

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**Title:** BRIEFING ON LOW-LEVEL RADIOACTIVE WASTE PERFORMANCE  
ASSESSMENT DEVELOPMENT PROGRAM PLAN

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**NUCLEAR REGULATORY COMMISSION**

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**PUBLIC MEETING**

Nuclear Regulatory Commission  
One White Flint North  
Rockville, Maryland

Friday, April 1, 1994

The Commission met in open session,  
pursuant to notice, at 10:00 a.m., Ivan Selin,  
Chairman, presiding.

**COMMISSIONERS PRESENT:**

IVAN SELIN, Chairman of the Commission  
KENNETH C. ROGERS, Commissioner  
FORREST J. REMICK, Commissioner  
E. GAIL de PLANQUE, Commissioner

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## STAFF SEATED AT THE COMMISSION TABLE:

JOHN HOYLE, Assistant Secretary

MARTIN MALSCH, Office of the General Counsel

JAMES TAYLOR, Executive Director for Operations

ROBERT BERNERO, Director, NMSS

JOHN GREEVES, Deputy Director, Division of Waste Management, NMSS

FRANK COSTANZI, Deputy Director, Division of Regulatory Applications, RES

MARGARET FEDERLINE, Chief, Performance Assessment and Hydrology Branch, NMSS

MICHAEL BELL, Chief, Engineering and Geosciences Branch, NMSS

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

10:00 a.m.

CHAIRMAN SELIN: Good morning, ladies and gentlemen.

This morning the Commission will receive a briefing from the staff on the status of the low-level radioactive waste performance assessment development plan. Before I got this document, I didn't even know what the words meant and now it's so clear I feel like I'm an expert. But I'm sure this discussion will disabuse me of such a notion. But it's really quite a good document, very clear and very interesting. So, my interest is quite whetted at what will be done and it's also very clear the staff has been extremely responsive to the original SRM and has kept up a long and difficult process with both perseverance and some ingenuity. So, we're very interested in hearing your report and the progress, the activities of the program, where it's going and how do we know when we're done.

Commissioners? You don't want to follow-up?

Mr. Taylor?

MR. TAYLOR: Good morning. As you may know, this effort in this area is a cross office

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1 effort and therefore we have staff from both Research  
2 and NMSS here at the table this morning. Frank  
3 Costanzi from Research, Mike Bell, Bob Bernero, John  
4 Greeves and Margaret Federline from the Office of  
5 NMSS.

6 This is a timely briefing. First we  
7 believe there are some important products to talk  
8 about which will be described by staff this morning.  
9 And second, the planned reorganization within the  
10 Office of NMSS and the combination of the high-level  
11 waste and low-level waste performance assessment  
12 activities combining in a single branch within the  
13 Division of Waste Management also adds to the  
14 timeliness of this. Margaret will be in charge of the  
15 Performance Assessment Branch and this will be her  
16 field.

17 CHAIRMAN SELIN: I gather her dowry is one  
18 work station computer that the low-level waste folks  
19 have been dying to get.

20 MR. TAYLOR: Mr. Chairman, I can assure  
21 you her dowry is well taken care of. But we will sum  
22 up the accomplishments of what has been going on in  
23 this area under the previous organization also.

24 So, with those opening thoughts, John  
25 Greeves will commence the briefing.

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1 MR. GREEVES: Good morning. Thank you.

2 (Slide) I'm going to start with chart 2.  
3 It's just an overview of the items that I'll be  
4 touching on during the briefing, some background  
5 material as to some of the interactions we've had in  
6 the past requesting this kind of work.

7 CHAIRMAN SELIN: John, I should tell you,  
8 levity aside, I am really serious about not just what  
9 the progress is but what the objectives are and how  
10 will we know when we've met these objectives? That  
11 wasn't in the paper and that is a part I hope you will  
12 discuss this morning.

13 MR. GREEVES: Yes.

14 CHAIRMAN SELIN: Okay. Fine.

15 MR. GREEVES: Okay. As I wanted to point  
16 out, the principal piece of the briefing is going to  
17 be the branch technical position and the test case.  
18 They're the real products as part of this process.  
19 We've learned some lessons in going through this  
20 process and I've got some of those outlined. We've  
21 got some ideas on how to develop this further, so that  
22 will be discussed in the additional guidance  
23 development. And, as you're aware, we've interacted  
24 with the other federal agencies in the states. So,  
25 I'll be going over some of that.

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1           As a start, we figured we'd better try and  
2       define what performance assessment is. It means a lot  
3       of things to different people. Most people in the NRC  
4       business think in terms of probabilistic risk  
5       assessment initially where you're looking at a reactor  
6       and electrical and mechanical components. We don't  
7       really have those in the waste business. So, when we  
8       use the term "performance assessment," what we're  
9       looking at is basically a consequence analysis for a  
10      low-level waste disposal facility where you're burying  
11      waste material that essentially is a source of  
12      contaminants that could go off the site in a plume.  
13      You really have the same situation in uranium recovery  
14      facilities and a high-level waste facility. So,  
15      that's what we mean when we talk about performance  
16      assessment. For today's discussion, it's essentially  
17      the compliance with dose standards set up in the  
18      regulations. That's the target that we use in terms  
19      of evaluating particular sites. We're looking towards  
20      both the technical position and the test case to  
21      demonstrate how that is done.

22           MR. BERNERO: If I could interrupt for a  
23      moment, John. It's a very important point.  
24      Performance assessment is really the essential  
25      licensing evaluation. In low-level waste we speak

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1 directly of compliance with dose standards. In high-  
2 level waste there is compliance with dose standards or  
3 release limit standards in the high-level waste 40 CFR  
4 191. But the essential character of it is this is the  
5 heart of a licensing safety evaluation. How will the  
6 waste vary and how will the system perform over time  
7 with respect to impact on the biosphere, on the  
8 public?

9 MR. GREEVES: (Slide) Okay. I just put  
10 chart 4 in here to give you a perspective of the  
11 people involved. As Jim Taylor mentioned, it is a  
12 joint effort between NMSS and Research and I want to  
13 give a little credit to the people that have worked on  
14 this. They've done a lot of hard work. So, I just  
15 wanted to show that. We refer to them as the  
16 performance assessment working group and they've done  
17 a lot over the last two years, as you can see with the  
18 documents you received.

19 All right. Let me recall how all this  
20 started. Back in '91 there was a staff requirements  
21 memo that the Commission sent down to the staff asking  
22 for a program plan in this area, which was needed to  
23 describe that. It asked us to show how we were  
24 integrating the staff effort in with our technical  
25 assistance activities and look towards enhancing the

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1 capabilities of the staff in this process, especially  
2 the in-house capabilities, which I'll be describing.  
3 How is this going to turn out to be guidance to people  
4 out in the agreement states, et cetera, and for us to  
5 focus on what are the key issues which you'll see as  
6 identified in the charts and question as to how are we  
7 coordinating with the DOE, EPA, the states, et cetera?  
8 What are the resources that are needed and what's the  
9 schedule for this process? So, that's the background.

10 There has been interactions with ACNW, as  
11 you're aware. They sent a letter to Commissioner  
12 Rogers back in '91 and so what came out of that was  
13 the first program plan in '92. We've updated that.  
14 You have a recent update with the paper that you just  
15 received. We also had a recent meeting with ACNW  
16 about a week ago where we basically spent a day on  
17 this topic.

18 So, with that, the goals of this process  
19 are to improve the performance assessment guidance  
20 that the staff does provide and there's a couple of  
21 different audiences for that. There are developers  
22 out there. How can they put together these pieces in  
23 terms of performance assessment? Then there's the  
24 regulators. How should they review a performance  
25 assessment when it comes in the door? So, with that,

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1 we have put together what we think are acceptable  
2 approaches in how to do that process and also we've  
3 been integrating the research results into this  
4 process.

5 I can give you one example. There was a  
6 code that was developed for the high-level waste  
7 program back in the early '80s called NEFTRAN. It  
8 turns out that that's been the work force of this  
9 activity that we used in the test case and I'm quite  
10 pleased to see something that the government invested  
11 back in those time frames that we've been able to  
12 apply it and it's stood the test of time. So, it's a  
13 principal work horse and I see Margaret is also using  
14 it in the high-level waste program.

15 COMMISSIONER ROGERS: Excuse me. Before  
16 you drop that, I don't want to focus too much on that  
17 kind of an issue, but it seems to me that someplace  
18 along the way it would be helpful to hear about how it  
19 is that that code was developed in the first place and  
20 that later on you found a great utility for it,  
21 because I think it speaks to the whole issue of how do  
22 we prepare for the future in providing the kinds of  
23 tools that we'll need in the future through our  
24 research programs. You've just cited, it seems to me,  
25 an incident in which something was developed a few

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1 years ago. I don't know what the utility of it was  
2 particularly at that time or what the motivation for  
3 its development, but it would be very interesting to  
4 see what the basis was on which that was started that  
5 later on we found -- it may have had immediate use  
6 right then, but it also seemed to have considerable  
7 use now.

8 So, without elaborating on that point, I  
9 personally would like to hear sometime just a little  
10 bit of a case study on any of the tools that were  
11 developed earlier that you found very useful in this  
12 process and what the impetus was for the development  
13 of those tools at the time because I think that may  
14 give us some guidance in the future with respect to  
15 how we view the importance of certain kinds of work.

16 DOCTOR COSTANZI: Mr. Commissioner, if I  
17 might, I think I can give you just a thumbnail sketch  
18 of NEFTRAN in particular. That code was developed in  
19 the early days of the waste management program in the  
20 Agency and it was developed in support of and in  
21 assistance to the development of 10 CFR Part 60. It  
22 was a high-level waste code. In recognizing what the  
23 EPA standard, at least what it was at that time, we  
24 thought it was going to look like and that it would  
25 require a performance demonstration which would be

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1 essentially a calculation of expected performance of  
2 repository.

3 The code was originally developed to  
4 handle saturated media flow and saturated media in  
5 basalt, I believe. It was modified to handle low-  
6 level waste situations, which of course now is much  
7 shallower than the deep geologic repository. But it  
8 was originally a high-level waste code and it was  
9 developed to support development of 10 CFR Part 60.

10 MR. BERNERO: But again, the transport of  
11 waste as a function of time is the essential  
12 similarity in high-level waste or low-level waste.

13 COMMISSIONER ROGERS: Yes.

14 MR. GREEVES: What impressed me was it's  
15 withstood the test of time. People are using it for  
16 a long number of years. I understand there is a  
17 NEFTRAN 2 at this point. So, it has been updated.  
18 But it was the work force code in the test case which  
19 I'll be describing.

20 The other goal was to enhance the staff  
21 capability, and as you'll hear that was enhanced by  
22 the doing of the process, basically writing the BTP  
23 and running the test case at the same time.

24 Okay. As far as the phases of the  
25 program, remembering that it goes back to really

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1 starting in '92, it was envisioned that there would be  
2 two phases. The first phase was to enhance that in-  
3 house capability and the strategy was to develop a  
4 branch technical position and to develop a test case  
5 which basically we describe as a wet test case, a  
6 humid environment. It was envisioned that phase 2  
7 would augment that experience gained and we would look  
8 at a second test case which would be a dry  
9 environment.

10 It turns out that we feel that we should  
11 modify the program in terms of looking at selected  
12 SDMP sites. We are confronted with these large SDMP  
13 sites, some of which the licensee sees that it could  
14 be a cell type environment which in some ways looks  
15 like a low-level waste disposal facility and we  
16 believe that it would be far more payoff to look at  
17 selected SDMP sites instead of looking at the dry  
18 site. We'd look at real sites that had real payoff  
19 for the staff. So, that's our proposed modification  
20 of the phased approach.

21 As far as --

22 CHAIRMAN SELIN: I'm sorry, Mr. Greeves.  
23 Is that as a demonstration or eventually you just want  
24 this to be an operational tool so each time --

25 MR. GREEVES: It's an operational tool, as

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1 I see it.

2 MR. BERNERO: Yes. On the larger, more  
3 complex decommissioning cases, I see it as a necessary  
4 part of the licensing performance appraisal of the  
5 site.

6 MR. GREEVES: I just couldn't see how we  
7 could afford to go off and do another mock-up case  
8 when we're really confronted with Commission decisions  
9 on these cases. So, we recommended that we modify the  
10 program and take advantage of it. I'll be describing  
11 some of that in the later slides.

12 Let me comment on the staff capability.  
13 There have been significant enhancements since the '91  
14 time frame. It was proposed back in that time frame  
15 that we obtain these 486 PCs which were at that point  
16 in time an enhanced approach. As we all know, they're  
17 the standard within the NRC at the present time. It  
18 turns out that these 486 PCs were adequate to conduct  
19 the first test case that we did work on. We will be  
20 looking towards having the work stations. Margaret  
21 already has a number of those. So, I'm quite looking  
22 forward to the combination of the two divisions and we  
23 will have that enhanced capability. We feel that the  
24 mix of the 486s and the work stations would be quite  
25 appropriate for our needs.

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1           Now I want to turn to the branch technical  
2 position. Let me recognize that this is a work  
3 product under development. It's a document. It's  
4 about 100 pages long and it is a draft and we have it  
5 out to our peer group for comments at the present  
6 time, like I'll be describing.

7           The next chart on 8, it's a little bit  
8 busy, but I wanted to put it in here to try and orient  
9 where we are in this process. Any of these activities  
10 you're talking about some sort of entombed waste.  
11 Some of them are quite complex and you've got a number  
12 of audiences that you need to speak to. When we met  
13 with ACNW, they did point out that we should in the  
14 document clarify which audience we're speaking to and  
15 various pieces of the document. There's also some  
16 things that are generic applications and others that  
17 are design specific. So, we would expect to improve  
18 upon the document as time passes.

19           Essentially when you look at this you're  
20 going through five different operations. You have to  
21 look at the infiltration, the water coming into the  
22 site. Then you need to consider do I have engineered  
23 barriers, how are they going to perform once the water  
24 gets into the disposal unit, how does it interact with  
25 source term and then eventually you have pathways

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1 coming off of this disposal unit, either through the  
2 groundwater or out into the surface water or even  
3 through the air. Ultimately you get a dose demand.  
4 I'll be describing a fair amount of that in the test  
5 case. So, that's an outline of what you will find  
6 described in the branch technical position.

7 In the position, the staff identified the  
8 significant attributes of performance assessment. You  
9 first are looking for an iterative process and you  
10 need to document that process. We had a discussion  
11 with ACNW about site characterization. It's very  
12 important to use these tools as a feedback loop to ask  
13 yourself, "Do I have enough information? If I need  
14 more information, where is the payoff, where can I  
15 spend my money in terms of additional site  
16 characterization?" We got some comment that it wasn't  
17 clear enough in the document that that iteration was  
18 taking place and I think that's good constructive  
19 comment that we can take advantage of. Obviously the  
20 design is part of that also.

21 The position calls for a formal treatment  
22 of uncertainty. When we got into this we recognized  
23 that some things were complex enough that to really  
24 understand what's going on you really do need to use  
25 formal uncertainty techniques like Latin hypercube

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1 sampling.

2 A point is you need a thorough  
3 understanding of the performance of the site. This  
4 helps you identify weaknesses where you might need  
5 additional information. And then finally the process  
6 should help you get in a position of reaching a  
7 defensible regulatory decision and ultimately you may  
8 find yourself in an adjudicatory hearing.

9 CHAIRMAN SELIN: I have three questions.  
10 I'd put them to you now, but they may be more  
11 appropriately answered later. One is what do the site  
12 designers use for their models? In other words, is  
13 there a model to build on or do we have to develop  
14 this from scratch? Or conversely, should they be  
15 using what we've developed? The second is a similar  
16 question of Department of Energy with their sites, and  
17 a third is what does EPA use in doing their standard  
18 setting?

19 MR. GREEVES: I might as well just have a  
20 go at it here. There's a whole host of models  
21 available out there. In fact, the staff has described  
22 those in their performance methodology documents which  
23 are in NUREGs. As far as what designers do, we have  
24 design staff ourself and they were some of the members  
25 of the team that you saw back there. Effectively what

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1 you do is customize the set of models that you want to  
2 choose for the design that you have developed for your  
3 site. There's a number of them available out there  
4 and we selected the ones that were useful for our  
5 design and it's my understanding that other designers  
6 would select models that were useful for theirs.

7 I think a point that has to be made is  
8 that there are simple models and there are complex  
9 models. You can go through this process and if you  
10 can bound the conditions with a simple model and you  
11 can defend that and you can stay with a simple model.  
12 If you can't, you normally go to a more complex model  
13 and maybe some of the other people on the group here  
14 might want to add to this.

15 MR. BERNERO: I would just like to add,  
16 especially with respect to DOE and EPA, for the last  
17 couple of years we have had continuing interaction  
18 with DOE and EPA with respect to model selection and  
19 application for remedial action cases in particular.  
20 This would be the DOE environmental management group  
21 and EPA and particularly as it gets over toward  
22 Superfund and similar cases.

23 As John put it, there isn't really a  
24 standard model. There are many submodels that may or  
25 may not be applicable and there's a great deal of

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1 controversy about how valid are some of the models.  
2 You know, many of them are more often used than  
3 others. So, there has been an intragovernmental  
4 activity to try to develop a better understanding and  
5 a better recognition of the better models that can be  
6 used.

7 CHAIRMAN SELIN: Will the position be a  
8 basis for this intergovernmental work?

9 MR. GREEVES: Let me point out that DOE  
10 has two groups, the performance assessment task team,  
11 which you'll see in the back, and the performance peer  
12 group. We have people on those, some of the staff  
13 members that are shown in the front participate in  
14 that process. They have -- the first group looks at  
15 performance assessment technology. They meet  
16 periodically, they come together, they talk about  
17 issues and they compare notes on what models they're  
18 using, what the time frame of interest are. So,  
19 that's one effort that we're involved with.

20 The second one is actually a review group.  
21 Apparently all the DOE sites, the waste sites, have to  
22 develop a performance assessment for their site, which  
23 comes to the second group and then the second group  
24 makes those comments on headquarters. Again, we are  
25 part of that in terms of we go to those meetings and

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1 we gain access to all those performance assessment  
2 techniques. So, it's an iterative process that I  
3 think we take advantage of by participating.

4 MR. BERNERO: But we are not developing  
5 the master model for everyone else, nor are we sitting  
6 back and waiting for the intragovernmental process to  
7 develop a master model that's directly transferrable.  
8 This is one of those activities, substantial activity,  
9 to apply appropriate models to waste disposal  
10 situation. So, it's part of that collective effort.  
11 It's not the only part and it's not a passive part.

12 COMMISSIONER de PLANQUE: Assuming that in  
13 some of these cases there's more than one model that  
14 presumably can be used for the same thing, has there  
15 been any effort to directly compare the results of  
16 these models given some standard input?

17 MR. GREEVES: The staff is involved in an  
18 effort with IAEA where a site is described and I  
19 believe it's up to 18 nations are looking at this and  
20 looking at the site, looking at the source term.  
21 There isn't total agreement on what source term each  
22 nation is going to use, but they have agreed on the  
23 site. So, that's one example. The other is INTRAVAL,  
24 which is also in the notes, where I think it's 13  
25 nations are looking at groundwater transport issues.

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1 So, these types of efforts are ongoing where a number  
2 of countries are looking at the same site conditions  
3 and evaluating it, doing an intercomparison with their  
4 procedures.

5 COMMISSIONER de PLANQUE: Have any gotten  
6 to the stage where they actually have results so that  
7 you can see the level of agreement between two  
8 different models given exactly the same situation?

9 MR. GREEVES: I'd have to ask the staff  
10 that question. I'm not --

11 COMMISSIONER de PLANQUE: My bottom line  
12 question under this is what is the level of agreement  
13 given different models and especially when you're  
14 looking at the bottom line being dose compliance.  
15 What kinds of differences are we talking about and are  
16 they anywhere near in the ballpark of the levels that  
17 we're talking about for standards?

18 MR. THOMA: My name is John Thoma.

19 The international test case is not done.  
20 We've done a lot of work on it. When you get the  
21 group together, you're not even close on orders of  
22 magnitude on agreement as to what the bottom line dose  
23 is. But they're each used in their different  
24 standard. Now, in our work, we have looked at a bunch  
25 of codes and there's a couple of them through the

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1 Office of Research that we've tasked saying, "Would  
2 you see how these codes compare?" But we have not  
3 done that across the board. But we're not developing  
4 brand new codes either. We're using off-the-shelf  
5 approved codes. The only code that "developed" is the  
6 integrated code that would take the output of one code  
7 and put it into another so we could do a systems  
8 model. We've only done that once using NEFTRAN as our  
9 main driver. We have not tried doing a series of  
10 codes.

11 COMMISSIONER de PLANQUE: Did I hear you  
12 say orders of magnitude differences between the --

13 MR. THOMA: The first time when the  
14 international group got together, but each nation is  
15 doing it in their own way.

16 COMMISSIONER de PLANQUE: Each one of whom  
17 thinks it's the best, right?

18 MS. FEDERLINE: Could I just add something  
19 about INTRAVAL? I think one of the biggest uses of  
20 these international intercomparisons is to point out  
21 differences. For instance, INTRAVAL in its second  
22 phase ran about 12 test cases where they actually took  
23 an experimental situation and everybody ran the same  
24 situation and then intercompared the results against  
25 the experimental results. Well, the codes were not

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1 identical to the experimental results. Obviously  
2 there were difficulties. But I think the real  
3 advantages in this is to see where the weaknesses of  
4 the codes are, spacial differences, scaling  
5 differences. I know concerns that the Commission has  
6 brought up before. But it allows the groups who are  
7 involved in the test cases to improve their own codes  
8 in the particular areas where vulnerabilities are  
9 identified.

10 So, as I see it, it's not so much  
11 identifying the best codes, but identifying where  
12 weaknesses and vulnerabilities are so that they can go  
13 on and improve the codes within their own country  
14 systems.

15 COMMISSIONER de PLANQUE: I understand  
16 that. I think what comes to my mind is when we get  
17 down to setting levels, dose levels for compliance,  
18 how realistic are they in terms of how accurately any  
19 of these models would predict the situation.

20 MS. FEDERLINE: Right.

21 COMMISSIONER de PLANQUE: You didn't get  
22 all yours answered.

23 CHAIRMAN SELIN: I really didn't get the  
24 answer. Is DOE going to use this or are they going to  
25 use something else? Is there reason to use something

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1 different? In other words, how robust is this?

2 MR. BERNERO: DOE is using different codes  
3 in different circumstances. EPA is doing the same  
4 thing, using different codes. There is some  
5 intragovernment coordination.

6 CHAIRMAN SELIN: That's got to be  
7 resolved. We can't have two federal agencies having  
8 basically a comparable situation and getting different  
9 answers.

10 MR. BERNERO: Yes. And I don't know what  
11 EPA is using in their forthcoming efforts on low-level  
12 waste.

13 MS. FEDERLINE: We shouldn't leave you  
14 with the impression that all codes are being used  
15 differently. For instance, RESRAD, I think, is used.  
16 That's a common code among the agencies. Really, I  
17 think where different codes are being used, many of  
18 these situations are very site specific. So, slight  
19 changes are made to codes to adopt --

20 CHAIRMAN SELIN: The question is do we,  
21 DOE and EPA get different answers for the same  
22 problem? That's a question that eventually you have  
23 to be able to answer.

24 MS. FEDERLINE: Well, I can only speak for  
25 high-level waste and we've looked at a variety of

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1 performance assessments performed by DOE and  
2 contractors and ourselves and we are showing the same  
3 vulnerabilities. In other words, we are running  
4 slightly different codes, but we are showing  
5 sensitivities at the site to similar parameters. So,  
6 I think that's the important thing.

7 MR. BERNERO: Perhaps Fred Ross can give  
8 you the answer on the low-level waste.

9 MR. ROSS: Fred Ross, low-level waste  
10 management.

11 It's important to separate the codes from  
12 the models. No two low-level waste sites are going to  
13 be exactly alike. So, the models or the assumptions  
14 that you use in the modeling are going to be somewhat  
15 different for each site, which is going to affect the  
16 dose. You can't necessarily compare the doses from  
17 one site to another.

18 Then the codes are brought in as a way of  
19 computing or implementing the models. What, for  
20 example, DOE is doing and I think what we're trying to  
21 do in the guidance is focus on process of modeling so  
22 that there's justification for assumptions and  
23 consistency in assumptions between sites and then it's  
24 up to the developers or the people doing the  
25 performance assessments to find appropriate codes that

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1 are relevant to those models. So, it's really -- it  
2 should be clear then, I think, that focusing on codes  
3 may not be a correct way to look at it. It's the  
4 modeling and the modeling assumptions and the  
5 processes that are recurring and the need to have some  
6 consistency. That's, in fact, what DOE is doing in  
7 their performance assessment task team. The task team  
8 is looking at all the PAs that are being done for the  
9 different sites and they're looking for consistency.  
10 They want to make sure that one site is looking at  
11 source term and making certain assumptions one way,  
12 that that's consistent with what another site is doing  
13 and that there's justification -- if there's  
14 differences, that there's a justification and a real  
15 reason for the differences and the differences aren't  
16 just simply the whim and whimsy, if you will.

17 COMMISSIONER ROGERS: Yes, but the  
18 ultimate question is what's the final results look  
19 like? I think the thing that we're all somewhat  
20 uncomfortable about as we listen to this is that the  
21 notion that there are different models that one might  
22 construct given a site, there's a site, whatever that  
23 site is and whatever it is is there, and one could  
24 adopt different models and in exploring those models  
25 one could adopt different codes. So, you've got this

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1 hodgepodge of things that could possibly be brought to  
2 bear on coming up with a final result. The question  
3 that I would be interested in, and I suspect everybody  
4 is interested in, is you just turn loose the entitles  
5 that would do the whole thing, pick a model, pick a  
6 code and get a result, and just let them do it, how  
7 different are the final results when all is said and  
8 done?

9 CHAIRMAN SELIN: For one site.

10 COMMISSIONER ROGERS: For one site.

11 MR. ROSS: They potentially could be  
12 vastly different. There's no question about that. In  
13 IAEA, in the models we've used, the results vary all  
14 over the board. The reason -- it's not just in the  
15 computation, it's in a lot of the assumptions that  
16 people use in the models.

17 COMMISSIONER ROGERS: Yes, but that's the  
18 point, that when all is said and done who cares what  
19 the details were of how they did it if when all is  
20 said and done things integrate out to the same bottom  
21 line result? If there are orders of magnitude  
22 difference in the final results, that's a very  
23 disquieting situation.

24 MR. ROSS: That potentially could be and  
25 is. However, you'd have to look at the assumptions

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1 and see which ones are more justifiable than others  
2 given the data that's available for the site.

3 CHAIRMAN SELIN: I don't want to spend too  
4 much on this, but there's a lot of work in here on  
5 internal consistency, and when other people are doing  
6 comparable things. Now, presumably DOE sites are  
7 somewhat different from ours. Their models are  
8 appropriate to stressing the characteristics of their  
9 sites. But when all is said and done, at some point  
10 we have to take a look with a test site, we apply our  
11 modeling and codes and they apply theirs and we get  
12 different results. What is that? That's part of a  
13 plausibility analysis.

14 MR. BERNERO: We have to root out the  
15 reasons for those differences.

16 CHAIRMAN SELIN: And maybe I'm just  
17 smarter than they are. That's always possible.

18 MR. BERNERO: No, or maybe modeling  
19 assumptions are skewed, whatever.

20 CHAIRMAN SELIN: But it's going to tell us  
21 something about the process and we need the external  
22 plausibility test as well as the internal consistency  
23 test that this paper talks about.

24 MR. TAYLOR: Yes. We agree.

25 COMMISSIONER ROGERS: And ultimately it

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1 relates to what the uncertainty band is on what you  
2 can make a statement about. The technical experts who  
3 want to go in and find out, "Well, just how did you  
4 make a particular decision," but from our point of  
5 view what's the uncertainty in any of these? We can  
6 be perfectly consistent in how we do things, but  
7 somebody else can be perfectly consistent and the  
8 results are wildly different. How do you deal with  
9 that? That's like two people doing an experiment,  
10 getting vastly different numbers, each of them with  
11 very small error bars that don't overlap on the two  
12 numbers. What do you do with that? That's the kind  
13 of a situation that sounds to me like we're dealing  
14 with here.

15 COMMISSIONER de PLANQUE: I wouldn't be  
16 critical of where we are in studying the models  
17 because I realize this is an extremely sophisticated  
18 complex problem and we're probably not going to solve  
19 it accurately in any of our lifetimes, if ever. I  
20 think the bottom line here is make use of that  
21 knowledge when we get into the regulatory framework  
22 and the standard-setting framework so that the numbers  
23 that we use and how we qualify those things is  
24 realistic with respect to what we actually know about  
25 the validity and the accuracy of these models.

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1 MR. TAYLOR: Of course we're at the draft  
2 of the staff or branch technical position and then the  
3 validity of that we hope others will test too in all  
4 that we do in the process. So, I think there's a lot  
5 of work beyond where we are, where we would welcome  
6 others internationally or even sister agencies coming  
7 in and saying -- critiquing the position that NRC  
8 takes.

9 CHAIRMAN SELIN: You'll see how that comes  
10 out when you do the validation. But normally you  
11 would expect that if we develop the model for the kind  
12 of low-level facilities we deal with and DOE for the  
13 kind they deal with, that the differences in the  
14 models wouldn't be that they would produce vastly  
15 different results, but there's might be very  
16 inefficient for our kind of facility or vice versa.  
17 In other words, it's where do you approximate and  
18 where do you calculate, not so much if the results are  
19 far off or the same physical thing like modeling.  
20 Then you should have some --

21 MR. TAYLOR: I think we'll leave here  
22 understanding the Commission's concern because you are  
23 right. If the results are vastly different, then what  
24 is the reason and what are the reasons?

25 COMMISSIONER ROGERS: Yes. That's

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1 important, but ultimately I think Commissioner de  
2 Planque's point is very fundamental. That is what is  
3 the state of knowledge here in this whole field of  
4 activity? If regulators are saying, "Well, you know,  
5 you've got to meet a certain standard within certain  
6 limits and an agency can construct a model and use  
7 computer codes that show that they, in fact, satisfy  
8 that, but somebody else comes in with equally  
9 plausible models and equally defensible computer codes  
10 and finds a very different result, what do you do with  
11 that? It sounds to me like the regulation has to be  
12 in tune with the state of knowledge. That's what we  
13 have to be concerned about.

14 CHAIRMAN SELIN: What I hear you saying is  
15 we don't know yet the answer to those questions. We  
16 have work to do on the internal consistency of our own  
17 work before we're ready to do the validation and I  
18 think you ought to just --

19 MR. BERNERO: I would just say that  
20 validation and verification is the essential problem  
21 with modeling long-term behavior of material in  
22 transport. The state-of-the-art is such that when  
23 you're talking about a short time horizon, a few years  
24 of transport, that's readily validated and verified by  
25 experimental programs or just groundwater monitoring.

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1 The state-of-the-art is pretty good there. But where  
2 you really get into difficulties is as the time  
3 horizon goes out and in high-level waste, of course,  
4 it's taken as a matter of course that people go to  
5 natural analogues and other techniques to try to get  
6 some sort of experimental basis. But in low-level  
7 waste, you get into those long time horizons as well  
8 and you'll see that shortly, and the question of a  
9 very long time horizon where the state of knowledge  
10 is just not as good, and this is an essential  
11 difficulty of modeling the transport and the impact on  
12 human kind of waste transport. That's why it's so  
13 important for us to do work ourselves, to have the  
14 staff capability to make a regulatory judgment because  
15 the state of knowledge is not good for the long  
16 horizon.

17 MR. GREEVES: Okay. I'll look forward to  
18 saying more from the IAEA test case and we can narrow  
19 these over time. It does take time to do that. Also,  
20 I think we'll get a chance to look at these at some of  
21 the selected sites that we're going to work on because  
22 there will be others looking at them too and obviously  
23 we'll be talking to each other about, "Licensee, what  
24 were your results? Here are ours. Let's match them  
25 up and see where we are." We would also be doing that

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1 for the site characterization process of some of these  
2 sites. So, there's much to be done.

3 COMMISSIONER de PLANQUE: Do you have any  
4 idea yet when the IAEA program will yield some  
5 results?

6 MR. GREEVES: I'd have to ask John Thoma.

7 COMMISSIONER de PLANQUE: Ballpark.

8 MR. GREEVES: A couple of years.

9 MR. THOMA: A couple years, ballpark  
10 answer on that. There's a lot of discussion going on  
11 and when you get the groups together they have to go  
12 back and work it out amongst their own internal groups  
13 before the next group gets together. In fact, we have  
14 another meeting with them at the end of this month to  
15 figure out where we are where's the next step.

16 MR. GREEVES: I guess I'd point out it's  
17 typical to find broad variations in results early on  
18 in our process. So, I'd look forward to the IAEA  
19 study to narrow within a couple of years.

20 Okay. See if we can move past that chart.

21 (Slide) The next chart is a busy slide  
22 and I really just put it in here to identify the two  
23 audiences that the branch technical position is  
24 speaking to. Above the dashed line it's addressed to  
25 the developer or the applicant. He's the one that's

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1 doing this iterative study here in terms of modeling  
2 and site characterization and this portrays the type  
3 of work that he would have to be doing.

4 Below the dashed line is where the  
5 regulator in fact now gets that application and on an  
6 audit basis does his own independent checks of those  
7 activities.

8 MR. BELL: John, I think this chart is  
9 very relevant to the discussion we were just having.  
10 Basically the position we're at is we've just made the  
11 first pass in all these model comparison efforts  
12 through this left-hand side of the chart and we're at  
13 this decision box and the answer is is this first pass  
14 of all these models that have been done adequate? The  
15 answer is no. People are going to have to go back  
16 around through this loop, look at the data, how it was  
17 interpreted, the assumptions they made and perhaps  
18 make several iterations through here before we get to  
19 the point where the Chairman was trying to get to when  
20 we get down below the dashed line, is there sufficient  
21 agreement between all the parties that we can make a  
22 confident licensing decision?

23 MR. GREEVES: Yes. There's a number of  
24 passes. The applicant would have to run through that  
25 before he would even submit an application.

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1 COMMISSIONER REMICK: Who is the  
2 contractor that we're using to do our modeling and  
3 integrating the models?

4 MR. GREEVES: The staff integrated the  
5 model in this case. They put together a systems model  
6 that included the NEFTRAN code, for example. We do  
7 have contractors working with the staff on this, but  
8 the staff --

9 COMMISSIONER REMICK: Who are those  
10 contractors?

11 MR. GREEVES: It's Sandia, PNL, Brookhaven  
12 National Lab and Oakridge National Lab. I may have  
13 left out one or two, but that's the spectrum of  
14 contractors working with us.

15 Okay. Next I want to describe the test  
16 case. The test case was intended to give an example  
17 of how to follow the branch technical position. The  
18 purpose of running the test case was to develop staff  
19 capability. As Bob Bernero mentioned, doing  
20 performance assessment is the essential licensing  
21 decision, whether you're talking about low-level  
22 waste, high-level waste or looking at a specific, for  
23 example, SDMP site. You've got entombed waste there.  
24 So, in our view, you need to have that capability in-  
25 house to a large extent. So, we wanted to test doing

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1 that with this particular case.

2 The test case, second, also gives you some  
3 insight into regulatory issues that face you, for  
4 example the time frame question which we're going to  
5 get to in a later slide.

6 The third, it gives you an opportunity to  
7 examine the consequences from various different  
8 conceptual models that you would need to evaluate.

9 Fourth, we felt that the test case was an  
10 opportunity to test the feasibility of the approach  
11 that we put in the branch technical position. It  
12 turns out that it was good for us to be developing a  
13 BTP and the test case at the same time. They fed each  
14 other in the process. So, it was quite good to do  
15 them concurrently.

16 As far as a problem statement of the test  
17 case that we developed, as I mentioned we did put  
18 together a systems model and the issue was to  
19 understand what the peak doses are to the general  
20 public and the mechanisms that you could get those  
21 doses are through the groundwater, the surface water  
22 and the air and all of these pathways were evaluated  
23 in the test case.

24 (Slide) The next chart again is a little  
25 busy. I just put it in here to describe that the DTP

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1 was demonstrated with this test case. We wanted to do  
2 some trial runs. We chose a combination of a  
3 southeast wet site with a hypothetical design that our  
4 design group put together, a concrete design, and we  
5 selected the source term from the Hanford waste  
6 disposal activity. So, we put these together in a  
7 combined set to run the test case.

8 (Slide) The next chart is just in here to  
9 give you a little perspective of the design that the  
10 staff selected. These are modular concrete vaults.  
11 You can see it's about 5,000 feet on one side, 3,000  
12 plus a little bit on another. Typically designers put  
13 the higher activity BC waste in the center and the A  
14 activity vaults on the outside. What's important in  
15 a setup like this is which direction is the  
16 groundwater flowing? It's flowing off to the right of  
17 the paper. And at this point where do you put a well  
18 that somebody may construct and show here? So, just  
19 to give you a perspective of what we chose for a  
20 realistic test case.

21 (Slide) The next chart, this is just a  
22 piece of the test case and the key in any of these  
23 waste disposal sites is to follow the water.  
24 Effectively the design that the staff came up with was  
25 a series of layers at the top of things like sand and

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1 gravel. They put in a geotechnical membrane that is  
2 typical for sites like this that people are  
3 incorporating in disposal sites of all kinds. They  
4 put in a clay layer to try and shed the water. They  
5 put in what's called a capillary barrier to try and --  
6 the point is to divert the water away from the vault.  
7 Then you do end up with the concrete vault.

8 They came up with a case where there was  
9 29 years of data, weather data available for a wet  
10 site. What you end up with is about 40 some inches of  
11 rain each year. It ends up that you can get about 17  
12 inches of that rain going down through the area of  
13 interest.

14 We looked at the degradation process of  
15 these barriers over time. We did not assume that they  
16 failed in a particular time. We gave them a  
17 degradation process. The staff was confident in this  
18 case that the barriers could be relied on for about  
19 500 years. We did look at full uncertainty within  
20 these time frames in terms of variation if  
21 infiltration, the hydrologic parameters and this was  
22 a fairly complex test case. Once you moved out of  
23 this arena, would you step into a source term analysis  
24 and a pathway analysis. It would involve similar  
25 uncertainties.

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1 COMMISSIONER ROGERS: That 500 years, was  
2 that just for everything except the concrete vault or  
3 did that include the vault?

4 MR. GREEVES: It included the concrete  
5 vault. It really worked as a system. And, you know,  
6 there are views as to how long you can rely on these  
7 things and in this test case the staff's position was  
8 that we can defend it out to 500 years, which becomes  
9 important. You can get rid of a lot of the nuclides  
10 if you can contain them for 500 years.

11 COMMISSIONER REMICK: Were the assumptions  
12 that the vaults were above ground covered or below  
13 ground covered?

14 MR. GREEVES: This was basically an earth  
15 mounded concrete bunker, so it's below ground. These  
16 are soil type layers above it.

17 COMMISSIONER REMICK: Probably one of the  
18 worst cases, except for deterioration of the barriers.

19 MR. GREEVES: It has advantages in terms  
20 of, if you're thinking of an above ground vault, you  
21 don't have the advantage of these clay layers over top  
22 of it.

23 COMMISSIONER REMICK: No, I'm thinking  
24 earth covered above ground. Earth covered above  
25 normal ground level is what I'm talking about.

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1 MR. GREEVES: Correct. Each of them have  
2 advantages.

3 COMMISSIONER REMICK: Especially where you  
4 have heavy rainfall on saturated earth, I would  
5 assume. But, assuming that, below ground would be one  
6 of the worst cases.

7 How about the facilities like Centre de  
8 l'aube and el Cabrill, which are vaults above ground  
9 but which will be earth covered?

10 MR. GREEVES: This is essentially -- it  
11 looks somewhat like those. These are vaults that, you  
12 know, are open during the construction phase. You put  
13 the waste in and you build this layer on top of it  
14 after you close it up.

15 Bob?

16 MR. BERNERO: Yes. If you go back to  
17 slide 8, that's a cartoon depiction that is generally  
18 like the French sites in that you're above the water  
19 table and you have a mound over it with the dual  
20 barrier.

21 COMMISSIONER REMICK: I agree with that,  
22 but in those cases at least you're above the normal  
23 ground level so the chance of water coming down has a  
24 great chance of running off to the side of the storage  
25 field, in contrast to the case where you have those

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1 same vaults under the surface and you have rainfall  
2 and you have saturated earth conditions, and I'm  
3 wondering which you assume. Do you assume they were  
4 down in the normal -- below the surface of the normal  
5 earth at that point?

6 MR. BELL: The test case is below grade.  
7 It turns out that whatever water does percolate  
8 between the vaults ends up helping you, in fact, as  
9 you go out, because it's water that's available to mix  
10 with the contaminated plumes and that's all taken into  
11 account in the uncertainty analysis of the process.

12 COMMISSIONER REMICK: The point I was  
13 trying to make, flux within the vaults themselves in  
14 general I would assume would be less when the vaults  
15 are above the normal surface of the earth, ground  
16 covered barriers and all that, and comparing that with  
17 a case where the vaults are below the normal surface  
18 of the earth where water there might stay there  
19 longer, and so it seems like the flux into the  
20 concrete vaults would be greater in one case than the  
21 other.

22 MR. BERNERO: It's a continuum.

23 MR. GREEVES: I think you're carrying this  
24 into another case that we didn't look at at this  
25 point.

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1 COMMISSIONER REMICK: Just trying to find  
2 out which case you were looking at.

3 MR. GREEVES: (Slide) I think if you look  
4 at the next slide it might be a little bit clearer.  
5 I put this slide in to just give the full picture  
6 that, you know, you do have to consider that  
7 infiltration. Eventually you get through an  
8 engineered barrier to a source term and you start the  
9 transport process of a plume coming off of the bottom.  
10 Actually, it goes down below the vault through the  
11 Vados zone and then contacts the water table and these  
12 show stream tubes which are plumes coming off and you  
13 can envision a well off to the right of this chart  
14 where the well is actually mixing the contaminated  
15 plumes with the fresh water. And you could also  
16 consider somebody out in surface water eating fish out  
17 of surface water environments, et cetera. These all  
18 were looked at in the test case.

19 Like I said, we spent a day going through  
20 all this with the ACNW and we needed the full day to  
21 go through and describe all this.

22 COMMISSIONER REMICK: We've followed up  
23 enough on my hypothesis.

24 Have you reached a point of knowing  
25 whether it might be better to limit the number of

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1 vaults at one immediate location and, as you say,  
2 arbitrarily 12 at one location and have another 12  
3 slightly removed from that rather than having 24 all  
4 together?

5 MR. GREEVES: I believe you could find  
6 that out using these techniques. You could also find  
7 out that you need to limit the inventory that a  
8 particular site might take, which I think is a more  
9 real question, if you find that some of the long-lived  
10 nuclides are causing you trouble out beyond 10,000  
11 years. You may put an inventory limit, which is  
12 provided for in Part 61.

13 COMMISSIONER REMICK: No, I was thinking  
14 more of the infiltration into the vaults themselves,  
15 if there was an advantage of not having a large group  
16 of vaults together and therefore having a much bigger  
17 mound.

18 MR. GREEVES: I would call that  
19 "optimization of design," and that is one of the  
20 techniques you should be doing in this process which  
21 is identified in the technical position.

22 (Slide) Okay. I just thought it might be  
23 useful to give you one example of some of the lessons  
24 learned as you go through a process like this. The  
25 diagram shows the results of some runs with time going

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1 out in years and then dose consequences on the  
2 vertical axis.

3 One of the things that people are faced  
4 with as they go through this process is, what do I  
5 take advantage of in terms of my defense of this  
6 particular site? Some might say, well, I've got all  
7 this concrete sitting there. It's obviously going to  
8 do something chemically to the environment. It turns  
9 out that it does buffer the environment.

10 One designer or applicant may say, well,  
11 I don't want to take any credit for it, and you end up  
12 with the triangles, so that's the run you get without  
13 consideration of the chemical buffering of just the  
14 chemistry of having all that concrete in the  
15 environment.

16 If you take a look at some of the things  
17 you might be able to achieve just by taking into  
18 account the chemical aspects of that material, you can  
19 see the second run there which is a little bit busy on  
20 this chart but it's significantly lower in terms of  
21 the dose result. So, this is one of the things that  
22 you could glean in going through this process and take  
23 advantage of and use as part of a defensible process.

24 In many cases, people don't take advantage  
25 of things. For example, the geotextile that I

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1 mentioned, most people don't take advantage of that in  
2 their analysis but they put it in because they know it  
3 will help.

4 COMMISSIONER ROGERS: Well, now, just  
5 before you leave this, I'm going to ask the same  
6 question. What about the 500 years? If the vault is  
7 going to have faults in it or -- I don't know what you  
8 assumed, after 500 years or sometime around 500 years,  
9 that looks like a very critical time here.

10 MR. BERNERO: A factor of five or  
11 something like that, five or even ten.

12 MR. GREEVES: The applicant would be there  
13 and we do recognize the vault deteriorates. We  
14 degrade its properties over time, but the chemical  
15 constituents are still there. The calcium is still  
16 there that is buffering the environment, and this is  
17 essentially what you'd have to come to the hearing and  
18 defend. I show this as an example of what you may  
19 want to take into account. You would have to defend  
20 that that chemical material, that buffering material,  
21 either the concrete or something else that you would  
22 place there would be in place for a long period of  
23 time. If you stick with natural materials, you  
24 probably stand a pretty good chance.

25 COMMISSIONER REMICK: Is there any

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1 explanation for why the curve increases out at 8,000  
2 years or so?

3 MR. BERNERO: Daughters, in general. In  
4 fact, this is a significant question. You get  
5 isotopic ingrowth with time and it raises questions  
6 about what sort of source term you have for uranium  
7 and thorium and the natural isotopes with very long  
8 half-lives that may not be an equilibrium.

9 From a regulatory point of view, if you go  
10 back, the environmental impact statement for Part 61  
11 did look at the very long time horizon. But in  
12 contrast to high-level waste, there is no explicit  
13 time horizon in low-level waste other than intruder  
14 dose and relying on societal protection for 100 years  
15 and things like that.

16 But this is what I would view as something  
17 of a regulatory uncertainty. Not only what causes  
18 this but is it significant. In the regulation of  
19 waste disposal, we as a nation have adopted relatively  
20 different standards for uranium mill tailings, for  
21 low-level waste, for decommissioning residues and for  
22 high-level waste now, and all with respect to the time  
23 horizon, whether or not humans might intrude and what  
24 the criteria area. So --

25 COMMISSIONER REMICK: The source term

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1 assumption here that would cause the daughters to  
2 build in --

3 MR. BELL: Low-level waste sites typically  
4 receive uranium and thorium not in equilibrium with  
5 their daughters. So, mainly what you're saying here  
6 is radium is starting to --

7 MR. GREEVES: Okay. As far as some of the  
8 results and the issues that presented themselves from  
9 the test case observations, the dose is most sensitive  
10 to flux through the vault as described earlier and it  
11 does turn out that that engineered cover is important.  
12 So, it is important to determine how far you could  
13 rely on something like that and also the solubility  
14 and retardation of critical nuclides is one of the  
15 important issues.

16 Some other observations of importance are  
17 that if you could contain those radionuclides for the  
18 first 500 years, you have done yourself a lot of good.  
19 So, I felt that the test case where the staff felt  
20 confident that they could look out to 500 years was a  
21 useful piece of work. The question that Commissioner  
22 Remick raised, what's important as you go out, iodine-  
23 129, technetium-99 pop out and also chlorine-36  
24 depending on an inventory of a particular compact if  
25 they had that type of material.

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1                   We talked about the ingrowth of daughter  
2 products. You've got the uranium situation if you  
3 have large inventories which would affect the radon  
4 gas situation.

5                   Bob?

6                   MR. BERNERO: I'd just like to interject  
7 with a pet subject here. Iodine-129 is conspicuous on  
8 this chart as one of the lingering concerns. It's  
9 interesting. Recently Margaret Federline and I had a  
10 chance to discuss this with the French regulators and  
11 the Sulane or Centre de l'aube has some kind of an  
12 observation constraint as they go forward, concern  
13 about inventory of I-129. This is a chronic problem  
14 in everyone's low-level waste disposal because in the  
15 first place you don't have a solid inventory  
16 measurement and you are adding less than numbers up  
17 and getting 2,000 less than X becomes 2,000X, which is  
18 a problem.

19                   The other is iodine-129 can be measured,  
20 but it has, of course, this enormous half-life. I  
21 think there can be serious reconsideration of iodine-  
22 129, is it really an appropriate regulatory concern.  
23 I just wanted to bring that up.

24                   MR. GREEVES: Let me add that we have a  
25 topic report under review that is addressing this

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1 question of are we over estimating the iodine-129  
2 inventory. So, in parallel, we're looking at that and  
3 we look forward to the results of that.

4 MR. BERNERO: And notice that the isotopes  
5 of important observation here are all isotopes with  
6 very long half-lives.

7 MR. GREEVES: Okay. Just moving along,  
8 just picking a couple of others, let me take the one  
9 in the middle, the air dose. This is an example of  
10 where you can do a deterministic approach. What the  
11 staff did was take the entire inventory of the gases  
12 coming off of this particular facility, the carbon-14,  
13 the krypton-85, the tritium, et cetera, and they  
14 released it all in one year and determined that you  
15 wouldn't have a problem. So, this is an example where  
16 you could use a simplified approach to come up with a  
17 deterministic answer, even at the same site.

18 I pointed out the chemical buffering  
19 question in that earlier example, so I'm not going to  
20 spend anymore time on that.

21 COMMISSIONER REMICK: Why do we assume  
22 that buffering is always a good thing that it locks  
23 up? Would there be any circumstances under which it  
24 would not have an impact?

25 MR. GREEVES: There are. If you use

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1       chelating agents associated with the waste coming out,  
2       they will in fact speed up the process and that's  
3       something the developer would have to take into  
4       consideration in his analysis and that's something the  
5       regulator would have to be asking the appropriate set  
6       of questions of the developer, "Did you account for  
7       all these chelating agents in your waste inventory?"  
8       They will accelerate, in fact, the material getting  
9       out.

10               MR. BERNERO:   And recall the chelating  
11       agents are used in decontamination procedures.

12               COMMISSIONER REMICK:   Yes.   Yes.

13               MR. BERNERO:   You know, cleaning machinery  
14       and things like that.

15               MR. GREEVES:   Okay.   As far as the  
16       technical and policy issues that we came up with,  
17       there's these five that you can see on this chart.  
18       The one that raises to everybody's top of the list is  
19       the question of the time frame.   We had a fair amount  
20       of discussion with the ACNW on this one and so we'd  
21       look forward to fleshing this one out.

22               COMMISSIONER ROGERS:   Could you just say  
23       a little bit on what that means?   Are you talking  
24       about orders of magnitude extension out beyond 10,000  
25       years?   What's the time frame for the issues there,

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1 very long-term, very short-term?

2 MR. GREEVES: Let me frame it this way.  
3 Most people think in terms of the 10,000 year number.  
4 However, some think that's too long, that there are so  
5 many uncertainties associated with 10,000 years we're  
6 kidding ourselves if we do calculations out there, and  
7 others say, "Oh, no, we've got to go out to a million  
8 years." So, there's a fair amount of debate about  
9 where this happens. Frankly, I think we need to  
10 tell -- provide the guidance to the developers and  
11 their regulators as to what we think the right piece  
12 is here. Presently in the position it says, "Look out  
13 to 10,000 years, run your numbers to 10,000 years and  
14 look for peaks beyond that." The document at the  
15 present time isn't real clear about what you do beyond  
16 10,000 years and I think that's something that we may  
17 very well want to run by you and make sure we get that  
18 pinned down as a policy issue.

19 COMMISSIONER REMICK: How does that  
20 conform with what I believe is the EPA approach in the  
21 hazardous and toxic waste area with infinite half-  
22 lives of 30 years?

23 MR. GREEVES: I have trouble explaining  
24 that one.

25 MR. BERNERO: I think you have to

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1 recognize that the 30 years comes out in the  
2 application. In the hazardous waste regulations and  
3 the laws, the statutes, I think EPA is tied much more  
4 to 10,000 years than they are to 30 years. It's the  
5 application and the choice of maintainable dual  
6 liners, leachate collection systems, features that  
7 require durability or maintenance to be assured of  
8 durability. It's an application.

9 COMMISSIONER REMICK: But the engineered  
10 vault system we're talking about has all those same  
11 things and perhaps even more.

12 MR. BERNERO: Yes.

13 COMMISSIONER REMICK: I don't understand  
14 what you mean by the applications versus --

15 MR. BERNERO: Well, there is at least a  
16 paper trail in hazardous waste regulation by EPA that  
17 has no migration for 10,000 years and things like  
18 that. But in the application, in an actual Superfund  
19 site or something like that, one finds dispositions  
20 that are required and approved of, "You've got to have  
21 a dual liner and a leachate collection system and  
22 monitor it for 30 years and endow a surveillance and  
23 corrective action program and these are details of  
24 implementation that, quite frankly, are not consistent  
25 with that time horizon. But that's the fact of what's

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1 out there.

2 MR. GREEVES: The second item on this list  
3 is treatment of uncertainty. Some people agree with  
4 the approach of using formal uncertainty techniques,  
5 some don't. We feel comfortable with it where it's  
6 warranted.

7 I talked about the role of engineered  
8 barriers and, as I said, we feel comfortable with at  
9 least the test case we went through, relying on them  
10 for about 500 years.

11 Another issue is the role of the site and  
12 the considerations of these processes out in time. Do  
13 you consider global climate changes and one of the  
14 things that ACNW pointed out to us was that we said  
15 beyond 10,000 years, don't consider that, and they  
16 said, "We didn't give an example to defend that." So,  
17 we need to punch up the branch technical position and  
18 provide a little bit more basis for some of the things  
19 that are in it.

20 The last one is the role of performance  
21 assessment during the operation and closure. It seems  
22 that most people do agree that this is a technique  
23 that should continue to be used beyond the licensing  
24 phase. You should use it for the operational and the  
25 closure phase to help you in any decisions you might

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1 be making then.

2 As far as where do we go from here, we've  
3 sent the branch technical position out to the various  
4 federal agencies, including DOE and EPA. Our sited  
5 and host states have copies of it for comments. We  
6 have received some early comments from DOE, USGS, EPA  
7 and the State of New York. We're also getting  
8 comments from some of our contractors. We're still  
9 awaiting some comments from the states, although  
10 Nebraska's just did come in this week and we expect to  
11 begin a formal evaluation of that set of comments in  
12 April. We look forward to a workshop over the summer  
13 for public comment on the document and resolving any  
14 policy issues that come out of this process and  
15 ultimately to revise the branch technical position.

16 As far as interactions with people, we've  
17 got a number of mechanisms where we get together with  
18 the agreement states. They on occasion do ask for  
19 technical assistance in this area and others. We do  
20 an annual training session. State programs has run  
21 this in the past. It usually occurs in July and we've  
22 also had specific sessions with the State of Nebraska,  
23 North Carolina and Pennsylvania on this particular  
24 topic.

25 As far as other vehicles, we do

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1 participate in the meetings that I think the  
2 Commission is familiar with, the low-level waste forum  
3 where the policy makers come to it. We come and give  
4 them presentations on technical topics such as this.  
5 We also participate in what's called the technical  
6 coordinating committee. That's a vehicle where the  
7 developers get together and share ideas. We go to  
8 those meetings and keep them posted on where we are in  
9 developing our guidance process.

10 (Slide) Next page.

11 We do end up getting invitations to things  
12 like the waste management meeting of the particular  
13 year. We were out at the waste management '94 meeting  
14 and we did present papers on both the branch technical  
15 position and the test case. We also chaired the  
16 session on performance assessment.

17 We have already talked about a number of  
18 interactions we have ongoing with the DOE program and  
19 the various committees that they have set up. It does  
20 give us a real opportunity to get copies of what  
21 they're doing and I find it's a valuable tool for us.

22 Internationally, we've talked earlier  
23 about the IAEA test case and I think we all look  
24 forward to some results from that within a year or  
25 two. I would mention the INTRAVAL project and also

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1 would point out that the staff does, on occasion, get  
2 a chance to get over. We visited with the French, the  
3 Spanish and the German government over about the past  
4 year.

5 As far as resources, they are laid out in  
6 the paper. We've been putting in about four FTE  
7 within the program office and Research has been  
8 running anywhere from 2 to 2.8 with some associated  
9 technical assistance dollars. As I mentioned earlier,  
10 we're going to look for splitting the program office  
11 effort and we will continue to have application of  
12 this with select SDMP sites. So, this subject will  
13 move around a little bit, but it's basically about a  
14 level of 4 FTE associated with continuing to develop  
15 these techniques, hopefully on case work.

16 COMMISSIONER REMICK: John, you indicated  
17 that those contracts are -- I think you mentioned four  
18 DOE labs.

19 MR. GREEVES: Yes.

20 COMMISSIONER REMICK: What's the  
21 probability that DOE is using those same labs for  
22 their modeling and so forth, which would not be a  
23 problem in this area? But my point is maybe there's  
24 a chance for some commonality of approach through  
25 using similar contractors since those are DOE labs.

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1 Do we know who DOE is using for their modeling and  
2 product development?

3 MR. GREEVES: Well, each DOE site has its  
4 own disposal program and its own performance  
5 assessment program for their sites. In some cases,  
6 the same groups that are doing the performance  
7 assessment of the DOE sites are also the contractors  
8 on our work, but not in every case. But they are  
9 basically at the same facility. They're aware of what  
10 each other are doing and they do communicate. I think  
11 one of the things I didn't mention before, I just  
12 didn't find a way to put it into the discussions that  
13 were going on, is some of the codes, the subsystem  
14 codes that we're using in the total systems analysis  
15 are, in fact, DOE developed codes or the same codes  
16 that they were using at their sites.

17 COMMISSIONER REMICK: Okay.

18 COMMISSIONER ROGERS: Before we leave this  
19 resources page, just a question about how realistic  
20 our '94 budget is. In light of the original budget  
21 estimate for '93 for contracts in NMSS was 500K and we  
22 spent 678 and now we're talking about going down to  
23 337, what -- was whatever led to the necessity for  
24 that additional 178K expenditure for contracts in  
25 NMSS, is that all over with? I mean is that apt to

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1 recur in some way?

2 MR. GREEVES: Yes. Commissioner Rogers,  
3 it's somewhat misleading just to look at the budget  
4 figures for a particular year because actually what  
5 happened is some of the work, some of the money spent  
6 with '93 dollars actually forward funded some of the  
7 '94 work. So, it's not dropping in half the way it  
8 looks like.

9 COMMISSIONER ROGERS: Okay.

10 COMMISSIONER de PLANQUE: It depends on  
11 which model you use, right?

12 MR. BERNERO: No year money.

13 COMMISSIONER ROGERS: Or computer program.

14 COMMISSIONER de PLANQUE: Yes.

15 MR. GREEVES: Well, in summary, the staff,  
16 I think, has made significant progress with these two  
17 principal products being the branch technical position  
18 and the test case. There's additional extensive  
19 effort in progress. We have been able to identify a  
20 number of issues going through this. In fact, a lot  
21 of these are contained in the user need letter that we  
22 recently sent over to Research in this program area.  
23 As we've described, we're making some mid-course  
24 corrections. We will be looking at selected SDMP  
25 sites and I expect that we'll be back with the program

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1 documents and briefings in the future and tell you  
2 about any other mid-course corrections that we think  
3 are needed as the program goes along. It's a living  
4 program and I wouldn't be surprised with some future  
5 corrections.

6 So that's the end of the presentation.

7 CHAIRMAN SELIN: Commissioner Rogers?

8 COMMISSIONER ROGERS: Well, let me say  
9 that I really think this is a wonderful piece of work,  
10 that everything I've seen and heard about both at  
11 presentations at conferences and the summaries that  
12 you've given us today I think indicate that this is a  
13 very fine professional integration of several of our  
14 efforts at NRC. I think that the team that involved  
15 both Research and NMSS is, to my knowledge, worked  
16 very well together and very effectively. That may  
17 serve as a very good model for other things that we  
18 may want to do in the future.

19 I really want to commend everybody  
20 associated with the effort because I think it's really  
21 been first rate, despite some of the problems that I  
22 expressed some concern about because I think they're  
23 just there and that's the real world. But with  
24 respect to the effort that we are putting in here, I  
25 think it's been very, very good. I really want to

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1 commend the staff for all aspects of this. In my  
2 opinion it's been a very fine piece of work.

3 I also think that your moving to start to  
4 immediately apply this, the techniques that you've  
5 been developing here to the SDMP sites is a very wise  
6 move. I think it's very important to start to begin  
7 to show results from research efforts. This is not  
8 just research, but a lot of it has had its start in  
9 research to actual regulatory issues that have to be  
10 dealt with in a timely way. I think it's very  
11 important that in doing that though that we don't let  
12 any of those become little mini-research projects in  
13 their own that somehow spin out. I think it's very  
14 important to keep that process very much under control  
15 so that we can continue to make -- to close out these  
16 SDMP sites in as rapid a way as we feel comfortable  
17 with from a safety and professional point of view.  
18 But I just wanted to say that I thought the work has  
19 been very good.

20 Some questions though. Have you  
21 identified any particular areas in which there is  
22 additional research that needs to be contemplated  
23 beyond what we may have touched on here today with  
24 respect to V and V issues, I guess, in models and  
25 codes?

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1 MR. BELL: Commissioners Rogers, one of  
2 the results of the process that the interoffice group  
3 has just gone through in developing these performance  
4 assessment models was that we almost simultaneously  
5 were preparing the test case and the VTP updated our  
6 NMSS office user need letter to the Office of  
7 Research. It identifies a number of areas where we,  
8 because of things we've learned in doing the test case  
9 and developing the BTP, we're asking Research to  
10 either help us improve some of the models or some of  
11 the source term information or some of the assumptions  
12 that we had to make about the performance of  
13 engineered barriers in the models. I think the two go  
14 very well together and compliment each other. If the  
15 Commission is interested, the staff can provide copies  
16 of the user need letter.

17 COMMISSIONER ROGERS: I'd like to see it,  
18 yes. I think the other Commissioners might be as  
19 well.

20 I also just didn't touch on it, but I  
21 thought that you mentioned early on that in developing  
22 the branch technical position together with the model  
23 analysis was really very helpful. It seemed to me  
24 that's absolutely the right way to go. To do the  
25 branch technical position before you had some

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1 assessment of your own capabilities and to be able to  
2 put this in a -- put the technical position in a  
3 realistic framework is really -- you wouldn't want to  
4 get it turned around the other way, in my view. I  
5 think that it's probably a lesson for us to learn as  
6 to how to proceed when we can. Now, sometimes events  
7 don't allow you to do things the right way, but it  
8 sounds to me like it was absolutely the right way to  
9 go.

10 But in carrying out your activities,  
11 looking at your own capabilities for performance  
12 assessment and talking with the states, I wonder what  
13 your impressions are of the ability of the states to  
14 conduct this kind of performance assessment for their  
15 own sites? It looks to me like it's gotten to be a  
16 very sophisticated technical and challenging -- very  
17 interesting challenging activity. I think we're just  
18 breaking into it, it seems to me, from a professional  
19 point of view, that we've sort of talked around a lot  
20 of these things in bits and pieces and now you're  
21 talking about an integrated program here that looks at  
22 the whole thing, which is very challenging to carry  
23 out and we know that some state agencies have very  
24 minimal numbers of staff members that could be turned  
25 loose on something like this. Of course, they may

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1 have to do it through contractors and so on.

2 But I wonder if you have any general  
3 comments about the ability of the states to manage  
4 performance assessment so that they can, in fact,  
5 answer the kinds of questions that we've been raising  
6 here?

7 MR. BERNERO: Do you want to do it? Let  
8 me.

9 This is a very sensitive point because  
10 it --

11 COMMISSIONER ROGERS: Oh, I know it is.

12 MR. BERNERO: In the development side of  
13 the state, you know the state can marshall the  
14 resources by calling on contractors and other assets.  
15 In the development of a performance assessment  
16 capability, in order to develop a site, you recall  
17 that one chart with the dotted line that said, "This  
18 is what the developer does," and then the regulator  
19 comes to audit. As far as the regulatory arm of a  
20 state is concerned, it's almost impossible for an  
21 average sized agreement state to have at their  
22 disposal the regulatory resources to do a truly  
23 independent assessment, which is what we're trying to  
24 do.

25 So, I view it as an essential capability

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1 for the NRC and perhaps -- I won't use the word  
2 "essential." I'll say an important asset through the  
3 workshop process and training process that we can  
4 share with agreement state regulators. They have to  
5 license. They need a sense of reality to be able to  
6 make a regulatory decision. The performance  
7 assessment I have before me is a legitimate, valid,  
8 robust performance assessment and it's very difficult  
9 for them to fund it on their own resources.

10 So, I think it's very important that the  
11 NRC not only have the capability for its own, but be  
12 able to share that through the technical assistance  
13 process.

14 COMMISSIONER ROGERS: That's all I have.  
15 Thank you very much.

16 COMMISSIONER REMICK: I'd just say that I  
17 thought both the paper and the discussion today was a  
18 good one. I'll withhold some of my compliments  
19 because I don't know quite what the end result is yet,  
20 but I will give you compliments on the process that  
21 you obviously have underway. The direction you are  
22 heading, and I agree on the SDMP, is a good specific  
23 example, and also on your enthusiasm.

24 When I came in today, one question I had  
25 was couldn't this supply the high-level waste, but you

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1 immediately answered that. You are actually using  
2 some information from the high-level waste area in the  
3 low-level waste and I compliment you on that. I think  
4 it's all the more reason why the combination of low-  
5 level, high-level makes some good sense.

6 I'm also very pleased to know that you  
7 have 486 PCs, that you're using them, that you're  
8 going to be getting work stations and of staff  
9 involvement. It's obvious to me, or appears to be  
10 anyhow, that you're on top of it. We have to use  
11 contractors, but it appears that you're very much  
12 involved in it and that's probably because we have  
13 some of the tools like your own PCs and things like  
14 that that you can become involved.

15 So, all in all, I'm quite pleased. I wish  
16 you the very best, but I'll look forward to the end  
17 result being a very -- as I agree with Commissioner de  
18 Planque, a very complex and not -- it's a very  
19 difficult area and not an exact science in all areas.  
20 So, we have to keep that in mind once again on  
21 believing bottom line numbers.

22 COMMISSIONER de PLANQUE: Well, I'm just  
23 going to say some of the same things. I think you're  
24 doing some excellent work here.

25 The problems clearly are very complex and

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1 I'm particularly pleased at the extent of interaction  
2 that you're having with other groups, not only within  
3 the United States, but internationally. I think  
4 that's critical, because everybody is facing the same  
5 issues, and I would just once more reiterate that you  
6 have to provide the reality check for those who are  
7 actually setting or proposing dose limits in the sense  
8 that they have to match, they have to be realistic  
9 knowing the state of the art and what the limitations  
10 are, especially with respect to validity, uncertainty  
11 and accuracy with which all of these estimates can be  
12 derived.

13 But I would thank you very much. It's  
14 been very good.

15 CHAIRMAN SELIN: I have a question, which  
16 is the first question. When do you get to the point  
17 where you feel sort of comfortable that we're now into  
18 maintenance as opposed to development? How much will  
19 we have spent by then? And what happens to the  
20 program?

21 MR. BELL: I'd like to take a shot at  
22 answering both the questions or maybe all three of the  
23 questions.

24 You asked what were the objectives, and I  
25 think maybe it became clear from the discussion. The

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1 objectives are to develop the capability to  
2 independently review an applicant's assessment of  
3 compliance with the 10 CFR Part 61 dose objectives,  
4 and in fact to independently review applicants' plans  
5 with other dose standards as well, since we're now  
6 thinking about applying this to the decommissioning  
7 program, and also to document it in a way that's going  
8 to be useful to the applicants to prepare applications  
9 and to the agreement state regulatory agencies who  
10 have to review their own applications. So, that was  
11 one of the questions you asked.

12 And the second, how do we know when we're  
13 done, well, I don't think the staff of this agency can  
14 ever say they are done until they have successfully  
15 reviewed a license application and defended it in a  
16 hearing. And that's one of the reasons why applying  
17 it to the decommissioning program is important.

18 We do not foresee a license application  
19 for a commercial low-level waste site to this agency  
20 for maybe four or five years at the earliest. We have  
21 decommissioning sites that we can start to apply these  
22 things to right now, to model and evaluate real sites.  
23 We'll eventually end up having to defend in hearings  
24 and when we've successfully done that we'll know at  
25 least for that case we're done. It won't mean that if

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1 you go apply it to a different site with very  
2 different hydrologic and meteorological conditions  
3 that you won't end up having to modify those models  
4 and make changes.

5 I think the same thing has happened over  
6 the years in reactor licensing. The staff can  
7 evaluate the class of light water reactors that are  
8 presently out there in operation and the industry  
9 comes in with an advanced class of reactors, and so  
10 new methods have to be developed. As I think John  
11 said very early in the briefing, it's a living  
12 process.

13 MR. BERNERO: I'd like to add to what Mike  
14 just said. I agree wholeheartedly with his responses,  
15 but, with respect to the resources, we're just sitting  
16 down -- next week, in fact, I'm sitting down to review  
17 the '96 budget proposals in this area, among others,  
18 and I envision that in the '95, '96 time frame, we  
19 shift not from completed development but shift more to  
20 an application mode with the possible changes, site-  
21 specific alterations which will be a fact of life.  
22 But I see this activity then as much more a license  
23 application mode, not necessarily licensing low-level  
24 waste disposal sites, but in any applicable use. And  
25 so, we're right now-- in '95, the effort directed

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1 toward this is tailing off and shifting into that  
2 other mode.

3 CHAIRMAN SELIN: I would just like to  
4 point out that when you get there -- see, now every  
5 time you learn something you can just put it into the  
6 model, but you're going to get to a point where  
7 configuration control becomes important, where we  
8 document something, where we can't -- we see a way to  
9 improve it. You just can't go put that in. You have  
10 to wait, you know, once a year do a set of updates so  
11 that the people who will be using these models,  
12 whether it's the operators or the states, don't have  
13 to work with a moving target. You know, they come in  
14 and they say "we find these results." "Oh, we fixed  
15 that last week. We just didn't get around to telling  
16 you."

17 In effect, the model becomes a rule. I  
18 mean, it's a predictable regulatory rule, and  
19 therefore it's going to have to be subject to the same  
20 kind of configuration management.

21 I thought this was terrific. I really  
22 think it's very interesting, but I am concerned that  
23 the resources are tailing off and I am concerned that  
24 there be sort of a clear stage to say, okay, now we  
25 have something. We're obviously going to have to do

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1 some maintenance, but, until we apply quite  
2 differently, development is done. We can start  
3 documenting, configuring. You can't do that until  
4 you've finished the validation, as we've talked about.  
5 If a whole new set of applications come up, of course  
6 that's a new mod. That's a new approach.

7 Thank you very much. Very good.

8 (Whereupon, at 11:30 a.m., the above-  
9 entitled matter was adjourned.)  
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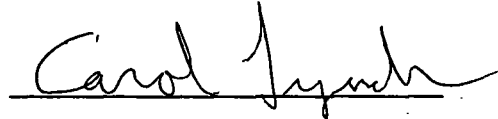
This is to certify that the attached events of a meeting  
of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON LOW-LEVEL RADIOACTIVE WASTE PERFORM-  
ANCE ASSESSMENT DEVELOPMENT PROGRAM PLAN

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: APRIL 1, 1994

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**STAFF BRIEFING ON THE  
LOW-LEVEL RADIOACTIVE WASTE  
PERFORMANCE ASSESSMENT  
DEVELOPMENT PROGRAM**



**April 1, 1994  
John T. Greeves, NMSS**

# OVERVIEW

- Background
- Principal Accomplishments
- Results/Issues
- Additional Guidance Development
- Interactions with Others
- Resources
- Summary/Conclusion

## DEFINITION OF PA

- Probabilistic Risk Assessment (PRA) - Performance Assessment (PA)
- Performance Assessment (PA) for today's briefing is defined as the technical analysis used to demonstrate compliance with dose standards.

## PAWG MEMBERSHIP

Member	Office/Branch
Ralph Cady	RES/WMB
Andy Campbell	NMSS/LLWB
Bob Hogg	NMSS/LLWB
Joe Kane	NMSS/LLWB
Robert Lewis	NMSS/LLWB
Chris McKenney	NMSS/LLWB
Tim McCartin	RES/WMB
Tom Nicholson	RES/WMB
Ed O'Donnell	RES/WMB
Jake Philip	RES/WMB
Phil Reed	RES/WMB
Fred Ross	NMSS/LLWB
Bob Shewmaker	NMSS/LLWB
Mark Thaggard	NMSS/LLWB

# GOALS

- Improve PA Guidance
  - Develop acceptable approaches
  - Integrate research results into PA
- Enhance NRC Staff Capability

## **PROGRAM PHASES**

- **Phase I (92-93)**

**Enlarge in-house LLWPA capability and develop regulatory guidance.**

- **Phase II (94 and beyond)**

**Augment the core of expertise with a more comprehensive and advanced capability.**

- **Program Modifications**

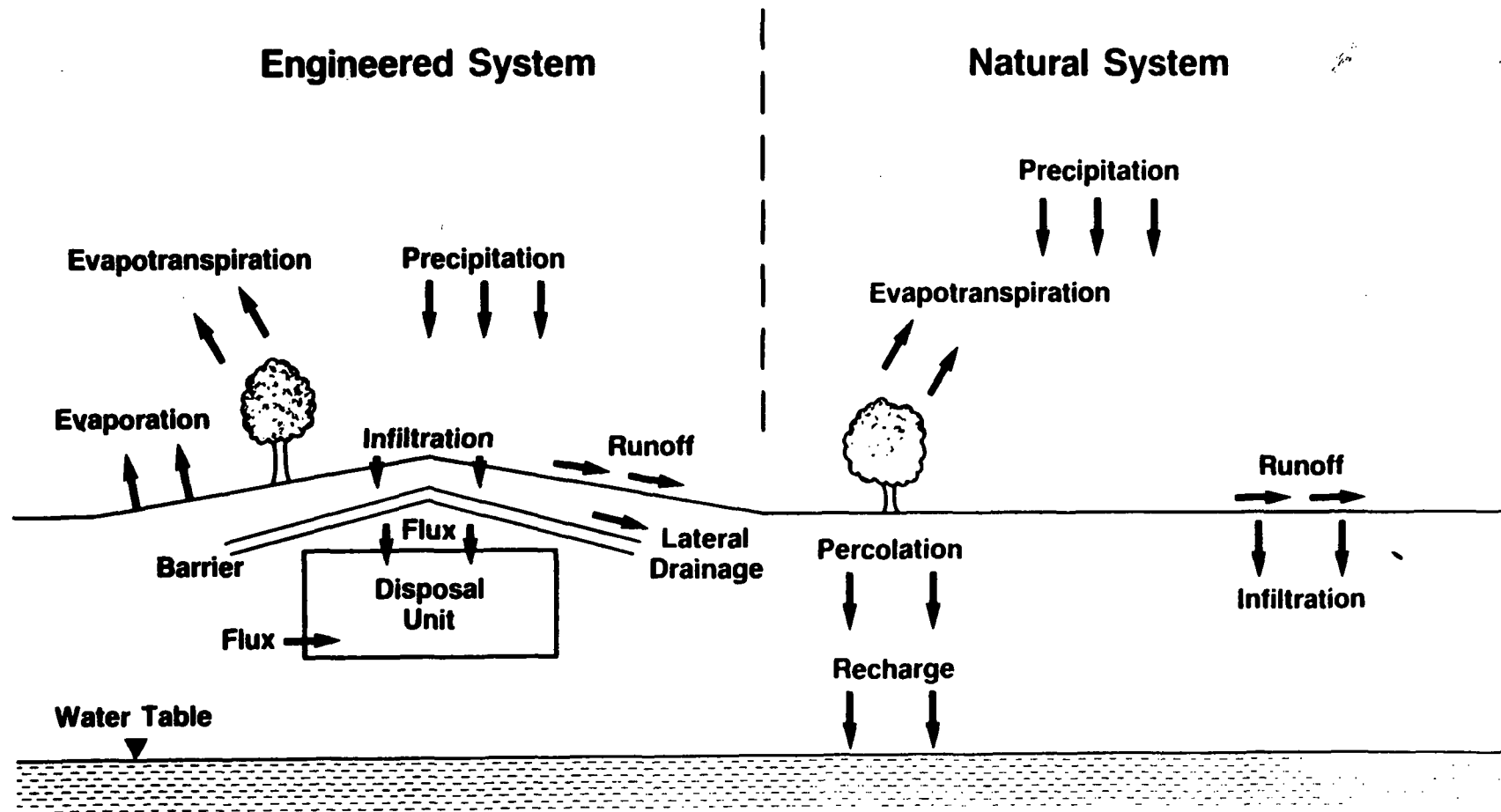
**Conduct selected SDMP on-site disposal reviews.**

## STAFF CAPABILITY/HARDWARE

- Significant enhancement of staff capability.
- In 1992 we obtained "enhanced" 486 PCs for staff use.
  - Adequate for analysis of many individual LLW PA codes and test case development.
- Work stations are now being made available.
- A mix of 486 PCs and work station systems appears appropriate for LLW PA efforts.

## BRANCH TECHNICAL POSITION

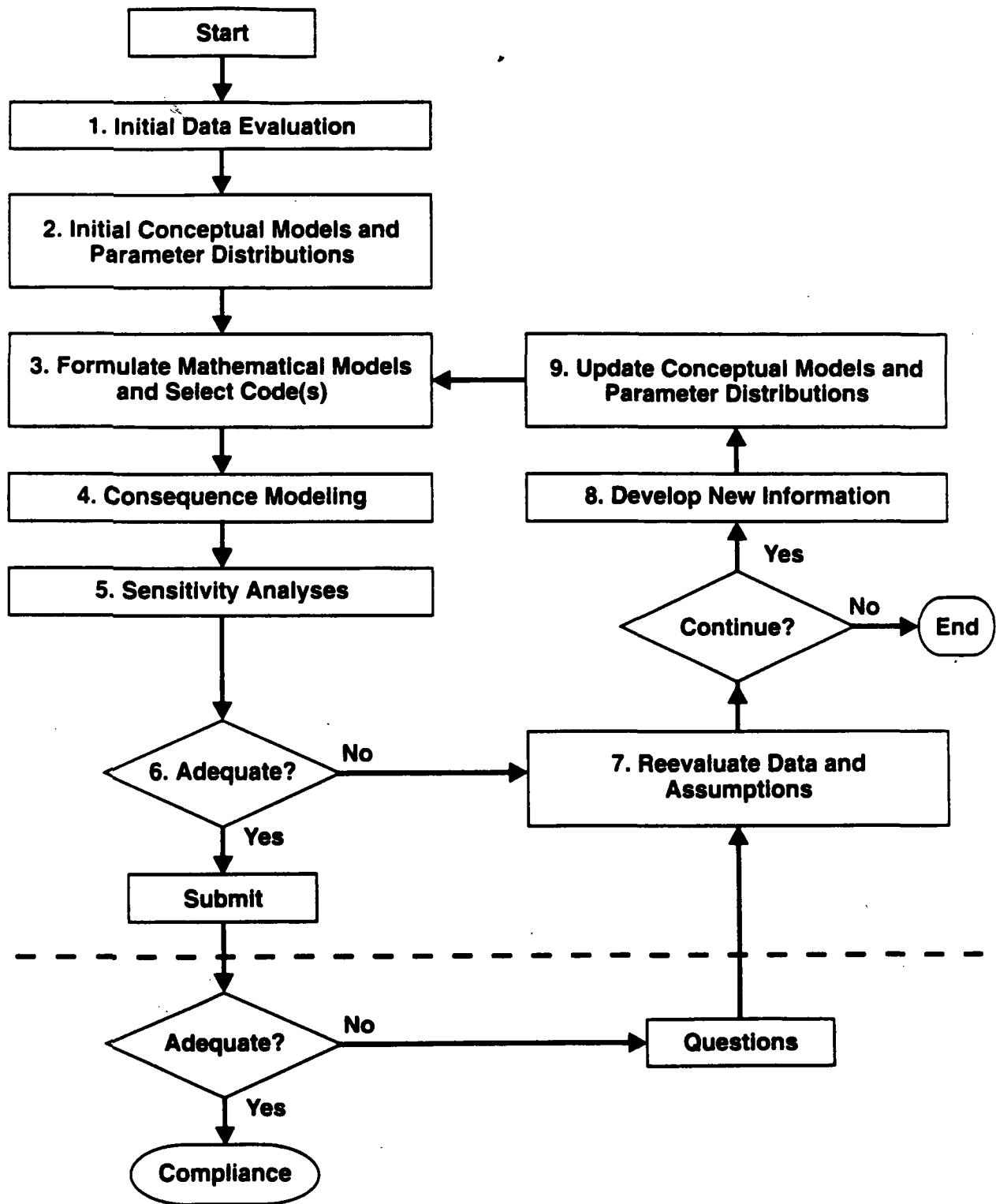




Schematic of processes in infiltration analysis.

## PA ATTRIBUTES

- Provide an iterative, documented process
- Integrate site characterization and design with PA modeling activities.
- Formally treat uncertainty and sensitivity as an intrinsic part of the process.
- Obtain a thorough understanding of the performance of the site.
- Provide a process for reaching a defensible regulatory decision.



Flowchart of overall performance assessment process.

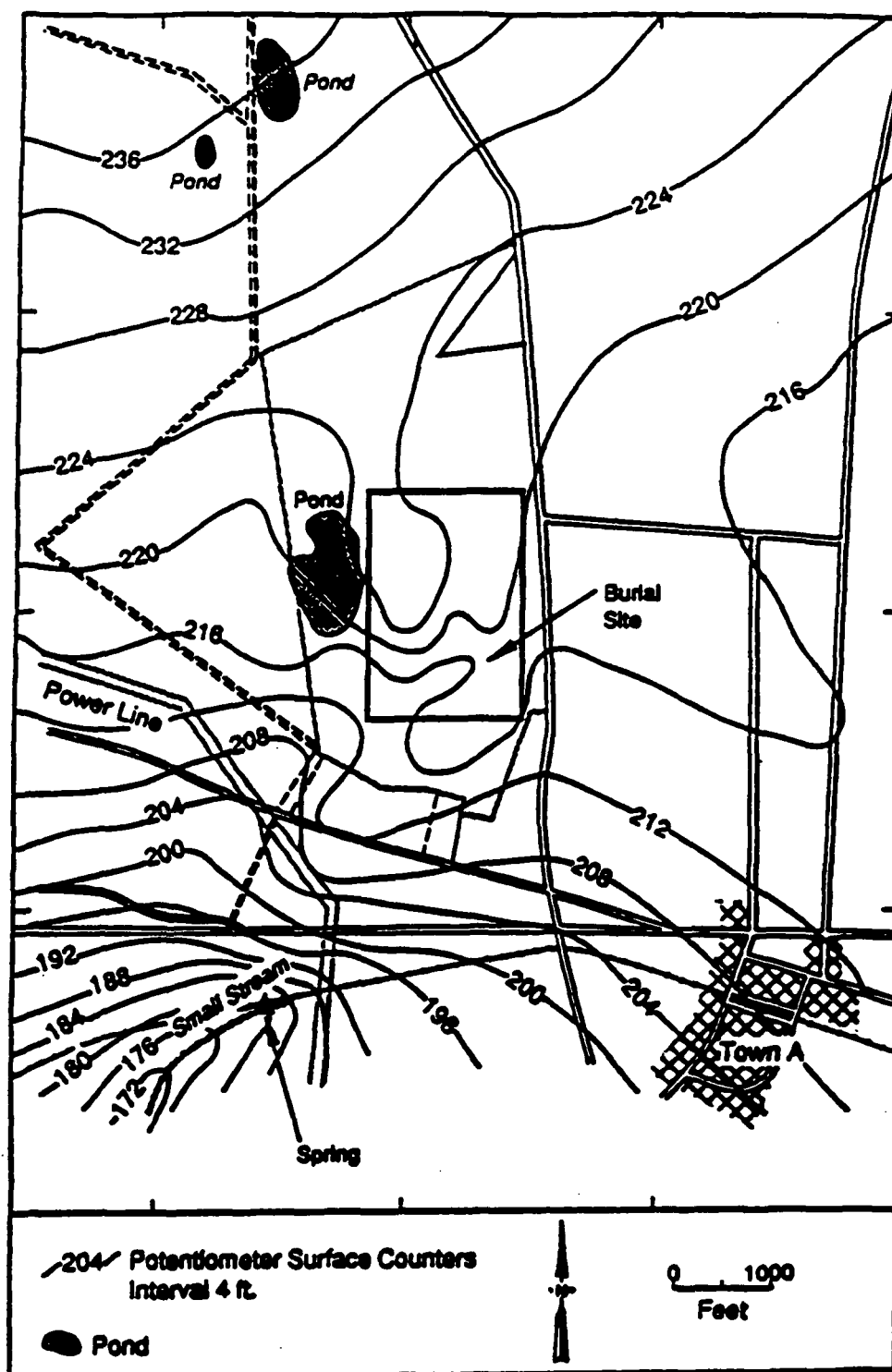
# TEST CASE

## PURPOSE AND GOALS OF TEST CASE

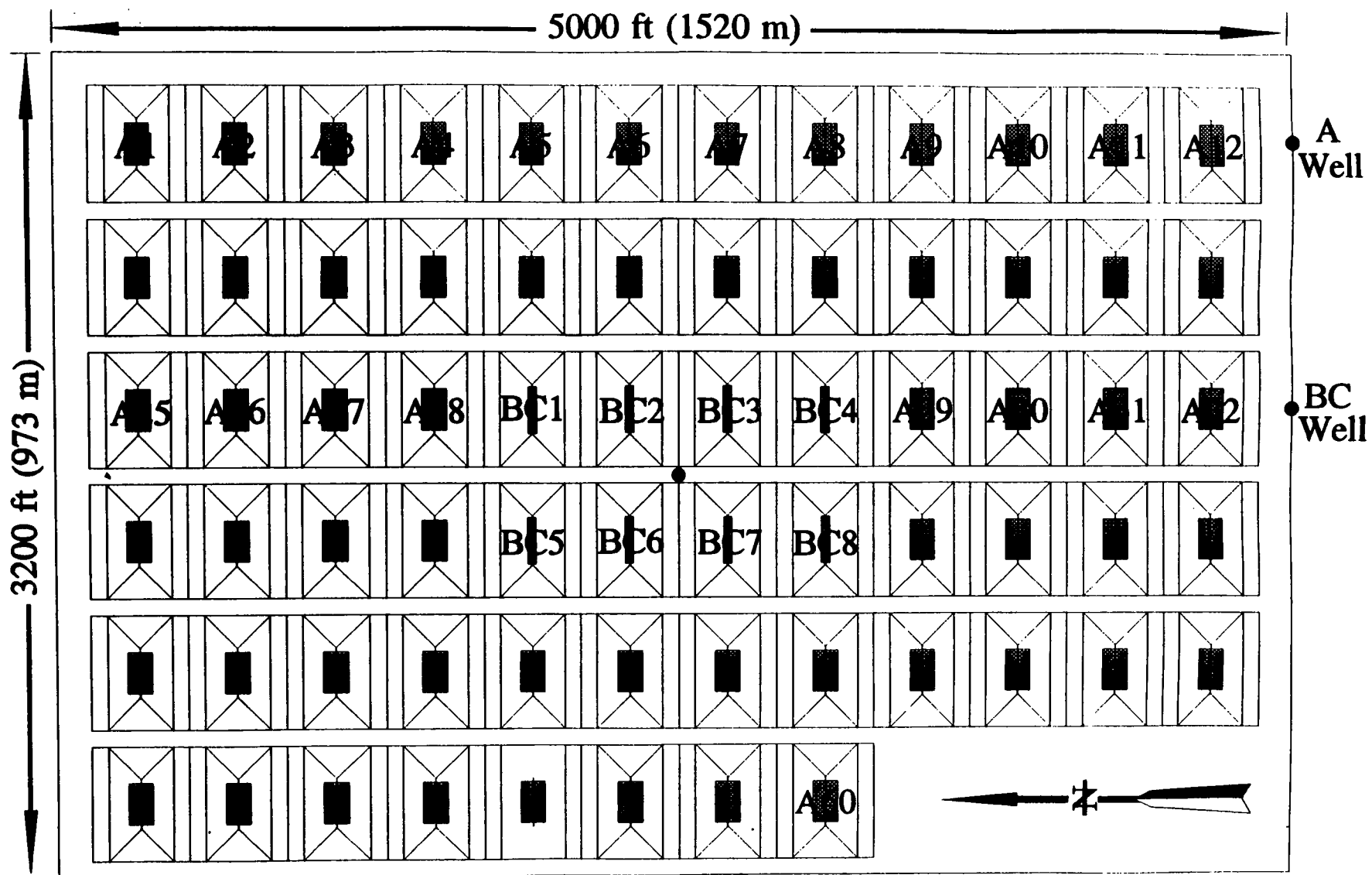
- To develop staff capability.
- To provide insight for resolution of regulatory issues.
- To examine consequences of different conceptual models in LLW PA.
- To test feasibility of approaches proposed in BTP.

## PROBLEM STATEMENT

- Estimate the peak dose received by the maximally exposed member of the general public. Potential significant off-site transport mechanisms:
  - Groundwater
  - Surface Water
  - Air



**Figure 2.4.8** Potentiometric Surface of Zone 1 at the Disposal Facility



Class A vaults: 94 ft x 142 ft

Class BC vaults: 25 ft x 165 ft

Regional Ground-Water Flow

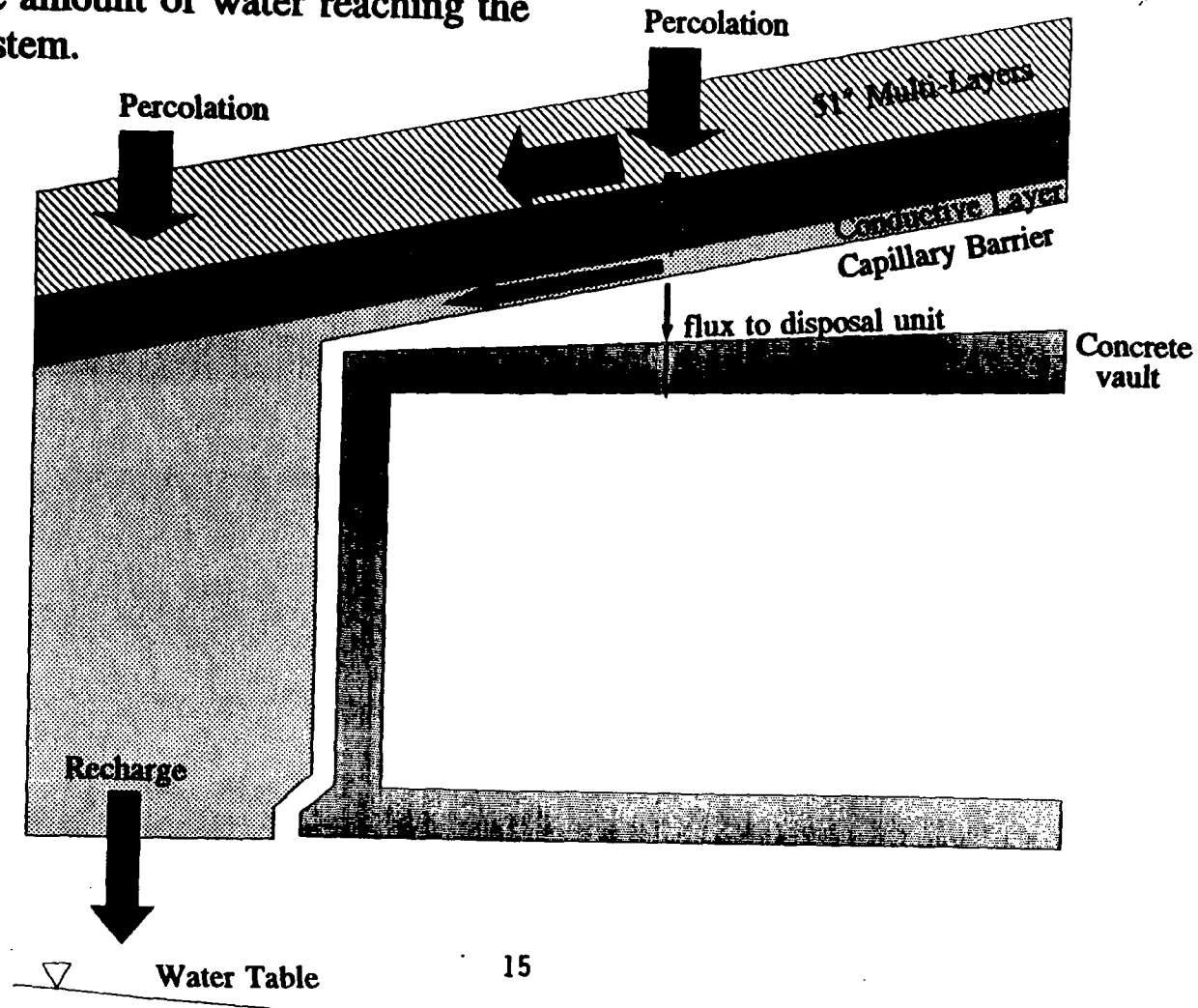


## Infiltration Conceptual Model

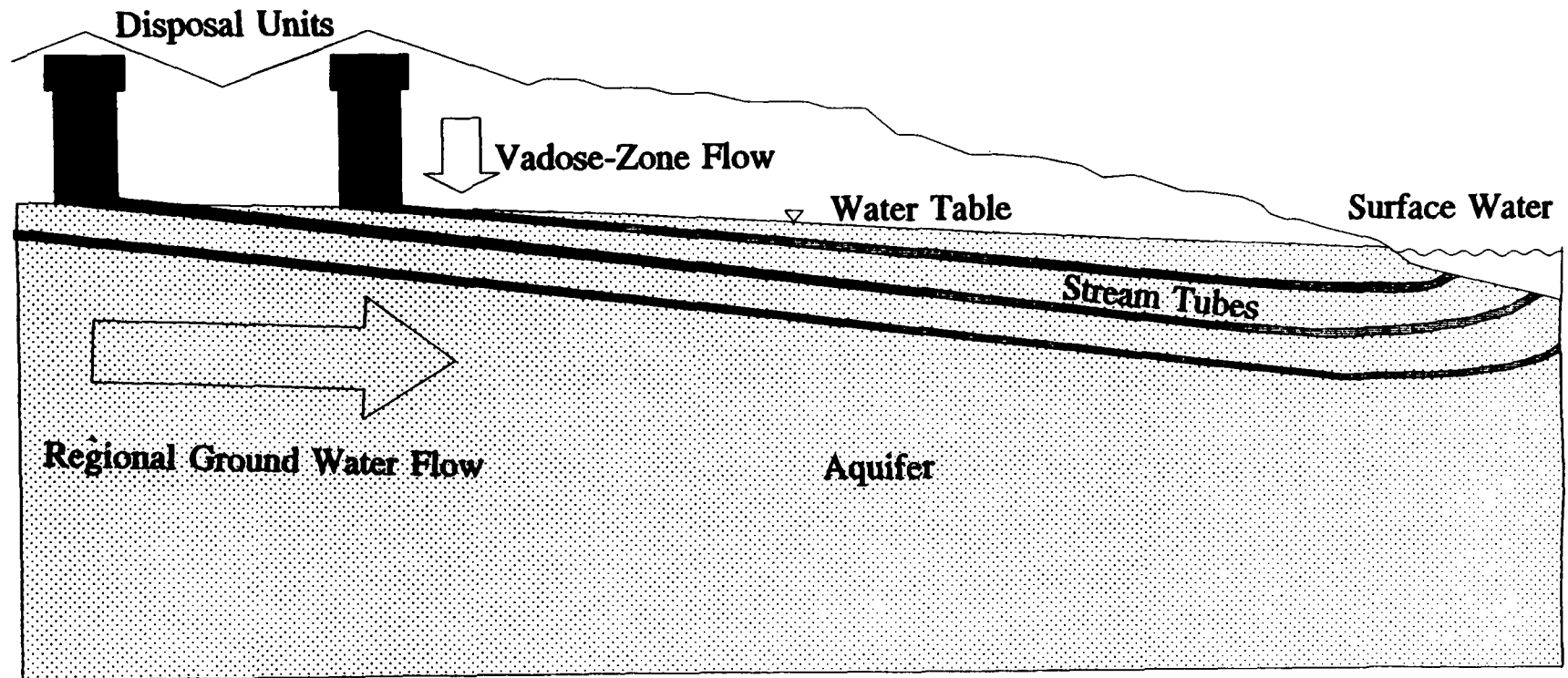
### Objectives:

To determine the amount of water reaching a typical disposal unit.

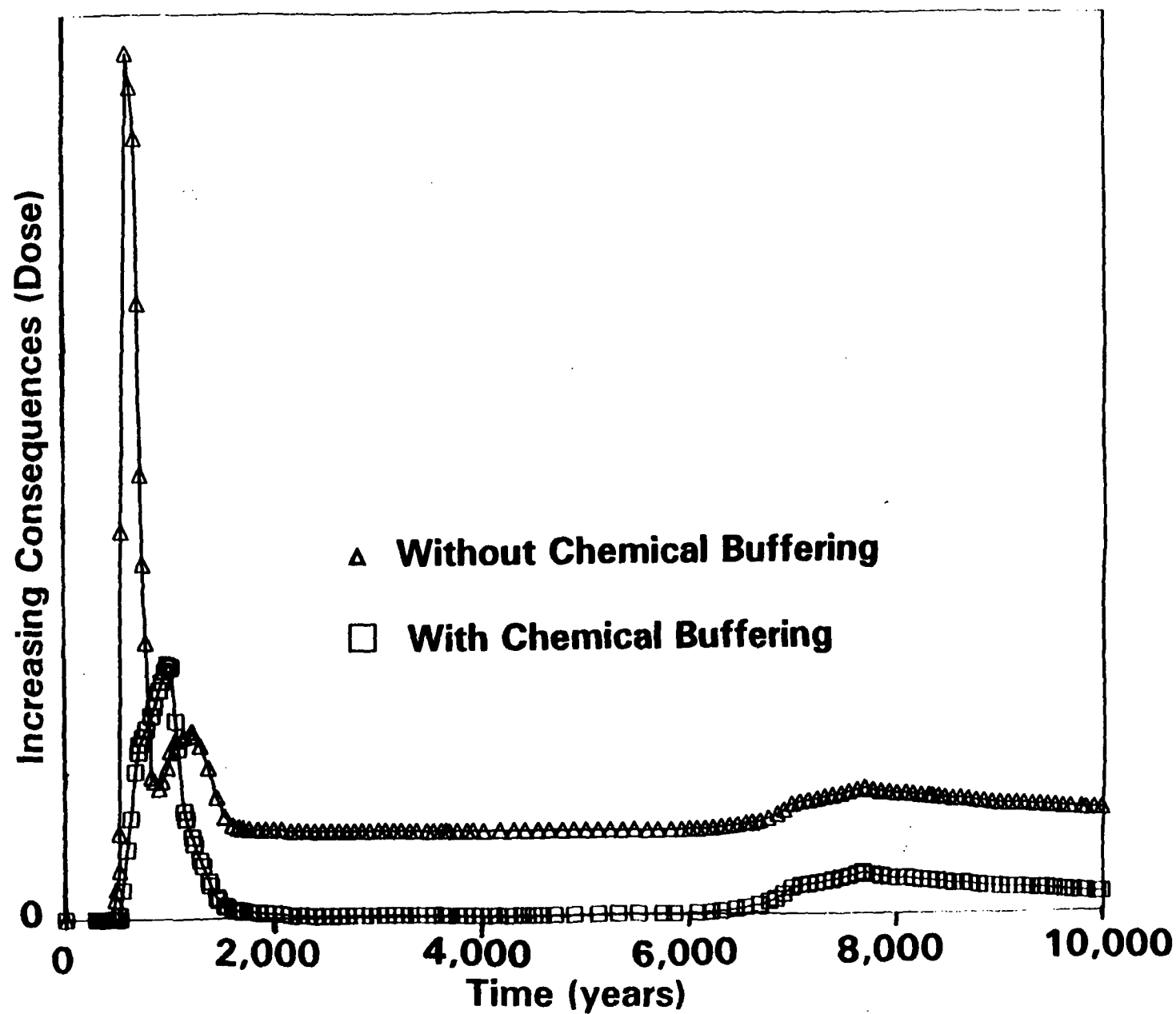
To determine the amount of water reaching the ground-water system.



## Conceptualization of Ground-Water Discharge to Surface Water



## Relative Significance of Chemical-Buffering due to Concrete



# RESULTS/ISSUES

## Test Case Observations

- For the conceptual model implemented, dose is most sensitive to :
  - the flux of water into and through the vault,
  - percolation through the engineered cover, and
  - solubility and retardation for critical radionuclides.

### Results/Issues (continued)

- Other important observations from the test case:
  - Predicting the long term behavior of engineered structures and environmental conditions is both difficult and important for the analysis.
  - I-129 and Tc-99 inventories are important and Cl-36 may be important.
  - Ingrowth of Ra-226 and other daughters may be important for large U-238 inventories.

## **Results/Issues (continued)**

- **Information on radionuclide specific waste streams, forms, and types may allow improvements to release models.**
- **For the test case, the off-site air dose can be bounded by conservative, deterministic calculations.**
- **Chemical buffering due to the presence of large volumes of concrete may have significant impact on the release of radionuclides from the disposal units.**

## **TECHNICAL/REGULATORY/POLICY ISSUES**

- **Time Frame for Performance Assessment Analysis**
- **Treatment of uncertainty in regulatory decisions**
- **Role of engineered barriers**
- **Role of the site and consideration of site conditions, processes, and events (i.e., global climate changes)**
- **Role of performance assessment during operational and closure periods**

## FURTHER DEVELOPMENT OF GUIDANCE

- Draft BTP sent to Federal Agencies (DOE, EPA, USGS) and sited and host Agreement States for comment (1/14/94)
  - Comments received to date
    - \* DOE/Performance Assessment Task Team (PATT)
    - \* DOE/LLW National Program
    - \* USGS
    - \* EPA
    - \* New York State



## **Further Development of Guidance (continued)**

### **\* NRC Contractors**

- Awaiting additional State inputs.
- Will begin formal evaluation in April
- Workshop on BTP after draft published for comment (summer 1994).
- Commission decision on policy issues.
- Revise BTP.

# INTERACTIONS

- Agreement States
  - Technical Assistance, as requested
  - NRC training conducted in July of each year.
- Nation wide
  - Attendance at State meetings
    - \* LLW Forum Meetings
    - \* Technical Coordination Committee

## **Interactions (continued)**

- \* Conferences (DOE Annual Conference, Waste Management Annual Conferences).**
- Interactions with DOE**
  - \* LLW National Program Office**
  - \* DOE/PATT (Performance Assessment Task Team)**
  - \* DOE/PRP (Peer Review Panel)**

## **Interactions (continued)**

- **International**
  - **Leadership in IAEA PA Test Case study**
  - **INTRAVAL PROJECT**
  - **Information exchange with specific national programs**

## RESOURCES

Office	FY 93	FY94
NMSS		
Staff	4.3 FTE	3.7 FTE
Contracts	\$678K	\$337K
RES		
Staff	2.8 FTE	2.0 FTE
Contracts	\$1.025M	\$850K

## SUMMARY

- Staff has aggressively pursued the Commission's directive in their 1991 SRM.
- An extensive effort is currently in progress.
  - Identified issues to be resolved
- Mid-course corrections
  - Currently to include selected SDMP sites
  - Program evaluated annually when the Commission report is due.



## **POLICY ISSUE**

**(Information)**

March 28, 1994

SECY-94-083

**FOR:** The Commissioners

**FROM:** James M. Taylor  
Executive Director for Operations

**SUBJECT:** ANNUAL STATUS REPORT ON PROGRESS OF LOW-LEVEL RADIOACTIVE  
WASTE PERFORMANCE ASSESSMENT DEVELOPMENT PROGRAM PLAN

**PURPOSE:**

To inform the Commission of staff's progress in carrying out the Low-Level Radioactive Waste Performance Assessment (LLWPA) Development Program Plan.

**SUMMARY:**

The Low-Level Radioactive Waste Performance Assessment Development Program Plan (SECY-92-060) was developed in response to a June 14, 1991, staff requirements memorandum (SRM). U.S. Nuclear Regulatory Commission staff has made significant progress over the past year in meeting the Phase I objectives of the plan. Staff has completed a draft "Branch Technical Position (BTP) on Performance Assessment for Low-Level Waste Disposal Facilities." This document has been distributed to all low-level waste (LLW) sited and host Agreement States, the Advisory Committee on Nuclear Waste (ACNW), the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the United States Geological Survey (USGS) for review and comment. A staff briefing of ACNW is scheduled for March 1994 and there are plans to brief the Commission in April 1994. Staff has also constructed an integrated systems model of a hypothetical LLW disposal facility and has been carrying out an iterative series of analyses to test different modeling approaches,

**Contact:** Andrew C. Campbell, NMSS  
504-2500

**NOTE:** TO BE MADE PUBLICLY AVAILABLE  
AT COMMISSION MEETING ON  
APRIL 1, 1994

including uncertainty and sensitivity analyses. In addition, contractors have provided ancillary analyses on different system components to support staff modeling efforts. The staff has also gained PA experience through interactions with State efforts, other Federal agencies (e.g., DOE and the USGS), foreign countries (e.g., France, Spain, and Germany), and international organizations, such as the International Atomic Energy Agency (IAEA).

#### BACKGROUND:

This paper provides the Commission with an annual status report of progress in implementing SECY-92-060. This is the second annual report; the first was provided in SECY-93-060. The Plan, which was produced in response to a June 14, 1991, SRM, has two primary goals: (1) to enhance staff's capability to review, evaluate, and conduct a LLWPA; and (2) to develop regulatory guidance based, in part, upon staff and contractor LLWPA modeling work and lessons learned from the simulations.

The plan was divided into two phases. Phase I was focused on enhancing in-house capability and developing regulatory guidance for LLWPA based upon existing state-of-the-art technology. Phase II was originally intended to focus on: (1) maintaining and augmenting staff capability; (2) updating regulatory guidance; and (3) incorporating significant technological advances from research efforts into NRC's performance assessment (PA) capabilities. Staff was considering extending the test-case modeling to an arid site (in contrast to the humid site currently being evaluated under Phase I). Phase II, however, is being modified, by applying staff capability developed in Phase I, to conduct PA analyses for certain Site Decommissioning Management Plan (SDMP) sites, where appropriate data are available. Other objectives for Phase II would be maintained; however, implementation of these other activities would be delayed because of limited staff resources.

The LLWPA program plan is being carried out by the Performance Assessment Working Group (PAWG), which is composed of staff from both the Low-Level Waste Management Branch (LLWB), Office of Nuclear Material Safety and Safeguards (NMSS), and the Waste Management Branch (WMB), Office of Nuclear Regulatory Research (RES) (see Enclosure). As described in SECY-92-060 and SECY-93-060, PAWG members are involved in all aspects of LLWPA, including research, methods to enhance staff expertise, development of regulatory guidance, and coordination of PA activities with Federal, State, and international organizations.

#### DISCUSSION:

##### 1. Implementing the Program Plan

##### 1.1. Enhanced Staff Capability

The first program goal is to enhance staff's capability to review and evaluate a license applicant's LLWPA, including conducting confirmatory PA analyses, if necessary. The primary strategy for achieving this program goal has been to develop and to exercise a test-case PA of a hypothetical disposal system in a



humid environment, using actual site data and a staff-generated facility design and source term inventory. This has allowed staff to test the performance assessment methodology (PAM) and models and has increased staff experience, insight, and understanding in LLWPA. The test-case has also enabled staff to test different approaches to LLWPA developed for the BTP. The modeling effort also has benefited from experience in the high level waste (HLW) PA effort, particularly in the areas of uncertainty and sensitivity analysis.

The staff has completed development of a fully integrated systems code that links sub-models for infiltration, engineered barrier performance, source term, ground-water transport, surface-water transport, and dose. The structure of the integrated systems code allows sensitivity and uncertainty analyses to be conducted for the overall PA analysis. The code has been subjected to an evaluation program within PAWG, to document it, to verify that it is carrying out the intended calculations appropriately, and to identify and resolve bugs and internal inconsistencies. The model incorporates a one-dimensional (1-D) streamtube approach for radionuclide transport, with appropriate geometric considerations to address two- and three-dimensional (2-D, 3-D) features of the site hydrogeologic system. Staff has demonstrated, through analysis of an analytical solution to the problem, that a 1-D streamtube is appropriate for this case. The data input for this integrated model consists of a list of parameters, the expected range of each parameter value, and the expected distribution (e.g., normal or lognormal) of each parameter for the different sub-modeling areas. Several different conceptual models are being evaluated. The staff is currently conducting full sensitivity and uncertainty analyses, using the integrated LLWPA code, for a resident agriculture scenario at the simulated site boundary. The purpose of this work is to determine the sensitivity of the calculated dose to different parameters and also to provide the framework for assessing the appropriateness of potential regulatory positions. The fully integrated code is designed around the specific features of the hypothetical LLW disposal site and, therefore, is not intended to be a generic code to be applied to all LLW sites. Nevertheless, the approaches developed and lessons learned in exercising the test case have been very useful in developing the BTP.

The computer codes incorporated into the model (including newly developed codes) allow modeling of specific physical phenomena of concern (such as waste form leaching and transport of radionuclides) in the PA process. Many of the codes contain complex, iterative numerical procedures that require powerful computers to reach a solution in reasonable time. The ability of staff to use PA codes and to discern both the capabilities and limitations of different codes, is a fundamental part of enhancing staff's proficiency in reviewing and evaluating a license applicant's PA.

The enhanced computer hardware, acquired in fiscal year 1992 (FY92) (i.e., four IBM-compatible 486 machines for NMSS and one IBM compatible-486 machine for RES) along with associated software and support equipment has proved adequate for developing the test-case model. These fast, powerful personal computers (with considerable amounts of expanded/extended memory and large hard disk capacity) allow staff to load and manipulate a large variety of

computer codes. However, since each realization of the data set in the integrated LLWPA model requires 2 to 3 hours of 486 computer time, and staff is running hundreds of realizations to exercise the code, more complex analyses (e.g., 2-D or 3-D models) will require the use of a larger computer system, such as advanced 486 systems with fast processors or workstation systems. The proposed merger of LLW and HLW Divisions will make the HLW workstation system available for LLWPA. Staff will evaluate specific needs for additional units for LLWPA modeling activities. Recently RES has obtained two work station units, which are dedicated for modeling. It is important to note that, because LLWPA analyses involve both simple and complex models and codes, the hardware requirements include a mix of 486 based computer systems, as well as more powerful systems.

The staff has also worked to achieve the goal of improved capability in LLWPA, through a number of other activities, including research activities described in SECY-92-060. To further enhance staff's capability to conduct and review LLWPAs, several workshops and meetings were conducted, in FY93, to enhance technology transfer to NRC staff from research and technical assistance contractors. In addition, in June 1993 NMSS/RES staff arranged a LLWPA meeting of NRC staff and several contractors to provide a technical review of the test-case modeling, including identifying potential problem areas (e.g., technical problems with data or inconsistencies in the models) and developing approaches for their resolution. This meeting also provided essential insights for developing the draft BTP.

NRC contractors have also been developing and evaluating codes suitable for PA modeling, and to supplement staff efforts, they are modeling specific parts of the test-case problem. These include: independent ancillary analyses of infiltration through a multi-layer cover; concrete degradation studies; source term modeling; geochemical modeling of radionuclide solubilities and sorption parameters; ground-water transport modeling in the saturated zone, and vapor-phase transport modeling in the unsaturated zone; surface water transport; air transport; and dose modeling. In addition, further development and improvement of the PAM and contractor input on LLWPA issues have been a significant help in developing the BTP. These projects are being documented and published as NUREG/CR documents, including: NUREG/CR-5927, Volume 1, which updates the PAM, August 1993; NUREG/CR-6070, which presents approaches on concrete barrier modeling in LLW disposal, November 1993; and the NUREG/CR-6114 series (Volume 1, published December 1993, which deals with applying the infiltration evaluation methodology; Volumes 2 and 3, which are in press, deal with vapor-phase transport analysis and ground-water flow and transport analysis, respectively).

## 1.2. Developing Regulatory Guidance

The second program goal is to develop regulatory guidance for LLWPA, in particular the BTP on LLWPA, and staff has also made significant progress in this area. Staff effort in developing the BTP on LLWPA is closely related to capability. The staff has completed a draft BTP for review by LLW sited and host Agreement States, ACNW, DOE, EPA, and USGS. The draft BTP has already been reviewed by NRC staff and by NRC contractors involved in LLWPA. The

principal guidance objective of the BTP is to provide license applicants and regulators with an acceptable methodology for performing technical analyses required in 10 CFR 61.13 to demonstrate compliance with the 10 CFR 61.41 performance objectives. This includes giving: (1) general guidance on an acceptable PA process that integrates site characterization and PA modeling; and (2) specific guidance on implementing NRC's PAM. The PAM was developed by NRC as one approach that may be followed in conducting a PA for a LLW disposal facility.

The revised schedule discussed in SECY-93-060 (the first annual status report) called for staff to prepare a draft BTP focusing on PA strategy and resolving policy issues by FY93. Subsequently, staff would incorporate revised sub-modeling area technical positions into the draft BTP in FY94. Staff, however, has completed both tasks, and the draft BTP sent out for review and comment is a complete document that incorporates five main sections. These sections of the BTP focus on the following objectives: (1) defining LLWPA in the context of the 10 CFR Part 61 regulatory requirements for LLW facility performance; (2) providing background information on LLW disposal, the NRC PAM and important issues in LLWPA; (3) describing an overall process for conducting PA modeling activities; (4) addressing important technical policy issues concerning interpretation and implementation of Part 61 technical requirements; and (5) providing guidance on acceptable modeling approaches for addressing technical issues about processes controlling LLW facility performance.

The goal of the review process is to receive comments from the sited and host Agreement States and appropriate Federal agencies, and to address these comments in revising the BTP. Staff will be briefing the ACNW on the BTP and test-case modeling in March 1994. A briefing of the Commission will follow in April. Subsequently staff will produce a revised draft BTP for publication in the Federal Register and public comment by all interested parties. Staff will also hold a public workshop on the BTP.

In addition, staff will continue to conduct the test-case modeling, including sensitivity and uncertainty analyses, using both staff resources and ongoing contractual technical assistance. This schedule will allow staff to address any outstanding technical issues. The staff will develop a NUREG on the test-case simulations to document the technical basis for the overall PA strategy and for specific sub-modeling area technical approaches. In addition contractor analyses of different sub-model areas of the test-case are being, and will continue to be, published as a series of NUREG/CR reports, which will provide further technical support for individual sub-modeling area technical positions. The Phase I test-case documentation is scheduled for completion in FY94. All of this work will be done within existing resource allocations. Because the BTP is an extensive and comprehensive guidance document, the need for developing a Regulatory Guide from the BTP will be reconsidered. Because of resource limitations, completing documentation of the test-case work may be extended into FY96, depending on the level of effort necessary for PA work on SDMP sites.

## 2. Interactions with Agreement States

During FY93, staff has had several interactions with Agreement States, where knowledge and experience gained from the LLWPA program have been directly applicable. For example, on June 4, 1993, NRC staff met with the State of North Carolina and provided an overview of the BTP development and test-case simulations. Staff also met with an individual from the State of Pennsylvania, to discuss LLWPA issues and approaches for modeling. In addition, on July 28, 1993, in Rockville, Maryland, staff (in conjunction with State Programs) participated in the LLW and Uranium Recovery Regulatory Workshop for Agreement States, which included a half-day session devoted to PA, including information on the PAM and strategies for modeling, the test-case simulations, and the development of the BTP. Staff also gave a presentation of this information at the LLW Host State Technical Coordinating Committee Meeting in Rockville, on August 24, 1993. The experience and knowledge gained from these LLWPA program activities permit direct feedback and input to staff's development of PA guidance. Staff has also worked to provide technology transfer to the Agreement States through various activities such as organizing workshops (discussed below) and distributing publications. Staff will continue these efforts in the future, as well as providing specific technical assistance when requested.

## 3. Interaction with National PA Activities

NRC staff has been active in national LLWPA activities, particularly in association with DOE. NRC staff is participating in the DOE PA Task Team (PATT) meetings, held approximately every four months. The purpose of PATT is to discuss and coordinate the LLW PA activities at DOE sites, identify and resolve technical issues, alert DOE headquarters to policy issues, and develop revised guidance for the disposal of DOE LLW. NRC staff also participates, as a non-voting member, in the DOE Peer Review Panel (PRP), which evaluates and determines the technical acceptability of LLWPAs for DOE sites and provides input to DOE HQ. Participation in both the PATT and PRP is beneficial to the NRC staff in developing regulatory guidance for commercial disposal facilities. Moreover, these activities provide an important means of coordinating NRC and DOE LLWPA endeavors.

Staff presented a day-long workshop on the LLWPA test-case modeling to the DOE/PATT in Gaithersburg, Maryland, on November 17, 1993. Because PATT members are practitioners of LLWPA and are directly involved in doing LLWPAs for DOE facilities, the workshop provided an excellent opportunity for technical discussion of issues in LLWPA and staff's test-case modeling efforts.

The staff has also continued interactions with the National LLW Management Program Office (NLLWMP), operated by EG&G at the Idaho National Engineering Laboratory (INEL) for DOE. This office provides technical assistance to the States under the 1985 Low-Level Radioactive Waste Policy Amendments Act. During FY93, the NRC staff had numerous technical interactions with the NLLWMP, involving activities such as joint planning of the annual DOE LLW Management Conference, to develop a comprehensive technical program on LLW PA;

and attendance by DOE LLW Program Office staff at selected NRC technical meetings. Staff is also discussing holding additional workshops on LLWPA through the NLLWMP.

Staff participated in a number of professional meetings, where topics pertaining to LLWPA were presented. Staff presented a number of papers on the development of LLWPA guidance and resolution of technical issues, and also participated in panel discussions on LLWPA at the DOE/LLW Management Conference in Phoenix, December 1 through 3, 1993, and the Waste Management '94 conference in Tucson, February 28 through March 3, 1994.

Staff helped organize and participate in a "Joint USGS-NRC Technical Workshop on Research Related to LLW Disposal," held at USGS headquarters in Reston, Virginia, from May 4 through 6, 1993. This workshop was the initial effort by NRC and USGS staffs conducted under the Memorandum of Understanding (MOU) between the two agencies. Over 60 participants from Agreement States, Federal agencies, DOE national laboratories, and private contractors meet to listen to ongoing USGS and NRC-funded research, and to discuss the technical issues involved. A USGS Water-Resources Investigations Report documenting the workshop proceedings is scheduled for publication in May 1994. Staffs from both the NRC and USGS are organizing the second joint project under the MOU, which is a special session on "Research Related to LLW Disposal," to be held at the American Geophysical Union (AGU) Meeting in Baltimore, May 23 through May 27, 1994.

Staff also organized a "Workshop on Performance and Modeling of Concrete as Engineered Barriers for LLW Disposal," in conjunction with staff at the National Institute of Standards and Technology, which was held in Gaithersburg, Maryland, from January 31 through February 2, 1994. There were more than 80 participants representing States, national laboratories, universities, consulting organizations, and representatives of five foreign countries (France, Spain, Switzerland, Great Britain, and Canada).

#### 4. Interaction with International PA Efforts

As described in SECY-92-060, staff has continued cooperation in international efforts concerning LLW disposal. The staff has participated, as a consultant to the IAEA, in the Coordinated Research Program (CRP) on the Safety Assessment of Near-Surface Radioactive Waste Disposal Facilities. The CRP is conducting test-case programs similar to NRC's. The staff and a contractor, Sandia National Laboratory, are participating in these PA modeling exercises. A consultant meeting was held from May 9 through 14, 1993, in Vienna, Austria. The meeting focused on finalizing the first test-case problem write-up and further development of the second test-case problem on LLW safety assessment for the CRP. In addition, plans were developed for a three week course for international participants in LLW PA modeling that was held at Argonne National Laboratory, February 14 through March 4, 1994. Two staff members gave one-day lectures at this training course. Several Agreement State representatives also attended this course under NRC's Agreement State training program.

As part of NRC's research information exchange activities with the French Commission de l'Energie Atomique (CEA) and the Swiss National Cooperative for the Disposal of Radioactive Waste (NAGRA), staff gave overviews of the PA program in Paris, France and Wettingen, Switzerland on October 14 and 15, 1993, respectively. At that time invitations were extended to CEA and NAGRA representatives to attend the concrete workshop discussed above.

In addition, staff members were able to visit disposal sites in Spain, France, and Germany, in FY93. Staff also provided a half-day briefing on LLWPA in a meeting with representatives from France on LLW disposal, held in Rockville, on March 31, 1993. February 14 through 18, 1994, staff discussed LLW disposal issues with representatives from the Czech and Slovak Republics and the Ukraine. The interaction during these visits, and the information on different approaches to LLW disposal and LLWPA in other countries, have proven to be very useful in evaluating domestic issues and approaches.

### 5. Resource Impacts

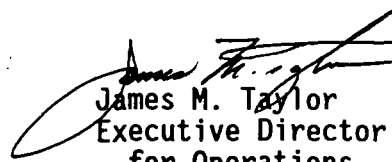
In SECY-93-060, staff provided a revised budget estimate of direct resources necessary to support Performance Assessment activities in FY93. The following data compare the budget estimate with actual staff time expended and contractor support obligations.

	FY93 Budget Estimate	FY93 <u>Actual</u>
NMSS/LLWB		
FTE	4	4.3
Contractors	\$500K	\$678K
RES/WMB		
FTE	2.8	2.8
Contractors	\$1.025M	\$1.025M

Additional resources of 0.3 FTE and \$178K were obtained from staff overtime expended and the reprogramming of FY93 funds.

In FY94, staff has budgeted resources of 3.7 FTE and \$337K for NMSS and 2.0 FTE and \$850K for RES to: (1) publish the BTP for public comment and hold a public meeting; (2) publish documentation of the test-case and ancillary analyses; (3) provide technical assistance on LLWPA to host Agreement States as requested. In addition, staff will commence some work on specific SDMP sites, to determine the applicability of the LLWPA methodology to site remediation efforts.

COORDINATION: The Office of the General Counsel (OGC) has reviewed this paper and has no legal objection.



James M. Taylor  
Executive Director  
for Operations

Enclosure: PAWG member list

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## PERFORMANCE ASSESSMENT WORKING GROUP

PERSON	SUB-MODELING GROUP	OFFC/DIV/BRANCH
Ralph Cady	Hydrology	RES/DRA/WMB
Andy Campbell	Proj. Manager, Source Term/Hydrology	NMSS/LLWM/LLWB
Chris Daily	Dose	RES/DRA/WMB
Bob Hogg	Dose	NMSS/LLWM/LLWB
Joe Kane	Engineering	NMSS/LLWM/LLWB
Jack Lentz	Hydrology	NMSS/LLWM/LLWB
Robert Lewis	Source Term	NMSS/LLWM/LLWB
Tim McCartin	Source Term	RES/DRA/WMB
Chris McKenney	Dose/Air	NMSS/LLWM/LLWB
Tom Nicholson	Hydrology	RES/DRA/WMB
Ed O'Donnell	Engineering	RES/DRA/WMB
Jake Philip	Engineering	RES/DRA/WMB
Phil Reed	Source Term/Air	RES/DRA/WMB
Fred Ross	Hydrology	NMSS/LLWM/LLWB
Bob Shewmaker	Engineering	NMSS/LLWM/LLWB
Mark Thaggard	Hydrology	NMSS/LLWM/LLWB

NOTE: Hydrology includes: Infiltration, Ground Water, Surface Water Sub-Modeling Groups

Enclosure