.  
8 There could be variation from room to room.

9 But I think if you go through this in the  
10 end and nail down where it went and where did it  
11 apply, I think you can identify the sources of  
12 disagreement. You can do the same thing for the next  
13 one.

14 So I think I like Mike's suggestion.  
15 Again, this may all be one distribution.

16 DR. D. COLEMAN: You know, one of the nice  
17 parts about having them wire the report up is to have  
18 it all laid out in black and white so anybody can read  
19 it. Maybe somebody can spot the point problem, "Oh,  
20 there's your problem right there."

21 CHAIRMAN RYAN: Hopefully the raw data  
22 will be in the report.

23 MEMBER CLARKE: The only thing that this  
24 suggests is that there really is merit to describing  
25 variation from method to method. And there is merit

1 to somehow quantifying uncertainty from lab to lab if  
2 these are going to continue. And then I think you can  
3 start to get a handle on it.

4 So a systematic approach through what was  
5 done, who did it, where it was done, you know, could  
6 I think be very helpful. You haven't done, I guess,  
7 enough analyses. You have no inter-lab variation --  
8 maybe you do; I don't know -- or inter-method  
9 variation between these different sample processes.

10 DR. D. COLEMAN: Yes. We have probably  
11 got data available to take a look at different --

12 MEMBER CLARKE: If you have got the data,  
13 then you could do a fix on that to some extent.

14 Thank you. That was my only -- really, it  
15 wasn't a question. It was one --

16 MEMBER HINZE: Dr. Ryan?

17 CHAIRMAN RYAN: Thank you, Professor  
18 Hinze. Just one last comment.

19 I'm reading the last slide. The technique  
20 that is testing rock samples from deep, unsaturated  
21 zone for bomb pulse chlorine-36 needs additional  
22 confirmation to build confidence in the measurement  
23 interpretation of data.

24 I guess I still agree with that. That is  
25 what I said -- I don't know -- two years ago at a

1 meeting in Vegas. I'm concluding that the ball isn't  
2 much further down the field at this point.

3 DR. D. COLEMAN: Yes. I would say that is  
4 a pretty good conclusion.

5 CHAIRMAN RYAN: Okay.

6 DR. D. COLEMAN: You know, there are some  
7 suggestive things in there.

8 CHAIRMAN RYAN: Right. You've got to --

9 DR. D. COLEMAN: We can look at them, but  
10 --

11 CHAIRMAN RYAN: We haven't gotten to first  
12 down.

13 DR. D. COLEMAN: Again, I hope this  
14 doesn't imply that it's just using this technique for  
15 fast pathways to the deep unsaturated zone, leaching  
16 that water out I'm talking about here, not the AMS or  
17 water samples or --

18 CHAIRMAN RYAN: No. Again, I appreciate  
19 the fact, one, this is a very difficult measurement;  
20 two is it takes real expertise and precision to do it.  
21 But in spite of the best efforts, it seems like it's  
22 hard to really nail down, you know, what is an actual  
23 sample value and what the distributions might be. And  
24 we're still struggling with that in the application of  
25 taking a sample all the way through to the end and

1 reporting a measurement.

2 DR. D. COLEMAN: And this is sort of a DOE  
3 conclusion. If you were to ask some of my  
4 researchers, particularly Los Alamos ones, they might  
5 have a different look at this. They have validated  
6 their results. And so that is probably something I  
7 should mention here also, you know.

8 MEMBER HINZE: They'll have a chance to  
9 express that in the report, right?

10 DR. D. COLEMAN: Yes. You can read that  
11 for yourself.

12 MEMBER HINZE: Okay.

13 CHAIRMAN RYAN: Allen?

14 VICE CHAIRMAN CROFF: I guess, as a  
15 practical matter, do you have any alternatives to this  
16 whole approach?

17 DR. D. COLEMAN: Well, our analysis is not  
18 inconsistent with a few fast pathways. And I think  
19 that is a reasonable modeling approach. So yes, I  
20 don't -- I mean, this data could be helpful. And it's  
21 interesting data to pursue.

22 And knowing that on the speed of travel of  
23 water to the repository horizon is a good thing to  
24 know. And I don't want to minimize the value that it  
25 could have, but I don't see this as snagged up or

1 anything waiting on this measure.

2 I mean, this is a measure that we  
3 undertook. And we're doing some more work to try to  
4 make sure we understand it. But it's not on the  
5 critical path, I don't believe, to -- you know, maybe  
6 moving forward with the license for the repository.  
7 That would be my -- so we're going to continue to  
8 pursue it and hopefully resolve it. And hopefully it  
9 will give some understanding of the --

10 VICE CHAIRMAN CROFF: Roughly how long is  
11 it that it is believed that water takes to go from the  
12 surface on one of these fast paths down to the  
13 repository horizon? Is it a 50-year or 500 or --

14 DR. D. COLEMAN: Yes, 50 or so years. If  
15 it's got a bomb pulse signature that you can  
16 confidently conclude, then that took place. Somebody  
17 could give you the hour, minute, and second that it  
18 was a bikini atoll test or something like that.

19 VICE CHAIRMAN CROFF: It was in the mid  
20 1950s. Somebody initiated the experiment that put the  
21 tracer in at the surface. I mean, granted, it may  
22 take a few years, but --

23 DR. D. COLEMAN: I don't think that's what  
24 they were thinking about, but people like David here  
25 are figuring out ways to utilize them. And that

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1 worked to increase everybody's knowledge, I guess,  
2 interesting work.

3 VICE CHAIRMAN CROFF: Okay. Thanks.

4 CHAIRMAN RYAN: Ruth, take it away.

5 MEMBER WEINER: Is there anywhere in the  
6 world where you can measure the variation of  
7 chlorine-36 without the interference of a bomb pulse  
8 or where you could with some confidence subtract the  
9 interference of the bomb pulse? What I'm getting at  
10 is, what is the variation that you get in chlorine-36?  
11 What is the range of variation without that? Do you  
12 know or is there any way to figure that out?

13 DR. ELMORE: There's been a lot of work  
14 done with ice cores from Greenland and Antarctic. And  
15 most of that ice is deeper than -- the H's are known  
16 pretty well for the ice. And that's where the bomb  
17 pulse is measured in an ice core.

18 And so the deeper ice, which goes back as  
19 far as 300,000 years -- and there have been profiles  
20 back there. And then there is nothing that sticks out  
21 anything close to the bomb pulse. It's all below  
22 1,000 times  $10^{-15}$ .

23 MEMBER WEINER: That answers my question.

24 DR. D. COLEMAN: I've seen graphs where it  
25 varied between 500 and 1,000 or something. And this

1 one has holocene. If you go to slide 7, you've got  
2 sort of holocene and maximum pleistocene, but it's  
3 varied through time. And I'm not sure exactly the  
4 mechanism for that.

5 It would be like magnetic field changes or  
6 something like that. That is the range sort of that  
7 it's varied between, I think.

8 DR. ELMORE: Yes, 500 to 1,000. I mean,  
9 there is another source, from mountaintops, where the  
10 cosmic ray flux is higher, production in the top meter  
11 of the surface. And that can go to a few thousand  
12 probably. So it can go higher than this but nothing  
13 like the bomb pulse.

14 MEMBER WEINER: There is nothing that  
15 would be comparable to the very high levels that you  
16 see in these reports?

17 DR. ELMORE: That is correct. And even if  
18 it's, I mean, somehow contamination from a nuclear  
19 facility or something, which could be more recent.  
20 But we know none of that goes past 1945. So prior to  
21 1945, there are no manmade sources either.

22 MEMBER HINZE: A last question. When can  
23 we anticipate a report from the university and  
24 community college system?

25 DR. D. COLEMAN: Well, 60 days from March

1 31 is their deadline to have their data in and through  
2 QA and some sort of a report. Now, it may not be this  
3 report that the USGS is working on in Los Alamos is  
4 two inches. And I'm thinking 60 days, you're going to  
5 be looking more like, you know, 10 pages with 4  
6 figures or something, which in some ways is a better  
7 report than your two-inch report anyway. So 60 days,  
8 I guess, is -- and they may be able to apply for some  
9 extensions but should be available maybe in the summer  
10 here.

11 MEMBER HINZE: Well, we'll appreciate a  
12 heads up through Neil Coleman on that. With that, I  
13 thank both of you gentlemen for excellent  
14 presentations. It's been very helpful, very  
15 informative. And with that, I'll turn it back to the  
16 Chairman.

17 CHAIRMAN RYAN: And, with that, Professor  
18 Hinze, it's time to adjourn for lunch and reconvene at  
19 2:00 o'clock.

20 (Whereupon, a luncheon recess was taken  
21 at 12:01 p.m. until 2:01 p.m.)

22 CHAIRMAN RYAN: This is Mike Ryan,  
23 Chairman of the ACNW. I would like to call the  
24 afternoon session to order and if I could ask the  
25 folks on the conference call phone to tell us who you

1 are.

2 MR. FITZPATRICK: Charlie Fitzpatrick from  
3 the State of Nevada.

4 CHAIRMAN RYAN: Okay. Thank you. Anybody  
5 else?

6 MR. JENKINS-SMITH: Yes. Hank Jenkins-  
7 Smith, Texas A&M University.

8 CHAIRMAN RYAN: Hello Hank. Okay. Thank  
9 you for introducing yourselves. We have reconvened  
10 the Committee and our afternoon speakers. Our session  
11 is going to be broken into two parts this afternoon.  
12 The first part Dr. Weiner will lead us in a discussion  
13 of a recent National Academy Transportation Study and  
14 then we'll go onto the NARM, Naturally Occurring or  
15 Accelerator-Produced Radioactive Materials rulemaking.

16 But before we do that, I'd like to  
17 introduce again to members and staff and particularly  
18 the staff beyond the ACNW staff a recent addition to  
19 the ACNW staff. Dr. Antonio Diaz joined the ACNW  
20 staff on April 10th. He will be working as the Team  
21 Leader for ACNW Technical Support branch. Dr. Diaz  
22 has a Bachelors degree in Electrical Engineering and  
23 a Masters degree in Nuclear Engineering from Brazil  
24 and he is a Ph.D. in Nuclear Engineering from the  
25 Massachusetts Institute of Technology.

1 He joined the NRC in November 2001 as a  
2 Technical Reviewer in the Spent Fuel Project Office  
3 where he was involved in the review of several  
4 transportation and storage applications in the  
5 technical areas of Thermal Criticality and  
6 Containment. He also participated in inspections of  
7 waste storage not only reviewing operations but also  
8 their associated procedures.

9 He acted as Section Chief for two months  
10 supervising the Technical Review group, TRA. Prior to  
11 joining the NRC, Dr. Diaz worked for several years as  
12 a consultant providing services to many U.S. utilities  
13 as well as the Electric Power Research Institute.

14 His main area of expertise was  
15 assimilation of multi-dimensional time-dependent  
16 neutronic and thermal hydraulic postulated events for  
17 light water reactor. Dr. Diaz's early MS work  
18 addressed the behavior of light water reactor fuel  
19 elements during normal and transient conditions in  
20 order to understand possible fuel failure causes.

21 Dr. Diaz, welcome to the staff and welcome  
22 to the ACNW.

23 DR. DIAZ: Thank you very much.

24 CHAIRMAN RYAN: And with that, Ruth, I'll  
25 turn over the next segment of the session to you.

1 Thank you.

2 MEMBER WEINER: Thank you, Mr. Chairman.  
3 The next section of our meeting we'll be discussing  
4 the recently issued National Research Council report  
5 on Transportation of Spent Nuclear Fuel and High Level  
6 Waste entitled "Going the Distance." And our  
7 panelists are, our panel, in fact, will be led by  
8 Kevin Crowley who is the Study Director for the  
9 Nuclear and Radiations Studies Board and he is  
10 assisted here by Joseph Morris who is the Senior  
11 Program Officer who will help him.

12 We also have Dr. Mel Kanninen who will  
13 talk on long duration fires and on anything else that  
14 you would like to add to. On the telephone, we will  
15 have hopefully Dr. Claude Young from the U.K.  
16 Although it is 7:00 p.m. in the U.K. now, he has  
17 graciously agreed to be present by phone and Dr. Hank  
18 Jenkins-Smith from Texas A&M University to talk about  
19 social and institutional challenges.

20 Please if there are any people in the  
21 audience who would like to make a statement or ask a  
22 question our normal procedure is to go first, have the  
23 presentations and have members of the Committee and  
24 staff ask questions and then there is enough time  
25 allowed, I believe, for anyone who wishes to make a

1 comment or ask a question to speak up. If you haven't  
2 signed in, I will recognize you at the time. With  
3 that said, Dr. Crowley, go ahead.

4 DR. CROWLEY: Thank you very much for the  
5 invitation to be here today. I'm sorry that more of  
6 our committee members couldn't join us, but they are  
7 pretty busy folks. What I'd like to do if it's all  
8 right with you is to take ten to fifteen minutes and  
9 just give you a high level overview of what's in the  
10 report and then we can dive into the issues that  
11 you've identified. Does that sound all right?

12 MEMBER WEINER: Certainly.

13 DR. CROWLEY: And it will be up to you  
14 whether or not you want to stop me along the way or  
15 whether you just want me to get through this. It's  
16 your pleasure.

17 MEMBER WEINER: I've noticed that the  
18 Committee is not shy about asking questions when they  
19 arise.

20 DR. CROWLEY: All right. So I have  
21 somebody to change the slides for me presumably. All  
22 right. Let's go directly to the next slide. I'm  
23 going to hit some of these very quickly and then spend  
24 a little time on some of the others.

25 This slide is just to remind you that

1 there are really two parts of this study, a part that  
2 was self-initiated looking at the risks of transport  
3 and key technical and societal concerns particularly  
4 over the next two decades. When we were almost  
5 completely finished with this study, we added a  
6 congressionally-mandated task looking at the matter in  
7 which DOE selects routes for shipment of research  
8 reactor fuel. So we had an additional meeting and we  
9 basically had to completely reorganize the report in  
10 order to include that extra task. Next slide.

11 Just a list of the study sponsors of which  
12 the Nuclear Regulatory Commission is one. Next slide.

13 This is the list of the study committee.  
14 You'll recognize some of these people but not all of  
15 these people. It was chaired by Dr. Neal Lane of Rice  
16 University who was formerly the Director of National  
17 Science Foundation and the President's Science  
18 Advisor.

19 And if you go to the next slide, you can  
20 see the collective committee expertise that is  
21 represented by the members. When we put this  
22 committee together, we tried to make sure that we had  
23 certainly the right mix of disciplinary expertise, but  
24 we also tried to have a balance between members who  
25 have worked in the nuclear spent fuel and high level

1 waste transportation area and members who have  
2 relevant technical expertise but who haven't worked in  
3 this area. Next slide.

4 So let me just go to the bottom line  
5 messages for the study. This is the first one and I  
6 think probably the most important one. The committee  
7 could identify no fundamental technical barriers to  
8 the safe transport of spent fuel and high level waste  
9 in the United States, but there are a number of  
10 societal and institutional issues, institutional  
11 challenges, to the successful initial implementation  
12 of large quantity shipping programs. The committee  
13 defines large quantity shipping programs as programs  
14 that ship on the order of hundreds to thousands of  
15 metric tons of spent fuel or high level waste and it  
16 specifically identified the Yucca Mountain Program and  
17 the Private Fuel Storage Program as examples of those  
18 types of large quantity programs.

19 This message, the committee spent a lot of  
20 time talking about this message. It's very carefully  
21 and narrowly constructed. It focuses on the technical  
22 aspects of transportation program. It's based on an  
23 assessment of past and present research programs and  
24 would apply to future programs only to the extent that  
25 they continue to exercise appropriate care and adhere

1 to applicable regulations. Next slide.

2 This is the committee's message with  
3 respect to security. When the Statement of Task was  
4 initially constructed which was before September 11th,  
5 the focus was not on security. It was on safety.  
6 After September 11th, we began to have discussions  
7 with the agencies, particularly the Nuclear Regulatory  
8 Commission, about trying to expand the task. We  
9 actually had a small group of committee members  
10 including Mel, Dr. Kanninen, who received a classified  
11 briefing from the Nuclear Regulatory Commission on the  
12 work that they were doing, although we didn't get any  
13 details on the results.

14 It was really just a scoping briefing and  
15 the committee concluded that there was enough  
16 information to perform, to do, a security review as  
17 part of this report, but we essentially ran out of  
18 time to do it and also there were questions about what  
19 information the unclear members of the committee could  
20 get and what we could put into an unclassified final  
21 report. So the committee was unable to perform an  
22 examination but recommended that such an independent  
23 examination be done and noted that in order to  
24 undertake such an independent examination, it would  
25 require the cooperation of several federal agencies.

1 Next slide.

2 Chapter 2 of the report addresses in  
3 detail package performance and this is something that  
4 Mel will be talking about a little later, but these  
5 are the committee's bottom line messages on that that  
6 the committee felt that current international  
7 standards and U.S. regulations are adequate to ensure  
8 package containment effectiveness over a wide range of  
9 conditions. But there might be a small number of  
10 extreme accident conditions involving very long  
11 duration fires and the committee recommended that the  
12 Nuclear Regulatory Commission undertake additional  
13 analyses of very long duration fire scenarios.

14 The Commission was in the process of doing  
15 work while the committee study was underway. Some  
16 results came out just as the committee was publishing  
17 its report. The committee noted those results but  
18 didn't have an opportunity really to examine and  
19 assess them. I think what the committee is really  
20 looking for is the Commission to demonstrate that it  
21 has an bounding level understanding of real world  
22 conditions that might lead to very long duration fires  
23 and that the Commission should put into place any  
24 appropriate operational controls and restrictions to  
25 reduce the likelihood that such fires would be

1 encountered or to reduce their consequences if they  
2 were encountered. Next slide.

3 Package testing, something else that Mel  
4 will be prepared to talk a little bit more about. The  
5 committee strongly endorses full scale testing and  
6 recommends that full scale testing should continue to  
7 be used as part of an integrated testing program. The  
8 committee also recommended the full scale testing of  
9 packages to deliberately cause their destruction  
10 should not be required. And again, this is a  
11 recommendation that the committee spent a lot of time  
12 on the wording and I want to emphasize it says "Full  
13 scale testing should continue to be used as part of  
14 integrated testing programs." Basically, what that  
15 means is keep doing what you're doing. Next slide.

16 Transportation risk, Chapter 3 of the  
17 report has a fairly lengthy discussion of  
18 transportation risk and the conclusions, the findings,  
19 from that are shown here. The committee found that  
20 the radiological health and safety risks associated  
21 with transport are generally low, again, with a  
22 possible exception of long duration fires, but the  
23 Committee also noted that the likelihood of such fires  
24 appears to be small and that their incurrence and  
25 consequences can be further reduced through relatively

1 simple operational controls and restrictions.

2 This finding that the radiological health  
3 and safety risks are low are based on a number of  
4 issues that were examined in the chapter, looking at  
5 historical shipments, looking at historical accidents  
6 and incidents, looking at the large number of  
7 analytical and computer modeling studies that have  
8 been done and looking at the full scale testing  
9 studies that have been done. Next slide please.

10 Social risks, this will be something that  
11 Hank, I hope, will address in more detail. The  
12 committee found that the social risks for  
13 transportation pose important challenges and that  
14 transportation planners can take early and proactive  
15 steps to establish formal mechanisms for gathering  
16 advice about these risks and the committee recommends  
17 that DOE take two steps to try to deal with the issue  
18 of transportation risk by creating a new advisory  
19 group and augmenting our current advisory group. I  
20 want to point out that the committee did not -- One of  
21 the things I've heard in the press is that the  
22 committee has called for more research on social risk.  
23 Actually, the committee's recommendations are for very  
24 pragmatic, problem solving steps that should be taken  
25 not just go back and do more research. Next slide.

1           There are several measures of comparative  
2 risk that are provided in Chapter 3, two of them of  
3 which I'm going to show you figures for on the next  
4 two slides, but one other quantitative measure just  
5 comparing the number of estimated latent cancer  
6 fatalities for a Yucca Mountain transportation program  
7 based on the final EIS that DOE published versus the  
8 number of cancer fatalities that you would expect just  
9 in the general population and the comparison is one to  
10 three latent cancer fatalities for normal transport  
11 for a Yucca Mountain program versus the four to six  
12 million fatalities that you might just expect from  
13 other causes. Next slides.

14           The committee presented what it calls a  
15 "Risk Ladder" for normal transportation risks. Let me  
16 step back for a minute and talk a little bit about the  
17 committee's philosophy in developing risk comparisons.  
18 Again, this was an issue that took a lot of time in  
19 the committee's closed meeting for discussion, but the  
20 committee decided very early on that it did not want  
21 the report to appear to be advocating for any  
22 particular level of risk and truly wanted to present  
23 information that someone who didn't know a lot about  
24 this topic could look at that information and then  
25 could decide for themselves what the transportation

1 risks were.

2 So what the committee attempted to do in  
3 comparing risks for high level waste and spent fuel  
4 transportation was to bracket them both above and  
5 below with risks for other kinds of societal  
6 activities. Early on in the committee's  
7 deliberations, there was discussion about what sorts  
8 of risk should you consider. Should you consider, for  
9 example, spent fuel and high level waste  
10 transportation risks and compare those to smoking or  
11 driving in a car and things of that sort and the  
12 committee said, "No, that's not where we want to go.  
13 We want to try to compare like risks."

14 So in the comparisons, they were really  
15 based on for normal transport conditions, exposures,  
16 other kinds of exposures to radiation and those  
17 exposures are shown here. There's a whole list of  
18 them, things like background radiation, radiation that  
19 you would get from airline flights, radiation that you  
20 would get from medical procedures. There's a lengthy  
21 discussion in the report about the pros and cons of  
22 presenting that kind of information, but this is  
23 basically where the committee came out.

24 In this figure, I know you can't read all  
25 of it, but the black bars show the various estimated

1 exposure types of a Yucca Mountain transportation  
2 program. The bar at the top is worker exposure. As  
3 it turns out, workers according to the DOE EIS are  
4 going to have fairly high exposures. In fact, workers  
5 are going to be burned out according to the EIS. As  
6 you get down into the public exposures, they are  
7 considerably lower and the lowest exposure, somebody  
8 who lives along a rail route that is used to transport  
9 spent fuel and high level waste, the committee could  
10 not find anything that was lower, a lower bracket  
11 below that, and that's the lower black bar around the  
12 figure.

13 MEMBER WEINER: Let me interrupt you just  
14 a moment.

15 DR. CROWLEY: Sure.

16 MEMBER WEINER: I assume that since this  
17 is from the FEIS that the worker dose was based on  
18 workers having to transfer bare fuel from the  
19 transport containers to the waste packages.

20 DR. CROWLEY: No, these are the workers  
21 that are going to receive doses during the transport  
22 program. So these include the people who will be  
23 driving the trucks, people who will be in the escort  
24 cars, people who will be doing the inspections of the  
25 cars.

1 CHAIRMAN RYAN: Could you define "burned  
2 out"?

3 DR. CROWLEY: They would receive the  
4 maximum allowable dose in a given year.

5 CHAIRMAN RYAN: You show 20 millisieverts  
6 and elements 50.

7 DR. CROWLEY: The DOE administrative limit  
8 is two.

9 CHAIRMAN RYAN: Administrative.

10 DR. CROWLEY: Right.

11 CHAIRMAN RYAN: "Burned out" is a relevant  
12 term. I just want to make sure that's clear.

13 DR. CROWLEY: Well, the report does not --

14 CHAIRMAN RYAN: You're not talking about  
15 anybody exceeding a regulatory limit.

16 DR. CROWLEY: No, and in fact the report  
17 does not use the term "burned out." That was a term  
18 that I used.

19 CHAIRMAN RYAN: I just want it to be clear  
20 because we're on the record. Thank you.

21 DR. CROWLEY: Okay. All right. The next  
22 slide shows a calculation that the committee did for  
23 accident conditions of transport and we used the  
24 complimentary cumulative distribution functions here  
25 comparing spent fuel and high level waste to other

1 kinds of hazmat transport and again the committee made  
2 an effort to find an upper and lower bracket, but was  
3 unable to do so. The top three curves show the CCDF's  
4 for three different kinds of hazmat, chlorine, propane  
5 and methanol and you can see the spent fuel CCDF is  
6 several orders of magnitude below that.

7 MEMBER WEINER: Again, what was your  
8 source of data for releases for the spent fuel?

9 DR. CROWLEY: That was from the Sprung and  
10 others, the 2000 Reexamination Report.

11 MEMBER WEINER: And did you consider in  
12 the accidents the sort of accident where the truck  
13 just sits there for hours and hours until somebody  
14 comes along and moves it when you have a fender  
15 bender? It doesn't affect the cargo, but the truck  
16 just sits.

17 DR. CROWLEY: No, this would be an  
18 accident that involved the actual release of  
19 radioactive material.

20 MEMBER WEINER: Thank you.

21 MEMBER HINZE: Does that include a fire?

22 DR. CROWLEY: Actually, I think the  
23 maximum releases are in a fire. You get the maximum  
24 releases in a fire, not from the mechanical impacts.

25 Okay. Let's go on. Again, I'm going to

1 just get through this quickly so that we can then come  
2 back and discuss some of this. Chapter 4 deals with  
3 research reactor spent nuclear fuel routing and this  
4 was the add-on task from Congress looking at DOE's  
5 program for selecting routes for research reactor  
6 spent fuel. There are two major findings here and Joe  
7 will be able to speak in more detail to this because  
8 he helped the committee prepare this chapter.

9 But the committee found that DOE's  
10 procedures for selecting routes within the U.S. for  
11 shipments of foreign research reactor fuel appear on  
12 the whole to be adequate and reasonable and the DOT  
13 routing regulations are a satisfactory means of  
14 insuring safe transportation provided that shippers  
15 actively and systematically consult with states and  
16 tribes along potential routes and states follow route  
17 designation procedures. Next slide.

18 That's all I'm going to say about Chapter  
19 4. Now let me finish up with just going through some  
20 of the findings and recommendations in Chapter 5 which  
21 is "Improving Spent Fuel and High Level Waste  
22 Transportation in the United States." Many of these  
23 findings and recommendations focus on Yucca Mountain,  
24 but the committee states in the chapter they would  
25 also apply to other large quantity shipping programs

1 and the committee notes that private fuel storage is  
2 an example of such a program. I also want to point  
3 out the committee did not attempt to undertake a  
4 detailed programmatic review of the DOE transportation  
5 program, although during the study the committee  
6 received several briefings from DOE and kept itself  
7 informed of the latest changes in DOE's program. Next  
8 slide.

9 The committee strongly endorsed DOE's  
10 decision to use mostly rail and to ship by dedicated  
11 train and recommended that DOE fully implement those  
12 decisions before commencing the large quantity  
13 shipment to the repository and also examine the  
14 feasibility of further reducing the need for cross-  
15 country truck shipments. The real concern here is, I  
16 think, if the Yucca Mountain repository were to open  
17 before the rail spur were finished, DOE might spend a  
18 lot of time and a lot of money standing up a truck  
19 program and might actually not have the time and the  
20 money to finish the rail program and could be stuck  
21 with a long term truck transport program. Next slide.

22 The committee recommended that DOE make  
23 public its suite of preferred highway and rail routes  
24 as soon as possible. Again, this would be for Yucca  
25 Mountain to support state, tribal and local planning.

1 And the committee recommended that DOE follow the  
2 practices of its research reactor spent fuel transport  
3 program which we discussed in Chapter 4 of involving  
4 states and tribes in the routing selections even for  
5 rail routing for which the states now do not have a  
6 formal role in selecting routes like they do for  
7 highways. Next slide.

8 The committee had something to say about  
9 the acceptance order for transport of spent fuel to a  
10 Yucca Mountain repository. Right now, the standard  
11 contract requires DOE to accept whatever fuel an owner  
12 wants to give it when the owner's spot in the  
13 acceptance view comes up and the committee recommends  
14 that DOE should negotiate with the spent fuel owners  
15 to ship older fuel first, not the oldest fuel  
16 necessarily, but older fuel first and that should  
17 these negotiations prove infective, Congress should  
18 consider legislative remedies and then finally, the  
19 committee recommended that DOE initiate transport to  
20 the repository with a pilot program involving  
21 movements of older fuel from closed reactors.

22 There were several things that drove the  
23 committee's thinking on this one, but one of the  
24 concerns again was the worker exposures. If you  
25 remember a few slides ago, the workers are getting

1 fairly high exposures. Also another concern is if  
2 there were to be an accident or a terrorist attack and  
3 you did have a release from the spent fuel package,  
4 obviously the colder and radiologically cooler that  
5 fuel is the better it is. Next slide.

6 The committee had something to say about  
7 emergency responder preparedness and recommended that  
8 DOE should immediately begin to execute its  
9 responsibilities and also federal agencies should  
10 promptly complete the job of developing, applying,  
11 disclosing criteria for protecting sensitive  
12 information. Protect what needs to be protected.  
13 Make the material that doesn't need to be protected  
14 open and accessible and we can talk a little bit more  
15 about the emergency response if you want in the  
16 follow-up.

17 MEMBER WEINER: I may reserve this  
18 question for Dr. Morris, but it's my understanding and  
19 has been my experience on the Whip project that DOE  
20 has been preparing emergency responders for some years  
21 now, that there is an on-going program. Are you going  
22 to comment on that?

23 DR. MORRIS: I wasn't planning on  
24 commenting on emergency response.

25 DR. CROWLEY: I can respond to this.

1 There is an active emergency response preparedness  
2 program for WHIP. That's correct.

3 MEMBER WEINER: I think there's also been  
4 an on-going emergency response preparedness under the  
5 applicable sections of the Nuclear Waste Policy Act,  
6 isn't there?

7 DR. CROWLEY: At this point, my  
8 understanding is that DOE has a Transportation  
9 External Coordination Working Group and they've been  
10 discussing emergency response, but at this point, DCE  
11 has not yet begun to execute its 180<sup>c</sup>)  
12 responsibilities.

13 And then finally, the next slide, yes, No.  
14 6, the committee makes a recommendation about the  
15 structure for DOE's programs for transporting spent  
16 fuel and high level waste to a federal repository and  
17 recommends that DOE's Secretary and U.S. Congress  
18 examine several options for changing that structure  
19 and the three possibilities that are discussed in the  
20 report are listed there, a quasi-independent DCE  
21 office, a quasi-government corporation or a fully-  
22 private organization and it would have been beyond the  
23 committee's task to recommend any one of those in the  
24 report. But the report does go through a fairly  
25 extensive discussion of the pros and the cons of each

1 of those organizational structures. And then finally,  
2 last slide.

3 We released the prepublication version of  
4 the report in February and it's available on that  
5 website. We're now working on the final version of  
6 the report which we'll have editorial and copy editing  
7 corrections and that should be issued in June. That  
8 in a nutshell is what's in the report.

9 MEMBER WEINER: Thank you. Are there any  
10 further questions from any?

11 CHAIRMAN RYAN: Just a quick follow-up.  
12 It's on the worker exposure question. Was that based  
13 on an analysis of calculational approaches to  
14 estimating worker dose or actual worker dose for folks  
15 that have moved that kind of material already?

16 DR. CROWLEY: In the DOE EIS for Yucca  
17 Mountain, it was based on assumptions, fairly  
18 conservative assumptions I should say, about the  
19 radiological age of the fuel that would be moved.

20 CHAIRMAN RYAN: So I think it's really not  
21 fair to say that workers will receive a dose or they  
22 will be burned out or anything of the sort because it  
23 really is a calculation and an estimate which by your  
24 own reckoning is conservative. There is a body of  
25 data on people that have made those kind of shipments

1 around the country whether it's military materials or  
2 spent fuel or Navy fuel or other things. So it would  
3 be interesting to see if your prediction meets actual  
4 experience and that experience is out there.

5 DR. CROWLEY: Yes, it's not our  
6 prediction. It's DOE's estimate which --

7 CHAIRMAN RYAN: DOE's estimate, but one  
8 you've embraced.

9 DR. CROWLEY: That's correct.

10 CHAIRMAN RYAN: But I think the actual  
11 experience is where the rubber meets the road and I'm  
12 going to guess it's not anywhere near 2 rem per year.

13 DR. CROWLEY: We did look into the  
14 possibility of getting data on actual exposures.  
15 Those exposures are not reported to the Nuclear  
16 Regulatory Commission. They are probably held by the  
17 individual operators, but they weren't accessible to  
18 the committee.

19 CHAIRMAN RYAN: And in fact, that can be  
20 tough, but there is real data if one wanted to move  
21 away from an estimate and into the real world.

22 DR. CROWLEY: Certainly.

23 MEMBER WEINER: I'd like to follow up on  
24 that comment and that is did your committee have any  
25 sense of how conservative the estimates at the ISR.

1 In some cases, I know that there was an assumption  
2 that there would be not shielding. In other words,  
3 there were assumptions made which are contrary to  
4 ordinary occupational practice. Did you comment at  
5 all on that? Did you give that any credence?

6 DR. CROWLEY: When we went through all of  
7 the analyses, not only the DOE FEIS but also the  
8 Reexamination Study which also formed the basis for  
9 the DOE FEIS, as the committee went through and  
10 analyzed the various assumptions, there were comments  
11 made in the report about the relative conservatism or  
12 nonconservatism. What you find in the, for example,  
13 the Reexamination Study and the DOE FEIS, there is a  
14 mixture of fairly significant conservatisms with  
15 realisms and it's not clear when you mix all of those  
16 things together. It's certainly conservative, but  
17 it's not clear how conservative it might be.

18 MEMBER WEINER: Bill.

19 MEMBER HINZE: Kevin, would you expand  
20 just a bit about your bottom line messages to an  
21 independent examination of transportation, security,  
22 etc? What do you mean by independent? Free from the  
23 governmental agencies?

24 DR. CROWLEY: Yes, in other words, this  
25 should not be an examination that the governmental

1 agency does itself. It should be an examination done  
2 by some organization independent of the government  
3 that has control over who is appointed to do the  
4 examination and also individuals who are free from  
5 conflicts of interest. It doesn't mean that -- I mean  
6 they could be experts, but they shouldn't be people  
7 whose careers or financial outlooks will rise or fall  
8 with the results of the study.

9 MEMBER HINZE: Was this recommendation  
10 prompted by any concerns or was this a matter of  
11 making the public perception very transparent, making  
12 the situation very transparent?

13 DR. CROWLEY: The committee saw nothing  
14 during the study that would have led it to believe  
15 that there was a transportation security problem in  
16 part because the committee just didn't get much  
17 information. There's a little bit of information in  
18 the open literature but not very much and some of it  
19 has been pulled back since September 11th. So there's  
20 a limited open source database from which the  
21 committee could have made any analysis. However,  
22 during the course of the committee's information  
23 gathering meetings, the committee heard again and  
24 again that this was a major public concern and one of  
25 the parts of the committee's Statement of Task was to

1 identify major technical and societal concerns and  
2 address them. So the committee tried to address them,  
3 wasn't able to and felt this is an important concern  
4 and somebody should address it.

5 MEMBER HINZE: Thank you.

6 MEMBER WEINER: Jim.

7 MEMBER CLARKE: Just a quick question,  
8 Kevin. You gave us the committee definition for large  
9 quantities. Your slides have two terms, long duration  
10 fires and very long duration fires. Did you have  
11 similar definitions for those?

12 DR. CROWLEY: They both refer to fires  
13 that exceed the regulatory 30 minute fires. The terms  
14 that are used in the report to characterize both of  
15 those are hours to days. Based on historical record,  
16 there are fires from accidents, train accidents  
17 mainly, that have burned for days. So that would be  
18 the committee's definition of a very long duration  
19 fire. Yes, the Howard Street Tunnel fire which is one  
20 of the accidents that is being analyzed by the Nuclear  
21 Regulatory Commission would probably fall under rubric  
22 of a long duration fire. It burned for hours.

23 MEMBER CLARKE: Thank you.

24 MEMBER WEINER: Allen.

25 VICE CHAIR CROFF: Can you elaborate just

1 a little bit on what caused the committee to recommend  
2 new organizational structures for the program?

3 DR. CROWLEY: You know how our committees  
4 are, Allen. We had a lot of discussion over a lot of  
5 meetings about that, but I think the bottom line was,  
6 and remember this report was completed before the  
7 recent schedule, the new schedule for Yucca Mountain  
8 was announced which has put things back by many years,  
9 the committee was operating under the assumption that  
10 the Department of Energy was driving for a license  
11 application first by the end of 2004 and then as soon  
12 as possible thereafter and opening a repository in a  
13 2011 and 2012 time frame looked at what the  
14 transportation program had been able to accomplish or  
15 not accomplish not because the staff were not up to  
16 the task. In fact, quite the contrary, the committee  
17 thought that a lot of the staff in the program with  
18 which it dealt with were pretty top-notch, but they  
19 just weren't being given the resources and the  
20 management attention that they needed to get the job  
21 done.

22 The committee felt that there might be a  
23 conflict here of mission because the transportation  
24 program was answering to management for the repository  
25 development program. They were competing for the same

1 pot of money and the same management attention and the  
2 committee felt that really the DOE Secretary ought to  
3 look at alterative structures that would take the  
4 transportation program out from under the repository  
5 development program and give at least equal billing  
6 within DOE.

7 The other concern that weighed in the  
8 committee's analysis was the fact that not only are we  
9 talking about a transportation program for a  
10 repository, but now we appear to be talking about a  
11 transportation program for interim restorage and  
12 possibly for even an integrated spent fuel recycling  
13 facility. So the committee sensed that the  
14 Government's need for a transportation capacity would  
15 be growing in the future and that having a  
16 transportation program that was again sitting under  
17 the repository development program was not the kind of  
18 transportation capacity that could service these other  
19 potential future needs.

20 VICE CHAIR CROFF: Thanks.

21 MEMBER WEINER: I had just a couple of  
22 additional questions. One is to follow up on Dr.  
23 Clarke's question. Your definition of large quantity,  
24 you would doubtless consider 100 shipments a large  
25 quantity. Is that more or less correct? Or let's say

1 1,000 shipments. That's a big quantity.

2 DR. CROWLEY: The definition that the  
3 committee used was based on mass shipped not on number  
4 of shipments.

5 MEMBER WEINER: You can translate it to  
6 number of shipments by saying so much mass per  
7 shipment.

8 DR. CROWLEY: It depends on the mode that  
9 you use.

10 MEMBER WEINER: All right. Let's say  
11 trucks for assemblies per cask.

12 DR. CROWLEY: You're going to ship about  
13 between 0.5 metric ton and 2 metric tons per shipment  
14 depending on -

15 MEMBER WEINER: Right. Per shipment. So  
16 what would you consider a large quantity shipment?

17 DR. CROWLEY: A large quantity shipping  
18 program would be a program that ships on the order of  
19 hundreds to thousands of metric tons. So you would be  
20 looking if you said each truck carried on the order of  
21 2 metric tons, then a program that involved 50 truck  
22 shipments would be considered in the committee's view  
23 to be a large quantity shipping program.

24 MEMBER WEINER: Is that independent of how  
25 long the shipping campaign is? In other words, you're

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1 not considering that the shipping campaign could last  
2 ten years, twenty years.

3 DR. CROWLEY: There is nothing in the  
4 report that has the time scale, although most shipping  
5 campaigns are for a more definitive period of time  
6 unless they're a very large quantity shipping program  
7 where you're shipping all of the time.

8 MEMBER WEINER: This gets exactly to my  
9 point. We have had shipping campaigns that have taken  
10 place inside of a year that have involved roughly,  
11 let's say, ten shipments just using ten spent fuel  
12 shipments and the truck estimates by DOE would be five  
13 or six shipments a year. Did that play any part in  
14 your designation of concern or your concern about  
15 large quantity shipments? Clearly, ten shipments, ten  
16 truck loads of spent fuel, ten highway truck loads of  
17 spent fuel, is not a large quantity shipment.

18 DR. CROWLEY: Not in a particular year,  
19 but if you had ten shipments year after year after  
20 year, that would be a large quantity shipping program  
21 at some point.

22 MEMBER WEINER: What would make the  
23 difference? Why would that be a large quantity? What  
24 assumptions are you making to make that large quantity  
25 shipment program? That's what I'm kind of driving at.

1 DR. CROWLEY: I don't think I understand  
2 the question.

3 MEMBER WEINER: All right. Are you  
4 assuming --

5 DR. CROWLEY: Try again.

6 MEMBER WEINER: I'll try again.

7 DR. CROWLEY: Okay.

8 MEMBER WEINER: Are you assuming that  
9 there is a cumulative effect of shipments year after  
10 year that would make a shipment of a relatively small  
11 quantity continuing year after year for say 20 years  
12 because the Yucca Mountain shipments are, there is a  
13 number at the end of there that would make that a  
14 large quantity shipment to be of concern? Is it the  
15 fact that you are inherently assuming some sort of  
16 cumulative effect?

17 DR. CROWLEY: You are assuming a  
18 cumulative effect because you're looking at an  
19 ultimate quantity and in that is entangled the number  
20 of shipments per year, the number of years that you're  
21 shipping. I should say that this demarcation, it's  
22 not a sharp demarcation and that's why the committee  
23 used words like "on the order of" and what it was  
24 really trying to get at was the occasional shipments  
25 that one makes, for example, from one reactor site to

1 another to even out-loads and spent fuel pools versus  
2 a program where you're having a focused, continuous,  
3 long term shipment of spent fuel from a lot of  
4 different sites, for example, to Yucca Mountain or a  
5 lot of different sites to an interim storage facility.  
6 A lot of those sites would be made -- Sorry. A lot of  
7 those shipments might be made along the same routes  
8 year after year. You're putting a lot of fuel on the  
9 road.

10 MEMBER WEINER: So there is an implication  
11 that if a lot of shipments are made along the same  
12 routes year after year that those shipments have a  
13 cumulative effect.

14 DR. CROWLEY: I think that's correct.

15 CHAIRMAN RYAN: I'm sorry. I'm lost.  
16 What is cumulative effect? Effect on what? By whom?

17 MEMBER WEINER: Effect on that people who  
18 live by the side of the road.

19 CHAIRMAN RYAN: So the point is the doses  
20 go up or if we're talking about collective dose, we're  
21 going up the wrong tree.

22 DR. CROWLEY: This has nothing to do with  
23 collective dose.

24 CHAIRMAN RYAN: Okay. I'm stuck with  
25 cumulative effect and I'm not sure what you mean,

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1 Ruth.

2 MEMBER WEINER: Yes. Well, I meant --  
3 Thank you for the clarification. I was trying to work  
4 around calling it collective dose, but clearly, the  
5 concern is risks posed by these shipments, is it not?

6 CHAIRMAN RYAN: The risk to an individual  
7 of a shipment going by is the same for each shipment  
8 theoretically.

9 MEMBER WEINER: Exactly.

10 CHAIRMAN RYAN: But it doesn't add up  
11 because it happens at different times.

12 MEMBER WEINER: That was exactly what I  
13 was getting at.

14 CHAIRMAN RYAN: It's not cumulative.

15 DR. CROWLEY: I don't think this -- It's  
16 not directly related to risk. It's the committee has  
17 called for a number of actions to be taken by  
18 organizations that are involved in the shipment of  
19 large quantities of spent fuel. The committee has  
20 actually made a fairly subjective judgment about steps  
21 that should be taken by these large shippers versus  
22 steps that would not be taken by the small shippers  
23 and the committee was particularly concerned that  
24 certain steps be taken by organizations like DOE and  
25 Private Fuel Storage for example in the training of

1 emergency responders for these shipments that involve  
2 large numbers of shipments, large quantities of fuel,  
3 that will go on for long periods of time.

4 MEMBER WEINER: Okay. Thank you. Did you  
5 have something to add?

6 DR. KANNINEN: I was interpreting your --

7 MEMBER WEINER: Could you lean into the  
8 microphone and tell us who you are?

9 DR. KANNINEN: Oh, who I am?

10 MEMBER WEINER: Yes, for the report.

11 DR. KANNINEN: Mel Kanninen just speaking  
12 out of turn. I thought perhaps in an attempt to  
13 clarify your question I was thinking you might have  
14 meant cumulative effect on the containers and/or other  
15 hardware of which there could be a concern if you are  
16 reusing these over long periods of time and that is  
17 something the committee did think about but did not  
18 think it was a major issue.

19 MEMBER WEINER: Thank you. Do any of the  
20 staff have a question at this point? Hearing --

21 MR. HAMDEN: (Inaudible.)

22 CHAIRMAN RYAN: The answer is no.

23 MEMBER WEINER: The answer is no. Thank  
24 you. Dr. Kanninen, you're on next I believe.

25 DR. KANNINEN: I don't really have a

1 presentation because basically Kevin took all the good  
2 stuff for himself. So I'd be left with nothing but  
3 detail. What I thought I would do is preserving the  
4 maximum amount of time for questions that I was hoping  
5 that you might have to just give you my own  
6 perspective on how the committee approached the  
7 question of package performance and standards and the  
8 concerns that we had and underlying the  
9 recommendations and conclusions that Kevin already  
10 gave you.

11 From my own perspective, I was not a  
12 member of the committee at its outset. I got a call  
13 from Kevin Crowley after the first meeting saying that  
14 the committee had decided that it needed an expert in  
15 materials and structural behavior and I guess they  
16 couldn't find one. So they asked me. It was supposed  
17 to be a funny line.

18 DR. CROWLEY: That was a joke.

19 DR. KANNINEN: Anyway, they did find me  
20 and I had not previously been associated with shipping  
21 radioactive containers and shipping. I was of course  
22 aware of it because a number of my colleagues had been  
23 doing that kind of work, for example, at Pacific  
24 Northwest and I interacted with them informally as to  
25 what was going on way back as far as, I don't know, in

1 the 1970s when all this started. So I guess that  
2 could be considered a good thing in a way because I  
3 certainly had no biases to anything except a bias  
4 towards good engineering.

5 I joined the committee for the first time  
6 at its meeting in Las Vegas and we heard quite a lot  
7 from the State of Nevada and their concerns in  
8 particular with regard a perceived need that they had  
9 for full scale package testing and other aspects and  
10 of course we heard from others as time went on. I did  
11 have some concerns initially in that if we're not  
12 doing full scale testing here, how could we possibly  
13 justify that these things are perfectly safe. As time  
14 went on, we began to get a broader horizon.

15 I think the greatest aid to my  
16 understanding was the week that I spent at a  
17 conference. It was the biannual conference of the  
18 PATRAM which is Package and --

19 MR. EASTON: And Transportation of  
20 Radioactive Materials.

21 DR. KANNINEN: That's it. Earl was there.  
22 So he would know the acronym.

23 MEMBER WEINER: Would you repeat it for  
24 the recorder?

25 DR. KANNINEN: PATRAM is Package and

1 Transportation of Radioactive Materials. Thank you,  
2 Earl. At that meeting, my eyes were opened, were  
3 opened even wider than they had been in the sense that  
4 we had people from all over the world involved in  
5 this, Europeans, Japanese, Asian countries, the United  
6 States of course, Canada and others and they were  
7 doing what I consider to be good engineering in the  
8 sense that you are doing experiments, small scale  
9 experiments; you're doing computer simulation, very  
10 sophisticated computer simulation.

11 And you're not doing these in isolation  
12 from one another. You're doing them together in a  
13 unified way, an integrated way and introducing full  
14 scale testing, a very expensive thing. So you have to  
15 be very cautious about not using them, but you're  
16 using them in the proof of principle way and that is  
17 the right way to do that. So I think as a result of  
18 my week at that conference I came away with a very  
19 strong opinion that the regulations are well founded,  
20 the IAEA regulations I mean, the drop test, the  
21 puncture test and not so much about the immersion  
22 test and I'll leave the fire out of it for just a  
23 minute because you appear to want to separate that.

24 But I had the impression and actually  
25 having the opportunity to witness a drop test of a

1 several ton article 30 meters and it's very impressive  
2 when you stand about 100 feet away and you hear the  
3 ground shake when it hits and hardly any damage  
4 visible. So as a result, the accumulation of all this  
5 kind of experience and of course, there are others on  
6 the committee too, I don't claim all of the structural  
7 mechanics and materials as well, there are others as  
8 well, Clyde for example, but I think we all are pretty  
9 much of the same mind that the regulations are well-  
10 founded and well carried out and respected and they've  
11 been in place for quite a long time and as the people  
12 at that meeting were fond of saying "We haven't had  
13 any accidents of any major sort or even minor sort  
14 with these regulations in place." The conclusion that  
15 we came to and Kevin reported to you is we're pleased  
16 with those and we think they will do the job.

17 The fire, I suppose I should get into that  
18 now, is a different story. The contrast there is you  
19 look at the mechanical testing, drop test, puncture  
20 test, you're looking at a combination as I said of  
21 good engineering which is computer simulation,  
22 modeling, large scale tests. You don't see that in  
23 the fire arena. You see a lot of computer modeling.  
24 You don't see the testing and the other thing. You  
25 also see a lot of people doing calculations or

1 simulations I should say for the same event and coming  
2 up with quite different conclusions.

3 And the best example of that, of course,  
4 is the Baltimore Howard Street Tunnel. The people at  
5 the University of Nevada, not just to pick on anybody  
6 particularly, is coming out with analyses of that  
7 incident that said these things would probably fail.  
8 Then the Nuclear Regulatory Commission looking at the  
9 same set of circumstances comes out with a different  
10 conclusion and these simulations were going on at that  
11 time that we had to wrap up our report. So this is  
12 the basis of us saying we think, I don't think we used  
13 the words that there's a problem there, but we really  
14 think that this, in my own words now, we don't think  
15 that the fire part of the four part regulations is in  
16 nearly as good a shape as the others and work ought to  
17 continue there which is not to say that anybody isn't  
18 doing a good job or they're not bringing their best  
19 resources to it. I think they need to continue on and  
20 I would add that they ought to look at the way that  
21 they have developed the other regulations and try to  
22 spread themselves out from merely looking at, this is  
23 my own opinion again, in fact, I don't think that this  
24 is in the report, that they ought to be looking at  
25 that same kind of a triage of things looking at model

1 experiments, full scale experiments to the extent that  
2 that's feasible, together with the computational  
3 simulations that they have.

4 I hope that gives you a little bit of  
5 background as to where I'm coming from and any  
6 questions you have I'd be glad to take. Kevin might  
7 want to add something.

8 DR. CROWLEY: Can I add something? Again,  
9 with respect to the long duration fires, there's a  
10 real contrast between the testing that has been done,  
11 this is real world testing, basically demonstration  
12 testing, and certification testing as well, the  
13 certification testing is where you're actually doing  
14 package drops and you're measuring the forces on the  
15 packages and you're looking at the deformation, and  
16 then the demonstration testing, for example, the  
17 Sandia testing done in the '70s where they crashed  
18 locomotives into casks and they ran trucks into walls  
19 and that kind of thing and then the Central  
20 Electricity Generating Board tests in the U.K. in the  
21 '80s. It's pretty clear from all of those tests that  
22 were done that the hypothetical accident conditions in  
23 10 CFR 71 are more severe a test of package  
24 performance than crashing a locomotive into a package  
25 at 100 miles per hour and that's very clear from the

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1 testing that's been done. We have enough testing now  
2 to know that.

3 That's not the case for thermal testing.  
4 The thermal test is a half hour optically dense, fully  
5 engulfing fire. It's not clear that that's a more  
6 severe test of package performance than you might  
7 encounter out in the real world and one of the reasons  
8 we don't know that is because we just haven't done as  
9 much work in that area. Certainly, full-scale  
10 demonstration testing has not been done to the extent  
11 that it has for mechanical testing and the simulation  
12 testing that is being done now. That's one of the  
13 things the Nuclear Regulatory Commission has been  
14 working on quite diligently and is still working on.  
15 But again, so far you just haven't seen the level of  
16 work there that you've seen in the mechanical test  
17 area.

18 CHAIRMAN RYAN: Kevin, could you or your  
19 colleagues maybe sharpen the point on that a little  
20 bit? You gave the criteria for the NRC criteria and  
21 you haven't really said how that translates to what  
22 happens or could happen in a fire. I mean is the  
23 temperature too low. Is the engulfing aspect, the  
24 time, too short? Do you have any sense of what other  
25 criteria might look or sound like and again, I'm not

1 trying to hold you to your rules as you see them now  
2 but just to explore that a little bit. It's not good  
3 enough or there hasn't been enough is okay, but why?

4 DR. KANNINEN: I think if we thought it  
5 wasn't good enough we would have raised some very big  
6 red flags. So obviously, we didn't come to that  
7 conclusion.

8 CHAIRMAN RYAN: Okay.

9 DR. KANNINEN: And we're uncertain.

10 CHAIRMAN RYAN: I thought I heard Kevin  
11 say there was concern.

12 DR. KANNINEN: Well, there is a concern  
13 that that may be the case.

14 CHAIRMAN RYAN: Okay. Fair enough.

15 DR. KANNINEN: But we did not reach that  
16 conclusion by any stretch of the imagination.

17 CHAIRMAN RYAN: Okay.

18 DR. KANNINEN: The temperatures in the  
19 regulatory are what? Eight hundred Centigrade they  
20 are.

21 DR. CROWLEY: Fourteen seventy-two.

22 DR. KANNINEN: I'm sorry. Fourteen  
23 seventy-two, less than was calculated to where these  
24 various accidents, at least the Baltimore Tunnel case  
25 and the time duration is certainly much longer than

1 the regulatory limit. So one would be a little --

2 CHAIRMAN RYAN: Then the next question is  
3 if a fire went on at some temperature for a longer  
4 period of time, would it really be an impacting thing  
5 or not. I guess I'm trying to help design a test  
6 while I was sitting here to see what the range might  
7 be to go from what's in the regulation to what might  
8 be more encompassing of the real potential experience.  
9 Do we put our magnitude away or a factor of two away?

10 DR. KANNINEN: Well, that's difficult to  
11 say. I mean you could obviously destroy a cask by  
12 giving it enough temperature for a long enough time.

13 CHAIRMAN RYAN: Sure.

14 DR. KANNINEN: So you must make a judgment  
15 based on what's really possible out there and you must  
16 always be guided by that.

17 CHAIRMAN RYAN: And those are the  
18 parameters I'm looking to understand a little bit  
19 better on what is really possible. Is it 2,000  
20 degrees C for five hours? Did you explore that at  
21 all?

22 DR. KANNINEN: No, we did not and I don't  
23 see how we could have either.

24 CHAIRMAN RYAN: No, I'm not saying you  
25 should have. I'm just saying did you.

1 DR. KANNINEN: No.

2 CHAIRMAN RYAN: Okay.

3 DR. CROWLEY: Let me add to that. I think  
4 again we've broken this into two classes. We'll call  
5 them the mechanical class and the thermal class. On  
6 the mechanical side, it's a little easier to bound  
7 things than it is on the thermal side and there have  
8 been a number of studies done and particularly the  
9 Central Electricity Generating Board Study where they  
10 very carefully thought through what are the kinds of  
11 mechanical accident scenarios that we might encounter  
12 and they really subjected the package to a severe  
13 test, probably more severe than they would actually  
14 really expect to encounter and they still showed that  
15 the mechanical forces put on that package were less  
16 than the 30 foot free drop test.

17 On the thermal side, again it's much  
18 harder to know what the upper bound of a fire is and  
19 I don't know that so much that it's the temperature  
20 because a hydrocarbon fire burns at the temperature a  
21 hydrocarbon fire burns at. But in my mind, it's  
22 really the duration and you have to think about the  
23 situations in which a package might be subjected to a  
24 long duration fire, very long duration fire, well in  
25 excess of the 30 minute regulatory test under a

1       circumstance where it would be very difficult to get  
2       to that fire and put it out.

3               I mean an obvious place where that could  
4       happen would be a tunnel, but there could be other  
5       places where that could happen as well. For example,  
6       you could have, this wasn't in the report, an  
7       interaction between a train carrying a spent fuel  
8       package and a train carrying hazardous materials in a  
9       remote location where it would be very difficult to  
10      mount an effective firefighting response. That  
11      package, that fire, could burn for hours before you  
12      could get out there and put it out.

13              So I think what the committee was calling  
14      for in the recommendation was really for the  
15      Commission to think through this process of what is a  
16      credible upper bound for the kind of a long duration  
17      fire that we might encounter and then to run the  
18      simulation and see how would these various packages  
19      behave in such a fire. And if there is an issue with  
20      behavior, are there simple operational controls that  
21      you could put into effect to avoid those kinds of fire  
22      scenarios?

23              MEMBER WEINER: We have -- Could you  
24      identify yourself for the reporter?

25              MR. RULAND: Yes. I'm Bill Ruland. I'm

1 the Deputy Director in the Spent Fuel Project Office.  
2 If it would please the Committee after the National  
3 Academy has finished their presentation, we're  
4 prepared to talk a little bit about these issues.  
5 Actually, I'm not prepared to talk about them. Earl  
6 is prepared to talk about them, but we came  
7 anticipating these issues would come up. So again, if  
8 it would please the Committee after this presentation,  
9 we'd be happy to talk about some of these.

10 MEMBER WEINER: Certainly. Would you like  
11 to be recognized immediately as part of the fire  
12 discussion or do you want to wait for that?

13 MR. RULAND: It's strictly up to you.

14 CHAIRMAN RYAN: Ruth if I could, let me  
15 make a suggestion. If you have a comment as we go  
16 along, it's probably more appropriate that you make  
17 that comment at the time because we are on a schedule  
18 this afternoon. We don't have an unlimited amount of  
19 time.

20 MR. RULAND: Okay.

21 CHAIRMAN RYAN: So putting in another  
22 series of formal presentations or even informal ones,  
23 really we ought to stick to our agenda and if you have  
24 comments now or want to participate, raise your hand  
25 and we'll be happy to have your comment as we go

1 along. That might actually help the audience as well.

2 MEMBER WEINER: I'd like to --

3 PARTICIPANT: (Inaudible.)

4 MR. RULAND: Yes.

5 MEMBER WEINER: Would you like to come up  
6 to the table, Earl, and make a comment now? While  
7 you're coming up, I have a question, two actually.  
8 When you were at the demonstrations in Germany, Dr.  
9 Kannenin, did you have a chance to observe the propane  
10 tank explosion sitting next to a spent fuel cask or  
11 did that take place at some other time? I have a film  
12 of it. That's why I'm asking.

13 DR. KANNINEN: No. The --

14 (Discussion off microphone.)

15 DR. KANNINEN: You're talking about a real  
16 demonstration.

17 MEMBER WEINER: Yes, it was a real  
18 demonstration.

19 DR. KANNINEN: No, the Berlin thing was  
20 done specifically for the PATRAM conference people  
21 from all over the world, but they only did that one  
22 test.

23 MEMBER WEINER: I see. No, I was asking  
24 really if you were familiar with the propane tank  
25 test, would you consider that in excess of the

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1 regulatory fire or couldn't you make just from that  
2 one test a judgment?

3 DR. CROWLEY: That's a very different  
4 animal. In that test, the fire was very brief and  
5 intense and it basically blew the cask away from the  
6 source of the fire. So it wasn't a long duration,  
7 fully engulfing fire.

8 MR. EASTON: It lasted seven seconds that  
9 fire --

10 MEMBER WEINER: Thank you. Identify  
11 yourself.

12 MR. EASTON: I'm Earl Easton. I'm with  
13 the Spent Fuel Project Office staff and first let me  
14 agree with Mel. I don't think the fire part of this,  
15 the thermal, has been as visible over the years as the  
16 structural part. But I do know there's been a lot of  
17 work, there's been a lot of testing, done on this. It  
18 just hasn't received the notoriety because I don't  
19 think it was determined to be the sexy issue at that  
20 time.

21 But let me just put this whole thing in  
22 some sort of perspective. In the past 30 years if you  
23 look at the FRA data, there's been around 21 billion  
24 train miles and if you look at that time just the  
25 hazmat reports where there's been reported release of

1 hazmat, that's about 1300 incidents and that's a drop  
2 to several tank loads. And if you go through and you  
3 look over those 1300 reports which I have, you will  
4 find that there may be five or six examples of where  
5 you really get a long duration, fully engulfing fire  
6 because it's not only the temperature. It's the  
7 location because you know most of the heat transfer is  
8 through radiation and if you're some distance, the  
9 view factor falls off and if you're down in the fire,  
10 the view factor falls off.

11 Again, the fire test is one-half hour,  
12 fully engulfing, 1475. But the important part people  
13 don't state is at the end of that test virtually  
14 nothing happens. So when we run out the analysis, we  
15 are able to run out the analysis six or seven or eight  
16 hours fully engulfing fires and you don't get any what  
17 we think are in the danger zone.

18 CHAIRMAN RYAN: Let me just translate that  
19 if I may, Earl. You do a 30 minute test and you  
20 extrapolate that by calculation for eight hours.

21 MR. EASTON: Yes, we do a fully engulfing  
22 extrapolation or computer simulation out to eight  
23 hours. The seals fail, but the seals are not the  
24 important things in accidents.

25 CHAIRMAN RYAN: I just want to understand

1 because you're using a lot of jargon and I'm just  
2 trying to translate it so I understand it.

3 MR. EASTON: Okay. Sorry.

4 CHAIRMAN RYAN: We have a lot of data on  
5 the half hour tests.

6 MR. EASTON: Right.

7 CHAIRMAN RYAN: You've somehow created a  
8 computer model that will allow you to take that  
9 reference first half hour and then model it out to  
10 seven or eight hours.

11 MR. EASTON: Right. We use the same  
12 assumption for the 30 minute test and we continue  
13 running that computer simulation out of seven or eight  
14 hours.

15 CHAIRMAN RYAN: So you're just making the  
16 assumption that everything stays the same for eight  
17 hours.

18 MR. EASTON: Right. And then --

19 CHAIRMAN RYAN: Let me just ask a couple  
20 questions if I might. Does that continue to heat up  
21 the inside of the contents?

22 MR. EASTON: Yes, it does.

23 CHAIRMAN RYAN: All that stuff. So all  
24 that real physics is included.

25 MR. EASTON: Yes, it does.

1 CHAIRMAN RYAN: Okay. I just want to  
2 understand that.

3 MR. EASTON: And then again when you look  
4 at it, there are several barriers to release. One is  
5 the seal, but that's primarily for normal conditions.  
6 I can explain that later if you want.

7 CHAIRMAN RYAN: Well, let me -- I don't  
8 want to get too far into the details because frankly  
9 this is for them to give their report. But it sounds  
10 like you're implying, tell me if I'm incorrect in  
11 assuming this, that the NRC test is okay as it is.

12 MR. EASTON: I think it's so and  
13 especially if you look at it in terms of risk  
14 informed. There are maybe five accidents that you  
15 might put in this category out of 21 billion rail  
16 miles.

17 CHAIRMAN RYAN: I hear you that the risks  
18 seem to be low or are low based on the statistics  
19 you've quoted, but what does that have to do with the  
20 test?

21 MR. EASTON: Well, if you look at each one  
22 of those five accidents and where the cask would have  
23 to be placed to get a fully engulfing fire, you find  
24 it's almost impossible. So really the fully engulfing  
25 test simulates how much heat goes in per time. You

1 very seldom get long duration and fully engulfing.

2 CHAIRMAN RYAN: But there's two questions  
3 there. If we had a fully engulfing and let's leave  
4 the probability of that alone for a minute, that's one  
5 question. The probability of that ever happening is  
6 a separate question. You're giving the information  
7 about the probability of it happening which is below  
8 the radar screen is what you're advising us to  
9 observe.

10 MR. EASTON: Right.

11 CHAIRMAN RYAN: Given that it is something  
12 people want to consider then we're back to what does  
13 that profile look like.

14 MR. EASTON: If it is something you want  
15 to consider, the test after a half hour of a fully  
16 engulfing fire --

17 CHAIRMAN RYAN: I'm not saying I do. I'm  
18 saying if it's something somebody wants to consider  
19 irrespective of the probability.

20 MR. EASTON: The test after a half hour,  
21 fully engulfing fire, the acceptance criteria is  
22 basically nothing happens to that cask.

23 CHAIRMAN RYAN: I know. I agreed to that.

24 MR. EASTON: A release. So if you carry  
25 out the analysis, you will find you really have six cr

1 seven hours before you get the fuel cladding heated up  
2 until you start worrying about the fuel cladding. You  
3 never really lose the lid to body contact with --

4 CHAIRMAN RYAN: Yes, you've reported that  
5 to us before. We don't need to cover all that.

6 MR. EASTON: Sorry.

7 CHAIRMAN RYAN: You talked about the seals  
8 going away and the metal -- and all that. We're up on  
9 that.

10 MR. EASTON: Okay. So we think that the  
11 test is pretty good. It's well understood and it  
12 really bounds all the accidents that we have really  
13 seen. And one further comment, if you go to dedicated  
14 trains and you go to a no pass rule in tunnel, this  
15 would probably have eliminated every historical  
16 accident in the last 30 years that you could have  
17 gotten a fully engulfing, long duration fire.

18 CHAIRMAN RYAN: Are you going to somehow  
19 memorialize that analysis in a report?

20 MR. EASTON: Yes, as soon as we put all  
21 the data --

22 CHAIRMAN RYAN: I know it's a lot of work,  
23 but it would be real helpful if that analysis was  
24 formalized and shared with everybody that had interest  
25 because that is in fact the real data.

1 MR. EASTON: As part of taking these guys  
2 very serious like we do --

3 CHAIRMAN RYAN: Thanks for your patience,  
4 Ruth. I'm done.

5 MR. EASTON: That's one of the ways we're  
6 going to respond to their call for --

7 DR. CROWLEY: Let me say. I think we've  
8 had a lot of interactions with Earl and Bill Brock  
9 during the study and I think they got the sense early  
10 on that this was an issue that the committee was  
11 concerned about and to their credit, they've done a  
12 lot of additional work to try to put this issue to  
13 rest. So I think they should be patted on the back  
14 for that.

15 CHAIRMAN RYAN: I agree. That's great.

16 MR. RULAND: Yes, I just wanted to say we  
17 appreciate the committee's comments in this particular  
18 area. We're already working as Earl has already said.  
19 We're not waiting. We're already looking at the  
20 research and the data. We're already taking action to  
21 try to incorporate operational controls which was a  
22 big part of one of the committee's recommendations.  
23 So again, we wanted to say thank to the committee and  
24 thank you for this Committee for listening to this  
25 important issue.

1 MEMBER WEINER: Thank you.

2 MR. EASTON: In fact, just Kevin put a bug  
3 in my ear, but when you go back and look at all the  
4 historical rail accidents and especially these five,  
5 they all involve the derailment of a single train. If  
6 you use dedicated trains, that largely goes away.  
7 FRA, we're in discussions with them. They're under a  
8 mandate whether to require dedicated trains based on  
9 risk.

10 The other thing is the other accident that  
11 doesn't go away is the tunnel fire which we're  
12 studying and we have already approached the  
13 Association of American Railroads about the  
14 possibility of changing circular OT-55 which would  
15 prohibit the practice of trains passing in tunnels  
16 carrying flammable liquids and that which we feel  
17 would have virtually eliminated the Baltimore Tunnel  
18 fire; although a dedicated train rule would eliminated  
19 the Baltimore Tunnel. So we're moving out very  
20 rapidly to try to get a better understanding of this  
21 whole thermal issue and when we come back in the  
22 summer and talk about the Baltimore Tunnel fire, maybe  
23 we'll have some of this memorialized for you.

24 CHAIRMAN RYAN: Before talking.

25 MR. EASTON: Okay.

1 MEMBER WEINER: Thank you.

2 CHAIRMAN RYAN: Thank you, Earl.

3 MEMBER WEINER: Jim, do you have any  
4 further questions? Bill?

5 MEMBER HINZE: I'm a little bit confused  
6 by Mel's comments and I'm referring to the committee  
7 strongly endorses full scale testing for -- performed  
8 under both regulatory and credible extra regulatory  
9 conditions. I heard you say that this type of testing  
10 was only really needed for the thermal area. Is that  
11 correct?

12 DR. KANNINEN: No, no. I said it is well  
13 practiced in the mechanical testing area, in other  
14 words, using that as a mirror for the people who are  
15 too worried about the fire to consider.

16 MEMBER HINZE: So the mechanical has been  
17 taken care of.

18 DR. KANNINEN: Yes, very much so.

19 MEMBER HINZE: But it doesn't say that in  
20 this recommendation that the emphasis should be on the  
21 thermal area.

22 DR. KANNINEN: You are referring to the  
23 statement.

24 MEMBER HINZE: I'm referring to slide  
25 nine.

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1 DR. CROWLEY: I think you're really  
2 looking at two different issues there.

3 MEMBER HINZE: So help me then.

4 DR. CROWLEY: The committee, one of the  
5 issues that came up during the study and again this  
6 was raised by several people at the committee's open  
7 meeting was the whole issue of testing and whether  
8 testing should be required for every package and  
9 whether in fact you might want to production test  
10 certain packages and whether or not you might want to  
11 test packages to destruction. I think what the  
12 committee was trying to say there was current practice  
13 is really good. It's an integrated process right now.  
14 This is how it should continue to be done.

15 MEMBER HINZE: Okay.

16 CHAIRMAN RYAN: Is this what it actually  
17 says in the text or is there explanatory material  
18 other than this bullet?

19 DR. CROWLEY: Of course, there is  
20 explanatory.

21 CHAIRMAN RYAN: I think maybe we're  
22 picking on a bullet and maybe the text explains what  
23 you just said. Is that right?

24 DR. KANNINEN: But if I could just add to  
25 what Kevin said, there was at the very beginning

1 people who were not enamored of the whole idea of  
2 transporting radioactive waste who would insist on  
3 full scale testing as Kevin already said and what they  
4 meant by that was testing to destruction whereas full  
5 scale testing in the sense of the regulatory thing is  
6 what we endorse and we do not endorse testing to  
7 destruction. So this bullet is sort of aimed at that  
8 particular point of view.

9 CHAIRMAN RYAN: Thank you very much.

10 MEMBER WEINER: That's a very good  
11 clarification. Thank you. Allen.

12 VICE CHAIR CROFF: I'm not sure I  
13 understand this and it's the full scale part. Why did  
14 the committee recommend full scale as opposed to  
15 current practice which is mostly fractional scale,  
16 calculations and this kind of thing?

17 DR. KANNINEN: No, the current procedure  
18 is to use full scale but to use it sparingly in a  
19 company with computation simulation and scale  
20 modeling. So you're working them all together. So  
21 you're using it in that way. You certainly are doing  
22 full scale testing.

23 CHAIRMAN RYAN: I'd have to go back and  
24 read our letter, Allen, but I think the committee is  
25 in agreement with what you just said, limited full

1 scale testing for certain performance questions.

2 VICE CHAIR CROFF: Yes.

3 CHAIRMAN RYAN: Calculational approaches  
4 which we agree that we saw some pretty sophisticated  
5 modeling tools in our Commission gathering and then  
6 the testing to destruction for the sake of destroying  
7 something, we said didn't make any sense.

8 DR. KANNINEN: That's correct and that's  
9 exactly what that bullet is aiming at.

10 MEMBER HINZE: A lot is lost in the  
11 brevity.

12 CHAIRMAN RYAN: And fair enough because  
13 you can't put it all in three lines of bullet.

14 VICE CHAIR CROFF: You mean you haven't  
15 already reported that.

16 (Discussion off microphone.)

17 MEMBER WEINER: Just to interject, it is  
18 the full recommendation which is considerably longer  
19 than what you summarized on your slide that is quite  
20 clear that it endorses the use of full scale testing  
21 to determine how packages will perform under both  
22 regulatory and credible extra regulatory conditions  
23 and I think that explains that you wish to continue to  
24 determine how packages continue to perform under these  
25 conditions that you have identified.

1 DR. KANNINEN: Correct.

2 MEMBER CLARKE: Excuse me, Ruth. The  
3 first part of Bill's questions addressed on Slide 8  
4 with a recommendation is made that the NRC to  
5 undertake additional analyses for long duration fire  
6 scenarios. It did have a column of -- Are there any  
7 specifics associated with that recommendation or is  
8 the recommendation to go back and look at different  
9 scenarios and go from there?

10 DR. KANNINEN: Well, our report was  
11 wrapped up prior to much of what the NRC is doing as  
12 you just heard Earl talk about. So they have really  
13 done that themselves and that of course is the best  
14 possible outcome for us to suggest and for them to  
15 act. So we're very pleased by this.

16 DR. CROWLEY: The committee did make a  
17 couple of comments and suggested that perhaps the  
18 historical record would be a good place to start if  
19 you were looking for credible, long term duration  
20 fires and two examples were mentioned. There was a  
21 Livingston, Louisiana fire, I think it was 1972, but  
22 I could be mistaken about the date, that burned for  
23 three days. Now they let that burn. Presumably they  
24 could have put it out if they wanted to.

25 MEMBER CLARKE: Was it a train derailment?

1 DR. CROWLEY: It was a train derailment.  
2 It was carrying plastics or plastic products I think.  
3 And then there was the Summit Tunnel fire in the U.K.  
4 which burned I think for about four days. In fact,  
5 based on the Summit Tunnel fire, the U.K. Department  
6 of Transport put a rule or a regulation in place that  
7 prohibited trains carrying flammable materials and  
8 trains carrying spent fuel from being in the same  
9 tunnel together.

10 MEMBER WEINER: Bill, any further  
11 questions? Allen?

12 VICE CHAIR CROFF: I wanted to be explicit  
13 on one point. We've been talking about the long  
14 duration fires, but something that I think was said  
15 was you're not recommending consideration of higher  
16 temperature fires, higher than the 1475.

17 DR. KANNINEN: I don't think -- We didn't  
18 make any recommendation with regard to specific  
19 targets either in temperature or time. We think that  
20 would have exceeded our capabilities.

21 VICE CHAIR CROFF: I'm asking sort of --  
22 You've said in general take a look at long duration,  
23 but what about higher temperatures?

24 DR. CROWLEY: There's nothing.

25 DR. KANNINEN: We did not exclude going to

1 higher temperatures.

2 VICE CHAIR CROFF: So the report is silent  
3 on that.

4 DR. CROWLEY: Yes.

5 DR. KANNINEN: Well, no, not entirely  
6 because as Kevin just said a moment ago, we  
7 recommended that we look at the accidents that have  
8 already happened and be guided by that. So if these  
9 accident suggest higher temperatures, then certainly  
10 you want to use higher temperatures.

11 VICE CHAIR CROFF: Okay.

12 CHAIRMAN RYAN: Or at least think about  
13 why or why not.

14 MEMBER WEINER: I'm going to ask. Do we  
15 have Clyde Young on the telephone.

16 PARTICIPANT: We weren't able to get him.

17 MEMBER WEINER: Oh well. Thank you. That  
18 is too bad. Mike, did you have further questions?

19 CHAIRMAN RYAN: No. Thank you, Ruth.

20 MEMBER WEINER: Okay. Moving right along,  
21 Dr. Morris, you're going to talk about emergency  
22 response, emergency preparedness.

23 DR. MORRIS: Actually, I was not.

24 MEMBER WEINER: Well, it's what it said on  
25 my little cheat sheet here.

1 DR. MORRIS: I'm sorry. No, I did not  
2 come prepared to talk on that.

3 MEMBER WEINER: That's all right.

4 DR. MORRIS: In fact, Kevin has covered  
5 all the parts of the report that I might have  
6 commented on and so I think I'll just leave it there  
7 and respond to any questions within my knowledge that  
8 you might have as we go on. We do have one other  
9 committee member on the phone and he know he's  
10 prepared to comment on some things that Kevin perhaps  
11 didn't touch on.

12 MEMBER WEINER: Yes.

13 DR. CROWLEY: Joe was really involved in  
14 preparation of the route selection chapter, Chapter 4.  
15 So if you have questions about that, you should direct  
16 those to Joe.

17 MEMBER WEINER: Is there any -- Well,  
18 let's leave that for the end as long as you're here.  
19 Hank Jenkins-Smith who is on the telephone. Hank, are  
20 you still there? Hello?

21 MR. JENKINS-SMITH: I'm sorry, Ruth. I  
22 lost you for a second.

23 MEMBER WEINER: I'm sorry. Well, you've  
24 sent some slides I understand.

25 MR. JENKINS-SMITH: I did.

1 MEMBER WEINER: And you're on, Hank, to  
2 talk about social risks, emergency preparedness and  
3 any other topic that you would like to address.

4 MR. JENKINS-SMITH: Sure. I should start  
5 with the social risk of talking to an audience you  
6 can't see.

7 CHAIRMAN RYAN: Hank, just to make life  
8 easier, if you just tell us "next slide please" we  
9 have TV sets around the meeting room here where  
10 everybody can see your slides and everybody at the  
11 table has a copy of your slides. So next slide please  
12 will keep us up-to-date with you.

13 MR. JENKINS-SMITH: Very good.

14 CHAIRMAN RYAN: Welcome. Thank you for  
15 being with us.

16 MEMBER WEINER: And welcome and this is  
17 not an all-together unknown thing for us. So we're  
18 aware of the risks.

19 MR. JENKINS-SMITH: Let me apologize for  
20 not being able to be there in person. Teaching  
21 schedules and so forth precluded that, but I do  
22 welcome the opportunity to talk to this group. I  
23 should note by way of beginning that someone gave me  
24 a remarkably optimistic title here outlined as "Social  
25 and Institutional Challenges and Solutions" and, boy,

1 I wish I had them. But I would rather title it  
2 "Social Risks, Challenges and Recommended Solutions."

3 And what I will do is briefly make some  
4 remarks on variations in risk perspectives that  
5 underlie some of the problems we have in discussions  
6 about technological risks. I will then address some  
7 of the implications of those varying perspectives and  
8 try to put all of that into the context where the  
9 rubber meets the road where agencies are attempting to  
10 carry out policies that have the characteristics that  
11 lead to the sorts of social risks we're addressing.  
12 And then I'll very briefly make some connections to  
13 the report recommendations because I think you need to  
14 see the pathway about what we did. Next slide please.

15 Dealing with social perspectives on risks  
16 is interesting and somewhat difficult. Now we're used  
17 to typical formulation which is usually short-handed  
18 as probability times consequence. When we're thinking  
19 about a potential hazard, we look across some suite of  
20 scenarios, identify the probability of outcomes and  
21 their consequences and we can essentially identify  
22 risk that way.

23 The problem with that is that many folks  
24 don't understand risk that way. A near cousin is  
25 prospect theory and in prospect theory, the value

1 that's put on a loss or a gain is hinged on the status  
2 quo. So if you think that a technological risk is  
3 going to take away something that you have you'll  
4 value it quite differently than you would the gain of  
5 an equivalent quantity of good things.

6 What we are typically dealing with is a  
7 prospect theory-like setting in which losses loom  
8 larger than potential gains. So thinking about it in  
9 probability times consequence terms is a little tough  
10 and you know we have a huge debate now over the  
11 precautionary principle and the way that we should be  
12 addressing risk and it spans continents and  
13 governments and policy issue areas and what we're  
14 dealing with falls in a chunk of these formulations of  
15 risk.

16 The problem for us when we try to address  
17 risk in a social setting is that the nature of risk  
18 itself varies. There are quite different dimensions  
19 on which people understand the phenomenon of risk.  
20 You'll probably all have seen on occasion discussion  
21 about the psychometric dimensions of risk, the notions  
22 of dread, uncertainty, whether the risk is voluntary  
23 and from the perspective of the receiver of a risk,  
24 it's often the case that these characteristics lead to  
25 massive differentiation in the way the risk is

1 understood and acceptable or opposed.

2 More generally, when you look across the  
3 landscape of potential hazards, people end up having  
4 to identify which kinds of events are the most  
5 fearful, and we trade them off against one another,  
6 I mean, the hazards of guns or gun control. And these  
7 kinds of problems permeate the societies and the kinds  
8 of dialogues they have about risk, and we're in the  
9 middle of that kind of a dialogue with respect to  
10 nuclear risks with shifting tides over decades about  
11 risks of things nuclear are understood.

12 Even more tricky is the way that risks get  
13 considered when we're making collective decisions in  
14 regulations, and legislation, and as it spills over  
15 into elections. And just as an example of some of the  
16 things that happened here, risks are often ill-suited  
17 in the sense that they don't match easily the kinds of  
18 choices that we make in the elections or in policy  
19 decisions, and they become, essentially fugitive  
20 problems. They are problems that can't really be cast  
21 as the choices that we normally make, or in terms of  
22 the institutions that we use, so problems that are  
23 seen more generally are recast in terms of risks and  
24 threats.

25 A specific example is what I've termed

1 ideological displacement here; and that is, that when  
2 broader political values are at stake, and these can  
3 be quite broad-ranging, they are often recast in terms  
4 of risk, so this social perspective problem leads to  
5 quite a cacophony when we start talking about risk.  
6 And the difficulty is particularly acute when you are  
7 part of a community of researchers or in an agency  
8 where there are very specific tight definitions about  
9 what risk means, and then you come into contact with  
10 somebody who's talking about it very differently, or  
11 understanding it very differently, and it leads to  
12 substantial confusion, often the perception that  
13 somebody else is being misleading, and it breaks down  
14 prospects for communication. Next slide, please.

15           The implications of these different kinds  
16 of perceptions of risk are large, and I will focus on  
17 what are generally termed perception-based impacts,  
18 and just go down a quick list here. The most  
19 immediate kind of implication that you can see from  
20 perceived risk at the individual level is increased  
21 stress and anxiety and kind of health complications  
22 that can result from that, or generally there's a loss  
23 of a sense of well-being of a sense that one is  
24 secure, and that these types of things can  
25 substantially reduce the overall quality of life of an

1 individual.

2 Broadly, in a social context, the  
3 imposition of disks, even if they are technologically  
4 well understood and the traditional measures of risks  
5 are quite small, a sense that these risks are being  
6 imposed can lead to a loss of trust, or even a  
7 breakdown of the usual social patterns within  
8 institutions in the extreme. These kinds of impacts  
9 can have huge implications for society.

10 On a more familiar ground here, we've  
11 talked a lot about in the committee about stigma and  
12 economic impacts that results from stigmatization of  
13 a place because of its contact with a known hazard  
14 like radioactive materials, place based losses  
15 includes such things as reductions in tourism, loss of  
16 agricultural value, shifting of economic activity like  
17 conventions. Much of this type of research has been  
18 focused on the potential implications for Adda and  
19 Clark County, in particular.

20 In addition, however, place based stigma  
21 losses can result in reduced property values, some of  
22 which has been measurable in cases of radioactive  
23 waste transport programs. These kinds of research,  
24 however, really haven't been able to nail down  
25 precisely what these processes are. There's a great

1 deal of uncertainty, there's a big difference between  
2 what one would expect in normal operations versus  
3 accident situations, and we don't have a great deal of  
4 experience with severe accidents involving radioactive  
5 material handling in the United States, which is a  
6 good thing, in general, but it means that the kinds of  
7 empirical evidence we have are limited.

8           Probably the most severe problem you get  
9 is when you compound historical patterns of exposure  
10 or reduced ability to handle these kinds of risks with  
11 ostensive social injustice. These lead to what risk  
12 communications folks refer to as outrage, which is a  
13 complete breakdown of ability to communicate, and a  
14 sense of zero sum, or negative sum gains in which one  
15 side views what the other is doing as incredibly  
16 harmful to their well-being. Next slide, please.

17           In a bit of context, when you think about  
18 the social perspectives on risk, these may just be  
19 conditions that one has to live with, but when I think  
20 of these things, and as much as the discussion in the  
21 committee went, you have to place them in the context  
22 of the people who are actually having to carry out  
23 programs or an agency perspective, and it might be DOE  
24 or NRC, but somebody has been charged with  
25 programmatic responsibilities.

1           The difficulty for those who are charged  
2 with radioactive materials management is that they  
3 have multiple principals, or I guess a shorthand might  
4 be bosses to whom they have to respond. They have to  
5 respond to various committees, a White House, various  
6 constituencies. Amongst those constituencies would be  
7 the locally affected communities who tend to be the  
8 place that the social risks loom largest. But an  
9 agency doesn't have the capacity to take one  
10 perspective and run with it. They're in a web of  
11 perspectives there. They also operate within budgets  
12 and deadlines, and the pulling and hauling of an  
13 overtime political process. And I certainly don't  
14 need to explain that to you, you live there.

15           It's also the case that in that agency  
16 context, the people that they contend with, especially  
17 those who have alternative perspectives on the  
18 programs, maybe even directly opposing what the  
19 program is doing, they're working with people with  
20 very different capacities to operate. And it often  
21 appears, though it may not be the case, that the other  
22 players have greater degrees of freedom than the  
23 agency does. They certainly do with respect to the  
24 kinds of things they can say, and the forms of  
25 expression, and action that can take place in a policy

1 process. But what that does, is it creates a context  
2 in which social risk is discussed where the key  
3 players, the agencies charged with carrying out these  
4 policies, perceive themselves to be caught between the  
5 proverbial rock and a hard place. And this results  
6 far too often in a kind of a bunker mentality for  
7 those who are charged with carrying out these  
8 policies, a perception of the public as hostile or  
9 stupid, particularly interest groups that are engaged  
10 there. And perhaps the most damaging effect is that  
11 this kind of a context where highly controversial,  
12 complicated issues expressed in competing languages,  
13 where agencies have limited room to maneuver  
14 undermines the capacity for policy learning, and that  
15 is a substantial concern to those of us who are on the  
16 committee thinking about these problems. Next slide,  
17 please.

18 I want to emphasize that the leading  
19 concerns we had in trying to devise recommendations  
20 were to address this inability, or to address the  
21 capacity for learning that really is the life's blood  
22 of making forward progress on policies like this. And  
23 the main pattern for doing this is to have a greater  
24 flow of ideas, even learning language between those  
25 charged with carrying out the programs and the

1 individuals who they're working with, around them,  
2 those who they are charged to protect and so forth.  
3 And if one can increase the breadth of the perspective  
4 and capability in the advisory groups, one can go a  
5 long ways toward doing this. It decreases the  
6 probability of a costly social misstep, the sort of  
7 problem that we see too often in programs that take  
8 decades to overcome. It increases avenues for  
9 informal representation. The greater the breadth of  
10 the types of people that are included in these  
11 advisory groups, the greater the capacity for informal  
12 processes of communication for breaking down of  
13 mistrust, essentially creating pathways by which  
14 people believe they've been heard, and their concerns  
15 accounted for. It opens up avenues for two-way  
16 learning between agencies and the social risk  
17 practitioners, and some of the broader sort of ripple  
18 communities that those risk practitioners operate  
19 within.

20 I don't want to argue that this is a  
21 panacea. I guess I'd call it more akin to a necessary  
22 than a sufficient condition for success, but it's one  
23 that I think is urgent, particularly given the  
24 propensity for perceptions to rigidify and create  
25 these types of defensive postures that so crowd the

1 aim of risk management. Next slide, please.

2 More specifically, we had two  
3 recommendations along these lines in the report. The  
4 first was to expand the technical external  
5 coordination working group. Now this group which I've  
6 had the good fortune to speak to on a number of  
7 different occasions currently is made up of  
8 technically trained individuals, people who are  
9 involved in various kinds of official capacities, and  
10 what we're recommending is that it be expanded to  
11 include people who more specifically and broadly deal  
12 with risk communication, understanding risk from  
13 various perspectives in order to open up the potential  
14 for greater two-way communication.

15 I should say that a great deal of this  
16 happened already. What we want to do is reinforce it  
17 and stabilize it to make sure that it's a continuing  
18 feature of the program. The second point was to  
19 retain and modify the nuclear waste technical review  
20 board. It's already an existing institution. It's  
21 functioned as an independent and generally respected  
22 voice in looking at technical issues. We'd like to  
23 see it expanded to handle the social implications of  
24 the nuclear waste transportation problem.

25 Now this would be a group that would

1 chiefly be speaking to those who are implementing or  
2 regulating the process, essentially translating social  
3 science and practitioner knowledge as we have it for  
4 those who need to use it. And in some sense, this  
5 group needs to be one that could have access to  
6 relevant classified materials so that they would be  
7 able to speak to those issues, so in some sense, think  
8 of these two recommends, one as more porous and open,  
9 and broadly two-way in the kind of communication that  
10 it's bringing from external communities through the  
11 TEC into agencies, and scanning for potential  
12 missteps, and creating greater trust, and reducing the  
13 barriers to learning.

14 The second one is more to have the sorts  
15 of people who can take the body of knowledge that's  
16 developed in research and practice and provide it to  
17 those who are having to make these decisions, but  
18 doing so in a setting where they are able to attend to  
19 the full suite of problems, including those having to  
20 do with security.

21 That's the gist of what I have to say. I,  
22 again, apologize for not being there to do it in  
23 person. I'm happy to take any questions you might  
24 have.

25 MEMBER WEINER: Start with the committee.

1 Jim, Bill, Mike? Allen, do you have --

2 VICE CHAIRMAN CROFF: No, it's all your's.

3 MEMBER WEINER: All right. Then I guess  
4 it is.

5 I have some, Hank, as you might expect. First of all,  
6 to what extent have you, or has anyone that you work  
7 with actually studied committees that combine or that  
8 have a breadth of membership? And in order that this  
9 not appear to be a leading question, I'll tell you  
10 what the background of the question is.

11 I've served on a number of such  
12 committees, as I believe we all have. And I do not  
13 observe that it increases either the appropriate, what  
14 we could consider an appropriate perception of  
15 estimated risk or an appropriate perception of  
16 perceived risk. I don't think the communication, to  
17 put it bluntly, it's been my observation, which is in  
18 no way statistical, that all too often, the wanted  
19 communication does not happen. And I'd like to know  
20 if you have studied such committees, if you have any  
21 examples of where it does happen?

22 MR. JENKINS-SMITH: Yes. There's been  
23 quite a bit of work on trying to understand small  
24 group development of perspective. There's a  
25 particularly good scholar at the University of

1 Washington named John Gastil, who's written quite a  
2 few books on the way that these kinds of conversations  
3 can lead to more general understanding.

4 Now I would also say that if you structure  
5 the incentives in ways that sort of misalign the  
6 interest of the group, you get serious problems. And  
7 it's not easy, it's certainly not guaranteed that  
8 you're going to break these things down. But I guess  
9 I would use the experience of this NRC committee, the  
10 one that wrote the report on transportation of spent  
11 fuel, and when we began this communication, there were  
12 a lot of tensions. We brought people together who  
13 hadn't worked together before, and who were in very  
14 disparate kinds of communities. And as the  
15 communication progressed, there had to be a lot of  
16 trust-building, the belief that people were being  
17 heard. It takes work, and I would suggest that in the  
18 creation of these committees, one has to attend to the  
19 potential problems here, that there needs to be  
20 committee chairs or managers of this process that are  
21 watching for those kinds of problems and addressing  
22 them.

23 It also means there's got to be some  
24 selection on the process of who you put in. I mean,  
25 if you put in people whose job or whose perspective is

1 to represent one point of view, and not to listen, and  
2 to essentially be gadfly or a naysayer with respect to  
3 a policy, then it's very difficult to work with them,  
4 so there's both a selection process and a management  
5 process associated with it. And no, the committee  
6 doesn't imagine that it would be a panacea, as I said.  
7 But I think it's a necessary condition, and it's one  
8 that's worth working at to make it go.

9 MEMBER WEINER: I guess my other question  
10 is a more philosophical one. In the natural sciences,  
11 you can do experiments, and you can repeat them. And  
12 if I burn the same, just to take a fire example, if I  
13 burn the same quantity of octane under the same  
14 conditions, I'm going to get the same temperature, and  
15 the fire is going to last the same length of time.  
16 Experiments are repeatable, and it's on that basis  
17 that the natural sciences do projections. They say  
18 well, this has happened every way, this way every  
19 single time we've done it, and we've done it  
20 independently and so on. That does not happen in the  
21 social sciences.

22 It's very difficult to predict on the  
23 basis of behavior, not only look at what happened with  
24 the waste isolation follow-up project. Everyone  
25 would have thought that the transportation of waste to

1 the WIP was going to end civilization as we know it,  
2 until the WIP actually opened, and now no one pays  
3 very much attention to those trucks at all. In fact,  
4 you've met with them in some very heavy traffic  
5 routes, and you get more members of the media than you  
6 do protestors. You get one or two protestors and a  
7 dozen TV stations. How do you reconcile that? How do  
8 you use perceived risk, social risk, if you will, to  
9 make predictions that you can have any kind of  
10 confidence in?

11 MR. JENKINS-SMITH: You've said quite a  
12 bundle of things there. One was the distinction  
13 between the social sciences and what you're calling  
14 the natural sciences. I suppose humans are unnatural,  
15 but --

16 MEMBER WEINER: Well, no, works in  
17 biology.

18 MR. JENKINS-SMITH: In general, any  
19 science has to struggle with the magnitude of the  
20 events and concepts that it intends to explain. And  
21 the wonderful thing about much of the natural science  
22 is the events, and the particles, and the interactions  
23 are nicely bounded, and easily defined. In the social  
24 sciences, the closest we get to that, typically, is in  
25 economics, where the event is a transaction or a

1 trade, and under those circumstances, there's a very  
2 well verified empirical body of literature that is  
3 able to make good sense of human behavior.

4 Psychology comes reasonably close, and  
5 psychologists do use experiments in which they are  
6 able to control many of the relevant variables, but  
7 the limitation that we chiefly come across in addition  
8 to the complex kinds of phenomenon we're attempting to  
9 deal with is we can't do natural experiments with much  
10 of this. We have to use statistical controls rather  
11 than experimental controls, and often we can't control  
12 for all of the relevant variables, so it does leave us  
13 with greater uncertainty.

14 Within risk perception, however, there are  
15 some aspects that are pretty well understood, that  
16 have been measured over quite a range of different  
17 circumstances. And in general terms, the kinds of  
18 phenomenon extend well beyond the nuclear risk to  
19 other kinds of hazards, and one can draw on a body of  
20 knowledge that's developed with respect to those. I  
21 guess I would challenge you a little bit on your  
22 perception of what is known and can be known, and  
23 understanding human behavior generally, and risk more  
24 specifically.

25 With respect to your other point about the

1 WIP case, now you have to disentangle propositions  
2 that are made for political purposes from those that  
3 are made for social science purposes. And I started  
4 out talking about the way that risk works in context,  
5 and if you understand risk in terms of what is the  
6 expected loss, versus what is the expected gain, or in  
7 terms of prospected area, I think the case of WIP  
8 makes good sense.

9           Before the shipment actually began, people  
10 were facing a prospective loss, however small they  
11 might have feared it to be, or however much  
12 uncertainty they took into the calculation. Once the  
13 trucks were actually moving, the status quo had  
14 changed, and the way the people understood the risk  
15 changed.

16           It's funny, this kind of a proposition has  
17 been around for a long time. It's often been called  
18 the bow wave effect, that with the onset of a new  
19 technology, there's an initial hurdle that has to do  
20 with prospective loss, that you're adjusting the  
21 status quo. Once you're passed it, it looks, kind of  
22 looking back, it looks ridiculous that people were so  
23 concerned. This is something that we've seen with  
24 fluoridation, with compressed steam, and with all  
25 kinds of technologies over time. And so I'm not so

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1 sure, as you are, that it's a counter-instance to  
2 explanatory power.

3 It is the case, however, that when you  
4 listen to all of the propositions made before an  
5 event, you're going to hear all kinds of strange  
6 stuff. I think it's incumbent on us to ask quite  
7 carefully what is the empirical and theoretical basis  
8 for the claim before we treat it as if it was a  
9 scientific proposition. But I think that sort of gets  
10 at my general answer to your question. We could go on  
11 at length on this, especially if you gave me a beer.

12 MEMBER WEINER: A final question - what  
13 advice beyond broadening the makeup of these  
14 committees did you have? What advice would you have  
15 for a regulatory agency that is dealing with social  
16 risks?

17 MR. JENKINS-SMITH: I would encourage  
18 regulatory agencies that are dealing with these kinds  
19 of problems to actually have staff positions; in other  
20 words, people who are part of the agency who are  
21 trained in those areas, who actually have studied  
22 these kinds of social risks, and engaged in that kind  
23 of research.

24 The difficulty that agencies have  
25 typically when they bring in people who chiefly have

1 engineering and other technical backgrounds is that  
2 it's hard to make judgments about what counts as  
3 theory and what's just a claim. I think one of the  
4 bad raps that social science gets is it's so entangled  
5 in politics that people who haven't formally studied  
6 it, don't really have the ability to differentiate the  
7 kinds of problems that are before them.

8 I also think that having people on the  
9 inside of agencies who understand that language and  
10 the concerns that are associated with it would permit  
11 much more productive conversation between that agency  
12 and affected communities, and also with elected  
13 leaders.

14 MEMBER WEINER: Thanks. Does anybody want  
15 to add anything? Kevin is looking as if he does.

16 MR. CROWLEY: This is Kevin Crowley. I  
17 would like to add to Hank's excellent comments. As he  
18 was sitting here talking about these issues, I was  
19 smiling because I was thinking about all of the  
20 discussions that went on within the committee. We had  
21 15-16 individuals of whom three were social  
22 scientists, hard core social scientists, and the  
23 others were pretty hard core technical people, and  
24 then some people who kind of straddled the area. Neal  
25 Lane was a good example of a straddler, even though

1 he's a physicist by training, through his government  
2 and policy work, he's been exposed to the social side,  
3 and I think is very intuitive on a lot of these  
4 issues.

5 But there was an initial time during the  
6 committee's meetings - we spent a lot of time just  
7 breaking down the barriers between the technical  
8 people and the social science people - and it wasn't  
9 just learning the language, but that was a part of it,  
10 because social scientists are very precise in their  
11 use of terms, and the technical people tend to be a  
12 little sloppy in their use of a lot of social science  
13 terms. I think there's a sense that gee, we're all  
14 people, so we all understand the stuff.

15 CHAIRMAN RYAN: Full scale/half scale.

16 MR. CROWLEY: The point I wanted to make  
17 was this. I think that when we really began to make  
18 progress was not only when we learned to speak each  
19 other's language, but particularly on the side of the  
20 technical, what I'm calling the technical experts,  
21 although social -- we never found good terminology to  
22 differentiate these two groups, values, technical and  
23 social science.

24 There was an acceptance on the part, I  
25 think, of the majority of the technical people that

1 this was important, and it was legitimate. There's a  
2 tendency, and I see it all of the time, without  
3 referring to any particular committee, but within some  
4 of our committees that have both technical and social  
5 science, and also out in the world when you get into  
6 a meeting and you have a social scientist standing up  
7 and speaking to a group of technical people, there's  
8 a tendency to dismiss a lot of that stuff. And when  
9 we really began to make progress in the committee was  
10 when there was a recognition and an acceptance that,  
11 you know, this is important. We may not understand it  
12 very well, but this is a hurdle that we have to get  
13 over.

14 And I think where the committee came out  
15 on a lot of its recommendations, particularly in this  
16 area, is that this is not a problem you can solve.  
17 It's a problem that you try to learn more about, and  
18 it's a problem that you work with the affected people  
19 to try and manage. And I think the term "manage" here  
20 is key. And that's why you're seeing in the report  
21 the recommendation for expanding these advisory  
22 committees, or augmenting existing committees so that  
23 you bring people on who can help in this understanding  
24 and management.

25 MEMBER WEINER: Thank you.

1 MEMBER CLARKE: Excuse me, Ruth.

2 MEMBER WEINER: Yes.

3 MEMBER CLARKE: Could I make a comment?

4 MEMBER WEINER: Please.

5 MEMBER CLARKE: As I was listening to  
6 Hank's answer, I was also reminded of one of those  
7 committees that Allen and I were on, the management of  
8 legacy waste sites, the first stewardship committee.  
9 And we had social scientists, and one in particular,  
10 and there are barriers, and I think many of those  
11 barriers were broken down through those conversations  
12 that you have outlined, so I think that is a good  
13 suggestion.

14 MEMBER WEINER: We have not discussed  
15 route selection. Oh, we have another comment.

16 MR. RULAND: Yes. Bill Ruland, again, the  
17 Spent Fuel Project Office. We've read the report and,  
18 of course, we scratched our heads a little bit when we  
19 saw that social risk discussion. As you can see, the  
20 two recommendations don't directly effect the NRC.  
21 But what we can do, and we have been doing is really  
22 we have an extensive outreach program in the Spent  
23 Fuel Project Office to talk to groups that are  
24 affected by transportation. You've all met Earl  
25 before, I know, and we devote a significant portion of

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1 his time to go out to these groups to listen to their  
2 viewpoints, and to try to bring back some of what we  
3 hear. And it's something we've done up to this point,  
4 and we continue to take a serious look about what we  
5 do in this area.

6 And, in particular, we're right now  
7 considering a contract where we kind of try to help  
8 ask SANDIA, not necessarily a group of social  
9 scientists, to help us come up with some demonstration  
10 aides so we can kind of demonstrate and try to educate  
11 folks. At this point, that's what we see our role in  
12 this area is. Yes, we continue to kind of think about  
13 it, but as the committee has learned, it is important.  
14 It's part of really the fabric of our office, and I  
15 believe it's the fabric of the NRC at-large, to really  
16 listen to the number of publics we have out there.  
17 Thank you.

18 MEMBER WEINER: Joe, would you like to  
19 comment, moving to another topic, unless somebody else  
20 wants to make a comment about social risk. Hearing  
21 none, would you like to give us a brief rundown on  
22 what you did with routing?

23 MR. MORRIS: Actually, Kevin's  
24 presentation did cover the key conclusions and  
25 recommendations on routing, and I'll just remind you

1 what Kevin said. The committee had two distinct  
2 tasks; one was the broad task of looking at the  
3 technical and social concerns connected with potential  
4 future large-scale shipments, mainly of commercial  
5 spent fuel. And the second task was a specific  
6 Congressionally mandated task to look at how the  
7 Department of Energy made routing decisions for  
8 shipments of research reactor spent fuel in the United  
9 States. And this has to do with most of the shipments  
10 that have taken place of research -- the largest  
11 quantity in the last decade, at least, has been  
12 foreign research reactor spent fuel that's repatriated  
13 to the U.S., and comes in mostly Charleston, South  
14 Carolina, and goes to DOE facilities in Nevada or in  
15 South Carolina. But there are other flows of research  
16 reactor fuel, as well, including fuel from university  
17 reactors, which is not the direct responsibility of  
18 DOE, because the universities here are NRC licensees,  
19 and also shipments from DOE reactors.

20 The committee's understanding was that  
21 this study charge came out of a specific -- primarily  
22 was the result of a specific controversy over a  
23 specific one of these shipments of some foreign  
24 research reactor fuel from the Savannah River facility  
25 in South Carolina by truck to Idaho in 2001, that the

1 State of Missouri objected to, and attempted to stop,  
2 so that was the background of it.

3 The committee's conclusions have to do,  
4 first of all, with DOE procedures, which the committee  
5 thought were reasonable and sufficient for planning  
6 the routes for these shipments. And also, with the  
7 DOT regulations. DOE is responsible for the  
8 management of certain of these shipments, DOT writes  
9 regulations that govern highway shipments of high  
10 level radioactive waste and spent fuel. And the  
11 committee concluded in that regard that DOT's highway  
12 routing regulations, which largely govern the way the  
13 Department of Energy routed that 2001 shipment that  
14 went through Missouri were also reasonable regulations  
15 if they were followed and practiced in the way that  
16 their framers intended them to be.

17 Beyond that the committee, I believe, saw  
18 that experience as very useful historical experience  
19 of an actual ongoing program involving the ongoing  
20 shipment on a routine basis of spent nuclear fuel on  
21 an orders of magnitude smaller scale than what would  
22 be involved in disposing of all the commercial reactor  
23 fuel in the country; but, nonetheless, a good example  
24 of how DOE confronted and overcame some of these  
25 problems having to do with routing and other aspects

1 of management of the program. And the committee  
2 highlights the routing practices, in particular, the  
3 formal procedures for consultation with states, and  
4 with tribal organizations along the routes as a  
5 worthwhile example that is applicable, keeping in mind  
6 the differences in scale that greatly complicate the  
7 problem, but is applicable as an example for  
8 procedures that DOE can follow in larger scale  
9 programs.

10 Beyond that, I think if there are  
11 questions about the --

12 CHAIRMAN RYAN: Just a little piece of  
13 anecdotal experience that picks up on Professor  
14 Jenkins-Smith's comments. As a resident of  
15 Charleston, South Carolina for many years, I can  
16 attest to the pattern of lots of press, lots of  
17 interest about the first shipment of reactor fuel,  
18 research reactor fuel, then it went away. The first  
19 MOX fuel shipment that went to Duke that came in  
20 through Charleston. Charleston is an interesting  
21 entry point for lots of things. It's I think the  
22 third-largest seaport on the east coast for material  
23 coming into the United States, but it was very  
24 interesting, I think, to me, and it's interesting to  
25 hear that there really is a social science pattern to

1 that, that the, let me call it uproar, for lack of a  
2 better word, or attention that it got, was very  
3 intense, very short-lived, and then non-existent. So  
4 shipments come and go, and I'm sure there have been  
5 dozens of them over time, or hundreds maybe.

6 MR. MORRIS: Hundreds. On the order of  
7 hundreds, I believe.

8 CHAIRMAN RYAN: Hundreds. And it was only  
9 the first one or two that kind of got the attention,  
10 and everything has been running like clockwork, as far  
11 as I can tell, ever since. It's interesting.

12 MR. MORRIS: That was an instance where  
13 the specific circumstances, the specific political  
14 circumstances are unique to every case, but that was  
15 an instance where, in fact, the states and DOE, and  
16 others involved; for example, the railroads, did  
17 realize that they were compelled to sit down and work  
18 out some understandings, which were then put into  
19 writing in transportation plans that govern that  
20 activity, in a sense.

21 CHAIRMAN RYAN: And I guess that leads me  
22 to the question, I wonder if it would be helpful to  
23 collect as many of these kind of case studies, as  
24 possible, and see if there's some other pattern that  
25 might better inform trying to get the process going

1 earlier rather than later, thinking of a new activity  
2 along these lines. Because, I mean, there are lots of  
3 them, there's not just the Savannah River, Charleston.  
4 There are lots and lots of shipments that have  
5 occurred. We've heard about lots of hazardous waste  
6 or hazardous material, or radioactive material kinds  
7 of shipments. It would be interesting to see if we  
8 can tease out some patterns that might be informative.  
9 And again, I'm thinking more broadly, just the social  
10 aspect as one, and also the government affairs aspect.  
11 I mean, those tend to be pretty complicated puzzles to  
12 sort out. And Lord knows, South Carolina's politics  
13 are relatively unique in many ways.

14 MR. MORRIS: I believe that, and maybe  
15 Hank Jenkins-Smith can comment on this, but I believe  
16 that some of the social science research on these  
17 phenomena that have to do with public reactions to  
18 radioactive waste shipments were situated on the  
19 experience of these foreign research reactor  
20 shipments.

21 MR. JENKINS-SMITH: Yes. A great deal of  
22 the initial work was based on that and, of course, on  
23 WIP. But the interesting finding that is still out  
24 now on the South Carolina case was that in part, if  
25 you recall, when that started up, the state sued the

1 federal government to stop the shipments, and the  
2 boats bringing the spent fuel over to the United  
3 States had to circle around in the ocean for a while  
4 as the court sorted out what it was going to do. And  
5 when the shipments were about to arrive, the  
6 *Charleston Courier* had a front page story with a line  
7 in red showing where the route was going to go  
8 alongside the governor's rather extraordinary  
9 statements about the likely affect on the health of  
10 the citizens when it did. And that event is a classic  
11 instance of both the expectations of loss in the  
12 initial case, and the mobilization of interest in  
13 trying to define the risk. And we've learned an awful  
14 lot from that, and it's still being studied, in fact.

15 CHAIRMAN RYAN: Thanks.

16 MEMBER WEINER: We have another comment.  
17 Judith, would you introduce yourself.

18 MS. HOLM: With your approval, I'm Judith  
19 Holm. I'm from the Civilian Waste Program in the  
20 Department of Energy, and we are a co-sponsor of the  
21 report, and I thank the committee again, and Kevin for  
22 all the work they did. Our feeling is that yes, we  
23 agree, there is a good system out there. We have been  
24 working within that system, and I wanted just for this  
25 committee's information, we welcome NRC's support, and

1 Earl and I have worked together a long time. The  
2 groups that he has been providing information to about  
3 the regulatory structure and NRC's role are the four  
4 state regional groups that we sponsor, the  
5 Transportation External Coordination Working Group is  
6 a group that our office sponsors and has managed for  
7 some 10 to 15 years now.

8 We agree that it's important to have the  
9 dialogue between technical and social science, and  
10 policy people. Don't forget the policy people,  
11 they're critical to this discussion, so I wanted to  
12 welcome any of you who are interested to attend any of  
13 these regional group meetings, of the tech group that  
14 meets twice a year. Come and see what we're doing.  
15 We do have a number of activities in committee  
16 underway addressing routing, and establishment of  
17 criteria, as you've suggested, working out the  
18 emergency preparedness funding system. We're hopeful  
19 that we'll be able to publish policy on that fairly  
20 soon, so we take your suggestions seriously, and are  
21 working through some of those suggestions right now in  
22 DOE. Thank you.

23 MEMBER WEINER: Thank you. Does any  
24 member of the committee, do you all have any further  
25 items you want to comment on?

1 MR. CROWLEY: You've mentioned emergency  
2 response service times, and I was prepared to just  
3 make a few comments about that, if you'd like.

4 MEMBER WEINER: Please.

5 MR. CROWLEY: Okay. Allen, did you have  
6 a --

7 VICE CHAIRMAN CROFF: No, go ahead.

8 MR. CROWLEY: Okay. All right. Well, you  
9 may remember that the recommendation, again, was DOE  
10 should begin immediately to execute its emergency  
11 responder preparedness responsibilities. And the  
12 committee recommended four particular steps that DOE  
13 might want it to take. And before I mention those,  
14 let me say that I think there was a lot -- again, this  
15 was one of those issues that got a lot of internal  
16 discussion during the committee meetings, and we had  
17 a committee member, Lacy Suiter, who was an Emergency  
18 Management Professional. He ran the Tennessee FEMA  
19 for 12 years, and then was in a high level position in  
20 the U.S. FEMA before he retired, and he still does a  
21 lot of consulting work, so he understands this area  
22 very well. And I think it was his sense that DOE is  
23 really missing an opportunity here, because emergency  
24 responders tend to be -- they're highly thought of  
25 within communities, they tend to be ambassadors to

1 communities, and when a public official or a member of  
2 the community says - they hear about the spent fuel  
3 and high level waste shipments coming through the  
4 community and they say, is this safe? Can we handle  
5 this? Having emergency responders who are trained to  
6 understand what's going out and can respond to the  
7 political leader or to the citizen, yes, this is okay,  
8 we can handle this. There's a real advantage to that.  
9 So in that spirit, the committee made four explicit  
10 recommendations for steps that DOE could take.

11 The first is to establish a cadre of  
12 trained emergency responders and to do this early, and  
13 to focus on the long-term professionals. Over 75  
14 percent of fire departments are either volunteer or  
15 part-paid fire departments, and there's a lot of  
16 turnover. So what you want to do is you want to focus  
17 on the people within those fire departments who have  
18 been around for a while and are likely to be around,  
19 and in the very early stages, focus on train the  
20 trainer activities, and try to get some input to your  
21 planning process. And I know some of that is already  
22 going on within the TEC.

23 The second recommendation was to work with  
24 DHS to provide consolidated all-hazards training.  
25 Under Section 180<sup>(c)</sup>) of the Nuclear Waste Policy Act,

1 DOE is responsible for providing financial support for  
2 emergency responder training. The committee felt that  
3 that support could go a whole lot farther, and be a  
4 lot more effective if emergency responders received  
5 training for spent fuel and high level waste emergency  
6 response as part of the other types of hazard training  
7 that they get, so that was the second one.

8 The third recommendation was to include  
9 trained emergency responders on escort teams. The  
10 committee noted that this would be a little easier to  
11 do if you were transporting material by rail, and  
12 particularly by dedicated train. But the thought  
13 there was, again, part of it is making your limited  
14 resources go farther, but the other part of it was,  
15 these people can establish liaisons with the emergency  
16 response organizations in the communities through  
17 which these shipments pass, so that you are, again,  
18 developing the good ties that you want to have to make  
19 the program success. And also, if there is an  
20 accident or an incident, that the emergency responder  
21 on the shipment is there as a resource to the local  
22 incident commander.

23 And then finally, the fourth  
24 recommendation was to use emergency response  
25 preparedness as an outreach to communicate more

1 broadly with communities about transportation plans  
2 and programs. And the idea, a couple of suggestions  
3 there the committee made were, for example,  
4 establishing a website where communities who would see  
5 these materials coming through could find out about  
6 DOE's emergency response programs, and about  
7 preparedness in their communities. And also, perhaps,  
8 even getting school children involved in, for example,  
9 making environmental measurements along sites. So the  
10 committee felt that there was a lot that DOE could be  
11 doing and wasn't doing to take advantage of the  
12 outreach opportunities in the emergency response area.

13 CHAIRMAN RYAN: One follow-up question,  
14 Kevin. That all sounds great, and I know a lot of  
15 that goes on, but delivery in an emergency is a whole  
16 different matter. And in that transportation  
17 accident, under the authority of the governor in the  
18 state in which it occurs, the governor has authority  
19 over what happens in the state. And if he wants  
20 somebody else's help, he has to ask, he has to ask the  
21 Feds and whoever it might be.

22 MR. CROWLEY: Well, initially the --

23 CHAIRMAN RYAN: Let me finish my question.  
24 So what I'm thinking about is how do you develop a  
25 plan - this is a general question - it's not

1 specifically about the governor's authority. How do  
2 you develop a plan of implementation to go along with  
3 your plan of training, because without both, I think  
4 you're wasting your money on either side by itself.

5 MR. CROWLEY: When you say "a plan of  
6 implementation" what are you --

7 CHAIRMAN RYAN: How are you going to roll  
8 it out? I mean, we're going to train a bunch of  
9 firemen, pick a town, in Washington, Bethesda, and  
10 we're going to get the first responders, who are  
11 firefighters. We are going to get emergency medical  
12 people, and others that might be potentially involved  
13 in a response, police, the whole works. So we train  
14 them all, and now there's a rail accident, and the  
15 railroad emergency response team, who owns the track,  
16 says we're in charge. And, of course, firemen -- how  
17 do you deal with the fact that when you have a  
18 response to a significant event, that you really have  
19 to understand the hierarchy and have some integrated  
20 plan on how you're going to make all those pieces fit  
21 in reality, and exercise that in some way. Having  
22 been involved in a few transportation emergency  
23 exercises over the years, that's the number one issue.  
24 It's not how do we get the equipment there and break  
25 out the radiation detection gear and all the rest.

1 It's who's going to give us authority to go measure  
2 something.

3 MR. CROWLEY: Well, if Lacy were here, I'm  
4 sure he could give you a very detailed response to  
5 that.

6 CHAIRMAN RYAN: But does the report go  
7 into that, I guess is my question.

8 MR. CROWLEY: The report recognizes that  
9 there is a system in place for response to accidents.  
10 If it were, for example, a rail accident, the rail  
11 operator does have a certain responsibility, but there  
12 would be an incident commander, and the incident  
13 commander would be appointed. It would be the county  
14 official or the city official, depending on what --

15 CHAIRMAN RYAN: Or the state. It could be  
16 a state official.

17 MR. CROWLEY: Well, if it were a  
18 significant emergency, the state might come in.

19 CHAIRMAN RYAN: Well, in some counties  
20 they don't have resources. I can name several --

21 MR. CROWLEY: But, again, there's a  
22 different system within each state.

23 CHAIRMAN RYAN: That's my point.

24 MR. CROWLEY: And usually, there's a  
25 memorandum of understanding among the localities in

1 the state that guide that.

2 CHAIRMAN RYAN: Good training without an  
3 implementation plan doesn't go very far. That's my  
4 point.

5 MR. CROWLEY: I don't think the committee  
6 would disagree with that.

7 CHAIRMAN RYAN: But I think that's  
8 something that we ought to take to heart, because how  
9 you train and who you train doesn't really come from  
10 an external view of who should be trained. It comes  
11 from how does that system work politically and  
12 socially, and who are the decision makers and the  
13 responders. Those are the people you train.

14 MR. MORRIS: One point that is in the  
15 report that's a little bit related to that concern is  
16 that the way to approach preparing the emergency  
17 responders for these kinds of incidents is to  
18 integrate that training and preparation in with  
19 broader -

20 MR. CROWLEY: All-hazards training.

21 MR. MORRIS: -- all-hazards emergency  
22 response training, rather than to see it as a separate  
23 activity.

24 CHAIRMAN RYAN: The other thing that maybe  
25 it's a component you thought about, or maybe it's one

1 should be thought about, is typically, the owners of  
2 transport units, casks, have emergency response teams  
3 that can be on a plane and get anywhere in the United  
4 States in relatively short order, typically under four  
5 or five hours, because their asset is at risk, so I  
6 think integrating real experts on the equipment that  
7 might be involved, whether it's a railcar, a rail  
8 cask, or a truck, or whatever it might be, is a  
9 dimension that people ought to think about, too.

10 MR. CROWLEY: There has been a lot of that  
11 thinking done. For example, I know that there's a  
12 memorandum of understanding among nuclear power plant  
13 operators, if you have an accident close to a plant,  
14 that operator can be called on for technical  
15 assistance. I think a lot of those are in place. Now  
16 whether or not they function as they're intended to  
17 function is another question. But DOE doesn't have  
18 responsibility for the implementation side, they have  
19 a responsibility for the training side. They do  
20 exercises in order to try to exercise that to make  
21 sure that everybody's on the same page.

22 CHAIRMAN RYAN: But there's a national RAP  
23 program, Radiological Assistant Program, and they do  
24 respond, and there's Broken Arrow responses.

25 MR. CROWLEY: That's right, there are

1 several levels of response.

2 CHAIRMAN RYAN: So DOE does respond to  
3 that RAP program.

4 MEMBER WEINER: Allen, you had a question?

5 VICE CHAIRMAN CROFF: Yes. I had a  
6 question on the routing business. Did the committee  
7 form any insights as to the adequacy of the databases  
8 that drive these routing analyses; in particular,  
9 population densities along the various routes, and  
10 whether they're adequate?

11 MR. CROWLEY: Joe, you should take that,  
12 because that came up explicitly in the research  
13 reactor routing study, and I'm thinking there the  
14 broad risk assessment that was done.

15 MR. MORRIS: Yes. The committee did not  
16 review the models in detail, but certainly their  
17 understanding of it was that the models - well, DOE  
18 used the highway and interline routing model in the  
19 RAD TRAN Risk Estimates in the EISs. The EIS's  
20 conclusion was, essentially, that this trans -- EIS is  
21 for the research reactor spent fuel shipments. The  
22 EIS's conclusions were basically, this is a very safe  
23 activity. They didn't quite put -- I forget exactly  
24 what the words were. It's quoted in there, but  
25 basically that the risk en route don't rise to the

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1 level of where this is a major concern, is basically  
2 where it ended up. EIS didn't attempt to use those  
3 models for comparing routes, and this was kind of part  
4 of the problem with down the road when the State of  
5 Missouri and the State of California started  
6 objecting, how do you know that our route is really  
7 safer than the route through the State of Nebraska?

8           When DOE started working with the states  
9 in these working group to pick the routes, the first  
10 thing they did was apply the DOT regulations, which  
11 are very cut and dry. And DOT regulations say  
12 basically, you go by an interstate, you go by the  
13 shortest route, you go by the shortest route from your  
14 point of origin to the point on the interstate that  
15 will take you where you're going, and the states can  
16 write exceptions to that, the states can make specific  
17 exceptions to that. So if you apply all those rules -  
18 and these regulations go back to the 70s, I believe,  
19 and DOT when they enacted the regulations did not  
20 require any detailed route-by-route comparisons - so  
21 when you apply all the rules, you come up with a route  
22 basically without going through detailed risk  
23 assessments of alternative routes. And so the  
24 committee's recommendation or conclusion was that  
25 that's a reasonable process, even though it does not

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1 involve detailed route-by-route comparisons.

2 Now the report goes one step farther than  
3 that, and it says that in some of this more  
4 microscopic examination of the routes, it seems like  
5 they were making decisions that could have been  
6 informed by data had it been available, but which were  
7 not, because the data were not available. And just  
8 one example was that it seemed like the states had a  
9 preference for routes where emergency responders were  
10 already trained, because that would mean they wouldn't  
11 have to train new emergency responders on some other  
12 route. But the implication of that is to tend to bias  
13 routes, or might be to tend to bias routes toward high  
14 population areas because that's where emergency  
15 responders are most likely to have training.

16 Well, there's no model that I'm aware of,  
17 or that seems to have been applied in these situations  
18 for analyzing those kinds of choices. Now maybe you  
19 could have, or simply other tradeoffs had to -- routes  
20 were avoided because they went through mountains -  
21 train, for example. Again, was any specific analysis  
22 done in that kind of a microscopic setting, and I  
23 don't know of any, so that's a long-winded answer.  
24 But the models that exist were not used for route-by-  
25 route comparisons of risk, because that's not what the

1 regulations call for. The regulations shortcut that.  
2 The report says there are worse situations where there  
3 should have been more analytical power brought to bear  
4 on the problem and it wasn't, and probably tools ought  
5 to be developed for that and they don't exist.

6 MEMBER WEINER: Just to expand on that,  
7 that was partly a result of the tools available at the  
8 time. There has been considerable expansion of the  
9 applicability of these tools, and the incorporation of  
10 the sort of data that you're talking about. One big  
11 lack, which has always existed, is that none of the  
12 tools used incorporate things like mountainous  
13 terrain. That's always a decision that you sort of  
14 make on the ground, so to speak. But if we were to  
15 redo that foreign fuel research analysis, you would  
16 see a much finer division, and it could be used for  
17 route-by-route comparison. In fact, DOE does a great  
18 deal of that right now for all kinds of things, not  
19 just spent fuel. It's something that is very easy to  
20 do.

21 I was going to ask about emergency  
22 response. Since most of the transportation of spent  
23 fuel will not take place for more than five years,  
24 probably ten, and since most of the emergency  
25 responders, which is, as Joe has noted, are not in the

1 urban areas. Most of the routes and most of the  
2 emergency responders are volunteer fire departments,  
3 and the personnel tends to change over on the more  
4 than annual basis, are you suggesting a continuous  
5 program of training, or is there some optimum time at  
6 which the training should begin? I mean, looking at  
7 the fact that there are not infinite resources  
8 available for this, did you discuss that in the  
9 report?

10 MR. CROWLEY: Well, there was long  
11 discussion about that within the committee, and there  
12 is discussion about that in the report. The committee  
13 heard from several individuals during the study that  
14 it's too soon to start training, and I think Lacy, in  
15 particular, but also some of our other committee  
16 members just didn't buy that argument. They said  
17 there are some things you can do very early, and one  
18 of the things that they highlighted that you could do  
19 very early would be to identify the permanent members  
20 of those departments. While there is a lot of  
21 turnover, there are also a cadre of people who are  
22 there for a long time, and you can focus your initial  
23 efforts on those people.

24 The committee was not advocating a large-  
25 scale training program of people who weren't going to

1 be there when you were ready to ship the fuel, but I  
2 would also point out that the committee also said one  
3 of the other things you should do is you should work  
4 with DHS to provide training as part of all-hazards  
5 training. This is training that everybody gets, and  
6 so DOE doesn't have to establish these individual  
7 training programs or provide aide to states to  
8 establish individual training programs. You make it  
9 as part of training the firefighters and other  
10 emergency responders get just as a matter of course.

11 MEMBER WEINER: Are there any further  
12 comments from anyone in the room? Hearing none, I'm  
13 going to turn - oh, sorry. Excuse me. How could I  
14 neglect you, John?

15 MR. KESSLER: John Kessler, Electric Power  
16 Research Institute. EPRI also co-funded the study and  
17 I want to thank the NES panel for a nice discussion of  
18 the issues. It certainly was a tough task. There's  
19 a couple of gems in there I really like. One, for  
20 example, is the description of the drop test onto an  
21 unyielding surface, the combination of the two.

22 I think that what confused me in the end  
23 all boils down to this issue of risk, and definitely  
24 have to put it in quotes, at least for a technical guy  
25 like me. Lest we technical people get a little too

1 smug, Ruth, I guess I would argue that we certainly  
2 deal with a lot of uncertainties on the technical  
3 side, as well. And in the end, what's always missing  
4 from these arguments, and I think is also missing from  
5 this one, is there's only so much money we can spend  
6 on this. And in the end, am I supposed to, as a  
7 policy maker, spend my money refining the release  
8 fraction from a certain kind of fire event, or am I  
9 supposed to spend my money on maybe instituting some  
10 sort of new external citizens advisory board or  
11 something like that?

12 I guess my uncertainty, pardon me for  
13 using that word, was I'm having a hard time  
14 understanding the commonalities in the use of "risk",  
15 the use of "risk-informed", the use of "bounding", the  
16 use of "credible accident scenarios", and how I mix  
17 social risk versus what, for lack of a better word,  
18 technical risk all together. I guess specifically on  
19 the fire one, there were words sprinkled through the  
20 report about using risk-informed approaches or risk-  
21 based approaches. I've probably got the words  
22 slightly wrong there, and yet we come to the fire, it  
23 seems as if we're talking about credible accident  
24 scenarios, where you're talking about sort of a  
25 bounding situation. And just on the technical side,

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1 that seems somewhat inconsistent, and I was looking  
2 for a clarification, which maybe I just missed when I  
3 read the report.

4 And I guess my last feeling about the risk  
5 is that well, I keep thinking we talk about social  
6 risks, and are we really talking about risks, or maybe  
7 it's on the technical side that we don't know what  
8 risk means. And I keep thinking that we bandy these  
9 terms around just to make the other side happy, and in  
10 the end, I'm still left with this idea of okay, in the  
11 end we, as a society, have to make a decision, are we  
12 going to do this, or aren't we going to do it? And if  
13 we're going to do it, how are we going to do it? And  
14 while I appreciate the need for social risks to be  
15 mixed up with the technical risks, the end of the day,  
16 I still wasn't quite sure what the NES was  
17 recommending regarding how one uses social "risks",  
18 and mixing it up with the technical risks.

19 MEMBER WEINER: Thank you. Hank, if  
20 you're still on. Hank? I guess he's not.

21 MR. CROWLEY: Can I take a crack at that?

22 MEMBER WEINER: You certainly may, Kevin.

23 MR. CROWLEY: Well, I think there are a  
24 couple of main takeaway messages from the report. The  
25 first is that from a technical basis, there really are

1 no barriers to the safe transport of waste. I hope  
2 that was the message that came through pretty clearly  
3 in the report. And I think the other message that I  
4 hope came through pretty clearly is that the  
5 radiological risks are generally well understood, and  
6 they're low. Those are really the two big messages.

7 There were a variety of other messages.  
8 One of the messages, I think, and again, this was from  
9 the social science side, is that there are these  
10 social issues that have to be attended to. And that  
11 if you ignore them, you ignore them at your peril.  
12 And again, we're not talking about solving them, we're  
13 talking about understanding them, and working with the  
14 affected communities to manage them. And the  
15 committee tried to recommend pragmatic ways to do  
16 that.

17 With respect to the very long duration  
18 fires, actually, I think what the committee wanted to  
19 see happen is what you heard Earl say he was doing,  
20 which is to demonstrate a bounding understanding. And  
21 one can do that probably without spending a lot of  
22 money. In fact, one of the points that the committee  
23 made was that the number of additional analyses that  
24 might need to be made are pretty small, so I think  
25 those are the messages that you want to take away.

1 MEMBER WEINER: Before calling on John, I  
2 have to ask one question. You said, "You ignore the  
3 social risks, and ignore them at your peril." Am I  
4 quoting you correctly?

5 MR. CROWLEY: That's what I said, and  
6 that's not what is in the report. That is my  
7 interpretation of what's in the report.

8 MEMBER WEINER: Okay. My question to you,  
9 for your interpretation, is what peril? I mean,  
10 suppose there is a massive objection to something, and  
11 to some shipment, as there is, and you do it anyway  
12 because you know that the risks are small, if even at  
13 all. And it happens, and then it's done, and that's  
14 that. And generally speaking, as we have heard, the  
15 social risk goes away, as well, so what peril?

16 MR. CROWLEY: I would hazard to say that  
17 you'd probably get disagreement with Hank on that. If  
18 you manage the social risks well, and you run the  
19 program well, they're manageable. I think that's what  
20 he would say.

21 The other point I would make about that is  
22 that the committee sensed, and you'll see this in the  
23 report, that sustained implementation of large  
24 quantity shipping programs was likely to be a  
25 challenge from a social point of view. And it's not

1 the shipment that you make here and there, it's these  
2 large programs that are going to be shipping for long  
3 periods of time, where you really have to attend to  
4 these issues.

5 MEMBER WEINER: Yes. I recognize the  
6 committee made a big point about consistently seeing  
7 to it that regulations were abided by. John, did you  
8 have a further -- hearing no further comment, I'll  
9 turn it back to the chair.

10 CHAIRMAN RYAN: Thanks. And that's an  
11 excellent discussion. I'm glad we had lots of  
12 participation and comments from your sponsors, as well  
13 as comments from you about your report. And thanks,  
14 Ruth, for leading us through a good discussion.

15 We're at a break in the agenda a few  
16 minutes early, so in order to conserve the later hours  
17 of the evening for other activities for us and you,  
18 why don't we just take a -- come back a few minutes  
19 early, at say 25 minutes to 5, and we'll start a  
20 little bit early. Instead of 4:45, we'll make it  
21 4:35, and see if we can get a little bit ahead of the  
22 game on our next presentation on NORM radioactive  
23 material.

24 (Whereupon, the proceedings went off the  
25 record at 4:22 p.m., and went back on the record at

1 4:37 p.m.)

2 CHAIRMAN RYAN: All right. If we could go  
3 back on the record please? Without further ado, Lydia  
4 Chang is here to talk to us about natural and  
5 accelerator-produced radioactive material rulemaking  
6 and how the formerly unincorporated radioactive  
7 material will now be incorporated into 10 CFR.

8 So, Lydia, welcome. And we are pleased to  
9 have you with us today. Thank you.

10 MS. CHANG: Thank you. Again, my name is  
11 Lydia Chang. I'm with the Rulemaking Guidance Branch  
12 within NMSS.

13 And today I'm just going to kind of give  
14 you an overview of the normal rulemaking efforts.  
15 First I will briefly touch upon the Energy Policy Act  
16 of 2005, the waiver that we issued, and the approach  
17 that we took and the strategy that we tried to  
18 implement. And give you a very high-level summary of  
19 the proposed rule and talk a little bit on the  
20 implementation consideration, the current schedules,  
21 and the next steps.

22 As you know, the Energy Policy Act of 2005  
23 was signed into law on August 8th within Section  
24 651(e) of the Energy Policy Act amended the definition  
25 of byproduct material in the AEA Section 81(e). And

1 also within that section, it amended the definition  
2 within an agreement state portion. It also amended  
3 AEA Section 81 indicating that this newly-defined  
4 byproduct, it is not low-level waste and therefore  
5 provides additional disposal options for disposal of  
6 such material.

7 It does require NRC to issue the final  
8 regulation within 18 months which is an extremely  
9 aggressive schedule. It also allows NRC to grant a  
10 time limit waiver so that we can have a smooth  
11 transition from NRC authority over to the agreement  
12 state.

13 Specifically, Section 651 amends the  
14 definition to include discrete sources of radium-226,  
15 material made radioactive by use of product  
16 accelerator and also any other discrete source of  
17 naturally occurring radioactive material that poses a  
18 similar threat in radium.

19 The material is also limited only to  
20 radioactive material that is produced, extracted, or  
21 converted after extraction, before, on, or after  
22 August 8, 2005. And it is used for commercial and  
23 medical research activities.

24 Since the NRC policy act does allow the  
25 Commission to grant a waiver, NRC evaluated the

1 situation, and published such waiver on August 31st in  
2 the Federal Register notice. That waiver allows any  
3 individuals engaged in activities involving NARM  
4 material to continue with their activities and also  
5 allows the states to continue to regulate the NARM  
6 material.

7 The waiver is effective through August 7,  
8 2006 for import and export NARM and it is effective  
9 through August 7, 2009 for other NARM materials within  
10 the Energy Policy Act and also within the waiver, NRC  
11 did indicate that we may terminate such waivers  
12 sooner. And we are planning to do that.

13 Our rulemaking approach is to try to  
14 cooperate with states. And the way that we tried to  
15 cooperate with states is forming working groups that  
16 actually had state participation. Not only the  
17 agreement state representatives but also non-agreement  
18 representatives.

19 We have four members from the states along  
20 with the NRC headquarters and regions working together  
21 in developing such proposed rule. We also have a  
22 steering committee that has made decisions throughout  
23 the way. As you know, there are several issues that  
24 we need management decisions on that so the steering  
25 committee was involved in that.

1 We also had two state representatives  
2 sitting on the steering committee making the decision  
3 along with NRC management.

4 Another --

5 CHAIRMAN RYAN: Lydia, just a quick  
6 question --

7 MS. CHANG: Sure.

8 CHAIRMAN RYAN: -- if I may on states. Do  
9 you feel like so far there has been good flow of  
10 information from those representatives out to say  
11 CRCPD and OAS in all the states?

12 MS. CHANG: Since we have so many state  
13 representatives I think within the working group task  
14 force and steering committee, the communication is  
15 very well. They also have done some ad hoc  
16 communication with them through the working group and  
17 also through the task force to collect information  
18 from the agreement state on the type of regulations  
19 they have, the type of issues that they now have.

20 They also have communicated with them on  
21 compatibility issues and, of course, back in early  
22 January when we sent out the draft Federal Register  
23 notice, it was distributed to all states. Not just  
24 the agreement states but also the non-agreement  
25 states. And we did, you know, receive a fair amount

1 of comments from them.

2 So from that perspective, I think we have  
3 pretty good communication with them.

4 CHAIRMAN RYAN: Great.

5 MS. CHANG: Whether they are happy or not,  
6 that's another story.

7 CHAIRMAN RYAN: Okay.

8 MS. CHANG: As I said, you know, we also  
9 have an Energy Policy Act Task Force who has helped me  
10 in developing some of the integral bases. And they  
11 are also the one who is working on positioning issues  
12 to make sure, you know, the final rule will be  
13 transitioned to the agreement states in an orderly  
14 fashion.

15 We also consulted with stakeholders by  
16 having a public meeting back in November of last year.  
17 It was a roundtable public meeting with a lot of the  
18 communities, especially from the medical field, that  
19 participated. We also had other federal agencies such  
20 as EPA, DOE, FDA.

21 We also had small meetings with select  
22 federal agencies such as FDA. We had a couple of  
23 meetings with them to better understand their process  
24 in evaluating power facilities. We also had meetings  
25 with DoD, DOT, and EPA in developing our definition of

1 discrete source and also in consulting with them on  
2 whether there are any radioisotopes with naturally  
3 occurring radioactive material should be considered to  
4 be including the byproduct material.

5 We tried to inform the public as much as  
6 we could so we have developed a website within the  
7 rule forum to include all the background information  
8 within that. So we have the public meeting summaries,  
9 transcripts, some background information on the Energy  
10 Policy Act. And most recently we also have placed the  
11 draft proposed rule on the website.

12 Our normal rulemaking strategy is very  
13 simple. As I have indicated before we started the  
14 presentation, radioactive material is radioactive  
15 material. So in our minds, the naturally-occurring  
16 radioactive material or accelerator-produced  
17 radioactive material, they have the similar properties  
18 as radioisotopes produced in reactors.

19 So where I tried to fit into our current  
20 existing regulatory framework and, of course, by using  
21 the suggested regulation as the model standard as  
22 required by the Energy Policy Act, we did look through  
23 the SSRs and tried to incorporate anything that is  
24 related to NARM into our regulation.

25 We are proposing to regulate all

1 radioactive material from production --

2 CHAIRMAN RYAN: If I may just interrupt  
3 you?

4 MS. CHANG: Sure.

5 CHAIRMAN RYAN: And this is kind of a  
6 clarifying question --

7 MS. CHANG: Sure.

8 CHAIRMAN RYAN: -- for some members who  
9 may not be familiar that the SSR is the suggested  
10 state regulation are what the CRCPD offers to its  
11 members but, you know, so they can adopt them.

12 MS. CHANG: Right.

13 CHAIRMAN RYAN: And if they do adopt them  
14 into their own formatting structure, because usually  
15 it is a matter of formatting and numbering the  
16 changes, they are, in essence, compatible with NRC  
17 requirements. Is that right? Is it far to say the  
18 SSRs in and of themselves are pretty much compatible  
19 with --

20 MS. CHANG: Right. Compatible with  
21 existing regulations.

22 CHAIRMAN RYAN: So that is a big,  
23 important step that the SSRs, if they are current and  
24 states use them, they have really taking a giant  
25 hurdle to be in compliance with their agreement state

1 obligation.

2 MS. CHANG: That is correct.

3 CHAIRMAN RYAN: Now there may be specific  
4 details that have to be addressed or if the state  
5 wants to be a little more conservative on some points,  
6 they might have a reason to do that. You sometimes  
7 get into evaluations of those details.

8 MS. CHANG: Right. I think lots --

9 CHAIRMAN RYAN: It is a big hurdle.

10 MS. CHANG: -- right, I think lots of  
11 states do have their own format.

12 CHAIRMAN RYAN: Right. They do try to  
13 include additional stuff to suit their state-specific  
14 needs.

15 CHAIRMAN RYAN: Right.

16 MS. CHANG: But in general, I would agree  
17 with you that the SSR is compatible with the NRC  
18 regulations. And I think in the past, of course the  
19 relevant section of SSR --

20 CHAIRMAN RYAN: Sure.

21 MS. CHANG: -- because the SSR includes a  
22 lot more than the AEA materials.

23 CHAIRMAN RYAN: Fair enough.

24 MS. CHANG: And I do believe that our  
25 state program has reviewed those draft documents prior

1 to them revising it and putting in final SSRs.

2 CHAIRMAN RYAN: Yes, great. Thank you.

3 MS. CHANG: We are proposing to regulate  
4 all radioactive materials from production  
5 accelerators. During the rulemaking process, we  
6 actually tried to categorize the accelerators from one  
7 that produces material and one that doesn't since the  
8 Energy Policy Act does indicate that we are only to  
9 regulate the material that is produced for medical,  
10 commercial, and research activities. We tried to make  
11 that kind of distinction.

12 And so in here if it produces material,  
13 then we will want to regulate both the intentionally-  
14 produced material as well as the incidental material.

15 CHAIRMAN RYAN: Just let me just throw out  
16 another quick question. One interesting question  
17 about accelerators is, particularly in the medical  
18 arena, is that they are getting energetic enough where  
19 there is neutron activation in material of  
20 construction, you know concrete walls and things like  
21 that. Are those materials going to be covered under  
22 --

23 MS. CHANG: If it is PET cyclotron that  
24 they are producing radioisotopes then it will be  
25 covered from the operational safety perspective.

1 CHAIRMAN RYAN: I'm thinking of a medical  
2 therapy unit where photo neutrons are produced.

3 MS. CHANG: Yes, I think about linac, from  
4 what I understand, we have been talking to several  
5 agreement states and their opinion is that the energy  
6 level is still not high enough to pose a concern.  
7 Usually it is about six MPAs.

8 And they believe that a lot of the  
9 activated materials are short lived. And even the  
10 ones that are higher lived, it is still within the  
11 system and they do not feel that anything special that  
12 needs to be treated.

13 CHAIRMAN RYAN: But thinking ahead for  
14 decommissioning, if you have to tear that building  
15 apart --

16 MS. CHANG: Yes.

17 CHAIRMAN RYAN: -- there is some level,  
18 low level though it might be --

19 MS. CHANG: Yes.

20 CHAIRMAN RYAN: -- and I guess what my  
21 real question is at this point, that is under your  
22 authority under the Energy -- that would be?

23 MS. CHANG: Once the waste is generated,  
24 yes, it will be.

25 CHAIRMAN RYAN: Okay. So --

1 MS. CHANG: As probably commercial  
2 activity.

3 CHAIRMAN RYAN: Yes. But I mean there is  
4 not a license for radioactive material by activation  
5 per se.

6 MS. CHANG: No.

7 CHAIRMAN RYAN: But when they go to  
8 decommission, they would still have to satisfy --

9 MS. CHANG: They would still have to  
10 dispose of them appropriately --

11 CHAIRMAN RYAN: Okay. And that may or not  
12 be --

13 MS. CHANG: -- as a radioactive waste.

14 CHAIRMAN RYAN: Right. And that could  
15 very well be a, you know, unimportant quantity or some  
16 other kind of determination which --

17 MS. CHANG: Right. Right. We just don't  
18 want you regulating for 20 years when we don't see any  
19 significant hazard associated with their operation.

20 CHAIRMAN RYAN: Fair enough.

21 MS. CHANG: And my last bullet, of course,  
22 is the other side -- if they do not produce any  
23 radioactive material then we do not want to regulate  
24 the activity on a component.

25 The draft proposal summary, I just want to

1 give you a very, very high level of the stuff that we  
2 have included in the proposed rule. Of course we have  
3 amend the existing definition of byproduct material  
4 along with some other definitions such as low-level  
5 waste.

6 We also have added a couple definitions.  
7 The discrete source definition is required by the act  
8 to be included. We also have added some other  
9 definitions such as accelerator, accelerator-produced  
10 radioactive material, things of that sort.

11 We also included a radium 226 and  
12 accelerator-produced nuclides to all our 10 CFRs such  
13 as in Part 30s, Part 33 regulations. We also have  
14 added a section on generalized issues specific for  
15 radium 226, part that is for items containing radium  
16 226.

17 We provided some grandfather provisions to  
18 recognize certain FDA and state programs and also  
19 certain individuals. We also allow for noncommercial  
20 distribution among medical use licensees to kind of  
21 reduce any impact that might have on the rulemaking.

22 CHAIRMAN RYAN: Just a couple of comments  
23 --

24 MS. CHANG: Sure.

25 CHAIRMAN RYAN: -- on those definitions.

1 And tell me if this is helpful or not. But in my  
2 first read of the draft when it first came out,  
3 recognizing you were going to give us a presentation,  
4 I sort of saved this question.

5 I think the definitions are probably the  
6 critical thing, or one of them. If we get those  
7 right, we won't have many problems. And if we get  
8 them wrong, we're going to have all sorts of questions  
9 and comments and special cases and all that.

10 MS. CHANG: Right.

11 CHAIRMAN RYAN: And the real question I  
12 ask is how are they risk informed. I struggle with  
13 discrete sources in particular and let me tell you  
14 why. If it is concentration-based, that is not a  
15 measure of risk. Not by itself.

16 Concentration without quantity doesn't  
17 mean anything much.

18 MS. CHANG: Or without a pathway.

19 CHAIRMAN RYAN: Well, but really just  
20 thinking about the radioactive material itself. If I  
21 have a very concentrated source but it is a small  
22 quantity, I might be able to put it in my shirt pocket  
23 and walk out the door. A static illuminator is one  
24 example. The source itself is highly concentrated.  
25 But the absolute quantity is small.

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1 MS. CHANG: Yes.

2 CHAIRMAN RYAN: On the other hand, if I  
3 get something that is a little more dilute but it is  
4 100 curies of something, you know, cesium, pick an  
5 isotope. You look at something that is pretty  
6 substantial in terms of potential for risk for  
7 somebody, you know, inadvertently handling it without  
8 knowledge or those kinds of things.

9 So how are we going to with discrete  
10 source being something we have got to define, go to  
11 the very concentrated but small quantity up to the  
12 maybe not so concentrated but specific up to the maybe  
13 not so concentrated but significant quantity from a  
14 direct exposure or other kind of risk perspective.

15 MS. CHANG: I don't know whether you have  
16 read the description of discreet source we came up  
17 with. We really did not go into the specific  
18 concentration or quantities. We actually tried to  
19 take a look at the intent of the material. And also  
20 how it is extracted.

21 CHAIRMAN RYAN: I guess what I am  
22 suggesting is maybe it would be a take away, homework  
23 problem for us to maybe look at that specific action  
24 and see if we have any additional thoughts or comments  
25 that might be helpful. But again, I'm thinking not

1 necessarily to criticize your definition but to think  
2 about it from a practical standpoint --

3 MS. CHANG: Right.

4 CHAIRMAN RYAN: -- did we see any cases or  
5 opportunities for pitfalls where that definition might  
6 not work?

7 MS. CHANG: Yes,

8 CHAIRMAN RYAN: Or could we change in a  
9 small way and make it work for everything? You know  
10 those kinds of things.

11 MS. CHANG: Right. I mean we struggle  
12 with the definition a lot, you know.

13 CHAIRMAN RYAN: Sure, come on down.

14 Well, thanks for that clarification. I  
15 didn't mean to get too far off your presentations.

16 MS. CHANG: Right. I was just going to  
17 read the definition for you.

18 CHAIRMAN RYAN: Oh, please, yes.

19 MEMBER HINZE: I just want to ask a  
20 follow-up question to where Mike was going. The  
21 driver for this is the Energy Policy Act? You are  
22 revising your regulations to be consistent?

23 Do you have flexibility to explore the  
24 definition?

25 MS. CHANG: Yes.

1 MR. MOORE: I can answer that.

2 CHAIRMAN RYAN: Just help us again for the  
3 record.

4 MR. MOORE: Sure, I'm Scott Moore. I'm  
5 Chief of the Rulemaking Governance Branch in NMSS.  
6 And that's the branch that Lydia is in.

7 To answer your question about do we have  
8 flexibility to explore the definition, the statute  
9 left it to NRC to actually define discrete. So the  
10 answer is yes. We do have flexibility to define  
11 discreet.

12 And discreet applies to radium 226 and it  
13 applies to NORM as well. It does not apply to the  
14 NARM provisions in the act. But it applies to radium  
15 and to NORM. And we have provided the staff with the  
16 rule, which is up with the Commission now.

17 CHAIRMAN RYAN: Okay.

18 MR. MOORE: So you have the rule. It is  
19 with the Commission now. And you can see in the rule  
20 what the definition is that it is proposing to the  
21 Commission and the rulemaking.

22 CHAIRMAN RYAN: Okay. So if we maybe took  
23 a careful look and, you know, formulated our comments,  
24 maybe had a short session to discuss anything we might  
25 have identified or the fact that we did or didn't

1 identify anything maybe at our next meeting, would  
2 that be possible?

3 Because what I'm trying to think is how we  
4 can give you timely comments recognizing your  
5 schedule.

6 MR. MOORE: The Commission's -- I think  
7 timewise, if you are looking at timing, we had  
8 originally planned for the Commission to get an SRM  
9 back to us, I think, this month. But it is also  
10 possible that the Commission may hold off on voting  
11 until after a May 15th meeting that they are holding  
12 with the staff and with stakeholders from industry.

13 The OAS CRCPD, the Council on  
14 Radionuclides and Radiopharmaceuticals, and also  
15 another advisory committee, the Advisory Committee on  
16 Medical Use of Isotopes is meeting with the Commission  
17 on May 15th. So it is very possible that individual  
18 Commissioners may not vote until after May 15th.

19 So if the ACNW chose to write anything or  
20 say anything to the Commission, then you know anything  
21 before that May 15th meeting may be timely. But right  
22 now the rulemaking package is actually with the  
23 Commission and they have it for a vote.

24 CHAIRMAN RYAN: Okay. Can we get copies  
25 of that around tomorrow? Great thank you very much.

1 Appreciate it, Scott.

2 MS. CHANG: Yes and the definition of  
3 discreet source is actually on page 111 of the  
4 proposed rule Federal Register notice. And the  
5 discussion, of course, in the supplementary  
6 information if you want to see the background on how  
7 we developed --

8 CHAIRMAN RYAN: How is it -- what your  
9 definition now -- is it relatively short?

10 MS. CHANG: It's only three lines.

11 CHAIRMAN RYAN: Okay.

12 MS. CHANG: It basically says the source  
13 with physical boundaries which is separate and  
14 distinct from the radiation present in nature and in  
15 which the radionuclides concentration by been  
16 increased by human process with the intent that the  
17 concentrated material will be used for its  
18 radiological property.

19 CHAIRMAN RYAN: That is interesting. It  
20 sort of allows you to take that and then create a  
21 range of sources. Or look at a range of risk settings  
22 for material that meets that definition. On first  
23 blush, that is interesting. It sounds pretty good.

24 MEMBER HINZE: According to that  
25 definition, how well do we monitor those sorts and how

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1 do we know where they all are? And so --

2 MR. MOORE: May I? It is important to  
3 remember that the definition for discreet source that  
4 is in this rule only applies to radium 226 and also to  
5 the NORM provisions. And I don't know, because I came  
6 in a moment or two late and I apologize for that, with  
7 respect to the NORM sources, I don't know if you have  
8 said this already, the staff is not proposing in this  
9 rulemaking package that any NORM sources be included  
10 in the areas that we pick up under jurisdiction.

11 There is a provision under the act that  
12 allows the NRC to pick up jurisdiction over discreet  
13 sources of NORM that have the equivalent risk of  
14 discreet sources of radium 226. And while we are  
15 including that in the definition, at this time, we  
16 don't envision any discreet sources of NORM that have  
17 any risks equivalent to discreet sources of radium  
18 226. Essentially there ass a placeholder.

19 MEMBER HINZE: Is that taking into account  
20 the cores from ore bodies and the exploration?

21 MR. MOORE: It takes into account  
22 everything that we know of at this point.

23 CHAIRMAN RYAN: That we know of? That's  
24 fine.

25 MR. MOORE: You know we don't, we don't,

1 or aren't aware of, and I think the proposed rule  
2 would be an opportunity for the public to comment on  
3 it and suggest any, if they believe that there are  
4 any. But at this point with respect to what we are  
5 aware of as a regulatory agency, we don't believe that  
6 with respect to discreet sources of radium 226, there  
7 aren't discreet sources of NORM that are of the same  
8 risk.

9 CHAIRMAN RYAN: The interesting part is I  
10 think the words were separate

11 MS. CHANG: Yes.

12 MR. MOORE: Then the definition.

13 CHAIRMAN RYAN: Yes. And then the  
14 definition. You know when I think about NORM ora NORM  
15 that is somehow enhanced, I think about the sewage  
16 treatment plant, and exchange resins and filters and,  
17 you know, stuff where materials like that accumulates.  
18 How would that fill in. Are those discreet sources?

19 MR. MOORE: Actually the water treatment  
20 facilities, we talked about that.

21 CHAIRMAN RYAN: Yes, we have.

22 MR. MOORE: And it would not come under  
23 this. There is a couple key provisions that they  
24 thought of under this, the staff thought of under this  
25 when they came up with the definition that is used in

1 definition. The distinct from radiation present in  
2 nature, separate and distinct from the radiation  
3 present in nature where the radionuclide concentration  
4 has bee increased has been increased by human  
5 processes with the intent that the concentrated  
6 material would be used for its radiological  
7 properties.

8 In the case of the water treatment  
9 facilities, you are removing it from the water. But  
10 there is no intent that you use it for its  
11 radiological properties. It is probably just waste.  
12 And so in that case, it wouldn't be a discreet source.

13 And it is arguable whether it is separate  
14 and distinct in some cases. So we believe -- the  
15 staff is of the opinion at this point that water  
16 filters resin beds and those kinds of things, would  
17 not be a discreet source.

18 MS. CHANG: Oh, and that was --

19 CHAIRMAN RYAN: But it still would be  
20 regulated under the NORM -- the new authority under  
21 the -- that you would now have over NORM materials  
22 because it is NORM or not?

23 MR. MOORE: No. Under the Energy Policy  
24 Act, we only have authority over discreet sources of  
25 NORM that are equivalent in risk to discreet sources

1 of radium 226. And at this time, the staff does not  
2 envision any --

3 CHAIRMAN RYAN: And that's -- and I think  
4 we discussed the fact that is a pretty big apple to  
5 bite into --

6 MS. CHANG: Right.

7 CHAIRMAN RYAN: -- all at once. So I  
8 think we understand the strategy is to get this part  
9 of the apple digested and then think about other parts  
10 maybe later on.

11 MS. CHANG: Right. And I guess another  
12 thing is that the Energy Policy Act did indicate  
13 radioactive material used for medical, commercial, and  
14 research activities. So if it is not used for those  
15 purposes, we feel that it is not under our  
16 jurisdiction.

17 So when we developed the definition with  
18 our federal agencies, we intentionally put in for  
19 radiological properties you exclude T NORM material.  
20 However T NORM would still be regulated by states.

21 CHAIRMAN RYAN: There are lots of T NORM  
22 out there. You look at the oil industry and the  
23 phosphate industry, I mean there are very large  
24 industry components with T NORM. So --

25 MS. CHANG: Right.

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1 CHAIRMAN RYAN: -- like I said, that's a  
2 big apple to bite into.

3 MS. CHANG: Right.

4 CHAIRMAN RYAN: You know it is  
5 interesting, too, and I think -- I'm sorry, Derek, but  
6 most of the agreement states -- well, most of the  
7 states have the authority and integrate management of  
8 those materials in part or in whole with their  
9 radiological programs and people that are agreement  
10 state people. So at least from the agreement states,  
11 there is a lot of overlap.

12 MR. MOORE: That is a very good point.  
13 And so there ought not be any lapse in regulation  
14 between most of the states and the NRC on most of  
15 these.

16 CHAIRMAN RYAN: And I think it is  
17 important for our record to reflect the fact these are  
18 not orphan materials that have no care and feeding at  
19 the moment. They are materials that are kind of  
20 shifting gears from being regulated in a state setting  
21 to now being integrated into the NRC setting and then  
22 passed back through the agreement state programs.

23 MS. CHANG: Right.

24 MR. MOORE: Right. Did I answer your  
25 question?

1 CHAIRMAN RYAN: Yes, Scott.

2 CHAIRMAN RYAN: Derek?

3 MR. WIDMAYER: Yes, Derek Widmayer with  
4 ACNW staff. Scott and Lydia, this is an area that you  
5 are specifically asking the public in the proposed  
6 rulemaking --

7 MS. CHANG: That's correct.

8 MR. WIDMAYER: -- right -- for feedback as  
9 to whether there are any sources.

10 CHAIRMAN RYAN: We'll take it as an  
11 assignment to pay attention to that part in particular  
12 and think hard about it.

13 MS. CHANG: Right. That leads to the  
14 other proposals we solicit public comments and input  
15 on. There are areas that we do that.

16 CHAIRMAN RYAN: Okay. Sorry. I didn't  
17 mean to get so far off track.

18 MS. CHANG: Oh, that's fine. No, no, no.  
19 Let me just continue. I think we already touched on  
20 that. We provide grandfather provisions to recognize  
21 the state programs in FDA and also individuals. We  
22 also allow for noncommercial distribution.

23 One thing that to us is very important is  
24 the implementation strategy for the proposal. Usually  
25 we don't include effective date but here we actually

1 include a section discussing our intention. And we  
2 are proposing to have an effective date 60 days from  
3 the day of the final rule.

4 We also --

5 CHAIRMAN RYAN: Did you get comments on  
6 that?

7 MS. CHANG: Probably. But, you know, as  
8 soon as they can provide us the basis why it should be  
9 longer --

10 CHAIRMAN RYAN: Sure, no, I understand.

11 MS. CHANG: -- I mean we definitely would  
12 consider it. Another thing that we have included  
13 within the rule is to authorize or allow continued use  
14 of the NORM if they comply with our requirements such  
15 as reporting requirements, RAS safety requirements.  
16 And also we also submit the appropriate documents that  
17 we request them to do.

18 We are allowing the individuals to submit  
19 license amendment within six months from the effective  
20 date. And also allow them for one year to submit the  
21 new license application.

22 Our transition plan --

23 CHAIRMAN RYAN: Just a second just so I  
24 understand. If somebody has NARM under the  
25 definitions, they can submit within six months from

1 the effective date for a waiver termination a license  
2 amendment.

3 MS. CHANG: Yes.

4 CHAIRMAN RYAN: So they are amending their  
5 license to keep the material or not keep the material?

6 MS. CHANG: To keep the material. They  
7 actually already have the material in hand.

8 CHAIRMAN RYAN: Now why do they have to  
9 submit within one year from the effective date of the  
10 application and waiver termination?

11 MS. CHANG: We've got to allow them extra  
12 time since if they have, for instance, if they have a  
13 PET cyclotron, it might take longer for them to  
14 prepare license application.

15 CHAIRMAN RYAN: Oh, that's for a situation  
16 where they have no license now?

17 MS. CHANG: That is correct.

18 CHAIRMAN RYAN: Oh, okay.

19 MS. CHANG: That's correct.

20 CHAIRMAN RYAN: So there are really two  
21 cases. If you have a license and you want to amend  
22 it, you get six months. If you don't have a license,  
23 you get one year.

24 MS. CHANG: That's correct.

25 CHAIRMAN RYAN: Thank you.

1 MS. CHANG: And we are planning to  
2 terminate a waiver sooner rather than later. And we  
3 are trying to do it in batchwise so we can have an  
4 orderly transition.

5 The NRC is required to prepare and publish  
6 a transition plan to facilitate orderly transition of  
7 the regulatory authority for NORM. We are treating  
8 the non-agreement state a little bit differently than  
9 agreement state within the Energy Policy Act. The  
10 governor from the agreement state can actually submit  
11 a certification that their program is adequate. Then  
12 we can automatically fold the byproduct material into  
13 their agreement. And then they can, of course,  
14 continue to regulate.

15 For non-agreement states, it will be a  
16 little bit interesting depending on their intention  
17 whether they want to become an agreement or not. We  
18 might want to make some judgment calls on how to batch  
19 different non-agreement states on when we want to  
20 terminate the waiver.

21 CHAIRMAN RYAN: Oh, that's interesting.

22 MS. CHANG: Yes.

23 CHAIRMAN RYAN: Is there a wide variety of  
24 materials that will come under this state by state?

25 MS. CHANG: Not the materials but you have

1 a different level of regulatory authority within the  
2 non-agreement states. Some agreement states have very  
3 good programs that almost look like the NRC  
4 regulations.

5 And then you also have some mediocre type  
6 that use registration process but they really don't  
7 touch a lot on the specifics. And then we also have  
8 a few states that have no program whatsoever.

9 MR. MOORE: Well, there is some variety in  
10 the types of materials. For instance, for the radium,  
11 there is -- I mean just radium -- just discreet  
12 sources of radium 226, there's radium needles, there  
13 are radium dials. There is --

14 MS. CHANG: Antiquities.

15 MR. MOORE: -- antiquities that are out  
16 there that people still have.

17 CHAIRMAN RYAN: That's a big category.

18 MS. CHANG: Big category, very low  
19 concentrations.

20 CHAIRMAN RYAN: Yes.

21 MR. MOORE: Other radium sources.

22 MS. CHANG: Lining rods. You have a  
23 variety of stuff with different concentrations.

24 CHAIRMAN RYAN: Vasoline glass.

25 MS. CHANG: What?

1 CHAIRMAN RYAN: Vasoline glass -- the  
2 green glass.

3 MS. CHANG: Oh, right, right.

4 MR. MOORE: For PET materials, there are  
5 all different kinds of positron emission tomography.  
6 And then there is other type of NARM-produced  
7 materials that are intentionally produced. And then  
8 there is the activated products and the accelerators  
9 themselves.

10 So there's a fair amount of different  
11 types of materials. But from a licensing health  
12 physics standpoint, for the NARM materials a lot of  
13 them have short half-lives. So, you know, we would  
14 only be concerned about the longer half-life ones.

15 CHAIRMAN RYAN: Well, some of those PET  
16 scanners are interesting, particularly the ones that  
17 produce radionuclides, some of the short-lived ones.

18 MR. MOORE: Right.

19 CHAIRMAN RYAN: You know we don't detect  
20 it so it's not a problem. That doesn't answer the  
21 question about dosimetry.

22 MR. MOORE: Right, right.

23 CHAIRMAN RYAN: So it is interesting to --  
24 I mean there will be some challenges, I think, as  
25 people think more and more about those.

1 MR. MOORE: There will be some huge health  
2 physics challenges. The doses from some of them are  
3 very, very high. Yes.

4 CHAIRMAN RYAN: Not just to the patient  
5 but to the --

6 MS. CHANG: But to the workers, especially  
7 for the extremities when they do extraction.

8 CHAIRMAN RYAN: Sure.

9 MR. MOORE: An interesting issue under the  
10 rule itself is that the rule only gives us authority  
11 over the materials produced in the accelerators not  
12 over the accelerators themselves. So it is a fine  
13 point in the statute but it doesn't give us authority,  
14 say like we have in nuclear reactors over the whole  
15 reactor. It only gives us authority over the  
16 accelerator-produced material.

17 So -- and we have discussed this at length  
18 with the agreement states. We have a public meeting  
19 in November. But we won't be licensing the operation  
20 of accelerators. The states will continue to do that.

21 We will only be licensing the --

22 MS. CHANG: Material.

23 MR. MOORE: -- the material and the use of  
24 the material.

25 MS. CHANG: The use of the material.

1 MR. MOORE: Right.

2 CHAIRMAN RYAN: Boy, that's a coordination  
3 challenge.

4 MR. MOORE: Yes, it is. It is. And so a  
5 lot of Lydia and the team's effort has been on  
6 interacting with the states. A huge amount.

7 MS. CHANG: Yes. I guess with an  
8 agreement state, it is really going to be seamless  
9 because they are already regulating it. And for non-  
10 agreement states, hopefully it is not a huge issue  
11 since they don't have all our programs.

12 So -- but it is going to be a coordination  
13 challenge.

14 Within the transition plan, the NRC does  
15 plan to include a waiver of termination process and  
16 the criteria we are planning to use in determining how  
17 to terminate the waivers.

18 The current status and schedule, as I  
19 indicated earlier, early January we did send a draft  
20 proposed rule to the states and also to the ACMUI for  
21 review and comment. Last month, EDO signed a SECY  
22 paper and forwarded it to the Commission for a  
23 decision.

24 We also have posted the draft proposed  
25 rule on the website early this month. And, of course,

1 the biggest challenge is trying to meet the statute  
2 deadline of issuing the final rule on February 7th,  
3 2007.

4 The next step, we are still waiting for  
5 Commission decision. Once we have the SRM, we will  
6 revise the proposed rule accordingly. And then  
7 publish in the Federal Register for a 45-day comment  
8 period. And we are planning to have a public meeting  
9 during that public comment period.

10 That's all I have. Any more questions?

11 CHAIRMAN RYAN: Oh, that was great, Lydia.  
12 We appreciate the exchange as we go along. It helped.

13 MS. CHANG: Thank you.

14 CHAIRMAN RYAN: Let's go ahead and go  
15 through. Ruth, do you have any questions?

16 MEMBER WEINER: It's very, very good.

17 VICE CHAIRMAN CROFF: One curiosity. In  
18 your slide, I guess it is eight, provide grandfather  
19 provisions. As I read this, it doesn't start before  
20 -- but only includes material procured after the  
21 policy act itself. So what has to be grandfathered?

22 MS. CHANG: No actually the regulatory  
23 authority goes before that. It is before, on, and  
24 after August 8th. And what we are trying to say is  
25 that a lot of the agreement states already have

1 problems in existence. For instance, they might have  
2 a specific license to allow manufacturers to  
3 distribute general license materials or exam  
4 distribution products. And we want to recognize that.

5 And we also want to grandfather  
6 individuals such as authorized users who has been  
7 working in the medical field for accelerated-produced  
8 material, learn to recognize them, so that they can  
9 continue to operate as authorized user for those  
10 materials.

11 VICE CHAIRMAN CROFF: Okay. Thanks.

12 MR. MOORE: The statute actually covers  
13 material produced on, before, or after the date of the  
14 act.

15 VICE CHAIRMAN CROFF: Okay.

16 MS. CHANG: Sort of like retroactive.

17 CHAIRMAN RYAN: I mean one example I can  
18 just -- there used to be in Barnwell at a company that  
19 made optical glass that had thorium dioxide in it as  
20 an additive for strength. And optical properties.

21 So they distributed, you know, all this  
22 optical glass hither and yon under a general license.  
23 And, you know, when it left the manufacturer, it was  
24 in essence glass. And that was the end of it. It is  
25 those kinds of things I think you are talking about in

1 that category.

2 MS. CHANG: Right.

3 CHAIRMAN RYAN: Yes. Well, so it is a  
4 real simple story. And all the challenges are easy.

5 (Laughter.)

6 MS. CHANG: We wish.

7 MEMBER HINZE: Does this also include my  
8 activated golf balls that go much further? I mean --

9 CHAIRMAN RYAN: They are irradiated, they  
10 are probably not activated. Were they activated?

11 MR. MOORE: Were they activated in a  
12 reactor or in a cultivator?

13 (Laughter.)

14 MEMBER HINZE: The committee visited White  
15 Shell one time and we were all provided with --

16 CHAIRMAN RYAN: Jim?

17 MEMBER CLARKE: Just to clarify one  
18 question. One example came up, the water treatment  
19 byproducts, resins, or whatever. The answer is they  
20 are being used for radiological purposes so they are  
21 not covered under this rulemaking. That is kind of an  
22 implicit, you know, answer.

23 Are you contemplating any exemptions or  
24 any clarifying guidance that would bring that to the  
25 attention of people?

1 MS. CHANG: The supplementary information  
2 actually describes that, you know, what is includes  
3 and what is not. So I don't think we need any more  
4 clarifications

5 MR. MOORE: And then separately with  
6 respect to the water treatment facilities in the areas  
7 of drinking water, the Commission has a paper that  
8 they are considering now. And one think that we would  
9 consider, depending on where the Commission goes on  
10 the NARM drinking water issue is communication  
11 directly with the water treatment facilities about  
12 whatever direction the Commission decides to take on  
13 that.

14 CHAIRMAN RYAN: And that was the subject  
15 of Scott's last presentation.

16 MR. MOORE: Yes.

17 MS. CHANG: That is really specific to  
18 source material. I mean NRC always has authority over  
19 source material.

20 MEMBER CLARKE: Could I just have one  
21 other quick one here?

22 CHAIRMAN RYAN: Yes?

23 MEMBER CLARKE: Final rulemaking is -- the  
24 deadline is February 2007. The rule becomes effective  
25 -- was that the --

1 MS. CHANG: Sixty days after the February.

2 MEMBER CLARKE: -- 2009 that the plant  
3 blew up? Or when --

4 CHAIRMAN RYAN: April -- this was tax day.

5 (Laughter.)

6 MEMBER CLARKE: Is there a period before  
7 which the rule goes into effect after the final rule  
8 is issued?

9 MR. MOORE: It is a complicated role  
10 actually. It is effective 60 days after the --

11 MS. CHANG: The publication.

12 MR. MOORE: -- the publication. And right  
13 now, there are waivers out for everybody -- actually  
14 for everybody until August 2009. What we would do is  
15 -- what the staff has proposed to the Commission is  
16 rescind the w=respect to federal facilities and Indian  
17 tribes immediately upon the effective date of the act.

18 And the reason for that is those  
19 facilities, federal facilities in Indiana tribes are  
20 self-regulating. They don't have any other body, for  
21 instance, a state regulator to oversee them. So they  
22 would then have that six month and one-year period to  
23 kick in. They would be allowed to continue using the  
24 material but have six months to apply for an  
25 amendment if they already have an NRC license or a

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1 year to apply for a new license.

2 And then for everybody else in a non-  
3 agreement state -- excuse me -- the facilities in  
4 agreement states on the date of publication of the  
5 transition plan, the agreement states by insurance of  
6 the statute, there is a provision in the statute that  
7 the governors of those states in the agreement states,  
8 can certify that they have an adequate program. And  
9 then NRC can review and accept their certification of  
10 adequacy.

11 So if the governor certify on the date of  
12 publication of the transition plan, that they have an  
13 adequate program. Then the agreement states then  
14 become regulating for their states. So the waivers  
15 rescind for the agreement states leaving only the non-  
16 agreement states left to cover.

17 And what we would plan to do is then in  
18 the intervening period between the effective date of  
19 the rule and the termination date of the waivers in  
20 phases phase out the waivers, starting with --

21 CHAIRMAN RYAN: Do I understand when the  
22 DOE and Indian tribes part, that they would get a  
23 license from --

24 MR. MOORE: Not DOE. Federal facilities  
25 and Indian tribes. Federal facilities being primarily

1 DoD, VA, you know, EPA. Not DOE. DOE is separated  
2 under the Atomic Energy Act.

3 CHAIRMAN RYAN: Okay. And Indian tribes  
4 would be like DoD and FDA and those?

5 MR. MOORE: Yes.

6 CHAIRMAN RYAN: Okay, great. Thank you.  
7 I just wanted to clarify that.

8 MEMBER CLARKE: Thank you.

9 MR. MOORE: Sure.

10 CHAIRMAN RYAN: Anybody else?

11 MR. WIDMAYER: I have one question.

12 CHAIRMAN RYAN: Yes, sir.

13 MR. WIDMAYER: Could you give us a little  
14 background on the compatibility issue controversy with  
15 the agreement states and what your feelings are about  
16 what kind of impact that might have on your final  
17 rule?

18 MR. MOORE: Yes but first I'd like to  
19 point out that you are guilty by association since  
20 Derek used to be part of the working group on which  
21 this rule was written.

22 CHAIRMAN RYAN: Well, the good news is now  
23 he is going to help us document useful solutions.

24 (Laughter.)

25 MR. WIDMAYER: The other thing is I have

1 three pages of questions and I'm only going to ask you  
2 one. So I am off the hook.

3 MR. MOORE: Okay. Lydia, why don't you --

4 MS. CHANG: Oh. Why don't you go ahead?

5 MR. MOORE: Yes, I'll just briefly  
6 summarize. With respect to the compatibility issue,  
7 with agreement states, the -- and you can see this in  
8 the rulemaking package that was provided to the  
9 Commission, the agreement states believe that the rule  
10 should be compatibility level D. And compatibility  
11 level D -- I want to be careful how I quote this --  
12 compatibility level D would allow the states to  
13 implement their own programs and we would not review  
14 those programs under MPAP and the agreement states  
15 would not necessarily be required to make any changes  
16 to their programs.

17 They would just decide if they have an  
18 adequate -- or, excuse me, if they have compatible  
19 programs themselves and if they need to make any  
20 changes, it would be up to the states to decide  
21 whether they wanted to make any changes.

22 CHAIRMAN RYAN: That's the staff's view or  
23 their view?

24 MR. MOORE: That is the agreement states'  
25 view. The reason they believe this is attached to the

1 paper they put forward argument and they really should  
2 speak for themselves but I guess I would paraphrase it  
3 as they believe that NRC's rule should be compatible  
4 with their rules because the statute said that the  
5 rule that we put forward should comply with the  
6 suggested state regs to the extent possible.

7 They believe that they have far more  
8 experience in this area than the NRC does because they  
9 have been doing it for years and years. And any other  
10 definitions of compatibility may require them to  
11 change their statutes which is a difficult thing for  
12 the agreement states.

13 NRC went through its compatibility  
14 categorization process, as defined in Management  
15 Directive I think 3.9 --

16 MS. CHANG: 8.9.

17 MR. MOORE: Pardon me?

18 MS. CHANG: 8.9.

19 MR. MOORE: 8.9 -- and came up with a  
20 compatibility categorization -- actually it is not  
21 compatibility categorization -- a categorization of  
22 H&S. If you go through all the compatibility  
23 categories and you get down to DE, you have to ask  
24 yourself another question. Is it needed for Health  
25 and Safety?

1           And if the answer to that is yes, then you  
2           come up with another identification level, an H&S  
3           identification level. And so it becomes identified as  
4           an H&S. And if you have an H&S, then the states would  
5           be required to review their programs to see if they  
6           need to make changes to their programs for adequacy  
7           purposes. And it would require an action on the  
8           state's part to review their programs.

9           So the states object to any designation  
10          other than a category D. And the NRC staff believes  
11          that and H&S is the appropriate designation. And I  
12          think I will leave it there. And then, you know, you  
13          all can read the Commission paper.

14          We were very careful how we worded it in  
15          the Commission paper. I don't want to speak for the  
16          agreement states. We let their words speak for  
17          themselves in the Commission paper. And I think they  
18          would be offended if I spoke for them. So I'm being  
19          careful.

20                 CHAIRMAN RYAN: And that's good. I mean  
21          I'm glad you are sensitive to their words and we  
22          appreciate hearing you quote them in essence. So  
23          that's good to hear.

24                 MR. MOORE: I will say they are invited to  
25          the May 15th meeting with the Commission. And I'm

1 sure they are going to speak for themselves at that  
2 meeting.

3 CHAIRMAN RYAN: That's great.

4 You know when I think about it, I try and  
5 think of what is the risk-informed approach. You know  
6 on the one hand, if it is D, it sounds like they don't  
7 have to do anything and nothing changes. So why are  
8 we going through this exercise if that is the case.  
9 That's just my two-second summary of what a D really  
10 is. I'm thinking out loud. Maybe I'm wrong but I  
11 don't know.

12 But if there is going to be a true  
13 integration of these materials that you have been  
14 asked to regulate under the Energy Act, then maybe it  
15 is an evolution over some period of time. It is an  
16 awful short schedule to get it done. And I recognize  
17 that is not your choice but something you are working  
18 toward because it is the requirement of the law.

19 It leads me to the question have you left  
20 in the regulation -- are there enough points of  
21 flexibility or placeholders or other things that can  
22 evolve over time simply and easily?

23 MR. MOORE: We think so. We think that  
24 there is a framework built into the regulations. But  
25 right now we don't even have implementing guidance

1 that is there for it. And so right now it is really  
2 just a framework.

3 And so I believe that it is very flexible  
4 at this point. If anything, it could probably be  
5 challenged on is there enough proscription out there  
6 to know how --

7 CHAIRMAN RYAN: Well, I mean it is a broad  
8 spectrum.--

9 MR. MOORE: Right.

10 CHAIRMAN RYAN: -- of new things. So  
11 flexibility and having the ability to interpret and  
12 evolve over time through guidance is not a bad plan.

13 MR. MOORE: Right.

14 CHAIRMAN RYAN: And if it is that  
15 flexible, and it has that built in, I mean I think  
16 that's reasonable. I mean, you know, we've -- and I  
17 think, you know, I've certainly made the point that --  
18 on the low-level waste regulation that, you know,  
19 license conditions, permit conditions, and regulatory  
20 guidance can cover an awful lot of the landscape by  
21 being flexible and adapting to individual states or  
22 individual waste streams or material streams or  
23 whatever it might be.

24 MR. MOORE: Right.

25 CHAIRMAN RYAN: You can certainly do a lot

1 in that area. And if that is built in, then maybe  
2 some of that anxiety will diminish with time.

3 MR. MOORE: I guess I'll let you all know  
4 what we said in the Commission paper. The staff's  
5 position on H&S is that a designation of H&S for the  
6 definition of byproduct material requires the staff to  
7 continue to assure that the essential objectives for  
8 11(e) (3) and 11(e) (4) byproduct material -- and that  
9 is the NARM material and also the NORM -- the radium  
10 -- discreet sources --

11 CHAIRMAN RYAN: Discreet radium.

12 MR. MOORE: -- discreet sources of NORM,  
13 if there ever will be any, are met. The essential  
14 objectives are met. And that assurances obtained by  
15 review of the complete set of regs that a state  
16 requests in an agreement and the review of newly  
17 adopted or amended agreement state regs and the review  
18 of the status of an agreement state regs is part of  
19 the IMPAT program.

20 And the staff notes that under a  
21 designation of D for such assurance would not be  
22 obtained since the program elements designated as D  
23 are not a required part of the agreement program.  
24 They could be dropped from or not included in the  
25 agreement state program. And the program could still

1 be found to be adequate and compatible. And,  
2 therefore, not reviewed by NRC staff.

3 So the staff's position is that it needs  
4 to be an H&S. But that is only the staff's position.  
5 And the agreement states don't agree with that at all.

6 CHAIRMAN RYAN: Do you go into further  
7 detail what the basis in public health and safety is?  
8 Or worker health and safety? And why that is the  
9 case?

10 MR. MOORE: We do in an attachment to the  
11 paper.

12 CHAIRMAN RYAN: I think, you know, to me  
13 that's where the rubber meets the road is that if you  
14 have made the health and safety case of why you think  
15 the review is important and needs to be done -- now  
16 you may end up with yes we're adequate or no, we need  
17 to tweak. Or we're actually overkill. We could be,  
18 you know, anywhere along that range.

19 But you are saying that it is H&S in order  
20 to force the review or have the review be part of the  
21 program rather than to change anything specifically  
22 that somebody is doing, you are just saying that you  
23 need to review it --

24 MR. MOORE: Right.

25 CHAIRMAN RYAN: -- with this in mind --

1 MR. MOORE: Right.

2 MS. CHANG: Right.

3 CHAIRMAN RYAN: -- to get there. And now  
4 that is H&S. C, of course, and B and A are, you know,  
5 go up the line.

6 MR. MOORE: Are at a much higher level.

7 CHAIRMAN RYAN: A much higher level of  
8 thou shalt.

9 MR. MOORE: Right.

10 CHAIRMAN RYAN: As opposed to you may  
11 think about --

12 MR. MOORE: Right.

13 CHAIRMAN RYAN: -- and, you know, things  
14 of that sort. So -- interesting. So that is in an  
15 appendix that discussion?

16 MR. MOORE: Yes.

17 CHAIRMAN RYAN: Yes, okay. Great.

18 MR. MOORE: An attachment to the  
19 Commission paper.

20 CHAIRMAN RYAN: Well, we've got -- Latif,  
21 hi.

22 MR. HAMDAN: Can I ask a question?

23 CHAIRMAN RYAN: Please. Step on up. Have  
24 a seat.

25 MR. HAMDAN: Latif Hamdan, NRC staff.

1 Just clarifying questions. The regulations for  
2 11(e) (2) and (3) are in Appendix E. So this rulemaking  
3 you are doing is separated from Appendix E?

4 MR. MOORE: Apart from it, yes.

5 MR. HAMDAN: So the second question is in  
6 the discussions here achieved for the rulemaking  
7 branch, what are you going to do about Appendix E? If  
8 everything has changed and so on, then eventually you  
9 will have to change Appendix E, right?

10 MR. MOORE: Actually, no, we don't believe  
11 so. And Lydia or Derek may be able to answer this  
12 better than I. But we believe that the waste impacts  
13 from this Energy Policy Act rule are very, very minor.  
14 So no. We had the division of waste management.

15 MR. HAMDAN: That is surprising because  
16 especially since they are making a new rule on their  
17 ISL, which was agreed on their Appendix A and now  
18 there is this definition of 11(e) (2) has changed, and,  
19 you know, Appendix A is tacked on to Part 40 so you  
20 would think one thing you want to do is --

21 MR. MOORE: 11(e) (2) isn't changing in  
22 Part 40. What we are doing is adding on on 11(e) (3)  
23 and 11(e) (4). So we are not changing 11(e) (2). We're  
24 adding on at 11(e) (3) and 11(e) (4).

25 CHAIRMAN RYAN: Latif, it sounds to me --

1 I appreciate your question -- but it sounds to me like  
2 that some care has been taken to try and not mess up  
3 the many --

4 MR. WIDMAYER: Yes, that's correct. In  
5 fact, the Commission had a large hand in developing  
6 the language that went into the Energy Policy Act to  
7 make sure that it was adding to the definition and not  
8 changing the existing definitions.

9 CHAIRMAN RYAN: Because we all know there  
10 are lots and lots of fingers out from 11(e) (2) to the  
11 rest of the Rosetta Stone we have created.

12 MS. CHANG: That's right. Part 40 is not  
13 changed.

14 MR. HAMDAN: But if nothing else, if the  
15 definition of 11(e) (2) has changed --

16 MR. MOORE: It didn't.

17 MR. HAMDAN: At least there it needs --

18 CHAIRMAN RYAN: Well, they are saying it  
19 hasn't - 11(e) (2) has not changed.

20 MR. HAMDAN: Yes.

21 MR. MOORE: No, it is adding 11(e) (3) and  
22 11(e) (4) .

23 MR. HAMDAN: Okay. Thank you.

24 CHAIRMAN RYAN: Those are different.

25 MR. HAMDAN: Thank you.

1 CHAIRMAN RYAN: He doesn't believe us but  
2 that is okay. That is interesting.

3 MR. MOORE: We changed the definition of  
4 byproduct material to include this new 11(e)(3) and  
5 11(e)(4).

6 MS. CHANG: Part 20 and Part 30 but  
7 nothing in Part 40. We did not change the definition  
8 in Part 40.

9 CHAIRMAN RYAN: Let's see. So now we have  
10 two definitions of byproduct material?

11 MR. MOORE: We do. And we talked about  
12 that for weeks.

13 MS. CHANG: Actually there are three  
14 definitions of byproduct material.

15 MR. HAMDAN: That is exactly my point.

16 CHAIRMAN RYAN: Well, you know, you didn't  
17 say that. Now what we understand what you were trying  
18 to say.

19 MS. CHANG: We have three definitions of  
20 byproduct material. And Part 20 is the one that is  
21 all inclusive. It includes 11(e)(1), (2), (3), and  
22 (4).

23 CHAIRMAN RYAN: Right, because that is --

24 MS. CHANG: In Part 30, it --

25 CHAIRMAN RYAN: -- the health and safety.

1 MS. CHANG: -- right, in Part 30 it is  
2 only related byproduct material. Therefore we only  
3 include the definition of 11(e) (1), (3), and (4).

4 CHAIRMAN RYAN: Right.

5 MS. CHANG: And Part 40, since that is  
6 related source material, the byproduct material  
7 definition only include 11(e) (2) so we actually have  
8 three different definitions.

9 MR. WIDMAYER: The staff was challenged  
10 with a notion as to whether they had to fix everything  
11 that was broken in all of 10 CFR in order to  
12 accommodate this change. And a decision was made  
13 early because of the schedule they can't do it. So it  
14 adds to the definition.

15 CHAIRMAN RYAN: Is all this clearly laid  
16 out in the package -- the Commission package? Because  
17 I'm thinking ahead.

18 MR. MOORE: I think so.

19 CHAIRMAN RYAN: You know we are sitting  
20 around here and we're, you know, somewhat smart folks  
21 and we're trying to struggle through all this. Of  
22 course you are experts on it. You have developed it.  
23 But it will be interesting to deal with these  
24 questions as it rolls out. And I'm sure that will be  
25 part of your key challenges, you know, going forth

1 once it is a rule. And helping agreement states  
2 implement it. And training and education and details  
3 will be really important. Interesting.

4 Where are we? How are we doing on time?

5 MR. WIDMAYER: We are way late.

6 CHAIRMAN RYAN: Any other questions?

7 Well again folks, thank you for a very  
8 informative presentation. We promise we will do our  
9 homework and come back with some version of substance  
10 for you, either yay, nay, or in the middle. We will  
11 talk to you next month. How does that sound? Maybe,  
12 Derek, we could take a placeholder of a half hour or  
13 so where if we do have feedback, we can work with you  
14 on trying to present that to you in a timely way.

15 MR. WIDMAYER: Okay. Thank you.

16 CHAIRMAN RYAN: Thank you both very much.  
17 We really appreciate it. Good job.

18 Okay. I think that is the end of our  
19 formal presentations today. We're going to consider  
20 letter writing. So at this point, Neal, we don't need  
21 the recorder any more I don't think. So we'll end the  
22 transcript at this point and just take up our  
23 discussion of letter writing.

24 (Whereupon, the above-entitled meeting was  
25 concluded at 5:36 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on

Nuclear Waste

169th Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.



---

ERIC HENDRIXSON  
Official Reporter  
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## NARM Rulemaking

ACNW Meeting, April 18-20, 2006

Lydia Chang  
U.S. Nuclear Regulatory Commission

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## NARM Rulemaking Efforts

- Energy Policy Act of 2005
- Waiver
- Rulemaking Approach
- Rulemaking Strategy
- Draft Proposed Rule Summary
- Implementation Considerations
- *Current Status/Schedule*
- Next Steps

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## Energy Policy Act of 2005

- Signed into law on August 8, 2005
- Section 651(e) of the Energy Policy Act:
  - Amends definition of byproduct material in AEA Section 11e.
  - Amends AEA Section 274b. to include newly added byproduct material for agreements with States
  - Amends AEA Section 81 to provide other disposal options for the newly added byproduct material
  - Requires NRC to issue final regulation within 18 months from the date of enactment
  - Allow NRC to grant time-limited waiver

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## Energy Policy Act (Cont.)

- Section 651(e) amends the definition of byproduct material in Section 11e of the Atomic Energy Act to include:
  - Discrete sources of Ra-226
  - Material made radioactive by use of a particle accelerator (or accelerator-produced radioactive material)
  - Discrete sources of naturally occurring radioactive material, other than source material, that NRC determines, in consultation with EPA, DOE & DHS, pose a threat similar to Ra-226
- Limited to materials
  - Produced, extracted or converted after extraction before, on, or after August 8, 2005
  - Used for commercial, medical, or research activities

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## Waiver

- Energy Policy Act allows the Commission to grant waivers allowing current programs to continue for the newly added byproduct materials (NARM)
- Waiver published on August 31, 2005 (70 FR 51581)
- Allows persons engaged in activities involving NARM to continue with their activities
- Allows States to continue to regulated NARM
- Effective through August 7, 2006 for import/export of NARM
- Effective through August 7, 2009 for other NARM activities
- NRC may terminate sooner

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## Rulemaking Approach

- Cooperate with States
  - Working group
  - Steering committee
- Consult with stakeholders
  - Public meeting
  - Meetings with other Federal agencies
- Inform the public
  - Website

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## NARM Rulemaking Strategy

- Use existing NRC regulatory framework
- Use the Suggested State Regulations for Control of Radiation (SSRs) as model State standards to the maximum extent practicable
- Propose to regulate all radioactive material from production accelerators (PET cyclotron)
- Propose NOT to regulate activated material from nonproduction accelerators (radiation therapy linac)

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## Draft Proposed Rule – Summary

- Amend "byproduct material" and certain other definitions
- Add "discrete source" and other definitions
- Include radium-226 and accelerator-produced radionuclides
- Add general license provision for products containing radium-226
- Provide grandfather provisions and recognize certain FDA and State programs
- Allow non-commercial distribution among medical use licensees

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## Implementation Strategy

- Effective date: 60 days from the date of publication of the final rule for Federal facilities
- Special provisions: Authorized by rule to allow continued use of NARM if comply with other requirements
- License amendment: Submit within 6 months from the effective date or waiver termination
- New license application: Submit within 1 year from the effective date or waiver termination
- Waiver termination: Sooner and in batches

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### Transition Plan Integration

- NRC is required to prepare and publish a transition plan to facilitate orderly transition of regulatory authority for NARM
  - Non-Agreement States
  - Agreement States
- Waiver is in effect through August 7, 2009; however, NRC plans to terminate sooner
- NRC plans to include waiver termination process in the transition plan

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### Current Status/Schedule

- January 3, 2006 – Draft proposed rule sent to States and ACMUI for review and comment
- March 27, 2006 – SECY-06-0069 signed forwarding the draft proposed rule package to the Commission
- April 6, 2006 – SECY-06-0069 and its enclosed draft proposed rule package made public and posted on NRC website
- February 7, 2007 – Required by the Energy Policy Act to issue final rule

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### Next Steps

- Commission decision on SECY-06-0069
- Revise proposed rule per Commission direction in Staff Requirements Memo
- Publish the proposed rule in the *Federal Register* for a 45-day comment period
- Plan for a public meeting during public comment period

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# Social Risks: Challenges and Recommended Solutions

Prof. Hank Jenkins-Smith  
George H. W. Bush School of Government and Public  
Service  
Texas A&M University

# Social Perspectives on Risk

- Variations in Formulation
  - Typical formulation: Probability × consequence
  - Competing formulation: Prospect theory (hinges on status quo)
  - Technological risk aversion – the “precautionary principle”
- Variations in Ontology of risk
  - Psychometric: dimensions of risk – dreaded, uncertain, voluntary...
  - Cultural Theoretic: Worldview identifies what we choose to fear
- Risk considerations in collective choice
  - Fugitive Values: issues ill suited to current institutions, procedures and power relationships are re-cast in terms of risk
  - Ideological displacement: risk is employed as an opportunity to express broader political values

# Social Implications

- Perception-based impacts
  - Stress and anxiety; health implications
  - Loss of “sense of well being” and security
  - Loss of trust
  - Stigma and economic impacts
    - Place-based losses
      - Tourism, agriculture, conventions
      - Property value losses
  - Sense of social injustice

# Agency Dilemmas

- Social concerns in context
  - NRC has multiple principles
    - Of which locally affected communities are but one
  - Budgets, deadlines, and competing interests
  - Program opponents typically have more “degrees of freedom”
- Caught between a rock and a hard place

## Report Recommendations

- Increase the breadth of perspective and capability in advisory groups
  - Decreases probability of a costly social misstep
  - Increases avenues for informal representation
  - Opens avenues for learning (two-way) between agencies and social risk practitioners
  - Not a panacea

# Specifics

- Expand the Technical External Coordination (TEC) Working Group
  - Currently chiefly technical and agency representatives
  - Enormous potential for 2-way communication
- Modify and Retain the Nuclear Waste Technical Review Board
  - Speaking chiefly to implementors and regulators
    - Translating social science and practitioner knowledge
    - Preferably cleared for access to relevant classified information



U.S. Department of Energy



## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

Presented to:  
**169<sup>th</sup> Advisory Committee on Nuclear Waste**

Presented by:  
**Drew H. Coleman**  
Physical Scientist U.S. Department of Energy

April 18, 2006  
Two White Flint North  
Rockville, Maryland

## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

- **Status of the United States Geological Survey (USGS)/Los Alamos National Laboratory (LANL) Activities and Report**
- **Status of the University and Community College System of Nevada (UCCSN) follow-on study**



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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

- **USGS – LANL Validation Activities**

- Early FY 1996 – Exploratory Studies Facility (ESF)  $^{36}\text{Cl}$  and Fracture Minerals Studies were started
- Objective was to test the effect of the Paintbrush Tuff nonwelded units (Ptn) on percolation
- Early results indicated localized bomb-pulse  $^{36}\text{Cl}$
- $^{36}\text{Cl}$  and fracture mineral sampling continued with excavation through the ESF and the Enhanced Characterization of the Repository Block (ECRB)
- In 1999: DOE funded a validation study with participation by USGS, LLNL and Atomic Energy of Canada Limited (AECL); Lawrence Livermore National Laboratory (LANL) was funded to provide a measure of oversight



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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

- **USGS – LANL Validation Activities (Continued)**

- USGS sampling method involved drilling of 50, four meter long boreholes. Forty boreholes in and around the Sundance fault and 10 in and around the Drill Hole Wash fault
- Early results of leaching and testing of these samples showed low  $^{36}\text{Cl}$  levels and resulted in the development of an optimum and standardized leaching method
- Leaching studies were performed on tunnel muck from niche 5 excavation in the ECRB; these studies resulted in agreement that passive leaching for relatively short periods was desirable



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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

- **USGS – LANL Validation Activities (Continued)**
  - ♦ USGS leached samples of the validation core and sent aliquots to LANL and LLNL
  - ♦ LANL processed the samples according to their protocol and LLNL processed according to their protocol
  - ♦ Results between the two generally agreed with  $^{36}\text{Cl}$  ratios of 200-500  $\times 10^{-15}$
  - ♦ Some core from Niche 1 that had shown a bomb pulse signature in earlier LANL work, remained available for testing
    - » Leachates, following the jointly accepted protocol, were prepared independently at USGS and LANL



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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

- **USGS – LANL Validation Activities (Continued)**
  - ♦ LANL  $^{36}\text{Cl}$  ratios from Niche 1 samples were 1140-8580  $\times 10^{-15}$
  - ♦ USGS  $^{36}\text{Cl}$  ratios from Niche 1 core were 244-708  $\times 10^{-15}$
  - ♦ A decision point had been reached, as no suitable sample remained available for testing for bomb pulse
- **USGS – LANL Validation Report**
  - ♦ DOE decided to have the groups write up the validation work in a joint report, and carefully document the results from both perspectives
  - ♦ The report entitled “Chlorine-36 Validation Study at Yucca Mountain Nevada” has been reviewed, and is expected to be available in the next few weeks



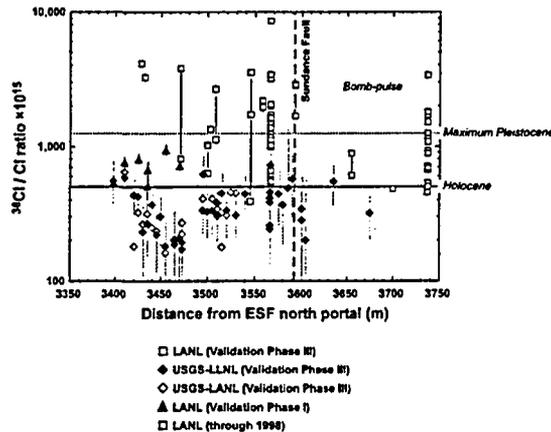
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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

Relations between  $^{36}\text{Cl}/\text{Cl}$  Ratios in Validation Study Samples from the Sundance Fault Zone and  $^{36}\text{Cl}/\text{Cl}$  Ratios in Samples from the Same Area Reported by LANL in 1996, 1997, and 1998



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7

## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

### • UCCSN Follow-on Work

- Proposals for a follow-on study were requested and evaluated. A proposal submitted by the University and Community College System of Nevada (UCCSN) was selected as a path forward in late 2003
- The Study is entitled "Bomb-Pulse  $^{36}\text{Cl}$  at the Proposed Yucca Mountain Repository Horizon: An Investigation of Previous Conflicting Results and Collection of New Data"
- The stated purpose of the UCCSN study was "to attempt to determine the cause of the conflicting results and obtain additional data"



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## Update on Chlorine-36 (<sup>36</sup>Cl) Studies

(Continued)

- **UCCSN Follow-on work** (Continued)
  - Scientific Investigation plans were developed by the UCCSN group, and preparations were underway to begin obtaining the samples. However, the work was put on hold by some priority work on the Mine Power Centers in the underground. The hold lasted approximately one year. Samples were collected from the subsurface during March and July of 2005 and from the surface above the north and south ramps of the ESF during September 2005.
  - The first set of samples were leached and tested for <sup>36</sup>Cl in August 2005, however the results were problematic in that unreasonably high levels of <sup>36</sup>Cl were seen in some samples, particularly for those containing low chloride content.



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## Update on Chlorine-36 (<sup>36</sup>Cl) Studies

(Continued)

- **UCCSN Follow-on work** (Continued)
  - The UCCSN investigators took measures to reduce the <sup>36</sup>Cl background and prepared and tested additional blanks to verify their techniques
  - The investigators are reasonably confident that the issues are resolved and they have tested rock and soil samples again. Those samples were analyzed by PRIME on 3/31/06 and the results are being reviewed by the study team
  - The UCCSN study has ended and the investigators are in the process of writing up their work in a final report
  - There are existing samples that remain unleached and available for further testing



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## Update on Chlorine-36 ( $^{36}\text{Cl}$ ) Studies

(Continued)

- **UCCSN Follow-on Work** (Continued)
  - The Project will examine the reports and discuss the work with UCCSN and Project investigators and decide on a path forward using Project processes.
  - This technique, that is, testing rock samples from the deep unsaturated zone for bomb-pulse  $^{36}\text{Cl}$  signature, needs additional confirmation to build confidence in the measurement and interpretation of the data



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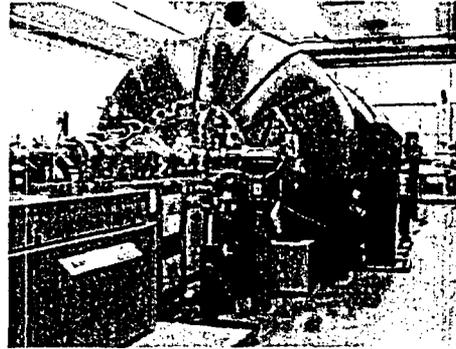
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# Accelerator mass spectrometry of $^{36}\text{Cl}$

FRANCE

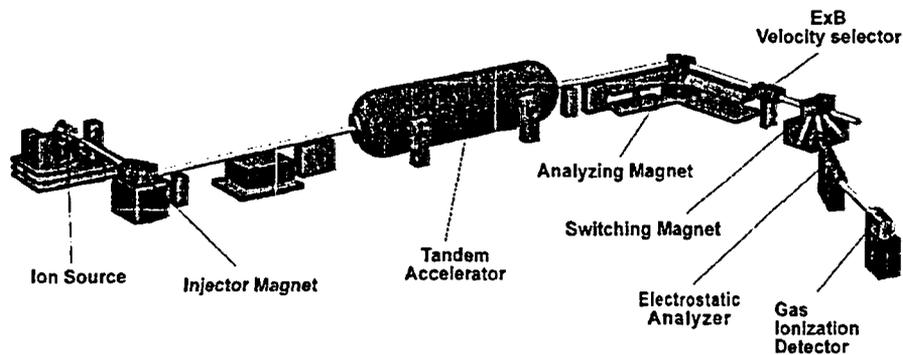
David Elmore, Dept of Physics, Purdue University

- Technique of AMS
- Problems and challenges
- Statistical data analysis
- Checks and balances



# Accelerator mass spectrometry

FRANCE



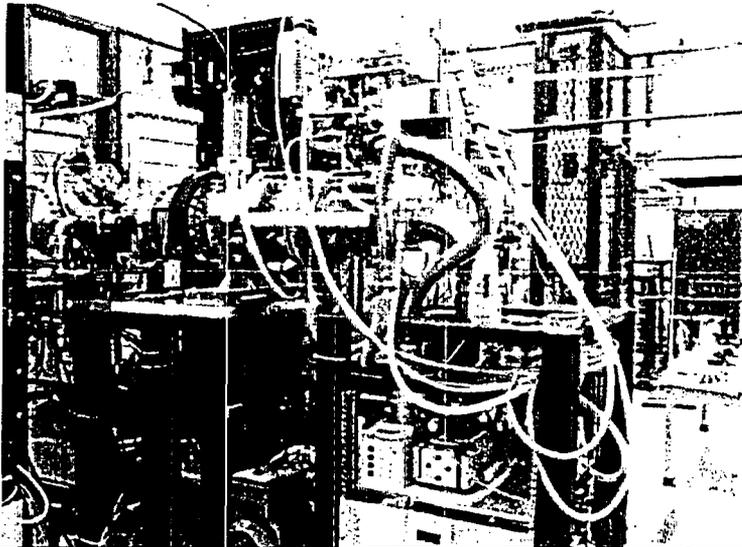
## Inside the accelerator

FR 125



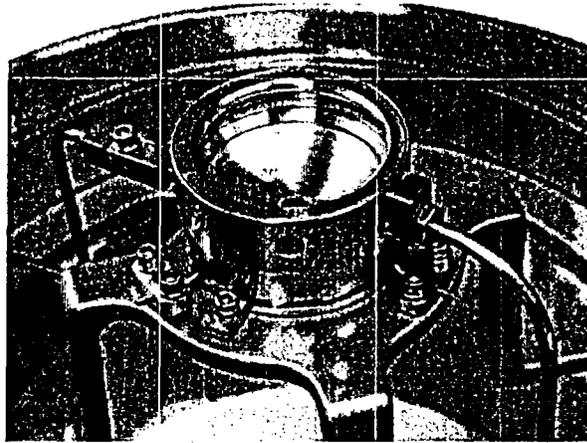
## Ion source

FR 125



## Inside the ion source

FRAMES



## AMS problems and challenges

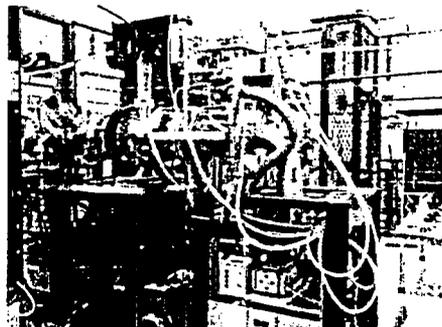
FRAMES

- Sampling
  - ▶ Mixing of sources
  - ▶ Chloride contamination
  - ▶  $^{36}\text{Cl}$  contamination
    - Bomb pulse
    - In-situ-produced  $^{36}\text{Cl}$
    - Reactor materials
  - ▶ Equilibration of carrier
  - ▶  $^{35}\text{Cl}$  spike carrier

## AMS problems and challenges

FR 12/21

- AMS measurements
  - Sulfur-36
    - Sample prep
    - Sample loading
    - Cathode material
  - Accelerator parameters
    - 30 power supplies
    - Terminal stability
  - Blank correction
  - Standards
    - $^{36}\text{Cl}$  loss in beam line
    - $^{36}\text{Cl}$  loss in  $^{36}\text{S}$  rejection



## Isotope ratio measurements

FR 12/21

- Cycle through isotopes 3 or 4 times
  - Measure  $^{35}\text{Cl}$ ,  $^{37}\text{Cl}$ ,  $^{36}\text{Cl}$  each cycle
  - Watch  $^{35}\text{Cl}/^{37}\text{Cl}$  ratio (3.12)
- Cycle through samples 2-5 times
- Measure a standard every 3-5 samples
- Measure a blank every 10-20 samples
- Stop when achieve 5% uncertainty

## Statistical data analysis

FA/MS/3

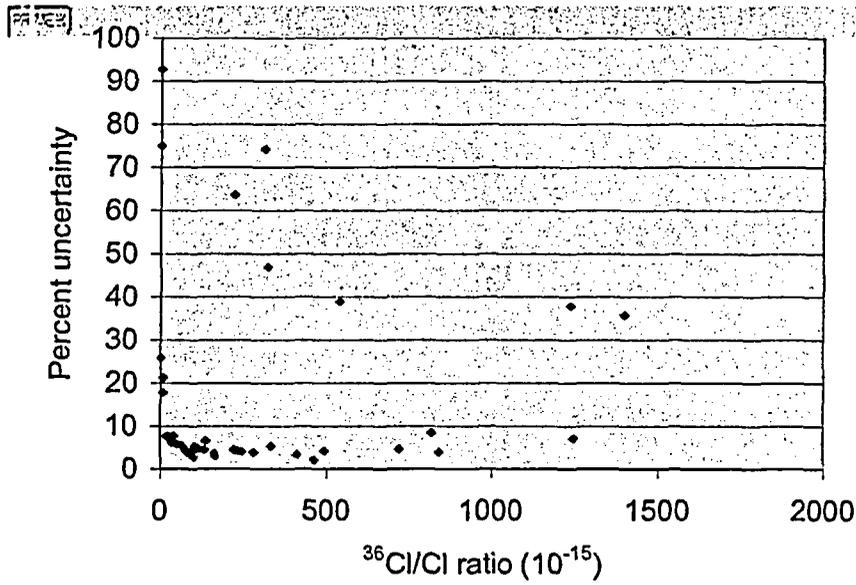
- Internal errors
  - Counting statistics →  $\sqrt{\text{counts}}$
  - Beam fluctuations
  - Combine in quadrature →  $\sigma^2 = \frac{1}{\sum (1/\sigma_i^2)}$
- External errors
  - Measure  $^{36}\text{Cl}/\text{Cl}$  several times
  - Measure standards and blanks often
  - Compute standard deviation →  $\sigma^2 = \frac{1}{N} \sum (x_i - \bar{x})^2$
- Conservative approach
  - Compute weighted average →  $\bar{x} = \frac{\sum (x_i / \sigma_i)}{\sum (1/\sigma_i^2)}$
  - Take larger of internal and external error

## Checks and balances

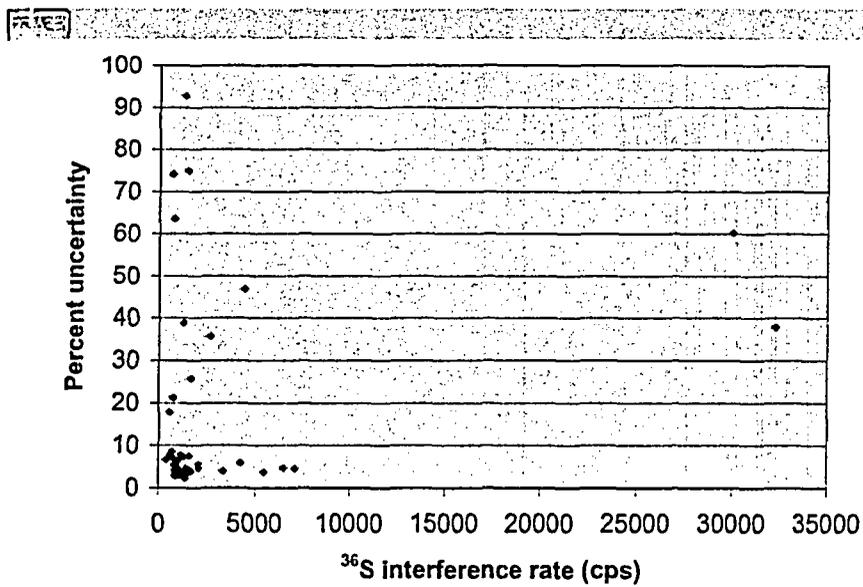
FA/MS/3

- Submitters responsibility
  - Chemistry
    - Low sulfur
    - Sufficient sample
  - Chemistry blanks
  - Multiple samples from each location
  - Multiple collection dates
  - Blind repeats
    - Same AMS lab, same run
    - Same AMS lab, different runs
    - Different AMS labs

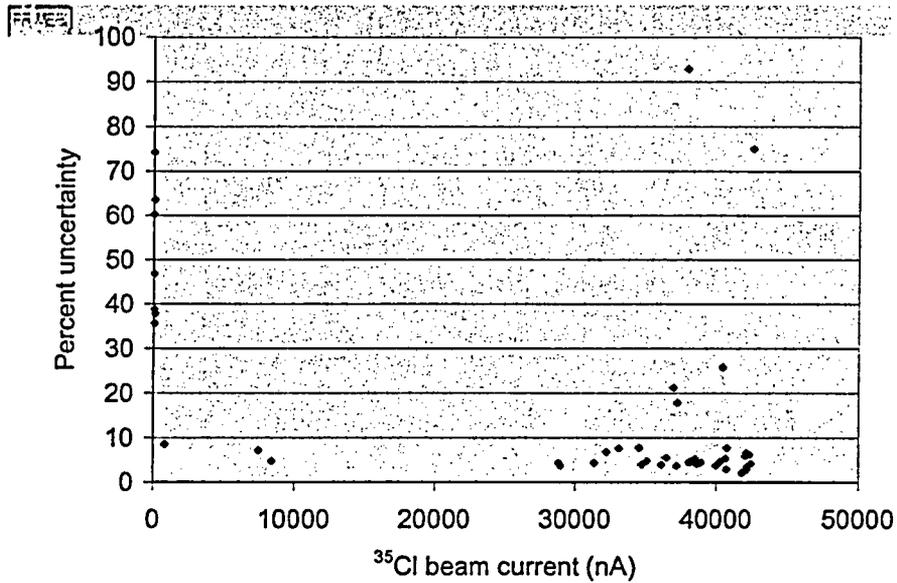
## Uncertainty vs. $^{36}\text{Cl}$ content



## Uncertainty vs. interference rate



## Uncertainty vs. beam current



## Conclusions

- AMS is a complex analysis tool
- Standards and blanks are used frequently
- A complete error analysis (usually) identifies samples with problems
- It is the responsibility of the user to submit multiple samples and blind repeats

**Agenda for Discussion of National Research Council Report on the Transportation  
on Spent Nuclear Fuel and High-Level Radioactive Waste**

**April 18, 2006  
2 PM - 4:30 PM**

- 2:00 - 2:15 pm Overview, Kevin Crowley, Nuclear and Radiation Studies Board**
- 2:15 - 2:45 pm Package Performance Testing, Mel Kanninen, MFK Consulting Services**
- 2:45 - 3:00 pm Long-Duration Fires, Mel Kanninen, MFK Consulting Services**
- 3:00 - 3:15 pm Emergency Preparedness and Selection of Transportation Methods and Routes,  
Joseph Morris, Transportation Research Board**
- 3:15 - 4:00 pm Social and Institutional challenges and Solutions, Hank Jenkins Smith, Texas  
A&M University**
- 4:00 - 4:45 pm General Discussion**

# **GOING THE DISTANCE?**

**The Safe Transport of Spent Nuclear  
Fuel and High-Level Radioactive  
Waste in the United States**

ACNW Meeting  
April 18, 2006

**THE NATIONAL ACADEMIES**  
*Advisers to the Nation on Science, Engineering, and Medicine*

## “Going the Distance?” Study

- Initiated by the National Academies
- Original study task:
  - Assess risks of spent nuclear fuel (SNF) & high-level radioactive waste (HLW) transport in the U.S.
  - Identify key technical and societal concerns for SNF/HLW transport, now and in the future
  - Recommend steps to address these concerns
- Expanded study task:
  - Assess the manner in which DOE selects routes for shipment of research reactor SNF between its facilities and recommend improvements
- Pre-publication report released in Feb. 2006

## Study Sponsors

- Department of Energy
- Department of Transportation
- Electric Power Research Institute
- National Academy of Sciences
- National Cooperative Highway Research Program
- Nuclear Regulatory Commission

## Study Committee

- Neal Lane, Rice University, Chair
- Tom Deen, National Research Council (retired), Vice Chair
- Julian Agyeman, Tufts University
- Lisa Bendixen, ICF Consulting
- Dennis Bley, Buttonwood Consulting
- Hank Jenkins-Smith, Texas A&M University
- Mel Kanninen, MFK Consulting
- Ernest Moniz, MIT
- John Poston, Texas A&M University
- Lacy Suiter, FEMA (retired)
- Joseph Sussman, MIT
- Elizabeth Ten Eyck, ETE Consulting
- Seth Tuler, Clark University
- Detlof von Winterfeldt, University of S. California
- Thomas Warne, Tom Warne and Associates
- Clive Young, UK Department of Transport

# Committee Expertise

- Decision analysis
- Health physics
- International transportation programs
- Materials/Mechanical engineering
- Nuclear engineering
- Nuclear physics
- Nuclear security
- Public participation
- Risk analysis
- Risk perception
- Science and technology policy
- Transportation operations
- Transportation regulations
- Transportation safety

## Bottom-Line Messages

- The committee could identify no fundamental technical barriers to the safe transport of spent fuel and high-level waste in the United States
- However, there are a number of social and institutional challenges to the successful initial implementation of large-quantity shipping programs

## Bottom-Line Messages (2)

- Malevolent acts against SNF/HLW shipments are a major technical and societal concern
- The committee was unable to perform an in-depth examination because of information constraints
- An independent examination of transportation security should be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage

## Selected Results on Package Performance

- Current international standards and U.S. regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions
- BUT there may be a very small number of extreme accident conditions involving very-long-duration fires that could compromise containment effectiveness
- The USNRC should undertake additional analyses of very-long-duration fire scenarios that bound expected real-world accident conditions ... and implement operational controls and restrictions as necessary to reduce the chances that such conditions might be encountered in service

## Selected Results on Package Testing

- The committee strongly endorses full-scale testing for determining how packages will perform under both regulatory and credible extra-regulatory conditions
- Full-scale testing should continue to be used as part of integrated testing programs to validate package performance
- Full-scale testing of packages to deliberately cause their destruction should not be required

## Selected Results on Transport Risk

- The radiological health and safety risks associated with the transport of SNF/HLW are well understood and generally low ... with the possible exception of risks from releases in extreme accidents involving very-long duration fires
- The likelihood of such extreme accidents appears to be very small, however, and their occurrence and consequences can be further reduced through relatively simple operational controls and restrictions

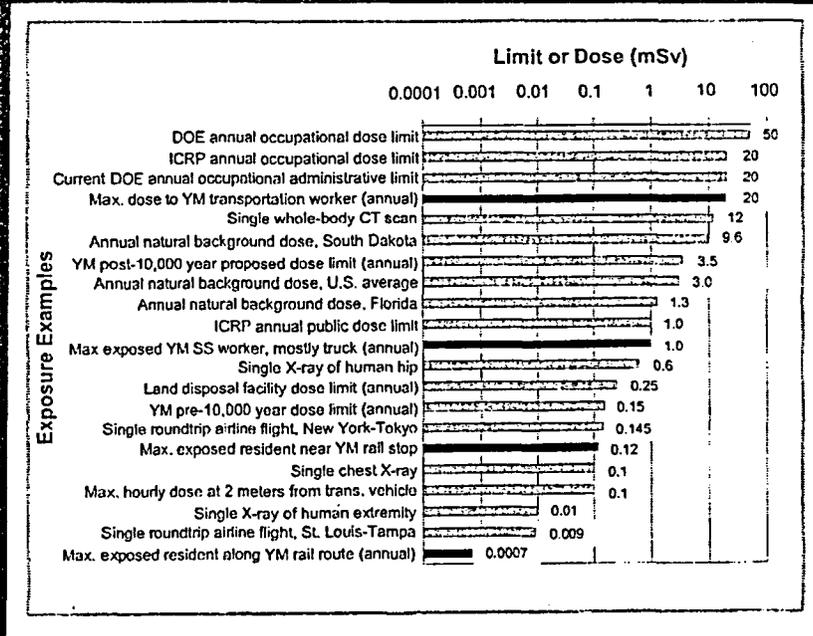
## Transport Risk (2)

- Social risks for SNF/HLW transportation pose important challenges to transportation implementers
- Transportation planners can take early and proactive steps to establish formal mechanisms for gathering advice about social risks and their management
- DOE should create a risk advisory group to obtain advice on risk characterization, communication, and mitigation

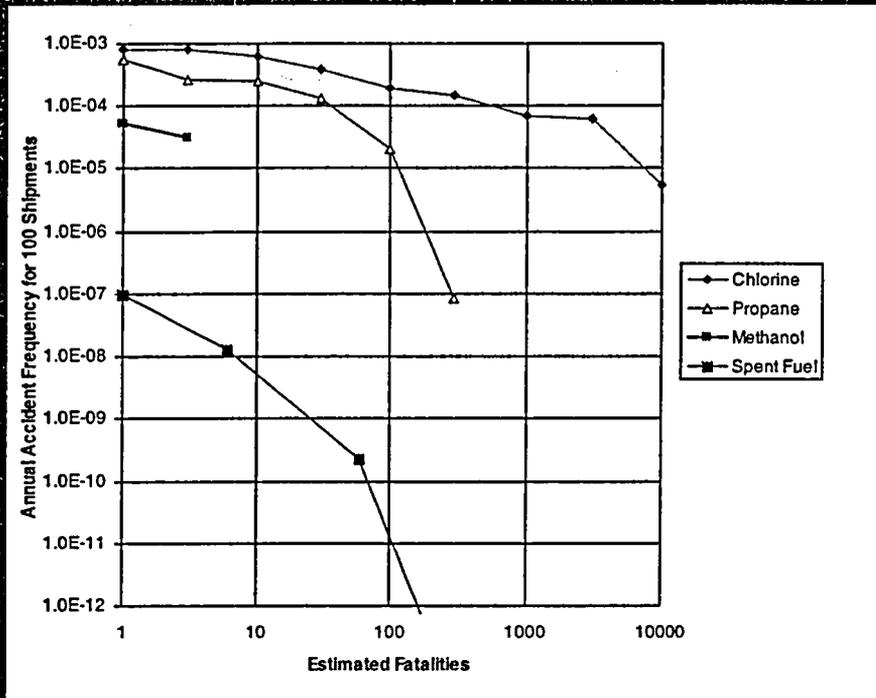
## Selected Results on Comparative Risk

- The report provides quantitative comparisons of radiological risks for normal and accident conditions of transport
- Normal transportation
  - Risk ladder comparing estimated YM exposures to other common exposure types
- Accidents
  - Complementary cumulative distribution functions for accidents involving spent fuel and other hazardous materials

# Normal Transport Conditions



# Accident Conditions of Transport



## Selected Results on Research Reactor SNF Routing

- DOE's procedures for selecting routes within the United States for shipments of foreign research reactor SNF appear on the whole to be adequate and reasonable
- DOT routing regulations are a satisfactory means of ensuring safe transportation provided that shippers actively and systematically consult with states and tribes along potential routes and states follow route designation procedures prescribed by DOT

## Chapter 5: Improving SNF/HLW Transportation in the United States

- Many of the findings/recommendations focus on DOE's program to transport SNF/HLW to Yucca Mountain but most also apply to other large-quantity shipping programs
- The committee did not attempt to undertake a detailed programmatic review of the DOE transportation program
- Recent changes in this program are mentioned in the report

## Improving SNF/HLW Transportation (2)

- The committee strongly endorses DOE's decisions to ship SNF/HLW to a federal repository by mostly rail using dedicated trains
- The committee recommends that DOE fully implement these decisions before commencing large-quantity shipments to the repository and also examine the feasibility of further reducing the need for cross-country truck shipments

## Improving SNF/HLW Transportation (3)

- DOE should make public its suite of preferred highway and rail routes as soon as practicable to support state, tribal, and local planning
- DOE should follow the practices of its research reactor SNF transport program of involving states and tribes in these route selections

## Improving SNF/HLW Transportation (4)

- DOE should negotiate with commercial spent fuel owners to ship older fuel first to a federal repository or federal interim storage
- Should these negotiations prove ineffective, Congress should consider legislative remedies
- DOE should initiate transport to the federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors

## Improving SNF/HLW Transportation (5)

- DOE should begin to immediately execute its emergency responder preparedness responsibilities by taking four steps
- Federal agencies should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting sensitive information about SNF/HLW shipments. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information

## Improving SNF/HLW Transportation (6)

- The DOE secretary and the U.S. Congress should examine the following options for changing the organizational structure of DOE's program for transporting SNF/HLW to a federal repository to increase its chances for success:
  - Quasi-independent DOE office reporting to upper-level management
  - Quasi-government corporation
  - Fully private organization operated by the commercial nuclear industry
- This recommendation does not reflect on the high quality of program staff

## Report Information

- The pre-publication version of the report can be ordered online at [www.nap.edu](http://www.nap.edu)
- The report can be read online for free at <http://fermat.nap.edu/catalog/11538.html>
- The final (printed) version of the report is expected in June 2006