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**NUCLEAR REGULATORY COMMISSION**

**ADVISORY COMMITTEE ON NUCLEAR WASTE**

**Title: MEETING: 120TH ADVISORY  
COMMITTEE ON NUCLEAR WASTE  
(ACNW)**

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

JULY 27, 2000

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

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2 UNITED STATES OF AMERICA  
3 NUCLEAR REGULATORY COMMISSION

4 \*\*\*

5 ADVISORY COMMITTEE ON NUCLEAR WASTE  
6 120TH ACNW MEETING

7 \*\*\*

8  
9 Nuclear Regulatory Commission  
10 Room T2B3  
11 Two White Flint North  
12 11545 Rockville Pike  
13 Rockville, Maryland

14  
15 Thursday, July 27, 2000  
16

17 The Commission met in open session, pursuant to  
18 notice, at 8:31 a.m., THE HONORABLE DR. B. JOHN GARRICK,  
19 Chairman of the Committee, presiding.

20 MEMBERS PRESENT:

21 DR. JOHN B. GARRICK, Chairman  
22 DR. GEORGE W. HORNBERGER, Vice Chairman  
23 DR. RAYMOND G. WYMER  
24 MR. MILTON N. LEVENSON  
25

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

[8:31 a.m.]

CHAIRMAN GARRICK: Good morning. The meeting will now come to order.

This is the third day of the 120th meeting of the Advisory Committee on Nuclear Waste. This meeting will be open to the public, and today the Committee will hear an overview from the NRC Staff on the Decommissioning Program.

We will review a project by NRC's Office of Nuclear Regulatory Research on Hydrogeological Model Development and Parameter Uncertainty; continue our preparation of ACNW reports; and finally discuss matters related to the conduct of Committee activities and matters and specific issues that were not completed earlier.

Howard Larson is the Designated Federal Official for the initial portion of today's meeting. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. We have received no written statements or requests to make oral statements from members of the public regarding today's session. Should anyone wish to, please notify a member of the staff.

It is requested that each speaker use a microphone, identify themselves, and speak clearly and loudly.

We're going to hear about the Decommissioning

1 Program, as I said, but what's of great interest to the  
2 Committee today is that we're going to get an overview of  
3 the entire program. This might be the first time we've done  
4 that.

5 And Ray Wymer, the Committee Member that's our  
6 expert in this area will take the lead in the questioning  
7 and discussions.

8 DR. WYMER: Thanks, John. He has already put me  
9 on thin ice now by calling me an expert.

10 [Laughter.]

11 DR. WYMER: This is part of the meeting I have  
12 been looking forward to, actually. We're going to have a  
13 discussion, I think, of the integration of the three parts  
14 of the D&D program.

15 We've heard about the site decommissioning  
16 management plan a number of times, and we've heard about the  
17 license termination plan, and we've heard about the modeling  
18 studies, all separately.

19 Now it's my understanding that we're going to hear  
20 it in an integrated fashion, and I'm interested to see if  
21 the whole is greater than the sum of the parts, or whether  
22 the integration is really just the three parts again.

23 Bob Nelson, I think, is going to lead off here,  
24 and I trust he will introduce the succeeding speakers, so  
25 let's commence.

1 MR. NELSON: Thank you. Good morning. My name is  
2 Bob Nelson. I'm Chief of the Facilities Decommissioning  
3 Section in the Decommissioning Branch of the Division of  
4 Waste Management.

5 Joining me today in this presentation are Stu  
6 Richards, Project Director for Decommissioning, Office of  
7 Nuclear Reactor Regulation; and John Buckley of my section.

8 We welcome the opportunity to discuss the  
9 Decommissioning Program with the Committee. This briefing  
10 is intended to provide the Committee with the status of the  
11 Decommissioning Program.

12 A similar status report was provided to the  
13 Commission in SECY 00-094, dated April 25th of this year.  
14 The presentation based largely on that paper, with some  
15 added information.

16 Copies of the paper and this presentation are in  
17 the rear of the room for the members of the public.

18 The Staff will provide a briefing to the  
19 Commission on the Program on October 23rd.

20 The function of the Decommissioning Program is to  
21 regulate the decontamination and decommissioning of material  
22 and fuel cycle licensees, power reactors and non-power  
23 reactors, resulting in the ultimate goal of license  
24 termination.

25 A broad spectrum of activities is associated with

1 this program, as described in Attachment 1 to the Commission  
2 paper. In meeting the briefing objectives stated here, we  
3 will discuss each of these principal activities.

4 This slide just provides a brief summary of the  
5 Decommissioning Program that I will describe in more detail  
6 in subsequent portions of this presentation.

7 On July 21st, 1997, the NRC published its final  
8 rule on radiological criteria for license termination,  
9 commonly called the License Termination Rule as Subpart E to  
10 10 CRF Part 20.

11 NRC regulations require that materials licensees  
12 submit decommissioning plans to support decommissioning of  
13 their facility, if such is required by a license condition,  
14 or the procedures and activities necessary to carry out the  
15 decommissioning have not been approved by NRC, and these  
16 procedures could increase the potential public health and  
17 safety impacts on workers or the public.

18 NRC regulations also require that reactor  
19 licensees submit post-shutdown decommissioning activity  
20 reports, commonly referred to as PSDARs, and license  
21 termination plans for LTPs to support the decommissioning of  
22 nuclear power facilities.

23 The Staff is currently developing guidance for the  
24 Staff and for licensees to use in reviewing and developing  
25 these plans and other information submitted by licensees to

1 support decommissioning of their facilities.

2 Some of the more importance guidance documents are  
3 listed on this slide. A more complete listing is supplied  
4 in Attachment 15 to the SECY.

5 Since there are some acronyms used here on the  
6 slide, I'll point out that MARSSIM, as you are probably  
7 aware, is the Multi Agency Radiological Site Survey and  
8 Investigation Manual, and Reg Guide 1.179 is the Standard  
9 Format and Content Guide for license termination plans.

10 Material and fuel cycle decommissioning activities  
11 include regulatory oversight of the site decommissioning  
12 management plan sites and other complex decommissioning  
13 sites; implementing the Commission's direction under  
14 Directive-Setting Initiative 9, by initiating a pilot study  
15 for performing decommissioning without submittal of a  
16 decommissioning plan;

17 Undertaking license termination file reviews;  
18 performing financial assurance reviews; providing West  
19 Valley oversight; interacting with EPA and ISCORS,  
20 inspecting SDMP and other complex decommissioning sites;

21 Maintaining the computerized risk assessment and  
22 data analysis lab or CRADL; and Office of Nuclear Regulatory  
23 Research providing data and models to support performance  
24 assessments.

25 You can see that we have a rather complex program

1 encompassing those elements. We also have extensive  
2 interactions with other agencies, and some of those are  
3 listed here on the slide.

4 I'll discuss West Valley a little later in the  
5 presentation, so I won't dwell on it here. ISCORS are the  
6 Interagency Steering Committee on Radiation Standards, and  
7 we work extensively with EPA through ISCORS, principally, to  
8 resolve issues related to regulation of radionuclides.

9 This interaction is necessary to avoid unnecessary  
10 duplication of regulatory requirements. Principal ISCORS  
11 activities are carried out through its subcommittees which  
12 report back to the full ISCORS Committee at its quarterly  
13 meetings.

14 The current Subcommittees include Risk  
15 Harmonization, Mixed Waste, Recycle or Clearance,  
16 Decommissioning/Cleanup, NORM, and Sewer Reconcentration.

17 ISCORS produces an annual report, NUREG 1707. The  
18 1990 report is currently in publication and should be  
19 available soon.

20 ISCORS also maintains a website at [ISCORS.org](http://ISCORS.org) for  
21 members of the public to have access.

22 The principal activity currently going on now with  
23 the EPA is the negotiation of a Memorandum of Understanding  
24 concerning the two agencies' interaction regarding cleanup  
25 of sites. That activity is currently ongoing, and the MOU

1 has not been finalized at this point.

2 In addition, the Staff has been interfacing  
3 extensively with EPA Region I regarding the review of  
4 license termination plans submitted by Maine Yankee. We  
5 anticipate similar interactions with our review of the  
6 Connecticut Yankee Haddam Neck LTP which we have just  
7 received.

8 Similar to our support of the development of the  
9 MARSSIM or Multi Agency Radiological Survey and Site  
10 Investigation Manual, we are participating in an interagency  
11 working group that is developing MARLAP, or the Multi Agency  
12 Laboratory Accreditation Program.

13 Finally, we routinely work with various state  
14 public health and safety organizations, other federal  
15 agencies, and tribal organizations in conjunction with our  
16 safety and environmental reviews of decommissioning plans,  
17 license termination plans, and other license submittals.

18 I'd like to introduce John Buckley, who will  
19 discuss our oversight of SDMP and complex decommissioning  
20 cases and our terminated license review. John?

21 MR. BUCKLEY: Thanks, Bob. Good morning. My name  
22 is John Buckley.

23 As Bob mentioned earlier, one of the main  
24 activities in materials decommissioning is oversight of the  
25 SDMP and otherwise complex decommissioning sites programs.

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1           As indicated on Slide 7, there are currently 29  
2 SDMP sites or complex sites; 26 of those 29 are actually  
3 SDMP sites; three are complex decommissioning sites.

4           Twenty-three of the 29 sites have already  
5 submitted decommissioning plans. The Staff has reviewed and  
6 approved 13 of the 23 decommissioning plans which we have  
7 received. Of the 29 sites, the Staff expects that by the  
8 time we get all DPs in hand, 11 of the sites will request  
9 restricted release.

10           DR. WYMER: These are all reactors?

11           MR. BUCKLEY: No, these are material and fuel  
12 cycle facilities.

13           And 11 of the 29 current sites may be transferred  
14 to Agreement States by the Year 2002. One site will go to  
15 Minnesota, possibly, and ten to Pennsylvania. To date, the  
16 Staff has removed 31 sites from the SDMP.

17           Detailed information on the current 29 sites in  
18 presented in Attachments 3, 4, 5, and 7 of the Commission  
19 paper, so if you need additional information, that's the  
20 place to look.

21           In 1990 the staff began a review of all previously  
22 terminated license files to assure that the licenses were  
23 properly terminated and that the sites posed no threat to  
24 public health and safety or the environment.

25           NRC contracted with Oak Ridge National Laboratory

1 to conduct this review. Oak Ridge reviewed approximately  
2 37,000 terminated license files.

3 Of the 37,000 files reviewed, regional inspectors  
4 have verified that 38 sites are contaminated with limits  
5 above the unrestricted release limits. A listing of the  
6 contaminated sites and their decommissioning status is  
7 presented in Attachment 6 of SECY-94.

8 The regions have almost completed their review of  
9 all the terminated license sites. Approximately 120 sites  
10 are left for review by the regions. Of those, 29 are loose  
11 material sites and approximately 92 are sealed source sites.

12 I will turn this presentation back over to Bob.

13 MR. NELSON: Do you have any questions on those  
14 two slides before we move on?

15 DR. WYMER: How many reactors are there, just the  
16 two that are --

17 MR. NELSON: We will get into those.

18 MR. BUCKLEY: The reactors come later. This is  
19 just the materials.

20 DR. WYMER: Okay.

21 DR. HORNBERGER: What is a loose material site?

22 MR. BUCKLEY: I'm sorry?

23 DR. HORNBERGER: Loose material.

24 MR. BUCKLEY: It is a nonsealed source. Anything  
25 -- everything not a sealed source is a loose material.

1 DR. CAMPBELL: I have a question. What was the  
2 release limit you used, is it the new LTR 25 millirem limit?  
3 In other words, did they do an analysis of these 38 sites to  
4 determine that they exceed 25 millirem? This says above  
5 unrestricted release limit. The unrestricted release limit  
6 is 25 millirem.

7 MR. BUCKLEY: But it has changed. So some of  
8 these sites were released prior to --

9 DR. CAMPBELL: So this is the old standard.

10 MR. BUCKLEY: Some are under the old standard,  
11 some are under the new standard. Attachment, if you look at  
12 Attachment 3, it will provide you an indication of which  
13 criteria is being used.

14 MR. NELSON: To the SECY, Attachment 3.

15 MR. BUCKLEY: Correct.

16 MR. NELSON: To the SECY.

17 DR. CAMPBELL: So some of them, they actually did  
18 assessments and determined that the amount of material on  
19 the site would exceeded 25 millirem?

20 MR. BUCKLEY: Correct.

21 DR. CAMPBELL: And then some of them you used so  
22 many picocuries per gram contamination levels that were the  
23 old standard?

24 MR. BUCKLEY: Correct.

25 DR. HORNBERGER: And the sites with 25 millirem,

1 these were basically field surveys that demonstrated that  
2 they exceed, or was it a computation?

3 MR. BUCKLEY: I think what the regions did, and I  
4 don't want to speak for them, but they went out and did  
5 field surveys. If they found something that looked like it  
6 was beyond twice, three times background, then they flagged  
7 it.

8 MR. NELSON: Any other questions before we move  
9 on?

10 [No response.]

11 MR. NELSON: The staff continues to implement the  
12 Commission's direction under Direction Setting Issue for  
13 DSI-9. There are three facilities currently in the pilot  
14 program, as identified on this slide. The purpose of the  
15 pilot program was to look at, exam the feasibility of  
16 licensees performing decommissioning without a prior  
17 approved decommissioning plan.

18 The pilot study was approved by the Commission in  
19 a staff requirements memorandum dated June 30th, 1998. We  
20 last reported to the Commission on this topic in  
21 SECY-99-160, dated June 22nd, 1999.

22 We plan to meet with each of these licensees this  
23 fall to determine how well they have done, where they are in  
24 their cleanup and what lessons we could learn from this  
25 activity, and provided a status report to the Commission in

1 January.

2 For example, the first site, the Westinghouse pump  
3 repair facility in Cheswick, is nearing completion of its  
4 activities, and they plan to submit a final survey report  
5 and request for release of portions of their site very soon.  
6 The other sites, I don't have a current status on, but we  
7 will be getting that as we move towards our fall meeting.

8 Another aspect of our decommissioning program is  
9 review of financial assurance. The staff routinely reviews  
10 financial assurance submittals for materials and fuel cycle  
11 facilities and maintains a financial assurance instrument  
12 security program. This entails review of decommissioning  
13 cost estimates, as well as the financial assurance  
14 instrument, whether it be a letter of credit, a standby  
15 trust agreement, et cetera, to verify that the instrument  
16 meets our requirements, could be executed if necessary, and  
17 that the cost estimate is reasonable for the activities  
18 anticipated. Routinely, between 40 and 60 financial  
19 assurance submittals are reviewed each year.

20 Also, under this area we are consolidating our  
21 financial assurance guidance which has consisted of a  
22 standard format and content guide, Reg. Guide 3.66, and a  
23 Standard Review Plan for decommissioning financial assurance  
24 submittals, NUREG-1337. The consolidation of these  
25 documents will be into our new decommissioning Standard

1 Review Plan so that we have fewer guidance, individual  
2 guidance documents on the street, and most of the guidance  
3 will be contained within the Standard Review Plan, a module  
4 and an appendix to that plan, that we briefed you on, I  
5 believe earlier in the year.

6 NRC's decommissioning responsibilities for the  
7 West Valley Demonstration Project and the West Valley site  
8 are specified under the West Valley Demonstration Project  
9 Act. Presently this activity includes prescribing  
10 decontamination and decommissioning criteria, reviewing  
11 draft portions of the EIS for decommissioning, and closure  
12 of the site, reviewing safety analysis reports prepared by  
13 DOE, and performing periodic onsite monitoring of project  
14 activities and records to assure radiological health and  
15 safety.

16 The Commission's draft policy statement regarding  
17 decommissioning criteria for the West Valley Demonstration  
18 Project and the West Valley site was issued in December 1999  
19 for public comment. The draft policy statement specified  
20 NRC's license termination rule as decommissioning criteria.  
21 We are currently reviewing comments received both from a  
22 public meeting, as well as written comments, and are  
23 preparing a follow-on submittal to the Commission.

24 It is currently the staff's plan to brief you in  
25 more depth on this in your October meeting, at which time we

1 will have prepared a submittal to the Commission. We will  
2 discuss that with you at that time.

3 In addition, we have developed a Commission paper  
4 on stakeholder involvement, because of the many stakeholders  
5 and complexities of that activity, and that is currently in  
6 its final stages of management review. It should be going  
7 to the Commission shortly as an information paper.

8 The Office of Nuclear Regulatory Research  
9 continues to provide data and models to NMSS to support  
10 assessments of public exposure to environmental releases of  
11 radioactive material from site decommissioning.

12 Research has provided NMSS with data on  
13 radionuclide solubilities that will be used to assess  
14 releases from ore-processing slag; data on degradation of  
15 archeological slags that will be used to assess the  
16 long-term performance of slags as a source of radioactive  
17 contamination.

18 As you may be aware, many of our SDMP sites  
19 processed ore containing radioactive material, and as a  
20 result have large amounts of contaminated slag onsite.

21 We will also produce guidance on characterization  
22 of decommissioning sites containing these slags, and provide  
23 documentation on unsaturated zone monitoring strategies for  
24 use in review of monitoring proposals for licensing actions  
25 concerning decommissioning and waste disposal facilities in

1       unsaturated media.

2                 We assisted in the development of technical bases  
3       to support selection of site-specific parameter values for  
4       estimating flux and transport in dose assessment codes.

5                 We are developing a probabilistic version of the  
6       computer code, RESRAD, and modification of the Sandia  
7       decision support system to allow multidimensional  
8       groundwater pathway analyses.

9                 Now, I'm going to move into the reactor  
10       decommissioning area, and I'll provide an overview of the  
11       NMSS involvement, and then I will turn this presentation  
12       over to Stu Richards, who will discuss NRR activities.

13                 From the NMSS side, reactor decommissioning  
14       includes our project management of technical review  
15       responsibility for decommissioning two power reactors. NRR  
16       has project management and licensing oversight for 17  
17       decommissioning reactor facilities.

18                 The program also includes implementation of the  
19       plan developed in response to Commission Direction-Setting  
20       Initiative Number 24; development of standardized technical  
21       specifications for decommissioning; conduct of core  
22       inspections and project management for all licensed,  
23       non-power reactors.

24                 NMSS has project management and technical review  
25       responsibility for the Firm I and Peach Bottom Unit I power

1 reactors; NRR has project managing and licensing oversight  
2 for 17 power plants that have either submitted DPs or their  
3 equivalent, or PSDARS.

4 We have Attachment 11 and 12 to the SECY paper  
5 which provide status information on each of these plants.

6 The NMSS principal activities in support of  
7 reactor decommissioning are summarized on this slide.

8 [Pause.]

9 Technical reviews of license termination plans are  
10 currently underway for Maine Yankee, Trojan, and Saxton. An  
11 acceptance review is in progress for the Connecticut Yankee  
12 license termination plan.

13 NMSS has supported public meetings for the first  
14 three, and will provide similar support for Connecticut  
15 Yankee.

16 In addition, we will be conducting confirmatory  
17 radiological surveys at these plants in support of the  
18 license termination process. Such surveys are currently  
19 scheduled in August for the Maine Yankee and Trojan plants.

20 Project management responsibilities for the Peach  
21 Bottom and Fermi plants for NMSS have been limited to  
22 processing minor amendment requests. It currently does not  
23 represent a major workload for us.

24 In the guidance development area, NMSS has  
25 recently published -- finalized and published NUREG 1700,

1 the Standard Review Plan for License Termination Plans, and  
2 we are supporting NRR in development of a variety of  
3 guidance documents related to decommissioning.

4 Are there any questions on that before I turn the  
5 presentation over to Stu Richards?

6 [No response.]

7 MR. RICHARDS: Good morning. Can you hear me all  
8 right? I'm Stu Richards. I'm the NRR Branch Chief  
9 responsible for the decommissioning power reactors. I'm  
10 also responsible for the operating reactors in Region IV.

11 I'd like to talk a little bit about what NRR does,  
12 and hopefully clarify this integration function here. Just  
13 a little bit of background:

14 When a power reactor shuts down -- well, let me  
15 back up. The rules are written for reactors to shut down  
16 with some forewarning, so the rules are written such that a  
17 plant enters the normal end of life but recognize they're  
18 going to go through decommissioning, and they have time to  
19 plan for it, and go through a normal process.

20 Unfortunately, virtually all the reactors that are  
21 presently in decommissioning, didn't get there that way.  
22 They found themselves in some kind of a problem and ended up  
23 going into decommissioning on fairly short notice. So  
24 there's a little bit of a disconnect between the experience  
25 we've had to date and the way it's supposed to really

1 happen.

2           Hopefully that will change in the future, but when  
3 a plant does enter the decommissioning phase of operation,  
4 the first thing they want to do is, they want to make the  
5 transition from an operating facility to a decommissioning  
6 facility.

7           And that is primarily NRR's role in the  
8 decommissioning activities. We have the front end, we take  
9 the plant from an operating unit into decommissioning, and  
10 really NMSS has got the back end when it comes time to  
11 terminate the license and determine what to do with the rad  
12 waste. That's their end of the business, and there's a lot  
13 of work in between where I think we both do a lot of work  
14 together. So I spend a lot of time talking to Larry Camper  
15 and Bob Nelson, and we actually are, I think, pretty well  
16 integrated.

17           There is a lot of transition right now in the  
18 decommissioning world. And I'll try and give you a little  
19 flavor of what's going on, and then hopefully answer your  
20 questions.

21           Again, the primary interest of plants that enter  
22 decommissioning is to get rid of all those operating reactor  
23 rules that apply, because, you know, when they shut down,  
24 they still have a full Part 50 license that applies to that  
25 facility.

1           The way it has worked in the past is that  
2 licensees have had to come in to NRR and request amendments  
3 to their tech specs or to get exemptions from the Part 50  
4 requirements that they don't think should apply to a  
5 decommissioning plant. That entails a lot of paperwork and  
6 analysis on their part, and also takes up a lot of the  
7 Staff's time to review all that work and to issue approvals.

8           We've been doing that on a site-by-site,  
9 case-by-case basis, so it's quite work-intensive.

10           About a year ago or year and a half ago, we  
11 thought, hey, it's time to stop trying to do that. Let's  
12 look at putting together what we call the integrated  
13 rulemaking and try and put together a process where plants  
14 can go through that phase and get relief from operating  
15 reactor requirements without having to provide us with  
16 paperwork and analysis and without us having to review it;  
17 just put it in the regulations.

18           In order to take that step, we felt we needed a  
19 single, solid technical basis for backing up these  
20 regulatory changes. So we put together a technical working  
21 group to take a look specifically at the risks of storing  
22 spent fuel onsite in the spent fuel pool.

23           And that study has been going on now for a little  
24 over a year. That group came out with a draft report early  
25 this year. We got comments back from the ACRS, from a

1 number of public stakeholders, and from the industry, and  
2 those comments are trying to be resolved with a date of  
3 August the 31st to come out with the final risk report.

4 But the idea here is that the primary event of  
5 consideration is the zirconium fire in the spent fuel pool.  
6 If somehow you drain all the water out and you get the fuel  
7 to start to burn, you have a very significant event, because  
8 you don't have a containment building; you can have multiple  
9 cores; you have a real problem.

10 On the other hand, the probability of that event  
11 occurring is very, very, very small. The draft report said  
12 it was less than three times ten to the minus six; at this  
13 point we can't say that's incredible and take it off the  
14 table, but it's pretty close to that.

15 So, at any rate, that's a little bit of background  
16 on what we're doing. The integrated rulemaking, the slide  
17 lists the five areas we're looking at.

18 What we did is, we picked out three or four of  
19 these areas as areas where the industry felt they could get  
20 immediate financial relief, if we could do something to make  
21 that transition easier for them.

22 Emergency preparedness, safeguards, and insurance,  
23 cost the industry a lot of money, and they feel that when  
24 they shut the plant down, they should no longer have to meet  
25 the operating reactor requirements that incur those

1 expenses.

2           So we're taking a hard look at those three. The  
3 backfit, if you go to the backfit rule for decommissioning  
4 plants -- or, actually, the backfit rule, period -- it's  
5 really written for operating reactors, and if you put on a  
6 legal hat, you could say this rule doesn't apply to  
7 decommissioning plants; it's not written that way.

8           Decommissioning plants felt like they should have  
9 the same protections as an operating reactor on the backfit  
10 rule, and the Commission told us to treat them the same, and  
11 then when we get around to it, to put into the rule, so  
12 that's why that's there.

13           And then operator training and staffing, again,  
14 when a plant shuts down, they still have all the training  
15 programs and staffing requirements of a Part 50 license.  
16 You know, they want to get away from that, they want to  
17 transition to the minimum staffing they need in order to  
18 basically maintain the spent fuel pool.

19           So, we have put together a rulemaking plan. We  
20 submitted that to the Commission at the end of June. That  
21 is SECY 001-45, I believe. That paper is now public,  
22 although the Commission has not voted on it.

23           We asked specifically that we be allowed to  
24 release it to the public in order to get prompt feedback.  
25 So we are waiting for direction from the Commission on how

1 to proceed on that.

2           The second major bullet on the slide talks about  
3 regulatory improvements, and what we're talking about here  
4 is, beyond the first five issues that we were looking at, we  
5 wanted to -- or we proposed to the Commission to take a look  
6 at all regulations in Part 50 that apply to decommissioning  
7 reactors, and our proposal is to modify all those  
8 regulations in some form so that we have one section of the  
9 regulations that applies to decommissioning plants.

10           As it presently stands, you know, you're searching  
11 through Part 50, trying to figure out, hey, what in here  
12 applies to me now that I'm shut down? So we thought that it  
13 would be proper to try and bring those altogether into one  
14 place.

15           We owe the Commission more information on that by  
16 September 15th of this year, and there's a resource issue  
17 there of whether that's the right approach to take.

18           The industry has a different view on these two  
19 items. They have recently come in with a letter to us that  
20 said we think you ought to do this in one shot, just put it  
21 into one rulemaking, and they felt that we could do the  
22 whole thing in 24 months.

23           Personally, I disagree with that. I think that's  
24 unrealistic to think that we can overhaul all the  
25 decommissioning regulations in 24 months.

1           And I feel that, you know, if you take that route,  
2 you end up with everything being held hostage to whatever  
3 the one hardest issue is.

4           So we had a workshop earlier this week with the  
5 industry out on the West Coast and challenged them to make  
6 sure they are asking for what they really want because if  
7 they want it as one package it is likely to drag on longer  
8 than 24 months.

9           On the other hand, there are no reactors right now  
10 that appear to be entering the decommissioning phase, so you  
11 can argue that what is the rush?

12           The next bullet talks about the generic  
13 Environmental Impact Statement for decommissioning. That  
14 was last done in 1988 and we are doing an update on that.  
15 We are working closely with the Environmental Protection  
16 Agency and the industry. I might note that specifically  
17 this update is going to consider entombment, rubblelization,  
18 and partial site release, which is selling off pieces of  
19 land before the plant actually enters the decommissioning  
20 phase, or the final license termination phase.

21           We are also responsible for guidance documents.  
22 Bob talked about some of the ones that NMSS is doing. We  
23 provide guidance documents for the post-shutdown  
24 decommissioning activities report.

25           When a plant enters the decommissioning phase one

1 of the first things they are required to do is to put  
2 together this overview document that describes what they  
3 intend to do in the future as far as decommissioning the  
4 facility. We also provide guidance to the inspectors. It  
5 talks about a handbook for the inspectors that we are  
6 putting together and various NUREGs.

7 One I would like to mention is that we do put  
8 together a Frequently Asked Questions NUREG that we find to  
9 be very helpful. We have a lot of public meetings and it is  
10 nice to be able to hand out a book that says, hey, here's a  
11 lot of the questions you might ask and has the answers in  
12 it.

13 We are also responsible for the Decommissioning  
14 Inspection Program while the facility is under the  
15 responsibility of NRR and work with the regions to define  
16 that program to make sure it is implemented properly.

17 Bob mentioned it before, but just to make sure it  
18 is clear, we have a memorandum of understanding between NRR  
19 and NMSS and what it says is that NRR is the Project Manager  
20 for the facility until all the fuel is out of the spent fuel  
21 pool. When it goes to either offsite, which right now it  
22 isn't doing, or it goes to dry storage, at that point NRR  
23 transfers responsibility for project management to NMSS, so  
24 again on the big picture we are primarily concerned with the  
25 facility entering decommissioning and making that transition

1 to truly a decommissioning facility, getting them through  
2 the changes in the tech specs and the regulations.

3 NMSS of course is focused on what to do with the  
4 waste, final surveys and license termination. There is a  
5 lot of overlap there and we do spend a lot of time talking  
6 together about it.

7 Flipping on to the next slide, the next slide  
8 is really just a status of facilities, the power reactor  
9 facilities that have entered decommissioning, twenty-one  
10 reactors between 1963 and 1998. Two have completed decon  
11 and dismantlement. That's Fort St. Vrain and Shoreham. We  
12 have got six that are undergoing active decon and  
13 dismantlement, nine that have chosen the safe store route  
14 where they are going to let the facility sit for awhile  
15 before they decide what to do with it, and we have four  
16 facilities that have a combination of storage and then  
17 decontamination and dismantlement.

18 That completes the two slides I have.

19 DR. WYMER: What actually constitutes going into  
20 decommissioning? If two have completed decon and  
21 dismantlement and if Maine Yankee is now coming in to talk  
22 to you about the two, are they not entering decommissioning?  
23 What does that mean?

24 MR. RICHARDS: Well, the two are the two that have  
25 had their licenses terminated.

1 DR. WYMER: That's already done. Okay.

2 MR. RICHARDS: The six -- let me back up to the  
3 options. You can -- when you shut the facility down you can  
4 enter SAFESTOR, basically bottle the facility up and let it  
5 sit, you have to complete the process within 60 years, or  
6 you can enter direct and active decon and dismantlement of  
7 the facility, such as Maine Yankee is doing.

8 DR. WYMER: That isn't entering decommissioning?

9 MR. RICHARDS: Yes, that is. All of these are  
10 entering decommissioning.

11 DR. WYMER: Oh, I thought you said earlier none  
12 were entering decommissioning.

13 MR. RICHARDS: No, no, no, no. I'm sorry.

14 DR. WYMER: Oh -- no new ones. Okay.

15 MR. RICHARDS: This is a summary of these 21  
16 reactors. The idea here is we have got some that shut down  
17 and enter decommissioning, active decommissioning, taking  
18 the facility apart right away.

19 We have got a number of facilities that shut down  
20 and elected to put the plant into a SAFESTOR condition.

21 DR. WYMER: Okay.

22 MR. RICHARDS: And we have got some that have a  
23 combination of both.

24 DR. WYMER: I thought I heard you say no reactors  
25 are entering the decommissioning phase.

1 MR. RICHARDS: No, I'm sorry, I meant no new  
2 reactors are on the horizon. We don't have any reactors  
3 right now that are operating that we know are scheduled to  
4 enter decommissioning.

5 DR. WYMER: Okay.

6 MR. RICHARDS: That is because of the deregulation  
7 of the industry and I think the license renewal and the  
8 purchase of facilities.

9 DR. WYMER: Okay, my apologies.

10 CHAIRMAN GARRICK: Isn't the whole issue of the  
11 schedule for a repository and the success of dry cask  
12 storage, for example, going to have a major impact on what  
13 constitutes decommissioning and the transition, say, between  
14 NRR and NMSS?

15 Well, supposing Yucca Mountain doesn't come about  
16 and simultaneously that dry cask storage works out to the  
17 satisfaction of everybody and the public picks up on this as  
18 the solution, at least for the time being, and the time  
19 being could be 100 years or so -- that would change things a  
20 whole lot, would it not?

21 MR. RICHARDS: Well, actually, right now I think  
22 both the industry and the NRC are carrying out their  
23 business based on the assumption that facilities are going  
24 to use the dry cask storage option simply because even I  
25 guess on the present schedule Yucca Mountain is pretty far

1 out in the future.

2 CHAIRMAN GARRICK: Yes.

3 MR. RICHARDS: There are a large number of  
4 operating reactors that already have dry storage. There are  
5 a number of decommissioning plants that either have it or  
6 are moving in that direction. There seems to be a  
7 recognition that if you want to get on with decommissioning,  
8 the thing to do is to license a dry storage facility under  
9 Part 72 and then just decommission the rest of your facility  
10 and get rid of the Part 50 license so all you have left is a  
11 dry storage ISFSI facility with maybe a very small staff of  
12 people care of it, and, you know, I am just speculating that  
13 it appears --

14 CHAIRMAN GARRICK: What if somebody comes along  
15 and says, look, since we are in a dry cask storage mode and  
16 we have fuel onsite, we would like to take advantage of the  
17 fact that this is a high level waste storage site and store  
18 other kinds of waste onsite that would be beyond the 25 MR.  
19 Are these kinds of proposals feasible?

20 MR. RICHARDS: If there is somebody here from the  
21 Spent Fuel Project Office, it might be best for them to  
22 answer, but I know there's facilities that are planning on  
23 storing the greater than Class C waste --

24 CHAIRMAN GARRICK: Right.

25 MR. RICHARDS: -- in dry storage casks with the

1 spent fuel actually.

2 CHAIRMAN GARRICK: Right.

3 MR. RICHARDS: As far as the low level waste, in  
4 order to terminate the license, they have to get that  
5 material offsite and meet the 25 millirem ALARA criteria, so  
6 again in order to terminate your Part 50 license you have to  
7 decontaminate, remediate the site to that license  
8 termination rule criteria, but you can rid of the Part 50  
9 license and still have your dry storage over here separate.

10 CHAIRMAN GARRICK: I guess what I am asking is a  
11 realistic appraisal of the situation. Does it suggest that  
12 quite possibly a lot of these will not get out from under  
13 Part 50?

14 MR. RICHARDS: Well, they have that option. They  
15 can still --

16 CHAIRMAN GARRICK: But you don't have a sense of  
17 how this might play out as far as --

18 MR. RICHARDS: Right now I think most facilities  
19 plan to go dry storage with a Part 72 license that are in  
20 active decommissioning, trying to terminate their license.

21 They are going to decontaminate the site to the  
22 license termination rule criteria, terminate the Part 50  
23 license, and you will be left with dry storage under Part  
24 72. I think that is what they are doing.

25 Larry, am I wrong on that?

1 MR. CAMPER: No, I think you are right. There are  
2 also economic incentives to do that too, because of the  
3 different categories of licensing.

4 I mean one of the things that prompts a movement  
5 from an operating facility to a facility in decommissioning  
6 is a categorical change in licensing fee, so that is clearly  
7 a motivator.

8 As Stu has said, the trend is a movement toward  
9 isolated storage onsite because of the high level waste  
10 repository problem. There will be probably a storage of  
11 greater than Class C but beyond that, no.

12 I think frankly any movement or any move by the  
13 industry to store waste other than that or to collect waste  
14 from other sites would probably not -- certainly would not  
15 be met with political receptivity and would pose a number of  
16 challenges for us as well.

17 I think what you are seeing now is what you are  
18 going to see for the foreseeable future.

19 The other thing that is interesting too, and as  
20 Stu mentioned, we just came back from a conference at NEI  
21 out on the West Coast, and there was a time when we were  
22 anticipating more reactors moving into decommissioning than  
23 we are. We can see, of the ones listed up here, we can see  
24 four more out there coming -- Humboldt Bay, SONGS I, Yankee  
25 Rowe coming back, and Big Rock Point. Those are the ones we

1 look out and project that might be coming along in terms of  
2 staff work for decommissioning per se.

3 CHAIRMAN GARRICK: That is the big thing that's  
4 changed over the last couple of years --

5 MR. CAMPER: Exactly.

6 CHAIRMAN GARRICK: -- is that license renewal  
7 expectation has gone from 4 or 5 percent up to maybe 80  
8 percent or 85 percent.

9 MR. CAMPER: Absolutely and of course the industry  
10 is very excited about that, as you might expect.

11 CHAIRMAN GARRICK: Right.

12 MR. CAMPER: But I think what you are seeing now  
13 is what you are going to see certainly for the foreseeable  
14 future in terms of how isolated storage is being handled.

15 The Yucca Mountain Repository question, you know,  
16 who knows?

17 CHAIRMAN GARRICK: Okay. Thank you.

18 MR. LEVENSON: Can I ask a somewhat general  
19 question, since we are on the idea that you have a crystal  
20 ball and can look ahead?

21 Do you have any perception -- the U.S. is spending  
22 a fair amount of money to subsidize silo storage of spent  
23 fuel in the former Soviet Union countries as something that  
24 is significantly cheaper than dry cask storage.

25 Do you have any perception that might be coming

1 into the U.S. picture?

2 It initiated here. It's what has been done at the  
3 EBR-2 Reactor for 30 years.

4 MR. CAMPER: I can't comment on that. I don't  
5 know enough about that trend to comment whether that will  
6 ever materialize.

7 MR. LEVENSON: You have heard no discussions?

8 MR. CAMPER: No, I am not aware of any.

9 MR. NELSON: I apologize for not introducing my  
10 Branch Chief, Larry Camper, Chief of the Decommissioning  
11 Branch, Division of Waste Management.

12 MR. CAMPER: We know each other.

13 [Laughter.]

14 MR. NELSON: Moving on, as a result of our recent  
15 organization, NMSS Environmental Review responsibilities  
16 fall under the Environmental and Performance Assessment  
17 Branch of the Division of Waste Management. However, those  
18 activities are budgeted under the decommissioning program,  
19 so I am including them here to provide a complete  
20 description of our budgeted program.

21 The activities in the environmental review area  
22 include preparation and review of Environmental Impact  
23 Statements, or EISSs, review of Environmental Assessments  
24 prepared by the Staff.

25 Presently it is estimated that EISSs will be

1 prepared for the following SDMP and complex decommissioning  
2 sites -- the U.S. Army Jefferson Proving Ground; Dow  
3 Chemical Company; SCA Services; Michigan Department of  
4 Natural Resources; Mallinckrodt Chemical; Shield Alloy  
5 Metallurgical Corporation; Fan Steel; Kaiser Aluminum;  
6 Sequoyah Fuels Corporation; the Babcock & Wilcox Shallow  
7 Land Disposal Area; The Moly Corp., Incorporated Washington,  
8 Pennsylvania facility; and Whitaker Corporation.

9 Three of these have already submitted  
10 decommissioning plans for restricted release. They are Fan  
11 Steel, Sequoyah Fuels, and Moly Corp Washington.

12 It is our practice to develop an EIS for all  
13 restricted release submittals.

14 The others that I mentioned we anticipate either  
15 are or may submit a decommissioning plan calling for  
16 restricted release.

17 The Branch will also prepare an EIS -- I should  
18 say that of the three -- Fan Steel, Sequoyah Fuels, and Moly  
19 Corp. Washington -- the Sequoyah Fuels' EIS is under  
20 development, the draft EIS.

21 The Branch will also prepare an Environmental  
22 Impact Statement for the West Valley site.

23 Environmental assessments must be prepared for  
24 most other licensing actions including approval of DPs  
25 involving unrestricted release for SDMP and complex

1 decommissioning sites.

2           The Environmental and Performance Assessment  
3 Branch reviews all the EAs that we develop.

4           That's all I plan on saying about that activity.  
5 Are there any questions in that area?

6           DR. WYMER: Just a comment. There is going to be  
7 an awful lot of restricted release sites around the country,  
8 and mostly it is the horizon that you can see to is 100 or  
9 200 years, something like that. And the question comes up  
10 of, how about after that, you know? What sort of plans or  
11 safeguards or what is in place to make sure -- I know that  
12 you have financial assurance considerations and you have  
13 various governmental involvements that have to be in place,  
14 if that is appropriate? But, still, the horizon seems close  
15 compared to the duration of the risk. Can you say anything  
16 about how comfortable you feel about that or what -- how it  
17 is handled?

18           MR. NELSON: Well, we are just -- restricted  
19 release is certainly a new approach to decommissioning. We  
20 haven't done a restricted release, completed a restricted  
21 release approval under the License Termination Rule. So, in  
22 some respects, we are learning as we go.

23           I need to point, though, restricted release is  
24 that. Our regulatory oversight would cease at the time we  
25 terminated the license. So there would not be, for example,

1 inspections. There would not be reports from the licensee  
2 to us for review. We would have to be satisfied that the  
3 licensee's plan for restricted release met all of our  
4 requirements and that we could -- and met the License  
5 Termination Rule such that we could cease regulatory  
6 oversight of the site.

7 DR. WYMER: That is the crux of the problem right  
8 there. How do you make yourself comfortable with the fact  
9 that everything has got to be okay after you turn it loose?

10 MR. NELSON: Well, to some extent the same way we  
11 -- to some extent, exactly the same way we do for  
12 unrestricted release. The dose limit is different but we  
13 still have to do a very similar assessment for restricted  
14 release. Of course, there are differences, but the  
15 similarities are that we have to do -- we have to assess the  
16 dose assessment performed by the licensee and conclude that  
17 the resulting dose is a reasonable estimate of the dose.  
18 Whether that is above 25 or below 25, the analysis approach  
19 is largely the same.

20 The real difference that we need to look at are  
21 the institutional controls and financial assurance that are  
22 put in place to keep the dose under 25. That is the big  
23 difference. We haven't reviewed one of those before. And  
24 so we have developed some guidance in the Standard Review  
25 Plan, but that is going to be a significant area of our

1 review. In fact, we believe it is so significant that we  
2 will focus our review for those cases on financial assurance  
3 and institutional controls before we begin the technical  
4 review.

5 We plan to do a phased review for restricted  
6 releases so that we can satisfy ourselves that those  
7 requirements, that we have some confidence that those  
8 requirements were met before we go into a significant  
9 expenditure for technical review.

10 I don't know if I can get more specific on what we  
11 were looking for in a -- I think that the real, I don't  
12 think is as much the cost estimate. I think we can  
13 reasonably estimate cost. The question is, what mechanisms  
14 would we authorize other than, say, a transfer to DOE for  
15 long-term oversight? What other mechanisms might we  
16 consider for institutional control?

17 MR. LARSON: That is on our agenda for October.

18 MR. NELSON: Yes.

19 MR. LARSON: And you can get a sense of Ray's  
20 interest in this topic.

21 MR. NELSON: Larry.

22 MR. CAMPER: Let me just add one thing to that. I  
23 was going to comment on this later. Getting back to your  
24 question about the integration of all these activities. We  
25 have the restricted release scenario in the regulations, and

1 it requires certain criteria, long-term durable controls,  
2 responsible third parties and things of this nature, as well  
3 as design considerations that go out beyond the timeframe  
4 that you were mentioning. But in all of this, what is  
5 emerging for us, we think is a big problem is finding, is  
6 for these licensees to identify a responsible third party  
7 that will be in this for the long haul.

8 As a result of that, the staff is working on two  
9 things. One is we have had previously, and are currently  
10 finalizing working arrangements with the Department of  
11 Energy where DOE would be a cooperating agency on the  
12 Environmental Impact Statements for these restricted release  
13 scenarios. That is something that there were some exchanges  
14 that went on between the two agencies back two or three  
15 years ago. Now, some of these sites, Sequoyah Fuels, for  
16 example, is at a point where it is time for the DOE to  
17 emerge in that role. We are working that issue.

18 But, secondly, and more importantly, and I think  
19 this kind of gets back to your integration comment really,  
20 one of the largest challenges we face in decommissioning is  
21 to ensure that we find viable third parties that will  
22 oversee these sites for the long haul. We are finding that  
23 while the regulations currently have what we think is a very  
24 good mechanism in terms of institutional controls defined  
25 within them, for licensees to find a responsible third party

1 to step up, whether it be a state government, a local  
2 government or even a private entity is problematic. And,  
3 therefore, we have grave concerns, as I think I pick up from  
4 your question as to, what can do this in terms of long-term  
5 stewardship?

6 There is a mechanism under 151(b) of the '82 Act,  
7 the Nuclear Waste Policy Act, that allows sites to be  
8 transferred to DOE. We will be talking more about that in  
9 your October meeting. But we are starting to --

10 DR. WYMER: Transferring to DOE doesn't --

11 MR. CAMPER: I'm sorry?

12 DR. WYMER: Transferring to DOE doesn't change the  
13 nature of the problem at all, it just gets it out of your  
14 backyard.

15 MR. CAMPER: Well, what it does do, though, is it  
16 provides a mechanism for long-term stewardship. I mean I  
17 think our regulations, in terms of the dose criteria, the  
18 requirements that have to be in place for a restricted  
19 release scenario to occur, are sound. The issue I think,  
20 though, is who will be that third party for the long haul?

21 DR. WYMER: Yes.

22 MR. CAMPER: DOE, of course, is structured to do  
23 that. They have the infrastructure, and they have a  
24 stewardship program that would seem to be ideal.

25 DR. WYMER: It is embryonic at the moment, but

1 they do have one.

2 MR. CAMPER: Right. So, we think that that is a  
3 pathway that needs to be explored more aggressive with DOE.  
4 And the staff has had a number of management level  
5 discussions with DOE managers about that. There will be  
6 communications that will take place between the two  
7 organizations in the near future. So that is an area where  
8 we think, in terms of the big picture, and the overall  
9 integration of activities, that is a key part of that  
10 puzzle.

11 DR. WYMER: That helps. Thanks.

12 MR. LEVENSON: Let me just ask a nit question  
13 about that. Is it to DOE or is it to the legal entity of  
14 the federal government, since there's motions afoot to  
15 dismantle DOE?

16 MR. CAMPER: Well, I wouldn't begin to comment on  
17 what is going to happen DOE as far as anything of  
18 dismantlement. I can only tell you that right now, we are  
19 working to solve and make sure that the institutional  
20 controls, you know, methodology currently set forth in our  
21 regulation, the LTR, that DOE seems at this point in time,  
22 under its stewardship program, to be a viable pathway.

23 Now, there are conditions for those transfers.  
24 And I dare say that DOE will be concerned that all those  
25 conditions are met, no cost to the government, for example,

1 on those conditions. But as far as the long-term prognosis  
2 for DOE, I couldn't --

3 MR. LEVENSON: No, I wasn't asking that. I was  
4 just asking whether the transfers is legally to the federal  
5 government, or specifically to DOE?

6 MR. CAMPER: It is to DOE under 151(b) of the '82  
7 Act.

8 DR. WYMER: Thanks, Larry. That helps.  
9 Sorry. Go ahead.

10 MR. NELSON: That's all right.  
11 Any other questions on that topic?

12 [No response.]

13 MR. NELSON: I would like to move on then to some  
14 of the efforts that we have taken and plan to undertake to  
15 enhance the effectiveness and efficiency of the program. I  
16 will provide a more detailed description of the streamlining  
17 and rebaselining initiatives in a few minutes. But over the  
18 past few years, we have also placed a significant emphasis  
19 on guidance development to assist licensees in complying  
20 with the License Termination Rule and to aid the staff in  
21 providing consistent and efficiency review of licensee  
22 submittals. Examples of this activity include the  
23 Decommissioning Standard Review Plan and the License  
24 Termination Plan Standard Review Plan.

25 In the next fiscal year we plan to conduct a

1 complete review of all decommissioning guidance and  
2 consolidate that guidance as required.

3 To support these efforts, we have conducted a  
4 variety of public workshops over the past year-and-a-half as  
5 input for our guidance development effort and we plan to  
6 continue to do so. An additional workshop, for example, is  
7 planned in November.

8 In support of our efficiency and effectiveness  
9 initiative, we have implemented the streamlining objectives  
10 summarized on this slide. Further, the staff is  
11 incorporating strategies to achieve performance goals that  
12 the agency has set in its strategic planning process.  
13 Examples include focusing on resolving key issues such as  
14 institutional controls for restricted release, which we just  
15 discussed in some depth. Other focus areas include partial  
16 site release and rubbleization, for example.

17 We conduct stakeholder workshops to seek licensee  
18 and industry and public input, and we have ongoing efforts  
19 to enhance our Standard Review Plans to make ourselves more  
20 efficient.

21 In September of '99, the division began to  
22 rebaseline the materials decommissioning program to  
23 determine the current status of each SDMP and complex  
24 decommissioning site, and to develop a comprehensive,  
25 integrated plan for successfully bringing these sites to

1 closure.

2 To facilitate planning, site status summaries were  
3 prepared as of the end of -- or as of December 31st, '99,  
4 and these were developed for each SDMP and complex site.  
5 These summaries for each site are included as an attachment  
6 to the Commission paper.

7 These summaries indicate the status of each site  
8 and identify the technical and regulatory issues that could  
9 impact the removal of the site from the SDMP or the  
10 completion of decommissioning.

11 For those licensees that have submitted a DP, we  
12 have developed a schedule based on that submittal. For  
13 those licensees that have not submitted a DP, we have also  
14 developed schedules, but those schedules are based on  
15 information that is currently available to the staff and the  
16 decommissioning approach we anticipate the licensee to take.

17 The comprehensive plan includes identification of  
18 all the major milestones associated with management of the  
19 site. We have done that using project management software  
20 and have produced an integrated Gantt chart for each site.  
21 An example of one such chart is included in the SECY, but  
22 the charts exist for all sites, and we are managing to those  
23 milestone charts.

24 In addition, for the License Termination Plan  
25 reviews that we are receiving, we are doing similar --

1 developing similar schedules and managing to those  
2 schedules.

3           The program is not without its challenges. We  
4 have talked about some of them today.

5           The License Termination Rule is a dose-based rule,  
6 and one of the challenges is to assess the dose from a  
7 released site. To assist in that effort, we've developed a  
8 technical basis document for dose modeling that is included  
9 in our Standard Review Plan for Decommissioning.

10           And the intent of that is, again, to provide  
11 guidance to both the licensees and the staff on an  
12 acceptable approach to do dose assessments. That should go  
13 a long way to assist us in that effort.

14           But even with that guidance, it's new to a lot of  
15 our staff. We have for many years, released sites under the  
16 SDMP Action Plan, which didn't really require dose  
17 assessment, so getting our staff up to speed, trained in  
18 doing this, is going to be a challenge for us.

19           The release of solid materials is equally a  
20 challenge. We don't have a consistent regulatory basis for  
21 releasing material.

22           We use guidance that we have developed, and this  
23 issue is clearly before the Commission, and until we have a  
24 rule of some type, we will still have to use what guidance  
25 we have, and often do a case-by-case review of licensee

1 requests to release solid material.

2 We've talked already about restricted release  
3 cases and I'm not going to dwell any more on that unless you  
4 have additional questions.

5 Under the topic of innovative performance-oriented  
6 approaches, it's important to note that the rule -- that our  
7 License Termination Rule is a performance-based rule, and  
8 that licensees are going to find and propose innovative ways  
9 to meet that rule.

10 Things such as rubblization is an example. We can  
11 anticipate similar approaches or other approaches in the  
12 future that we're going to have to address. These are not  
13 cookbook solutions, and will require some effort by the  
14 staff to review.

15 Partial site releases: Again, under the SDMP  
16 action plan criteria where you have set numbers you have to  
17 meet, it was an easy determination that you had cleaned up a  
18 site and therefore could release it.

19 We now have a dose-based rule, and you have to  
20 look at a partial site release, and one of the questions  
21 that arises is, to what extent does the site that you  
22 propose to release contribute to the dose on the site that  
23 still is under license?

24 So that --

25 DR. WYMER: Or vice versa?

1 MR. NELSON: Or vice versa, exactly. And, of  
2 course, finality, with the ongoing disagreement between the  
3 Agency and the EPA over acceptable decommissioning criteria,  
4 finality remains a question that the licensees have to  
5 consider in their decommissioning approach.

6 Just one final word before I conclude the formal  
7 presentation: You asked about integration of the program.  
8 You've heard all the pieces described here.

9 To assist in that integration, we have formed the  
10 Decommissioning Management Board which meets every two  
11 weeks. It consists of appointed members from the Offices,  
12 NMSS, NRR, Research. OCG attends, and these meetings have  
13 set agendas, issues that are brought up before the Board  
14 receive a coordinated review.

15 An example is Standard Review Plan for  
16 Decommissioning. Each one of the modules of the Standard  
17 Review Plan was reviewed by the Board before it was  
18 published.

19 This Board, as I mentioned, I think, very  
20 effective in providing the integration needed and the  
21 guidance needed to the staff on addressing these issues.  
22 It's an effective forum. Their meetings are well planned,  
23 the agenda set, action items assigned, and followed up on at  
24 subsequent meetings.

25 This has gone a long way to bring the integration

1 necessary to bring all these complex pieces into play.

2 That concludes our presentation. We welcome your  
3 questions or comments.

4 DR. WYMER: Thank you very much. I like your list  
5 of challenges. Those are about the ones I guess we would  
6 have come up with here since we've had discussions on this  
7 in some degree of detail or other.

8 Let me ask you about a couple of specific things:  
9 One is the status of rubblization. I know that Maine Yankee  
10 has come in, and I know that they have sort of backed off a  
11 little bit from it now because of the State of Maine's  
12 requirements that are more stringent than the NRC's, I  
13 think.

14 And where does that stand now? Do you have a  
15 sense?

16 MR. NELSON: I can tell you where the Maine Yankee  
17 review stands. Maine Yankee has submitted and LTP and they  
18 have asked us to review the LTP that has been submitted to  
19 us, which includes rubblization.

20 They have told us that they plan to submit a  
21 revision to their License Termination Plan. We don't know  
22 the extent of that revision; we don't know what they're  
23 going to change. And until -- whether or not they remove  
24 the rubblization concept is a question I can't answer.

25 That plan is tentatively scheduled -- the revised

1 plan, they have committed to try to submit a revised plan by  
2 the 31st of October, and until we get the revision, we won't  
3 know what's in it.

4 But in the meantime, we are proceeding with the  
5 review of the plan they have submitted, and that review is  
6 ongoing, and at such time that we get a revision, we'll  
7 review the revision and make adjustments as necessary.

8 So rubblization is still in the -- still part of  
9 that concept and we are reviewing it.

10 DR. WYMER: The second question has to do with  
11 clearance. We know that Secretary Richardson has put a hold  
12 on everything with respect to releasing materials,  
13 especially like the nickel from the K-25 plant, which causes  
14 a lot of problems to everybody.

15 But that then -- the DOE then, as I understand it,  
16 turned it over to the NRC and said, okay, give us a ruling.  
17 And NRC turned to the National Academy of Sciences and said,  
18 write us a report.

19 What's the status of the report?

20 MR. NELSON: I'm not personally involved with the  
21 clearance rule or the release of solid material rulemaking  
22 efforts. I'm looking around to see if there is anyone from  
23 the staff who might be able to address that.

24 MS. TROTTIER: Where's my microphone? I'm  
25 Michelle Trottier, Research. We are expecting a proposal

1 from the Academy by week's end. I think that's tomorrow.

2 Their Governing Board has met. They have reviewed  
3 what their staff put together based on what we submitted to  
4 them in our Statement of Work, and so we expect to be  
5 beginning that shortly. But it has not commenced yet.

6 DR. WYMER: It will take a couple of years before  
7 you get the report?

8 MS. TROTTIER: It probably will. I do think that  
9 what the Governing Board was concerned with was the  
10 timeframe. The Commission wanted a very short turnaround on  
11 this, and I suspect that what we will see from the Academy  
12 will ask for a little more time.

13 But nonetheless, it is not a simple issue, as you  
14 might guess.

15 DR. WYMER: Okay, thanks. Let me ask, John, have  
16 you got any specific questions?

17 CHAIRMAN GARRICK: Well, I am trying to figure out  
18 what the real technical issues are here, so that we can be  
19 helpful. Larry had mentioned that one of the primary  
20 problems was the identification of viable third parties to  
21 oversee sights, et cetera, et cetera.

22 I agree with Ray that this last viewgraph is  
23 pretty much on target with what we have identified as some  
24 of the issues.

25 But when you talk to a lot of the facilities

1 people and the reactor people, in particular, and ask them  
2 what are the primary problems associated with  
3 decommissioning, more often than not what comes out of that  
4 is an identification of the handling of low-level waste  
5 materials, solid materials, as being the one that has the  
6 greatest amount of uncertainty surrounding it, or at least  
7 if you follow the regulations as they now are, the options  
8 seem to be quite limited.

9 So, the release of solid materials or the handling  
10 of low-level waste materials product from the  
11 decommissioning of facilities apparently continues to be a  
12 major factor, particularly if you think about economics.

13 The safety issues do not seem to be particularly  
14 significant. So, I would ask you the same question, and  
15 that is, what do you really see as the principal problems  
16 with our primary interest being on the technical side,  
17 associated with an effective regulatory program on  
18 decommissioning?

19 Are they pretty much what you've touched on here?

20 MR. NELSON: Well, I think they are. The  
21 challenges slide, I think, are the principal challenges that  
22 face us.

23 In some respects, we're on a learning curve. We  
24 have, in addition to the dose-based rule, we have MARSSIM,  
25 which is a new approach to site surveys, so we are in some

1 cases learning as we go there.

2 MARSSIM -- we are -- for example, the staff is  
3 used to in a decommissioning plan, getting a very detailed  
4 final status survey plan as part of the decommissioning  
5 plan. Under our old guidance, NUREG CR 5849, that was  
6 possible.

7 Under MARSSIM, however, you need to know -- you  
8 need to have some information about the post-remediation  
9 condition of your site to determine the number of samples  
10 you need to take.

11 So in some respects, you can't submit the same  
12 detail, final status survey plan to the staff up front  
13 before you decommission.

14 So, that's something we're trying to gain some  
15 comfort with, and therefore, what do we expect in the form  
16 of a final status survey plan under MARSSIM?

17 That's an area where, for example, we're learning.  
18 I wouldn't call it a significant challenge, but it is a  
19 learning curve.

20 And as the industry is learning MARSSIM as they  
21 implement it, I think that implementing MARSSIM is a new  
22 approach, and, therefore, I think, a minor challenge.

23 But it's an implementation challenge, and I  
24 wouldn't call it a real technical challenge.

25 Outside of those that I had identified, I think

1 that those are the real challenges that face us.

2 The dose-modeling, that would encompass things  
3 like rubblization, because, you know, you have a different  
4 source term with rubblization. And so you need to look at  
5 --develop a site-specific dose model of leaving that  
6 material behind.

7 MR. CAMPER: I would add to that by answering that  
8 there are four things that I see on the horizon that the  
9 Committee could be of assistance to the Staff on in the near  
10 term:

11 The first is, you will be provided in the October  
12 timeframe, the Staff's proposed Decommissioning Criteria for  
13 West Valley. That will come to you as the Staff is  
14 providing the proposed final decommissioning criteria to the  
15 Commission about the November timeframe.

16 We've briefed the Commission's staff recently on  
17 West Valley. We owe them another status report in  
18 September, and one of the things that they specifically made  
19 it clear to the staff on, was that they were strongly  
20 interested in seeing ACNW input on the decommissioning  
21 criteria.

22 Now, we have a very tight schedule, and we're  
23 going to react as best we can, given that schedule, between  
24 October and November when the Commission expects to see the  
25 paper.

1           And I know that that timing is not necessarily  
2 consistent with your normal process, but we're going to be  
3 having some interactions with you on that. So that's a big  
4 one on the horizon, as I see it, near-term.

5           Secondly, as Bob pointed out, we have put a lot of  
6 work into going back and looking at RESRAD and D&D. We work  
7 closely with Research in doing that.

8           We try to make those modeling approaches more  
9 probabilistic in nature, to remove some of the conservatism  
10 of the default parameters in those. I think that at some  
11 point, having the Committee take a look at those modeling  
12 codes in current terms, post those adjustments, and seeing  
13 if you think that we have done all that we can do to make  
14 them as probabilistic as possible, and to make sure that we  
15 have the appropriate level of conservatism in the default  
16 values, I think that's something that would be of value to  
17 us down the pike.

18           Thirdly, on this issue of clearance, Stu and I  
19 just came back from this meeting with NEI, and I will tell  
20 you that this clearance issue is very, very big on the minds  
21 of the reactor community that is undergoing decommissioning  
22 or wanting to clear materials from their sites, whether they  
23 are operational or in decommissioning.

24           They see it as a very large question mark. They  
25 think it has the potential to impact the costs that they

1 project for decommissioning.

2 A number of them are coming into us with  
3 innovative approaches. For example, Big Rock Point met with  
4 us recently and discussed a pending licensing action in  
5 which they want to be able to clear some materials that  
6 would end up in landfills that would be a disposal. They  
7 want to do that not under a 20.202, because they have  
8 concerns about the material that would ultimately go to  
9 landfills still being characterized as being radioactive in  
10 nature, so they're pursuing a licensing action, and that's  
11 sort of an interesting twist.

12 I think that at some point, as we look at some of  
13 those types of licensing actions in the months to come, I  
14 think coming to the Committee and sharing with you the  
15 technical basis for which we are making those decisions, and  
16 getting your input on it, and opportunity to put your  
17 footprint on whether or not the technical logic seems to  
18 make sense or not, would be of value to the Staff.

19 The finally, of course, there is the one I  
20 mentioned earlier, that being institution controls. We'll  
21 talk with you about that in October. I think it will be  
22 interesting for you to hear a bit more about the role, the  
23 possible role of DOE and what we might do further in terms  
24 of other pathways or approaches for dealing with the  
25 institutional controls issue.

1           So those are the four that I see in the near-term  
2 where I think specific feedback from you would be of value.

3           CHAIRMAN GARRICK: Thank you, that's good.

4           DR. WYMER: George?

5           DR. HORNBERGER: I was particularly interested in  
6 your reviews of the License Termination files, these 37,000  
7 files. And so if I do the simple math here, it looks as if  
8 you have got about 1 in 1,000 where you released a site that  
9 maybe you shouldn't have. So, you know, a Type 1 error rate  
10 of about 10 to the minus 3, and NRC probably wants to do  
11 better than that.

12           And I was just curious, have you gone back, or do  
13 you plan to look at those 38 to see what lessons are to be  
14 learned in how you do your job? In other words, what went  
15 wrong?

16           MR. BUCKLEY: The 38 cases that were identified  
17 that were found contaminated, I think what happened was that  
18 there was a lack of documentation in the file. In many  
19 cases in those, there was no final survey that was done.  
20 Those tended to be the very old licenses, the ones that were  
21 terminated early on in the late '50s and '60s.

22           Oak Ridge found that the licenses that were  
23 terminated from '85 to present turned out to be very good.  
24 There were very few mistakes made. I believe that number is  
25 one or two, as opposed to the remaining licenses that were

1 -- the sites that were contaminated. So, most of the  
2 mistakes that were made were made early on, and from, I  
3 would say roughly '80 forward, the results were quite good.

4 DR. HORNBERGER: The other thing that occurred to  
5 me is that it might be interesting to apply D and D to at  
6 least the 38, just to see whether or not DandD would have  
7 kept them in. I am just -- it is just an interesting  
8 perhaps exercise to apply DandD to a test case, or a series  
9 of test cases where you have some interesting historical  
10 information. And they are probably not terribly complicated  
11 sites, although I don't know too much about these SDMP  
12 sites. Just a thought.

13 DR. WYMER: Milt?

14 MR. LEVENSON: I have got a couple of questions.  
15 In the area of both rubblization and clearance or free  
16 release of material, do you perceive the technical part,  
17 that is, monitoring what is there as being a significant  
18 part of the problem you have?

19 MR. NELSON: No, I don't see that as a problem. I  
20 think that the -- we haven't seen a problem to date in  
21 monitoring, and I don't know why it would arise in the  
22 future.

23 MR. LEVENSON: The basis of my question is that  
24 the committee visited some decommissioning sites in Europe  
25 in May and they did a couple of interesting things. They

1 don't call it rubblization, but they have solved the  
2 hypothetical question about how do we know there isn't some  
3 activity inside that concrete that might come out, by just  
4 running it all through regular aggregate crushers to a  
5 relative small size and run it under counting equipment on  
6 conveyers and make real sure there is nothing inside before  
7 they dispose of it.

8           And they have a similar sort of philosophy with  
9 metal things. It has to have only external surfaces that  
10 are monitorable so that things like structural steel if  
11 there is riveted sections, they cut that out. Say maybe we  
12 don't know what is inside between the two plates. So they  
13 feel much more comfortable and have more public confidence  
14 on releasing things when they can say every bit of surface  
15 is external and has been surveyed.

16           I wondered if, when you get into the areas of  
17 release, whether anybody had thought ahead about how do you  
18 assure yourself that the monitoring really does tell you it  
19 is okay?

20           MR. NELSON: Well, I will answer that in two  
21 parts. Right now our release criteria are surface  
22 contamination oriented. We don't have volumetric release  
23 criteria. That volumetric release criteria question is the  
24 crux of the release of solid material technical issue. What  
25 are the criteria? And then what -- how do you measure that?

1 And that is clearly a technical issue that hasn't been  
2 answered.

3 To date, if a licensee wants to release  
4 volumetrically contaminated material, we would have to  
5 analyze that on a case-by-case basis and do some type of  
6 dose assessment on it. But I don't know that we have an  
7 issue at this point with measuring it. It is, once you know  
8 what it is, what criteria to apply, and how do you make that  
9 assessment?

10 DR. WYMER: It is my understanding that the  
11 Division of Research has issued a contract or subcontract to  
12 study the problem of measuring volumetric contamination. I  
13 wonder what the status of that study is. Is there anybody  
14 in the audience who can speak to that? Here we go.

15 MS. TROTTIER: Actually, we have two contracts,  
16 and these are follow-ons to work that we did for the License  
17 Termination Rule. One is with EML, the Environmental  
18 Measurements Laboratory, and the other one is with ORISE.  
19 And I will make an offer to you, because Commissioner Diaz  
20 has expressed a lot of concern about this issue,  
21 particularly the concept of detectability, and that, you  
22 know, he makes a true statement -- with enough effort, you  
23 can detect anything.

24 So what we are doing next month is briefing him on  
25 these contracts. And it might be worthwhile for the

1 committee to hear the work that we are doing, maybe at an  
2 upcoming meeting, so that, you know, we can give you the  
3 status. I mean these are about a year into their work and,  
4 in fact, they are going to present their current status at  
5 Research's Water Reactor Safety Meeting in October.

6 So, any time that there is time on your calendar,  
7 and if it is of interest, we would be glad to bring our  
8 contractors in and just give you a brief synopsis of the  
9 progress that they are making to date on this issue. It is  
10 basically volumetric measurements. You know, what is  
11 capable, what is realistic? Costs, all the factors  
12 associated with doing this kind of measurement.

13 DR. WYMER: Well, this is important enough, there  
14 is enough money at stake that it probably would be worth our  
15 while, if we can fit into our schedule, to hear something  
16 about it.

17 MS. TROTTIER: Right. I understand that.

18 DR. WYMER: So we will talk about that.

19 MS. TROTTIER: Okay.

20 DR. WYMER: Thanks.

21 MS. TROTTIER: Oh, Cheryl Trottier from Research.

22 DR. WYMER: Let me ask around the table if the  
23 staff has any questions? I guess we have time to invite  
24 audience --

25 CHAIRMAN GARRICK: Well, I want to comment on one

1 thing or ask a question, because there has always got to be  
2 one off-the-wall question, and I will provide that. I am  
3 kind of curious as to whether or not this whole business of  
4 contaminated sites is being looked at by some systems -- or  
5 from a systems oriented perspective. And I am not thinking  
6 just of radioactive contamination. I am much more worried  
7 about the arsenic contamination in Silicon Valley, for  
8 example, and what goes in those kind of industries than I  
9 am, at least from a public health and safety standpoint,  
10 than I am from these, a large number of these sites.

11 It just seems to me that the opportunity here is  
12 fantastic for some creative systems engineering of looking  
13 at these sites in the context of what makes sense to make  
14 use of so-called restricted sites. And I guess my question  
15 is, and I know that the NRC, I have been told many times the  
16 NRC regulates, it doesn't solve problems, so it is probably  
17 outside your scope, and that is why I put it in the category  
18 of off the wall, but I wonder if there is an attempt on some  
19 sort of an interagency basis or interagency/industry basis  
20 to take a look at the kind of activities that are necessary  
21 to have as a fundamental part of a society's infrastructure?  
22 Many of them involve hazardous materials and what-have-you.

23 I can't believe that there wouldn't be a way to  
24 optimize this process in such a way that every acre of these  
25 sites could be put to very good use even if they are left in

1 a restricted state, if we had at our disposal the ability to  
2 manage all activities and all hazardous operations and  
3 manufacturing facilities, and process plants and  
4 what-have-you.

5 Is there anything like this being done at a high  
6 level that gives people assurance that these are not lands  
7 that are lost to mankind forever? Because the truth is  
8 there are many operations that are far more hazardous than  
9 what we are talking about at most of these sites. And it  
10 just seems that some creative geographer or somebody could  
11 find very extremely effective ways to have these sites serve  
12 mankind and take and in the end save the need for siting  
13 some of these facilities in what are currently pristine  
14 environments. Are you participating in anything like this?

15 MR. NELSON: Yes.

16 CHAIRMAN GARRICK: Are you aware of any such  
17 investigations or studies?

18 I just think we are very uncreative as a nation  
19 when it comes to this kind of an issue, and that radiophobia  
20 has created such a barrier to the use of locations that have  
21 had radiation related activities that we have become stupid  
22 about effective utilization of our resources. And I am  
23 curious if the NRC has ever contacted in any -- to be  
24 engaged in any of these kinds of studies.

25 MR. NELSON: I am not aware of any interagency

1 studies that may be going on. My suspicion is if anyone  
2 were doing it, it would be EPA. So I am not aware of any.

3 DR. WYMER: Let me ask if there is -- oh, a staff  
4 member.

5 MR. LEVENSON: Use the microphone and identify  
6 yourself, please.

7 MR. FREDRICHS: I am Tom Fredrichs, I am in NMSS  
8 in the Division of Waste Management. And as far as reusing  
9 some of these sites, I don't know if the NRC is involved in  
10 any interagency sort of things, but we are cooperating with  
11 some of the licensees to reuse these sites, some of the  
12 reactor sites where they are going to repower with a fossil  
13 fuel facility. And that is part of the partial site release  
14 challenge that we have, to be able to get these sites put  
15 back into productive use more quickly than if we would have  
16 to wait for the entire site to be -- the license termination  
17 process to go through.

18 So, I mean it is not a nationwide effort, but we  
19 are at least making some small steps in that direction.

20 CHAIRMAN GARRICK: Thank you.

21 MR. LEVENSON: And sort of in that connection, the  
22 question I was going to ask, and it is still relevant, is,  
23 what are the restrictions on restricted release? What does  
24 that really mean? What options are there for use of the  
25 land?

1 MR. NELSON: I think that to a large degree  
2 depends on a couple of things. One, the nature, amount and  
3 physical arrangement of the material that may be left  
4 behind, and the licensee's own intent for that land. If  
5 there is a large amount of material buried onsite, but the  
6 site boundary includes some buffer zone, I would imagine  
7 that part of that site could be put to some other productive  
8 use, maybe a park or whatever.

9 So, I don't think there are any restrictions on  
10 restricted use. Restricted use doesn't mean build a three  
11 foot concrete wall around the facility and have an armed  
12 guard standing by. It means that you have placed -- that  
13 there are restrictions on how you can use the site and those  
14 restrictions would have to be based on some of the factors I  
15 mentioned.

16 But, ultimately, it comes down to what the  
17 licensee wants to use that property for. Normally, it would  
18 remain -- the title would remain with the licensee, or the  
19 ex-licensee once the license is terminated, and so they  
20 would have to make the proposal on how that land would be  
21 used or not used after the license was terminated, and the  
22 legal mechanisms they would put in place to ensure that that  
23 was the only uses that the land would be put to use for.

24 MR. LEVENSON: Yes, I think that the sites  
25 probably, John, generally fall into two categories, those

1 that were power plants. That means they have access to  
2 cooling water and media that makes them good for power  
3 plants, and they are probably people who will seriously  
4 consider reusing the site. I think the more difficult one  
5 are the nonpower plant sites.

6 CHAIRMAN GARRICK: Yes.

7 MR. LEVENSON: Which might not have motivation the  
8 same way as for power plants. Power plant sites are at such  
9 a premium that somebody is going to repower them.

10 MR. NELSON: Well, let me say we know of no power  
11 plant that is planning on a restricted release at this  
12 point. The only restricted release proposals that have been  
13 submitted or discussed with us have been from materials  
14 licensees. So, I don't think -- at this point the reuse of  
15 power plants is not an issue.

16 MR. CAMPER: Yes. I would only add to that, I was  
17 going to comment sooner or later, if you look at the power  
18 plant sites, I mean they really are pristine in the final  
19 analysis. I mean typically there is not a groundwater  
20 problem. And even though License Termination Plans have  
21 been submitted designed to meet our standard of 25 millirem  
22 and ALARA unrestricted, when it is all said and done, as a  
23 result of the scabbling and decontamination takes place, if  
24 you look at your final site survey results, you are probably  
25 going to find those sites in the order of a few millirem.

1 So, they really are quite clean.

2 It is the more complicated process sites or  
3 material sites that pose problems, not the least of which,  
4 of course, is groundwater in some cases.

5 DR. WYMER: Yes. DOE has a whole bunch of  
6 materials handling sites, as you know, and they also face  
7 the problem of restricted release and greenfield release,  
8 and some of the solutions, just for Milt's -- answering  
9 Milt's question, some of the things that they are  
10 recommending range from wildlife management parks to parks  
11 for children to manufacturing sites. There is almost an  
12 infinite spectrum of things, pretty much as you have  
13 indicated. It depends on the imagination and the wishes of  
14 the people that are on site.

15 MR. NELSON: Right. And we have seen some variety  
16 in those material sites. For example, Jefferson Proving  
17 Ground site in Madison, Indiana, they fully plan to use that  
18 as a game reserve, and to have a portion of the site  
19 available under the Fish and Wildlife Service, another  
20 portion to the Air National Guard, but the DU contaminated  
21 portion would be restricted access and would be retained as  
22 a game reserve under the Fish and Wildlife Service, that is  
23 their proposal.

24 In a number of other cases, probably the greatest  
25 majority of those 12 sites are looking at some form of

1 onsite disposal of large volumes of waste and some type of  
2 an impoundment cell.

3 So, there is a variety of approaches and, again,  
4 the nature of the restrictions will have to depend on those,  
5 you know, the three or four criteria identified earlier.

6 DR. WYMER: Okay. I would like to give the  
7 members of the audience a chance to participate, and I think  
8 maybe in order to start, I would like to see if there is  
9 anybody from the Nuclear Energy Institute who would like to  
10 comment on this, who is in the audience, since I am sure  
11 they have been involved in all of these areas one way or  
12 another.

13 I guess not. Is there anybody else in the  
14 audience that wants to make any comments? It is a passive  
15 group.

16 [Laughter.]

17 MR. NELSON: We just gave an excellent  
18 presentation and answered all their questions.

19 DR. WYMER: We appreciate it. Thank you very  
20 much. I think we picked up 20 minutes to work on letter  
21 writing.

22 MR. NELSON: Thank you for your time.

23 CHAIRMAN GARRICK: Thank you.

24 [Pause.]

25 CHAIRMAN GARRICK: I think what we would like to

1 do, and we don't need to be on the record for this, is  
2 review the one remaining letter that we have.

3 [Recess.]

4 CHAIRMAN GARRICK: We'll come back to order.

5 The next item on our agenda is hydrology research.  
6 The committee member that is going to lead this discussion  
7 will be George Hornberger.

8 DR. HORNBERGER: Great. I am not prepared to  
9 lead.

10 [Laughter.]

11 DR. HORNBERGER: Okay, so actually you will recall  
12 that we have had a number of discussions related to research  
13 being conducted by the Office of Research and this is a  
14 continuation on it. In one sense we are lucky in that we  
15 overlapped with a workshop that Tom Nicholson put together,  
16 but it was held simultaneously. We are unlucky that we  
17 couldn't attend it, but we are lucky that we have some of  
18 the people who are in town because of the workshop, not  
19 because of the ACNW meeting, willing to stay over and come  
20 to the ACNW meeting, although Lynn might say that they came  
21 to the ACNW meeting and Tom was lucky that they were here  
22 for his workshop.

23 [Laughter.]

24 CHAIRMAN GARRICK: Are you suggesting they  
25 wouldn't come to the ACNW meeting?

1 DR. HORNBERGER: We have presentations from  
2 several people, and Phil, you are going to go first?

3 MR. OTT: First, with a little introduction.

4 DR. HORNBERGER: Oh, okay. Bill is going to do  
5 the introduction. Sorry, go ahead.

6 MR. OTT: Bill Ott from the Office of Research.

7 My first remark is there is no luck involved at  
8 all. When Tom was planning the symposium I essentially told  
9 him let's try and do it in conjunction with an ACNW meeting  
10 so that we can have some overlap and meet with you.

11 CHAIRMAN GARRICK: You have made us feel better  
12 already.

13 [Laughter.]

14 MR. OTT: We are actually attempting to come to  
15 you more often and help you at the end of the year be  
16 prepared to write something on the Research program. A  
17 couple of months ago we had Linda come in. We've got Shlomo  
18 and Glendon and Phil and Peter here today. We hope to do  
19 this at least once more, maybe twice more this year and  
20 bring in some other contractors to meet with you.

21 Today we have got the PIs that are essentially  
22 running the hydrogeology research in the program. We have  
23 projects with both Pacific Northwest National Laboratory and  
24 the University of Arizona. We are basically looking at  
25 uncertainties related to modeling of hydrogeologic systems.

1           Specifically, we are looking at parameter  
2 uncertainty, primarily at PNNL, and in conceptual model  
3 uncertainty. They represent two aspects of the program.

4           The work at PNNL is directly responsive to a user  
5 need. It is the work that was requested of us by NMSS. It  
6 is currently being used by NMSS and is being used by the  
7 Office of Research in terms of helping to improve models  
8 like RESRAD and DandD.

9           The work at the University of Arizona is not user  
10 need originated. It is essentially what we call  
11 anticipatory research and was initiated because we conceived  
12 of a potential problem in the future dealing with  
13 assertions, allegations, whatever by opponents of licensing  
14 actions, that we just have the wrong conceptual model, how  
15 do we deal with the uncertainties associated with such  
16 contentions.

17           That's really about all I wanted to say. I wanted  
18 to point out the difference and indicate that we are trying  
19 to do this to help you guys with your Research report.

20           Oh -- one other thing I wanted to mention. There  
21 are other activities going on in the conceptual model area.  
22 The National Academy should come out with a report this fall  
23 on the symposium that was held about a year ago out in  
24 California. This fall at the AGU meeting in San Francisco  
25 there is going to be a special session, which I believe was

1 organized by Shlomo on uncertainties in modeling and he may  
2 mention more about that during his talk.

3 Without further ado, I will introduce Phil Meyer,  
4 who is one of the PIs on the PNNL project. Phil?

5 MR. MEYER: Thank you, Bill.

6 My name is Philip Meyer. I would like to just  
7 make sure that everybody realizes that my colleague, Glendon  
8 Gee, is here as well and will be available for question  
9 answering. Because the research symposium was held, we also  
10 have a lot of additional material. Should that come up in  
11 questions we'll be pleased to provide that.

12 I am going to be talking in pretty broad, overview  
13 terms here in a short presentation and we will have more  
14 later, if needed.

15 Like Bill said, the motivation for this research  
16 is that it was undertaken in response to a user need from  
17 NMSS and in the broadest of terms our work is intended to  
18 support the development of guidance for the termination,  
19 license termination process.

20 The general background for the problem is that the  
21 dose assessments that are used in the determination of the  
22 safety of the site rely on simplified models in a lot of  
23 cases. The models are formulated in addition with fairly  
24 limited site-specific data and these are characteristics of  
25 the analyses that the Staff with NMSS are very concerned

1 about and that were uppermost in our minds in addressing the  
2 issues.

3           Given that these two conditions hold, the result  
4 is that when you make predictions of dose for comparison  
5 with the regulatory standard that those predictions are  
6 uncertain, and our research is intended to provide the NRC  
7 Staff with improved tools to address that uncertainty and to  
8 quantify it.

9           I'd just point out that this consideration of  
10 uncertainty is consistent with the risk-informed approach  
11 adopted by the NRC.

12           The research objectives of our project were to  
13 document a method for assessing uncertainty and in doing  
14 this we have extended previous methods that we have  
15 developed for the NRC in previous project work on the Low  
16 Level Waste Program and also for SDMP sites.

17           The emphasis here is to try to provide practical  
18 tools, so will work fairly closely with NMSS Staff to  
19 provide them with tools that they can use and tools that  
20 they need as they proceed through their guidance  
21 development.

22           In addition, they specifically asked us, the NRC  
23 specifically asked us to look at three codes -- DandD,  
24 RESRAD, and MEPAS. These are three dose assessment codes  
25 that you may or may not be familiar with that are used by

1 their licensees and by the NRC Staff.

2 That is not to say that any of the methods that we  
3 have worked with are not applicable to other codes but we  
4 are specifically directed to look at these codes.

5 The relationship of this project to other  
6 projects -- there's work that was mentioned this morning  
7 regarding modifications and improvements to the DandD code  
8 and the RESRAD code. Those projects are going on at Sandia  
9 and Argonne National Laboratories and information that we  
10 developed on generic probability and distributions for soil  
11 hydraulic parameters has been incorporated in those two  
12 codes recently in terms of the default parameter  
13 distributions that have been implemented in the latest  
14 versions of those two codes.

15 In addition, we are collaborating with Drs. Neuman  
16 and Wierenga on some of the work that they are currently  
17 doing that they done in the past. The monitoring project at  
18 the Maricopa site in Arizona gathered a fair amount of data  
19 which we are trying to use in our test case applications  
20 that we're currently working on and the current project on  
21 conceptual model uncertainty has a lot in common with our  
22 work, and we have been trying to interact with Dr. Neuman on  
23 that.

24 Just some brief background so that I can be as  
25 complete as possible. You might ask yourself why hydrologic

1 uncertainty is even important, and the reasons are fairly  
2 straightforward. One is that when you calculate dose you  
3 find that the dose is very dependent upon the hydrology, so  
4 the calculation of dose is sensitive to your conceptual and  
5 parameterization of the hydrologic components of the  
6 problem.

7           In particular, with the relatively simplified  
8 models that we are looking at, there's two basic terms, the  
9 source term -- which is a function of the amount of water  
10 that enters the waste -- we refer to that as net  
11 infiltration, being the water that passes below the zone of  
12 the roots, where it would be possibly taken back up through  
13 evapotranspiration.

14           The other thing is that the travel times with  
15 these models, and not only these models but in reality, the  
16 travel times of the contaminants are dependent upon the  
17 net -- the net infiltration as well.

18           So the dose is very sensitive to the hydrologic  
19 terms and in addition the hydrologic terms are difficult to  
20 estimate accurately, particularly given limited data at many  
21 of these sites, and in addition to limited data the  
22 properties, hydrologic properties, often vary spatially and  
23 temporally, so it makes them -- with limited data you have  
24 possibly greater uncertainty about what the parameter values  
25 should be.

1 I have already mentioned that the codes are using  
2 fairly simplified models for relatively complex processes.

3 Just a couple examples of the kind of variability  
4 that we're talking about. This is some data from the Las  
5 Cruces trench site on saturated hydraulic conductivity.

6 It is well-known that saturated hydraulic  
7 conductivity varies spatially significantly and you can see  
8 here that the variability on this plot, which was a number  
9 of meters in dimension, is several orders of magnitude.

10 On the right-hand side here is the data from the  
11 USDA facility in Coshocton, Ohio that shows the drainage  
12 from four lysimeters located at the same location  
13 essentially and you can see that there's a lot of  
14 variability. This is annual drainage from lysimeters. You  
15 can see there's a lot of variability between lysimeters and  
16 also a lot of variability over time.

17 In terms of having a short record, if you have a  
18 record of data at a site it is going to tend to be short.  
19 You have to try to represent the long-term average process  
20 at a site. Using a short record you are liable to be  
21 inaccurate in that estimate.

22 Just an additional example to illustrate spacial  
23 variability -- this is a site on the Hanford site where  
24 Glendon is currently conducting some experiments, and there  
25 has been some experimental work in the past. This is just

1 an interpolation from bore holes, bore hole geophysical logs  
2 of the bulk density at this site, and you can see a lot of  
3 variability and you can also see that although at this site  
4 you might interpret the bulk density as resulting in a  
5 layered process, in fact it is not perfectly layered and the  
6 experiments conducted at the site have illustrated that a  
7 lot of the water -- waterflow and transport -- at the site  
8 from a point source injection does not travel downward but  
9 in fact moves laterally.

10 And that's important because a site like this, if  
11 you wanted to model it with a code like RESRAD, MEPAS, or  
12 D&D. You would have to assume that the flow and transport  
13 was one-dimensional.

14 In fact, here is a schematic from the RESRAD  
15 documentation, illustrating some of the approximations used  
16 in that code. And I list some of the important  
17 approximations over here.

18 As I said, you have to assume that all flow is  
19 one-dimensional, and, in fact, that it's steady state, and  
20 also occurs under a unit gradient.

21 In addition, the code only allows simple layering,  
22 and within each layer, the properties have to be homogeneous  
23 and isotropic.

24 And in addition, the transport curves, absorption  
25 process curves is modeled linearly and in an equilibrium

1 state.

2 And in addition to those, with any code, you have  
3 numerical approximations to the equations that you're  
4 solving, and in this code they may be, because of the  
5 simplifications, may be more severe than others.

6 DR. HORNBERGER: What does isotropy mean in one  
7 dimension?

8 MR. MEYER: Well, of course, there is no isotropy  
9 in one dimension. I'm just pointing out that you don't have  
10 an option. If you have a site where you have clearly  
11 anisotropic properties, you can't represent that.

12 So, the basic procedure for assessing uncertainty  
13 is to first off, assess the code's conceptual model and  
14 identify the hydrologic parameters, which is not too hard to  
15 do with the simplified codes, since the parameter set is  
16 fairly limited.

17 One of the issues is, due to the simplification,  
18 the codes use lumped parameters, as I have already  
19 discussed, and that has implications for an uncertainty  
20 assessment because in that case, you're looking for, in  
21 terms of the parameter uncertainty, you're looking for the  
22 uncertainty in that lumped parameter. You're looking for  
23 the uncertainty in a parameter that has to represent a  
24 fairly large area of -- a fairly large domain.

25 And that both helps you and it hurts you. I helps

1 you in the fact that you can use -- that there are sources  
2 of information for the parameter probability distributions  
3 that are probably more valuable because you're looking at a  
4 lumped parameter, but at the same time, that parameter  
5 really represents an effective parameter at the site, and  
6 so you have difficulty in interpreting measurements that  
7 might be made at the site in terms of what the proper  
8 effective parameter for the scale of the model should be.

9 We have worked to identify sources of information  
10 for parameter probability distributions, and I mentioned  
11 those previously, that some of that information has been  
12 incorporated into RESRAD and D&D, and we have also looked at  
13 ways to combine generic information that might represent  
14 value of a parameter obtained from data gathered across the  
15 country and applied to a particular site.

16 We call that generic information, in that it's not  
17 site-specific; it represents an average value for, say, a  
18 particular soil type for measurements made across the  
19 country or within a larger region, and contrasts that to  
20 site-specific data which is gathered actually on the site.

21 In terms of an uncertainty assessment, you need  
22 some way to combine those two types of information, and we  
23 have provided a plausible method to do that.

24 In terms of the actual analysis itself, Monte  
25 Carlo simulation is used. The codes, RESRAD, and MEPAS both

1 have built in Monte Carlo shells that are available to use  
2 with those codes to get probabilistic results, and D&D,  
3 they're currently working on that option.

4 One other thing: We look at sensitivity analysis  
5 and statistical correlation measures to try evaluate  
6 parameters that are critical to the analysis. Those  
7 parameters would be useful to probably gather more  
8 information on them, that sort of issue.

9 So, as far as the status of the project, one of  
10 the tools that we have provided to the NRC staff is a  
11 simplified water budget model that gives you a transient  
12 estimate of the components of a water balance in the near  
13 surface.

14 The code uses or tries to use available climatic  
15 data and a very simple flow representation in order to be  
16 applicable at the majority of sites with the limited data  
17 that we anticipate to be available.

18 It has been delivered to the NRC staff, and we've  
19 got a water resources research paper that is currently in  
20 press.

21 This NUREG 6656 provides a variety of information  
22 that goes into more detail. I believe the Committee all got  
23 a copy of that.

24 It goes into more detail on what I've talked about  
25 and the methods that we're currently using.

1 I was out here in February of this year, and  
2 provided an all-day training session to NRC staff, and we  
3 are currently applying the methods to hypothetical test  
4 cases. These are intended to demonstrate the application of  
5 a lot of things. They are a lot easier to understand, once  
6 you see an actual demonstration.

7 And this test case, we actually got a lot of the  
8 information from the NRC staff in terms of the source, the  
9 characteristics of the source, and the scenarios that we're  
10 looking at, trying to make it as applicable to their license  
11 review process as possible, their termination review  
12 process.

13 And there is a variety of analyses that we're  
14 looking at. That report on the test case application should  
15 be out by September.

16 Some of the remaining work that we've identified  
17 are problems that have come up in terms of -- as we go along  
18 with the analysis -- are proper definition of effective  
19 parameter values. I've actually had in my presentations, a  
20 number of licensees come up and talk to me about their  
21 particular sites, and this is always one of their issues, is  
22 that they've got a scattering of data and they're trying to  
23 apply one of these models.

24 And they don't know how to reconcile, and what the  
25 best way to reconcile the data is, with the respective model

1 that they're trying to use.

2 There are a couple of issues involved there, only  
3 one of which is effective parameter values. The other one  
4 is something that Slomo is going to talk about in a minute,  
5 and that's whether or not they should be or how to decide  
6 whether or not their site fits within the framework of the  
7 codes that I have been talking about.

8 Another issue is the general applicability of  
9 Bayesian Methods which are used to combine the site-specific  
10 information with more generic information on soil property  
11 distributions.

12 CHAIRMAN GARRICK: Are they already in your  
13 methods, the Bayesian Methods?

14 MR. MEYER: Yes. Well, there is one particular  
15 method that is documented in one of the NUREGS that we put  
16 out that we have been working with.

17 CHAIRMAN GARRICK: But that bullet doesn't mean  
18 that you're questioning their applicability? No?

19 MR. MEYER: I'm not questioning the applicability.

20 CHAIRMAN GARRICK: Okay.

21 MR. MEYER: Establishing the general  
22 applicability, under what conditions should they be used and  
23 when should you --

24 CHAIRMAN GARRICK: The answer to that is obvious;  
25 they are generally applicable.

1 [Laughter.]

2 MR. NELSON: The question is how to apply them.

3 CHAIRMAN GARRICK: Yes, that's right.

4 MR. MEYER: We had a little bit of discussion  
5 about this yesterday, the pitfalls or the issues to look out  
6 for. One of the other issues that has come up is the  
7 interpretation of uncertainty assessment results when you're  
8 using simplified and/or conservative codes.

9 That's an issue that I have just started to talk  
10 about or just started to think about. I haven't talked  
11 about it too much yet. But it seems to me that there's a  
12 little bit more to the issue of when you're using a  
13 conservative code when you apply an uncertainty assessment,  
14 what exactly the uncertainty assessment results mean.

15 It's clear to me what they mean when you're trying  
16 to represent a site as realistically as possible, but if  
17 you're working on a conservative analysis, it's not always  
18 clear cut, and I think it deserves a little bit more  
19 investigation.

20 Another issue is the relationship between  
21 conceptual model uncertainty and parameter uncertainty for  
22 these simplified codes, and hopefully that's something that  
23 Slomo will be able to help me out on.

24 There is a variety of statistical correlation  
25 measures that have been proposed for use, and I haven't

1 really seen any good guidance on how to use those,  
2 particularly with respect to this particular problem.

3 In any event, this project is scheduled to be  
4 completed next year in October, and so we will have whatever  
5 work done at that point. That's all I've prepared.

6 DR. HORNBERGER: Thanks, Bill. Questions? Milt?

7 MR. LEVENSON: Yes, have one. In assessing the  
8 uncertainty for simplified models or conservative models, et  
9 cetera, do you find the uncertainty distribution as  
10 significantly different?

11 That is, I would guess that in a simplified model,  
12 the uncertainty might be symmetrical, whereas in a  
13 conservative model, it's highly unlikely that the  
14 uncertainty is symmetrical, and, therefore, you're getting  
15 into evaluating uncertainty and you need to connect that  
16 somewhat with the basic way you got the number in the first  
17 place; is that right?

18 MR. MEYER: I'm not exactly clear on what you're  
19 asking, but in general, the uncertainty tends to be -- the  
20 uncertainty in dose tends to be highly skewed, in my  
21 observations, so that you -- the distribution of dose has --  
22 tends to have a few values that are significantly larger and  
23 you've got a few cases in terms of your Monte Carlo results  
24 that result in very high doses, significantly higher,  
25 perhaps, then the median dose.

1 MR. LEVENSON: Yes, that comes out of the Monte  
2 Carlo, but the question is, if you've used kind of a  
3 simplified model, do you see a different skewing than if  
4 you're basically starting with something that's a very  
5 conservative model.

6 In a very conservative model, wouldn't you find  
7 fewer high doses in the uncertainty range?

8 We tend to use uncertainty as though it was  
9 symmetrical and independent of the number to which you apply  
10 it, and I don't think that's really correct.

11 DR. HORNBERGER: Perhaps I'll try to help clarify  
12 that.

13 MR. MEYER: Okay.

14 DR. HORNBERGER: The idea might be, if you have  
15 your log K distribution and you use the realistic log K  
16 distribution, even in a simplified model, then more or less  
17 you're taking into account that you could be wrong on both  
18 sides.

19 If, on the other hand, you took a, quote/unquote,  
20 conservative case and said, well, I'm going to not use that  
21 hydraulic conductivity distribution; I'm only going to use  
22 the very high end, then you would be injecting some  
23 asymmetry into the uncertainty involved because it would be  
24 much more unlikely that you would have higher values than  
25 you chose.

1 MR. MEYER: Yes, and that's my point out worrying  
2 about the interpretation of the results of an uncertainty  
3 analysis when you're using conservative models.

4 That's my concern, is that how do you -- it's not  
5 clear to me how you actually interpret the result, if you  
6 have a conservative model? The parameters really mean  
7 something different than instead of really meaning the way  
8 that I tend to interpret a parameter uncertainty. It's that  
9 it represents a degree of belief in the actual value of that  
10 parameter.

11 So if you're trying to represent some extreme  
12 values or more unlikely values, at the same time, trying to  
13 interpret the results as this is my degree of belief of the  
14 way the dose is going to be, those two seem to be  
15 irreconcilable to me.

16 MR. LEVENSON: I think I would agree, and that's  
17 why I raised the question. There is a tendency to make  
18 certain assumptions that uncertainty really defines that  
19 things could be worse.

20 And if you're doing conservative calculations, it  
21 may be that all the of uncertainty is on the other side.

22 MR. MEYER: Right.

23 MR. LEVENSON: I'd encourage you to pursue that  
24 effort.

25 DR. HORNBERGER: Ray, do you have anything?

1 DR. WYMER: No.

2 DR. HORNBERGER: John?

3 CHAIRMAN GARRICK: In your applications, have you  
4 begun to develop any feel -- or in your trial applications  
5 -- for how the contributors to uncertainty are distributed?

6 For example, how much does the retardation  
7 phenomenon contribute to the uncertainty? That's an  
8 interesting question, and, of course, it's very  
9 isotope-dependent.

10 But that's why I qualify it by saying in your  
11 applications, what have you learned about the principal  
12 sources of uncertainty?

13 MR. MEYER: In terms of these simplified codes,  
14 because they are simplified, the processes, the choice of  
15 processes as to what's going to actually have the most  
16 influence on dose, and, therefore, probably contribute to  
17 most uncertainties, is fairly limited.

18 And I mentioned the net infiltration rate having a  
19 strong influence on the dose. The distribution coefficient  
20 also is extremely important for exactly the same reasons.  
21 One is that it largely controls the release in these models.

22 The controls are released from the source, so it  
23 determines how much stays up in the source, in which case it  
24 could be good or bad, depending upon whether you have a  
25 pathway available to the surface that's independent of the

1 release from the source in water.

2 And the other thing that the distribution  
3 coefficient controls is the rate of transport via water.

4 CHAIRMAN GARRICK: Right.

5 MR. MEYER: So those are really the two dominating  
6 factors in terms of the parameters that I have looked at.

7 There are also some parameters that are particular  
8 to some of these models. In RESRAD you have to decide how  
9 you're going to -- or what the parameters are that govern  
10 the well location and the pumping rate from the well, and  
11 those are sort of related to the exposure. It's something  
12 that's difficult to predict how someone in the future, how  
13 the well -- some hypothetical well in the future is going to  
14 be configured.

15 And those parameters are pretty important also,  
16 that's my experience. Some of the other parameters that you  
17 might expect would be pretty important like the saturated  
18 hydraulic conductivity, because of the simplifications in  
19 the models themselves, tends to be less important, but maybe  
20 not realistic.

21 DR. HORNBERGER: Phil, as you know, if I look at  
22 D&D, in particular, that code, as you know, it was really  
23 developed as a screening tool. Now, whether you believe  
24 that's good, bad, or indifferent, that really was the intent  
25 when it was developed at Sandia.

1           And I'm just curious. In your work, obviously now  
2 your work and others' work on D&D is moving toward using  
3 this screening code in a more realistic context.

4           Do you see any problems in doing that?

5           MR. MEYER: I definitely do. And part of it's the  
6 issue of applying a screening code in not so much in --  
7 well, I mean, there is an issue of applying it in a  
8 site-specific case, but I think that that's more of a  
9 standard hydrogeological problem, deciding whether any code  
10 is applicable at a particular site.

11           There is nothing unique about that. I think the  
12 D&D code is fairly limited. It was intended to be limited,  
13 have limited application that should be conservative.

14           So, that's separate from the issue of trying to  
15 apply D&D using a probabilistic analysis, and that's the  
16 issue that we've been talking about, and I have some strong  
17 reservations at this point about that. That's sort of my  
18 intuitive feeling, but I haven't done any technical analysis  
19 to try to clarify that or make it clear to other people.

20           DR. HORNBERGER: Okay. The other question that I  
21 have is, clearly, as you said in not just D&D but RESRAD and  
22 MEPAS as well, you have to wind up, if you're going to use  
23 these in a site-specific case, defining effective parameter  
24 value, because they are effective parameters that are lumped  
25 models throughout.

1           So, you've done some work on how you might define  
2 these effective parameters. What I'm curious about is that  
3 in some of these sites, the evaluation is to be over fairly  
4 protracted periods, long time periods.

5           And my guess is that some of these effective  
6 parameters might depend upon the climate forcing that you  
7 have. And if your time periods are long enough and your  
8 climate changes, have you investigated how effective  
9 parameters might not be constant parameters?

10           MR. MEYER: Not really. I mean, one of the issues  
11 -- well, no, I'd say I haven't really looked into that.

12           I think that, just thinking about it, other than  
13 the forcing term from the top, the amount of water that  
14 you're applying to the system, I can't think of anything  
15 that would change. I mean, the soil properties are going to  
16 evolve over time, over a thousand years, and I don't know  
17 how much they would change, but probably relatively little.

18           So I haven't really looked into whether or not the  
19 effective value of the properties of the soil or a KD term  
20 would depend upon the amount of water you're applying to the  
21 system. I don't know if --

22           DR. HORNBERGER: What about rooting depth?

23           MR. MEYER: Rooting depth only comes in -- let's  
24 see, in RESRAD, rooting depth only comes in in terms of the  
25 external pathway -- not the external pathway, but the plant

1 uptake.

2 So, you know, those are issues that are -- it's  
3 really hard to deal with those.

4 DR. HORNBERGER: Those are unknowns.

5 MR. MEYER: Because you're speculating about  
6 future conditions.

7 MR. OTT: Thanks, Bill. We have asked the  
8 investigators to be reasonably brief so that they will be  
9 available afterwards for a group discussion so you can quiz  
10 them again.

11 So, both Phil and Glendon will be here after Slomo  
12 and Pete get done. But with that, I'd like to introduce Dr.  
13 Slomo Neuman from the University of Arizona, and Dr. Pete  
14 Wierenga.

15 Slomo will give the general overview for the  
16 project. The project also involves some test cases and  
17 using some datasets, one of which is actively being  
18 developed at the Apache Leap tuft site, and Dr. Wierenga  
19 will speak to that during the presentation.

20 MR. NEUMAN: Good morning. I do appreciate the  
21 opportunity to talk about our research with the ACNW with  
22 respect to the last two days' workshop. I can tell you that  
23 I have gotten away from it with one full page of handwritten  
24 suggestions, ideas and comments that I find very useful for  
25 my future work.

1           One very important element of the work we are  
2 doing is peer review, so any review and any comments that we  
3 can get from people with various backgrounds as this group  
4 would be, we would welcome.

5           The project that we are working on is formally  
6 titled Testing of Groundwater Flow and Transport Models. I  
7 am collaborating with our outgoing Department Head of Soil,  
8 Water and Environmental Science, Professor Peter Wierenga.  
9 The work has both theoretical, computational, and laboratory  
10 as well as primarily field components, so what we will do is  
11 I will present a very short overview, hopefully short  
12 overview, of what we are doing and then ask Peter to tell  
13 you a little bit about one of the major field studies that  
14 we are presently conducting in support of this work.

15           The object of our study as defined by the NRC are  
16 models of groundwater flow and transport as they impact  
17 performance assessment not only -- I understand that today  
18 you are focusing on decommissioning -- decommissioning  
19 reviews would be one aspect where these kinds of models  
20 would have some importance, but we are asked to actually  
21 consider the broader context of decommissioning, uranium  
22 recovery, low level and high level waste, so really it is  
23 the gamut of groundwater flow and transport modeling or  
24 modeling aspects as they impact virtually anything that the  
25 NRC is doing where groundwater plays a role.

1           The motivation for this study was that a number of  
2 years ago NRC Staff has identified conceptual models of site  
3 hydrogeology as a major source of uncertainty in performance  
4 assessment in any of these contexts.

5           I will not have time to define conceptual models,  
6 but let me just say that I understand behind the term  
7 "conceptual model" any hydrogeologic interpretation of site  
8 data. You go to a site. You collect whatever geological,  
9 hydrologic and other information you can, and you face a  
10 problem in that the subsurface is very complex. You have  
11 very limited information even when the database is large  
12 about that subsurface.

13           The system is an open environmental system and it  
14 is in the nature of open environmental systems of this kind  
15 that they are given to multiple interpretations. In the  
16 language of modeling they are given to the promulgation of  
17 multiple conceptual models, so the objective as defined for  
18 us was to recognize this and to develop as well as test to  
19 the extent possible experimentally -- this is why we are  
20 running an experimental component -- a method or a strategy  
21 for, first of all, selecting the correct model or range of  
22 models, interpretations for the available data, evaluating  
23 them, and hopefully coming up with some idea of how to  
24 assess the uncertainty associated with multiple  
25 interpretations.

1           Now I consider the NRC to have been prescient in  
2 its recognition of both of these problems, conceptualization  
3 and associated uncertainty, because very shortly after their  
4 request for proposal has come out, others have formally  
5 started recognizing that conceptual modeling is indeed of  
6 major importance for environmental issues

7           In particular, I thought that I would mention to a  
8 recent National Academy book called, "Research Needs in  
9 Subsurface Science," which was focused on the EM Science  
10 Program within DOE, and it lists four research emphases.  
11 The second in the list is conceptual modeling.

12           They propose to in fact do basic research in this  
13 area. They think that such basic research may eventually  
14 bring about the development of a tool box or methodologies  
15 and the NRC in fact is hoping that we will come up with a  
16 toolbox which focuses on new ideas, very strongly on  
17 groundwater heterogeneity because the subsurface is so  
18 complex and variable, scale dependence, and various aspects  
19 of uncertainty, so we are conducting our field work as well  
20 as much of our theoretical primarily in areas that encompass  
21 this range of issues.

22           One of the very first things that we were formally  
23 asked to do as part of this project is to review the  
24 literature, and that included a good number of  
25 representative NRC environmental impact and other types of

1 reports, but more so the general hydrogeologic literature  
2 and this is how I would today, from today's perspective,  
3 characterize some of the main conclusions that I have drawn  
4 from this literature survey.

5 I would start by saying that virtually all, with  
6 very few exceptions, attempts at groundwater modeling, not  
7 only by regulatory agencies or the DOE but virtually by  
8 every practitioner today, as well as very often by academics  
9 is to adopt a single conceptual model and once you decide  
10 what interpretation of the existing data you are willing to  
11 accept, you then run with it.

12 When we say that we are dealing with conceptual  
13 models, I think it would be fair to say that we are dealing  
14 with the most important and fundamental aspect of modeling,  
15 the very first step, where you decide what is it that you  
16 are going to deal with and how are you going to deal with  
17 it, the conceptual framework?

18 I will refer to it later in the conceptual  
19 mathematical context as the structural framework, the nature  
20 of your equations, not so much the parameters that enter  
21 into them, but just how do you write your equations, what  
22 processes do you include, what area are you going to study,  
23 what inputs are you going to adopt as being significant to  
24 your problem.

25 What perhaps surprised me to some extent, and

1 perhaps less so, was that I found myself focusing at the  
2 beginning primarily on what a statistician might call Type  
3 II modeling errors, and that is the adoption of an invalid  
4 hypothesis, in the language of the statistician -- for us it  
5 would be a model by not rejecting a model that perhaps is  
6 not entirely supported by the available data.

7           You may have a draft methodology report in your  
8 hand which contains not all but some of the many examples  
9 that I have collected, and many of them in the regulatory  
10 context -- not all of them in the regulatory context --  
11 where this arises.

12           And so I have literally focused on that very, very  
13 heavily until now. What is wrong with some of the models  
14 that people have been using? Why is it wrong, and what can  
15 be done? How can this be remedied?

16           I really think that everyone, including the NRC,  
17 needs help in just recognizing this problem. So I would say  
18 that Type II models are the most pernicious type, and for a  
19 scientist, they are always the worst, because no scientist  
20 wants to be caught with a criticism saying your theory is  
21 wrong.

22           Less so are Type I modeling errors, which also are  
23 a result of selecting a single conceptual model. Those  
24 types of errors arise due to the fact that even though the  
25 model you have selected may be justified by the data that

1 you have used to come up with it, there may be, and very  
2 often there are, alternative models which are equally  
3 likely, which you have not considered.

4 So you have, by rejection, essentially -- by  
5 omission, rejected possible valued alternatives which may or  
6 may not be important to the final performance assessment  
7 questions that you're asking, but that has to be  
8 established.

9 Type I errors are important to or can be analyzed  
10 using existing statistical methods, much more easily than  
11 Type II methods. So, our approach at the present is to look  
12 primarily in a subjective manner at this type of error and  
13 try to introduce quantitatively uncertainty due to the other  
14 type of error.

15 It becomes very apparent, primarily because of  
16 Type I errors, that by working with a single hydrogeologic  
17 concept, a priori, and never considering anything else, one  
18 would, a priori, underestimate uncertainty, because of  
19 under-sampling of the model space, but even of more concern,  
20 at least of concern to me, is the possible statistical bias,  
21 if you wish, introduced by Type II errors when one chooses  
22 an invalid model.

23 So, I was very concerned with that for quite some  
24 time and still am.

25 CHAIRMAN GARRICK: Do you distinguish between the

1 issue of invalid model and the misuse of a valid model?  
2 Under sampling could be a misuse of a valid model.

3 MR. NEUMAN: Not necessarily a misuse, but by  
4 selecting a model which is appropriate for the task, given  
5 the data that is available, all models that we use are  
6 conditioned on the information available to us. The  
7 information is never complete, so everything is conditioned  
8 on what you have.

9 By not considering other possibilities, you may be  
10 excluding outcomes of a performance assessment that you  
11 should not be excluding, so the outcomes that you do  
12 consider may be valid outcomes, given the information that  
13 you have.

14 But there may be other valid outcomes which simply  
15 never enter into the picture.

16 CHAIRMAN GARRICK: That's what you mean by the  
17 alternative?

18 MR. NEUMAN: Then we mean exactly the same. And  
19 in the report, there are quite a number of examples, one of  
20 them, for example, being the issue of what causes the high  
21 hydraulic gradient on the Northwest side of Yucca Mountain.

22 And I present in the report in your hands, a  
23 step-by-step analysis that I have done of -- I don't  
24 remember how many -- seven, eight, nine, quite different  
25 conceptual models that have been proposed by various people

1 for this. And I rank them according to my own  
2 understanding.

3 And it is this kind of ranking that I hope we will  
4 be able to incorporate into eventually a guidance document,  
5 which is what the NRC hopes. I don't know how successful  
6 such a guidance document can be. It can never encompass all  
7 possibilities, but that should be an example of what we hope  
8 to do in terms of Type II errors, in particular, in other  
9 words, eliminate all models that are not fully supported by  
10 all the available data, and rank the remaining ones in terms  
11 of this the most likely or most plausible in light of the  
12 data and so on and so on.

13 So, this is systematic conceptualization, as well  
14 as an attempt to introduce uncertainty into the analysis,  
15 due to less than ideal models. A question which is of great  
16 importance to those who use simplified models -- of course,  
17 the NRC, as well as other regulatory agencies, as well as  
18 the DOE, do rely on multimedia models in which the  
19 hydrogeologic component -- and I cannot speak to other  
20 components -- is greatly oversimplified.

21 So the question then arises, and, in fact, has  
22 been raised earlier, how does that simplification impact  
23 both the choice of the model and the uncertainty associated  
24 with it, the Type I and Type II errors?

25 One of the things we will try to do is to come up

1 with a formalism by which a complex hydrogeologic  
2 environment, as it is implied by the available data, could  
3 be simplified by appropriate averaging techniques, whether  
4 it is averaging in space, or averaging in time. Our  
5 preference is averaging in probability space, because it  
6 maintains some of the information about spacial variability  
7 that is so important to geologists and hydrogeologists.

8 But it certainly is not the only way in which this  
9 can be done. But one of the conclusions from my literature  
10 survey was -- and I was surprised to hear this gentleman ask  
11 earlier about conservative complex models versus less  
12 conservative simple models, because what I keep hearing from  
13 the NRC licensing staff, and what I keep reading in the NRC  
14 documents, and not only NRC, is the notion that simple  
15 models are, a priori, conservative, simple and perhaps  
16 generic.

17 And I find that not to be the case in many cases  
18 -- in most cases I have examined.

19 So it's kind of a little bit going the other way.  
20 Here is what we are then attempting to do:

21 We are attempting to develop a methodology which  
22 addresses the issues I have just listed. It definitely does  
23 focus on the subsurface hydrogeologic aspect of things, so  
24 it doesn't cover everything.

25 The two elements are conceptualization and

1 uncertainty. Our work is generic in that it should apply to  
2 the entire gamut of groundwater-related modeling activities  
3 that the NRC is concerned with, but we hope that it will be  
4 of practical use.

5 I hear today that the NMSS is not finding the  
6 material we have so far released as being of direct  
7 practical use to them. I am surprised to hear that in light  
8 of my review, because I think that some of the examples I  
9 have included should already have been of use as examples of  
10 how one should attempt to eliminate Type II errors, which,  
11 in fact, can be found in some documents.

12 But we will try, and this will require more  
13 communication between us and the NRC over the next year or  
14 two. We will try to make it sound even more practical by  
15 developing step-by-step guidelines to what one should be  
16 doing.

17 We are very much interested, and I think it's very  
18 important that our research be supported by real site data.  
19 And this is one reason why we are applying, testing some  
20 aspects of the ideas and the methodologies that we are  
21 developing, on real sites.

22 And the ultimate product should be a systematic  
23 framework for identifying and quantifying uncertainty, once  
24 the systematic logic for conceptualization has been  
25 completed.

1           As Phil Meyer has pointed out, we benefit from  
2 collaboration with PNNL, and here are some examples of  
3 actual collaboration: Exchange of databases, learning  
4 methodologies, especially the Bayesian Methodology, which  
5 one of my students has used, the one that Phil Meyer has  
6 developed with Glendon and his colleagues.

7           It was already mentioned that Mary Hill of the  
8 USGS and I are organizing a special session for the Fall  
9 meeting on predictive uncertainty of groundwater models. I  
10 was hoping originally that it would be a special session,  
11 not only on predictive uncertainty but also on conceptual  
12 models. That was vetoed by the AGU committee that looked at  
13 it.

14           They consider conceptual modeling to be a nebulous  
15 concept, not clear just exactly what it means, and very  
16 little work has been done. I forgot to mention, but that  
17 was one of my findings from the literature survey.

18           There is virtually nothing in the hydrologic  
19 literature. I shouldn't say nothing, but virtually nothing  
20 about conceptual modeling.

21           It's starting to come out. This book that was  
22 mentioned earlier, which is supposed to come out will soon  
23 be perhaps one of the very first things about it.

24           And we hope to eventually transfer this  
25 information through some kind of a workshop to the NRC

1 licensing staff. We envision, at the current budget rate,  
2 to complete this in about two years. If the budget changes,  
3 so will this change.

4 Now, I will not go at this point into the details  
5 of this overhead, because I think I'm taking more time than  
6 I should, but I will mention that there is an established  
7 methodology in groundwater modeling -- I will refer to it as  
8 the traditional approach. This is the most recent and  
9 sophisticated representation of that traditional approach.

10 There is an approach that one can use with  
11 existing tools and concepts and very often does use in  
12 groundwater hydrology where one postulates a deterministic  
13 model, then postulates an uncertainty model for the  
14 parameters. Sometimes, if there are monitoring data,  
15 optimizes these parameters, these prior parameters to come  
16 up with posterior parameters and associated uncertainty, and  
17 then propagates the uncertainties through the model. There  
18 are various techniques to do that.

19 We hope to transcend this by incorporating in this  
20 methodology, ideas relating to structural model uncertainty,  
21 the conceptual mathematical aspects, and ideas which are so  
22 important in a geology where things vary on a multiplicity  
23 of scales beneath your feet, no matter where you go.

24 There are issues of resolution of information lost  
25 by averaging. There are serious issues of scale, and

1 uncertainty or randomness due to an inability to measure  
2 everything beneath our feet.

3           These issues to which I refer to as stochastic  
4 elements, because they are typically treated in a stochastic  
5 manner, these two aspects, we are working on, incorporating,  
6 piecemeal, because there is no way we can cover the field,  
7 into our theory -- or into our methodology, I should say.

8           So that would be the first bullet on this next  
9 overhead, integration of structural and stochastic aspects  
10 into the traditional uncertainty analysis that is presently  
11 available as a tool, perhaps has to be put into a single  
12 document, but we are finding that that doesn't always work.

13           One of the requirements at this stage is to come  
14 up with effective parameters. I'm so happy that that  
15 concept has arisen earlier.

16           These effective parameters encounter a severe  
17 problem of scale. An effective parameter for this volume is  
18 not generally going to be the same as an effective parameter  
19 for this volume, and an effective parameter for one type of  
20 hydrogeologic variable is going to be different than for  
21 another.

22           So, we find that the traditional approach may  
23 sometimes not be the best, and so we are also developing and  
24 looking at potential non-traditional ways of incorporating  
25 those two aspects into the methodology.

1 I will finish my part of the discussion by just  
2 alerting you to this. There is a series of two overheads.  
3 I will not go through this unless you ask me to go  
4 specifically through some aspects.

5 But it lists for you, work to date, part of which  
6 has been completed, and part of which is ongoing. And under  
7 each element here, work element, you will see whether it is  
8 ongoing or completed.

9 I did mention the literature review which resulted  
10 in the letter report of March, 1998. A draft methodology  
11 letter report, which we hope will evolve into a NUREG,  
12 hopefully rather soon, that was published last November.

13 Our field laboratory -- we have more than one, but  
14 the active field laboratory now is the Apache Leap research  
15 site, and I remember talking to you about that last time we  
16 met. Probably the members of the Committee are not entirely  
17 the same, but nevertheless, I'll be happy to go back to that  
18 discussion.

19 I will only mention, and then stop, that the past  
20 work that was done at the Apache Leap research site, which  
21 is an unsaturated fractured rock site, was done with  
22 high-level nuclear waste as the focus, though the work is  
23 entirely generic, and most of the work that my group has  
24 been doing there -- of course there were previous groups  
25 also under NRC support that have been doing work there --

1 most of our work was associated with air testing and  
2 characterization of the rock, as well as study of scaling  
3 properties and so on, using air.

4 All of that has now been completed. It has led to  
5 a certain conceptual framework that we feel comfortable  
6 with, and that was an evolution, and I will be happy to  
7 discuss that, if that is of interest to you.

8 The question we are asking now is how relevant is  
9 all this air testing and the results obtained from that, to  
10 water flow? And that is of concern, not only at Yucca  
11 Mountain. We considered this site to be a sort of analog of  
12 Yucca Mountain, but it would be of interest to any site  
13 close to the surface in which a fractured porous rock -- it  
14 doesn't have to be tuft; it could be sandstone; it could be  
15 chalk -- is encountered.

16 For that purpose, Professor Peter Wierenga is  
17 running at the site, water and tracer experiments, and I  
18 would now call on Peter to tell you a little bit about those  
19 experiments.

20 DR. CAMPBELL: Before Pete gets started, I want to  
21 apologize that we don't have his viewgraphs. We will get  
22 copies of his viewgraphs after we're done today. And if you  
23 accidentally in the audience got a set of viewgraphs that  
24 are missing -- these are two-sided viewgraphs, and the ones  
25 that were handed out, if you got a set that's only

1 one-sided, throw it away, and there are some two-sided  
2 viewgraphs in the back.

3 MR. WIERENGA: Thank you very much. It is a  
4 pleasure for me to present my material here at this  
5 distinguished meeting.

6 The cooperators after the program, I am listing on  
7 this overhead. This is in addition to myself and Dr.  
8 Neuman, we have a post-Doc and a technician and a retired  
9 scientist from the USDA, Mr. Rice, who is on an hourly basis  
10 also helping out on this project based on his extensive,  
11 very extensive field experience in this area.

12 The sites are located in southern Arizona, or  
13 central Arizona, more or less. And we have talked today  
14 about two sites. The site of my talk today is the Apache  
15 Leap site. That is about the same elevation as Phoenix.  
16 Here is Tucson and here is the border with Mexico, of  
17 course, and there is the Maricopa site that was -- we did  
18 earlier studies, and hopefully will continue additional  
19 studies.

20 This is a regular alluvial site, and this is a  
21 fractured rock site.

22 The fractured rock site was used for earlier  
23 studies by Dr. Neuman and his students, and they did the air  
24 permeability studies on this site, and they installed these  
25 bore holes, vertical and standard bore holes. There is

1 another one somewhere here.

2 And they did air permeability studies between  
3 those bore holes. They cleaned up part of the site, and  
4 found a large fracture here, and then built our infiltration  
5 studies over this site, so this is Plot Number 1, 2, 3, 4,  
6 5, 6, 7, 8, 9, so we established nine plots, each three by  
7 three meter for a total plot size of nine by nine.

8 And then we installed various observation points,  
9 measuring devices, drilled holes and installed measuring  
10 devices below the surface of these plots and then flooded  
11 the plots with water.

12 We kept a constant head of water on the plot. I  
13 show you a few slides, additional slides of that setup.

14 The devices that we used to measure the water  
15 below the surface of the plots were basically three devices:  
16 One is the neutron probe, which gives us a relative count  
17 rate which is related to the water content or the degree of  
18 saturation.

19 We used a tensiometer which measure the matric  
20 potential in the rock material. The matric potential is  
21 related to the energy with which the water is held in a rock  
22 material, and then we used a solution sampler that is used  
23 to extract the pour water from the rock material which we  
24 then take to the laboratory to analyze.

25 So these three devices were installed on each plot

1 at different depths. This is a viewgraph of a tensiometer  
2 which is a porous body that is filled with water and then we  
3 have -- basically we have here a pressure transducer and the  
4 pressure transducer has it's leads to a data logger at the  
5 top, and the negative pressure that we measure then with the  
6 pressure transducer after is in equilibrium and the  
7 surrounding material is recorded, and that gives us an idea  
8 of the degree of saturation or the matric potential of the  
9 rock material.

10 This is one phase of the installation of the  
11 material. This is the solution sampler. There are two  
12 leads to the surface, and we apply vacuum on those, and draw  
13 the samples through this porous body into the stainless  
14 steel and then apply pressure and force it to the surface,  
15 so we have those at five depths below the surface.

16 Here is a further version of the project. Here we  
17 have completed the -- we have a concrete barrier around each  
18 plot and these are the various devices in each plot, and  
19 these are the supply tank, and each tank is connected to one  
20 plot and by measuring the level of water, the rate of  
21 waterfall in this tank we know how much water has  
22 infiltrated to the surface of this plot. It's a fairly  
23 simple setup.

24 DR. HORNBERGER: Did you tag the water at all,  
25 Pete?

1 MR. WIERENGA: Now we have lately tagged it with a  
2 bromide tracer. We would like to do additional work on it  
3 but I will show you some results and show you what comes out  
4 of it -- but we could tag the water in each individual plot.

5 DR. HORNBERGER: Right.

6 MR. WIERENGA: This is a later completed version.  
7 We also built a structure over this -- this is our  
8 instrument trailer -- so it prevents rain. Of course, the  
9 surface of each plot, there's a floating cover on each plot  
10 so we have no evaporation losses and whatever goes into the  
11 plot we know pretty sure that all of that is infiltrating in  
12 the plot.

13 DR. HORNBERGER: It looks like Biosphere 3.

14 [Laughter.]

15 MR. WIERENGA: Thank you. It's hot too. It is  
16 warm and in the winter that is nice to work on it, and in  
17 the summer it gets awfully warm, a little too hot.

18 There is a great deal of variation, variability --  
19 not variability but spatial variability in the infiltration  
20 rate. This is the cumulative amount of water that was added  
21 to each of those plots of the first 200 days. We are now at  
22 about Day 250 so we started this experiment just before  
23 Christmas, started flooding it, and so you see in Plot 3 and  
24 9 we have fairly high rates but at Plot 5, for example, we  
25 have only a rate .036 and these are in between.

1           The rates are fairly steady but here they drop off  
2 a little bit and these are also steady but then they  
3 accelerate. Why that is? We don't really know that.

4           In a mineral soil you would see, of course,  
5 initially you would have a very high rate going into a dry  
6 soil, but as time goes on you would see a slowing down of  
7 the rate and sometimes a great deal of slowing down of the  
8 rate but in this fractured material this is not happening.

9           The data that we have from this is this is an  
10 example of the relative count rate measured with a neutron  
11 probe. The relative count rate, as I said, is related to  
12 moisture content. As you see, as time goes on at 30  
13 centimeters the water content is increasing and so is it at  
14 55 but to a lesser degree. The water content was much  
15 slower at 30 centimeters initially than at this depth,  
16 therefore it has a lower count rate because of the drying  
17 out of the profile before we started the experiment, but  
18 then gradually wetted up.

19           This is the deeper one at 450 centimeters was  
20 initially already quite moist, and there you see that it is  
21 30 and 150 centimeters. It kind of reached the same  
22 relative moisture content, so this is kind of the behavior  
23 that we observed with the neutron probe.

24           It is a very slow process. I thought the  
25 experiment would have already been over, but this is a

1 long-term experiment because the permeability of the  
2 material is not fairly high.

3           Now in a vertical direction, you see a great deal  
4 of variability. You barely see -- you see the water  
5 infiltrating. You could see some, in this particular plot,  
6 some response maybe down to these depths. These variations  
7 are mostly due to uneven absorption of water from the rock  
8 material itself by the dry bentonite that we packed around  
9 the neutron probe. We have to pack everything with  
10 bentonite to prevent preferential flow along the observation  
11 devices down to the subsurface.

12           Another set of readings is from the tensiometers.  
13 This is in Plot Number 9, an example of the tensiometer data  
14 that we get with tensiometers. As you can see, there's a  
15 couple interesting things. Initially at the surface it was  
16 dry so you get a very negative matric potential, but as the  
17 water front arrives it gets fairly wet, so it wets up and it  
18 becomes closer to saturation.

19           The saturated soil of course, the matric potential  
20 is zero, and that 1 meter is following and then the 2 meter  
21 is following. The 3 meter is fairly steady. Initially it  
22 was wetter because that became -- we packed the tensiometer  
23 cups in a wet silica flour, and that finally diffused into  
24 the surrounding rock but here it stabilized and then the  
25 water front is arriving and it gets closer to saturation.

1           The 5 meter depths again was a little water  
2 because of the construction of the tensiometers'  
3 installation, then it's fairly flat and nothing -- the  
4 waterfront clearly has not arrived there.

5           Now then, is this a good example or is this a bad  
6 example? In the next slide I have plotted all of them, all  
7 of the data from all of the tensiometers, and you see a  
8 large variation in their behavior. While this one is  
9 arriving fairly fast, Plot 8 is responding fairly fast, this  
10 is at 50 centimeters, Plot 7 is really a laggard and it took  
11 almost -- what is this? -- 100 days between the arrival  
12 between one plot versus another, so it is not a fairly even  
13 process and that is what you quite often see in the actual  
14 world in the hydrogeological setting.

15           Now this is at one meter. Again this is arriving  
16 later, but the behavior is also slower. It is slowly  
17 wetting up, so it looks almost like it's matric flow and not  
18 fractured flow in this sense. Otherwise in fractured flow  
19 one would see a rapid increase at some depths, at some  
20 tensiometer, but here we don't see this, but again quite a  
21 difference between the arrival of the wetting front at that  
22 depth.

23           This is the three meter one and again we see here  
24 slowly wetting up here, here it was already. The moisture  
25 content was relatively high already at the 2 meter depth,

1 but here we see for example the 6 meter one is increasing,  
2 the 2 meter is fairly steady but then starts increasing, so  
3 I am feeling that the moisture front has kind of arrived  
4 after about 100 days at this particular depth, by and large.

5           These are the tensiometer data. Now of course  
6 after about 200 days, we added a bromide tracer to all the  
7 plots, to the water in all the plots, and so far we have  
8 seen only appearance of the bromide in the subsoil of the  
9 Plot Number 8 at 1 meter, and the amount of bromide was 30  
10 parts per million, I believe, and so we see an increase in  
11 the bromide concentration at this depth at, after day ten,  
12 but we did not see any bromide at 50 centimeters, although  
13 we have a device there, and we did not see bromide at any  
14 other points except at 5 meters it is appearing now -- I  
15 mean at half a meter in Plot 5 and last weekend, this past  
16 weekend, my people told me it was up to 10 parts per  
17 million, so this data shows fairly irregular behavior of the  
18 water flow, but much more so of the tracers, and I think  
19 this tracer is, in my opinion, clearly some indication of  
20 fractured flow in this plot and perhaps this one also.

21           Maybe we will see more of it as the waterfront and  
22 the tracer front is moving deeper in the profile, but so far  
23 we have not seen any response to the tracer. What we'd like  
24 to do also to learn a little bit more, have a different  
25 tracer on each plot. The problem with that is the cost of

1 analysis goes up a little bit, and I don't know whether we  
2 will be able to afford it, but that would give us even more  
3 insight in the behavior of the tracer through the subsoil.

4           So if I can -- by the way, the bromide behavior is  
5 also clear from the washing out of the salt. The salinity  
6 of the subsoil is relatively high, so when the salinity  
7 decreases, the bromide increases so we have two independent  
8 measures that it is not an analysis problem. It is really  
9 actual data.

10           So far we have regular variability in infiltration  
11 rate. After flooding 200 days more or less you reach the 3  
12 meter depth and we have not yet reached the 5 meter depth  
13 except in one plot. It seems to break through.

14 Breakthrough of bromide has occurred at Plot 5 at half a  
15 meter and at Plot 8 at one meter, but no bromide observed at  
16 other points and the early bromide breakthrough in Plot 8  
17 indicates fractured flow.

18           That is what I wanted to tell you about this  
19 experiment. Hopefully, if we continue this, at least maybe  
20 another half a year or a year, constant flooding, then we  
21 will learn a little bit more about the importance of  
22 fractured flow at this point. So far, I feel I wasn't  
23 totally convinced that we would see fractured flow, but my  
24 conceptualization of that plot was incorrect and I must now  
25 see that we do have fractured flow at this site and that has

1 to be accounted for in the models even though maybe it is  
2 happening only at one point, but one point over 9 x 9 is 81  
3 square meters. If you multiply that over a larger area,  
4 then it becomes quite often -- quite clear that this kind of  
5 behavior is very important for environmental impacts.

6 Thank you for your interest.

7 DR. HORNBERGER: Thank you, Pete. I am sure we  
8 have some questions for Slomo and Pete. I just would -- for  
9 those on the committee who perhaps don't recognize it, I  
10 should point out that we have a phenomenal concentration of  
11 expertise on the vadose zone processes in semi-arid and arid  
12 conditions in this room. Woe be the world if we had a  
13 disaster in this room today.

14 [Laughter.]

15 DR. HORNBERGER: That is not their only expertise  
16 but I know the committee has some interests in vadose zone  
17 processes in arid regions, and I just want to remind you  
18 that you can take advantage of the expertise in the room.

19 Questions for Pete or Shlomo? Ray, do you want to  
20 go first or do you have to bug out?

21 DR. WYMER: I have to bug out. I know very little  
22 about the field but I do know Shlomo and I am impressed with  
23 the clarity and lucidity of it and the very high conceptual  
24 level that you have tackled her and the information you have  
25 presented. That is about the extent of what I can talk

1 knowledgeably about.

2 MR. LEVENSON: I just have one comment in response  
3 to Shlomo's question. My question was really not as to  
4 whether simple or complex models were more conservative. My  
5 question was the distribution of uncertainty should not be  
6 the same for conservative and nonconservative models.

7 MR. NEUMAN: If I may just make an observation in  
8 that respect, one of the attributes of relatively simple  
9 models with fewer compartments, larger compartments that is  
10 often cited is the fact that the variance of the parameters  
11 reduces as the size of the compartment or the averaging, the  
12 level of averaging increases, and that is definitely true,  
13 so you could say uncertainty goes down, but on an overhead  
14 which I think you may have but I have not shown I make the  
15 observation that at the same time the mean of the  
16 distribution moves as you average, and so by averaging you  
17 are moving, shifting the entire distribution -- yes,  
18 indeed -- you are reducing the spread, but you are removing  
19 the mean, and unless you are aware of it and factor it in,  
20 you end up with a bias, and I am more concerned with that  
21 bias -- in other words, the reduction of the uncertainty.

22 MR. LEVENSON: That is really the issue that I was  
23 trying to address. Very good. Thank you.

24 DR. HORNBERGER: John?

25 CHAIRMAN GARRICK: Well, I am not going to talk

1 about the earth science component of this but one of the  
2 things that this committee has spent a lot of time advising,  
3 if you wish, the NRC on, is that analyses ought to be done  
4 on the basis of getting a handle on results that are as  
5 realistic as possible.

6 This debate of uncertainty analysis and  
7 conservative uncertainty analysis makes no sense to me. If  
8 you are talking about an uncertainty analysis the only time  
9 it makes any sense to me is when it is uncertainty about  
10 what you consider to be a reasonable model and a reasonable  
11 investigation.

12 A set of distribution functions that are called  
13 conservative to me don't have much meaning. A set of  
14 distribution functions that are a direct result of your best  
15 attempt at a realistic appraisal of a parameter or an  
16 aggregation of parameters does make sense, and then the  
17 concept of conservatism is something you apply in the face  
18 of that information, but I was just curious about some of  
19 the strategies that you are adopting here as far as these  
20 dose calculations are concerned in terms of the uncertainty  
21 analysis and I think it is essentially an oxymoron to talk  
22 about uncertainty analysis and conservatism.

23 To be sure, the distributions ought to be your  
24 best shot at what you believe your state of knowledge is  
25 about a parameter --

1 MR. NEUMAN: I am extremely glad to hear you say  
2 that because that is exactly my philosophy.

3 CHAIRMAN GARRICK: Yes.

4 MR. NEUMAN: I am willing to accept from  
5 regulatory agencies sometimes the need in the face of lack  
6 of information and lack of ability to develop a fully  
7 realistic model to err on the side of conservatism, but I  
8 can think of many examples where the word "conservatism" as  
9 you suggested has no meaning and my favorite example, which  
10 is a very simple one, when you are propagating a solute --  
11 it could be a contaminant or otherwise -- through a column  
12 of porous medium it will depend, the transport will  
13 depend -- for inert tracer will depend on the velocity and  
14 on the dispersivity of the medium.

15 If you change the dispersivity, you make it small,  
16 you get a sharp front and it will take longer for the  
17 contaminant to reach the edge. One could say that by  
18 therefore increasing the dispersivity, one is being  
19 conservative because one will get a sooner and earlier  
20 breakthrough.

21 Well, but at the same time, you will get a lower  
22 peak because you have increased your dispersivity and in  
23 that sense you are not conservative.

24 So I couldn't agree with you more that the notion  
25 of conservatism often doesn't make sense, and I would

1 perhaps add to this that I think it has been grossly misused  
2 and is being grossly misused.

3 CHAIRMAN GARRICK: Well, the point is that there  
4 is a point beyond which you obscure the truth. You obscure  
5 the validity of the analysis and what the evidence for that  
6 analysis can support.

7 MR. MEYER: I just want to make a clarifying  
8 comment, since you seem to be addressing some of the issues  
9 that I raised.

10 The issue is not so much the use of conservative  
11 distributions for parameter values. The parameter values,  
12 the distributions of those that we have used in all of our  
13 analyses, are not conservative parameters.

14 They represent the best estimate of the knowledge  
15 about that parameter at a particular site, and in the face  
16 of limited data.

17 However, the models themselves, the implementation  
18 of the processes, which in the codes are intended to be  
19 conservative in some way, and so you're taking those --

20 CHAIRMAN GARRICK: Well, this is --

21 MR. MEYER: You're taking the parameters that may  
22 not -- that aren't conservative, but you're applying them in  
23 models that may be intending to model the whole situation in  
24 a conservative way.

25 CHAIRMAN GARRICK: It was designed that way

1 because it's a screening tool, and so I understand that,  
2 yes.

3 But what we're trying to preach here is, let's  
4 understand, on the basis of the evidence, what can be said  
5 about a parameter, and then if we want to apply conservative  
6 values or criteria to that, we can do that. But let's start  
7 with knowing what our best shot is and what the real answer  
8 is.

9 MR. MEYER: Right.

10 DR. HORNBERGER: Slomo and Pete, you've introduced  
11 a very vexed question, this whole issue of structural  
12 uncertainty, if you will. And now that you've changed -- or  
13 Pete's changed his mind about his conceptualization, okay,  
14 at the Apache Leap site. He just told us that.

15 But I'm curious now, given that, does that just  
16 mean that you change your favorite conceptual model, or does  
17 it mean that you actually have several different conceptual  
18 models that you would apply now?

19 MR. NEUMAN: Do you want to start, Peter?

20 [Laughter.]

21 MR. WIERENGA: Well, of course, one should always  
22 be open to different conceptual models. And focusing on one  
23 conceptual model that things will happen, like you have in  
24 mind beforehand, that is not the right way -- not the right  
25 way to conduct science.

1           So, I think that, while I discussed it with Slomo  
2 this morning, he thinks that a continued model with the  
3 possibility of having fractured flow in the -- with a spot  
4 of the -- model, is probably the way to go.

5           And I would agree with that. It looks to me that,  
6 you know -- and I'm not an expert in fractured rock, but it  
7 doesn't really matter so much, where that fracture is, but  
8 what does matter is that the water of the tracer gets there.

9           And so maybe it's more important, how many of  
10 these fracture one has per surface area that contribute to  
11 quick transport of contaminants from the surface to the  
12 subsoil or to the groundwater, but not necessarily, you know  
13 -- we really don't have to know precisely, the description  
14 of the pathway; what we need to know is what is the chance,  
15 what is the -- how many of these pathways are there per  
16 surface area, to do the modeling?

17           And maybe Slomo has a better answer to it, but,  
18 yes, I did change my position.

19           MR. NEUMAN: Not better, but I just want to add a  
20 little bit. And that is that we have been working at this  
21 site for at least a decade now. And our concepts have been  
22 gradually shifting.

23           My own work until now, as I said, was associated  
24 with air flow. Well, we are now pretty much convinced that  
25 in order to properly characterize air flow under the

1 conditions of our testing in the past, one could justify  
2 taking this fractured medium and conceptualizing it for  
3 modeling purposes as a heterogeneous continuum in which  
4 permeability varies, air permeability varies from point to  
5 point, according to a random field model.

6           And we have come up with a particular fractile  
7 representation of that, but that's kind of a secondary  
8 issue. So a continuum stochastic representation, random  
9 field representation, seems to work for as far as describing  
10 the heterogeneity that we could observe, based on our  
11 experiments.

12           Now comes Peter's experiment, and low and behold,  
13 I do not think that the particular air permeability model  
14 that we have developed is fully going to explain the air  
15 flow -- the water flow.

16           We don't know, though, because our air tests were  
17 down below three-meter depths, and his water has not reached  
18 below three meters yet. So it's extremely important that we  
19 continue this test for at least half a year to a year to see  
20 just how deep this will get, and hopefully so it gets into  
21 the domain where we do have air permeability data and see  
22 what happens.

23           But even more important than that is what Peter  
24 showed you about the difference in behavior between water  
25 and tracer. It is obvious, I think, based on his

1 preliminary results, and likewise obvious if you compare the  
2 air and the water results so far, that a conceptual model  
3 and associated mathematical model that may work for one  
4 phenomenon, may not work for another phenomenon. And that  
5 is the really interesting thing that is happening here.

6 This is why I think this idea is so interesting.  
7 It also raises some extremely interesting scaling issues.

8 And so as far as I'm concerned, if I may enter a  
9 plea here, in the past we have been working for the NRC at  
10 other sites. One of the earlier sites was in saturated  
11 granite at a site called Oracle.

12 We were able to extract a lot of very useful  
13 information from that. One of the conceptual changes that  
14 that site has instituted, in my own mind, is that I started  
15 that work believing that one should be able to carefully map  
16 in three dimensions, the distribution of fractures in  
17 granite and then use that geometric information, plus  
18 geologic understanding of the fractures, to make predictions  
19 about flow.

20 And the conceptual shift that has occurred in my  
21 mind was that that is not a viable way to proceed. And I  
22 now have collected a huge set of data from other sites which  
23 supports that.

24 But the plea: What has happened is that as we  
25 have completed our -- the easy part, the hydraulic testing

1 part, the project's original plan called for additional  
2 tracer testing.

3 But we were stopped in the midst, and we were  
4 never able to verify that what we have learned about the  
5 site regarding hydraulics, would also apply to contaminant  
6 or tracer transport, because the budget was cut right there  
7 because Congress shifted its interest onto Yucca Mountain,  
8 and so everything had to now go into the vadose zone, and we  
9 were dealing with the saturated zone below the water table.

10 It took the Department of Energy and others years  
11 to discover what we have said at the beginning, that Yucca  
12 Mountain does have a saturated zone, and one should not  
13 focus only at the shallow area, but the original concept was  
14 that contaminants will never reach that deep.

15 So, these concepts are changing and evolving with  
16 time. And my plea is the following:

17 The same thing happened to us with air  
18 permeability testing at the Apache Leap. The original  
19 program was to continue with gaseous tracer tests. And  
20 Walter Illman, I don't know if he's in the room or not, who  
21 conducted the pneumatic tests for us, was all set up with  
22 his technician to go ahead.

23 But then the budget was cut for that, and so we  
24 have never had a chance to do tracer tests. And just think,  
25 if Peter did not have a chance to run tracer tests in

1 conjunction with his water tests, how less rich would we be  
2 about our understanding?

3           How much more limited would we be in our ability  
4 to see what is happening at the site? I really think that  
5 it is absolutely essential that there be more continuity in  
6 the funding of projects which the NRC considers, a priori,  
7 to be meaningful; otherwise, let's not even start funding  
8 them.

9           But if you fund them, fund them continuously so  
10 that a good amount of information of this kind can be  
11 gained. So in this particular case, I would just simply  
12 suggest, let's make sure that Peter has the budget to run  
13 his experiment for at least another half a year to a year.

14           DR. HORNBERGER: To the extent that the ACNW  
15 controls the Office of Research Budget, we will dot hat.

16           [Laughter.]

17           MR. NEUMAN: I know you don't.

18           MR. WIERENGA: I would like to add, though, that I  
19 feel that, in general, the NRC research staff has been very  
20 supportive and very generous in the support of my research  
21 and Dr. Neuman's research.

22           But there are things outside their control, also,  
23 like it is out of your control, it is also out of their  
24 control.

25           And I'm really grateful for all of the support

1 that I have had from the Nuclear Regulatory Commission to do  
2 this work. I would be happy for the support.

3 MR. NEUMAN: All I can say to this is amen, and,  
4 in particular, Tom Nicholson really deserves, I think,  
5 accolades for the way he has been supporting our research  
6 all these years.

7 DR. HORNBERGER: Before I leave and let you off  
8 the hook on my question, I'll let you guys off the hook, but  
9 I wanted to see if I could put Glendon on the same hook,  
10 because I know that he has a lot of insights developed from  
11 lots of work he's done at Hanford.

12 Do you have any insights on this whole issue of  
13 structural model uncertainty and how we should handle it for  
14 vadose zones?

15 MR. GEE: Well, I am very interested in, and  
16 endorse Slomo's approach. I think it's not been done  
17 before.

18 Certainly Hanford is just beginning to come to  
19 grips with these kinds of problems. Charlie Kincaid, who  
20 basically is doing a lot of the modeling for the Hanford  
21 site was here yesterday, but unfortunately he's not here  
22 today to perhaps provide some insights.

23 But basically I think he actually came for the  
24 two-day presentations so he could listen and learn and  
25 hopefully integrate some of the things that are being

1 planned, and benefit from the NRC research in this area.

2 I just think it's an extremely important aspect of  
3 the modeling that has not been looked at before, and I'm  
4 grateful that NRC is interested in it.

5 DR. HORNBERGER: I just have one other general  
6 question: I don't know if any of you -- well, I'll throw it  
7 out and see if any of you want to answer it.

8 One of the things that we get asked, that is, the  
9 ACNW, in evaluating, if you will, the NRC's research program  
10 is to what extent the NRC should be involved in doing  
11 research, because, after all, one argument could be made  
12 that it should be up to the applicants for licenses to do  
13 the research.

14 The other argument is that NRC has to have  
15 expertise, capabilities to do reviews. Do you have any  
16 insights for us on how you would weigh in on such an  
17 argument?

18 MR. NEUMAN: Can I try?

19 DR. HORNBERGER: Slomo?

20 MR. NEUMAN: On this question, of course, I've  
21 been working off and on for the NRC for quite a number of  
22 years, and this is a question that arisen almost on every  
23 occasion where the research program was reviewed one way or  
24 another.

25 I cannot speak for the need for research by the

1 NRC and its contractors in areas other than the areas I am  
2 familiar with. But it seems to me that the issues that the  
3 NRC is facing are of tremendous complexity, and, in  
4 particular, the issues that I'm familiar with, which pertain  
5 to hydrogeology, groundwater being a major transporting  
6 element in the environment of radionuclides and other  
7 contaminants, actively or potentially.

8 The earth is such a complex system, and we know so  
9 little about it that I just do not believe that it is  
10 possible for either a regulatory agency such as the NRC or,  
11 say, an agency such as the Department of Energy that might  
12 apply for a license for high-level waste storage or other  
13 entities that would apply for license that entails analysis  
14 or requires analysis of subsurface processes.

15 I just don't see how the NRC could possibly do  
16 this work in good faith and with competence, without having  
17 a good understanding on its staff, an up-to-date,  
18 state-of-the-art understanding of as much as possible  
19 relating to these processes, as they pertain to the task at  
20 hand.

21 It so happens that other agencies, and certainly  
22 private groups, are not going to do the kind of research  
23 that the NRC is currently supporting. It's unique.

24 Even the experiment that Peter is running now is a  
25 unique experiment. You think about it as a simple

1 experiment, but it is far from simple, but it's absolutely  
2 unique.

3 The Department of Energy has botched similar  
4 experiments at the Idaho basalt site, and I can assure you  
5 that when we concluded our work at Oracle in saturated  
6 granite, I paraphrased to the NRC, Churchill by saying never  
7 have so few done so much in so little time for so little  
8 money.

9 [Laughter.]

10 MR. NEUMAN: And I can say that again.

11 [Laughter.]

12 MR. NEUMAN: And so I really think that despite  
13 the fact that perhaps the NMSS does not always see where all  
14 of this is leading in terms of their practical needs, I  
15 really think that it is of relevance, and I certainly would  
16 think that it is a very good thing for the NRC to do some  
17 research of this kind, and perhaps more than it's doing.

18 MR. WIERENGA: Also there is really not much  
19 possibilities in this country to get long-term funding for  
20 field research, and unfortunately, we don't have right now,  
21 the structure in the government so that we could easily do  
22 more integrated work.

23 I see that we also need to do long-term work, but  
24 also more integrated work. For example, scientists from the  
25 National Labs could participate in an experiment that we do,

1 and take other measures of, let's say, how water and how  
2 this process behaves in the subsoil. I don't see that much  
3 happening in this country, and we don't seem to have the  
4 mechanism for it.

5 But certainly we need to do some longer-term work,  
6 and the NRC is in a position to have more continuity in  
7 their program as opposed to an NSF grant that takes three  
8 years, and that's almost impossible to do the work for the  
9 type of budgets they have.

10 You cannot do field work for that, it's  
11 impossible.

12 DR. HORNBERGER: Phil?

13 MR. MEYER: If I could just second what Slomo and  
14 Peter said, but I also want to offer just a little bit  
15 different perspective.

16 I have attended a number of public workshops in  
17 which there are a lot of licensees in attendance, and both  
18 from the questions and comments that they make in the  
19 meeting, and also from my personal interaction when they  
20 have come up to me and told me about their sites and what  
21 the issues are, that they are, number one, strapped for  
22 expertise in addressing the hydrogeologic issues at their  
23 site.

24 And, number two, that probably it's related; that  
25 they are desperate for guidance, and they look to the NRC to

1 give them guidance on how to analyze their sites. I don't  
2 think that it's just that they want a -- at least that's not  
3 my impression, that they just want a cookbook so that they  
4 can quickly get on with, you know, the processes, but that  
5 they seem to be genuinely concerned about doing a good job.

6 And in my experience, the work that the Research  
7 Office has supported has offered a lot to the licensing  
8 staffing the time that I have been working with the NRC.

9 DR. HORNBERGER: Thanks. Well, I have a host of  
10 detailed questions, but I think they will have to wait till  
11 Slomo's AGU session.

12 Thanks very much. Thank you, Mr. Chairman.

13 CHAIRMAN GARRICK: All right, I think that what  
14 we'll do is recess now for lunch, and then come back and  
15 continue our ACNW report-writing session. I should announce  
16 that we are targeting to adjourn at 3:00, and I think this  
17 will terminate our need for keeping a record.

18 [Whereupon, at 12:35 p.m., the recorded portion of  
19 the meeting was adjourned.]

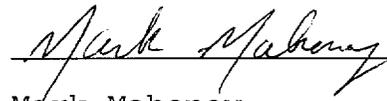
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This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: 120TH ADVISORY COMMITTEE  
ON NUCLEAR WASTE

PLACE OF PROCEEDING: ROCKVILLE, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

  
\_\_\_\_\_  
Mark Mahoney

Official Reporter

Ann Riley & Associates, Ltd.

**STATUS OF THE  
DECOMMISSIONING  
PROGRAM**

**ACNW BRIEFING  
JULY 27, 2000**

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Decommissioning Branch  
Division of Waste Management

# OBJECTIVES OF BRIEFING

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To provide a comprehensive overview of the Decommissioning Program including:

- Summary of the Decommissioning Program
- Status of SDMP sites/Complex sites
- Summary of the Reactor Decommissioning Program
- Staff efforts to enhance efficiency and effectiveness of the Decommissioning Program

# **SUMMARY OF THE DECOMMISSIONING PROGRAM**

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Decommissioning Program activities can be divided into the following areas:

- Programmatic direction/guidance development
- Material and fuel cycle decommissioning
- Reactor decommissioning
- Environmental Assessment Task Force Functions
- Decommissioning Management Board

# DEVELOPMENT OF GUIDANCE

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Major guidance developed by staff in 1999-2000 include:

- In 1999-2000 staff developed 16 guidance documents
- SRP for Decommissioning Plan
- SRP for Evaluation Nuclear Power Reactor LTPs (NUREG-1700)
- Environmental SRP for reviewing EIS
- Preliminary Guidelines for Evaluating Dose Assessments in Support of Decommissioning (appendix SRP Decommissioning Plans)
- MARSSIM
- RG 1.179

# MATERIAL AND FUEL CYCLE DECOMMISSIONING

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Activities include:

- Oversight of SDMP & other complex decommissioning sites
- Pilot study for performing decommissioning without a DP
- License termination file reviews
- Financial assurance reviews
- RES support in providing data & models to support PA

# INTERACTION WITH FEDERAL/STATE AGENCIES

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- West Valley oversight
- Interacting with EPA and ISCORS
- EPA for LTPs
- MARLAP
- State PH&S Organizations

# OVERSIGHT OF SDMP & COMPLEX DECOMMISSIONING SITES

Currently there are 29 SDMP & complex decommissioning sites

- 23 of 29 sites have submitted DPs
- 13 of 23 DPs submitted have been approved, 10 under review
- 11 sites will likely request restricted release
- 11 current SDMP sites may be transferred to Agreement States before 2002 (MN-1, PA-10)

SDMP progress to date

- 20 sites removed from SDMP after successful remediation
- 11 sites removed from SDMP by transfer to Agreement States or Federal entity

# LICENSE TERMINATION FILE REVIEWS

- ORNL reviewed approximately 37,000 license files
- ORNL identified approximately 675 loose material 564 sealed source license for further review by the Regions
- 38 sites had contamination above unrestricted release limits
- Approximately 120 sites remain to be evaluated

# PILOT STUDY FOR PERFORMING DECOMMISSIONING WITHOUT A DP

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- Pilot Study resulted from DSI-9
- Three facilities are taking part in Pilot Study to perform decommissioning without submitting a DP
  - ▶ Westinghouse Pump Repair Facility, Cheswick, PA
  - ▶ Westinghouse Facility, Forest Hills, PA
  - ▶ Phillips Research Center, Bartlesville, OK
- Progress/status meeting with licensee (10/00)
- Commission Paper (01/01)

# REVIEW OF FINANCIAL ASSURANCE SUBMITTALS

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- Staff reviews between 40 - 60 financial assurance submittals each year
- Staff maintains a financial instrument security program
- Currently revising/consolidating guidance

# WEST VALLEY OVERSIGHT

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- Activities include:
  - ▶ Prescribing decontamination and decommissioning criteria
  - ▶ Reviewing draft portions of EIS
  - ▶ Reviewing Safety Analysis Reports
  - ▶ Periodic on-site monitoring
- Draft decommissioning criteria issued December 1999
- Status on stakeholder interactions (Commission Paper)

# OFFICE OF NUCLEAR REGULATORY RESEARCH ACTIVITIES

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Current activities include:

- Provide revisions to RESRAD/DandD
- Provide update to Sandia Environmental Decision Support System
- Provide data on radionuclide solubilities
- Provide data on degradation of slags
- Provide guidance on characterization of sites
- Provide unsaturated zone monitoring strategies
- Provide technical basis for dose modeling parameters

# REACTOR DECOMMISSIONING

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- NMSS supports NRR at public meetings required upon receipt of PSDAR
- Interact with States(s) and Federal regulatory agencies on issues related to reactor decommissioning
- Conduct workshops focused on a variety of decommissioning issues (industry, States, Federal agencies, and Stakeholders participants)
- Develop guidance documents related to reactor decommissioning
- Evaluate on a case-by-case basis new approaches to reactor decommissioning
- Review LTPs and prepare SERs, EAs, and license termination orders or amendments
- Participate in-process confirmatory surveys

# REACTOR DECOMMISSIONING ACTIVITIES

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## ■ Reviews in progress

- ▶ Reviewing LTPs for Maine Yankee, Trojan, Saxton, and Connecticut Yankee
- ▶ Project Management responsibility for Peach Bottom Unit 1 and Fermi Unit 1

## ■ Guidance development reactors

- ▶ SRP Decommissioning of Nuclear Power reactors (NUREG 1700)
- ▶ Supported NRR in the development of a variety of decommissioning guidance documents

# DECOMMISSIONING SECTION INITIATIVES

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- Integrated Rulemaking
  - ▶ Emergency preparedness
  - ▶ Safeguards
  - ▶ Insurance
  - ▶ Backfit
  - ▶ Operator training and staffing
- Regulatory Improvements
- Generic Environmental Impact Statement (GEIS)
- Guidance Documents
  - ▶ Reg guides
  - ▶ Handbook for inspectors
  - ▶ NUREGS
- Decommissioning Inspector Program

# DECOMMISSIONING REACTOR STATUS

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- 21 Reactors Shutdown Between 1963 and 1998
  - ▶ 2 completed DECON and dismantlement
  - ▶ 6 undergoing DECON and dismantlement
  - ▶ 9 currently in long-term storage
  - ▶ 4 planning a combination of long-term storage and DECON and dismantlement

# ENVIRONMENTAL EVALUATIONS

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Environmental Task Force activities include:

- Review of environmental assessments (routine/FONSI)
  
- Preparation & review of EIS'
  - ▶ 12 EIS' will be prepared for SDMP sites
  
  - ▶ EIS will be prepared for West Valley

# **STAFF EFFORTS TO ENHANCE EFFICIENCY & EFFECTIVENESS OF DECOMMISSIONING PROGRAM**

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Staff activities include:

- Implementing streamlining objectives
- Rebaselining initiative
- Development of guidance
- Public meetings/workshops

# STREAMLINING OBJECTIVES

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- Proactive role in interacting with licensees
- Reduce number of RAIs
- Conduct in-process/side-by-side confirmatory surveys
- Rely on licensees QA program to reduce the need for large confirmatory surveys
- Incorporate strategies to achieve performance goals identified in Strategic Plan

# REBASELINING INITIATIVE

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Activities include:

- Determine current status of each site
- Identify activities required to bring each site to closure
- Develop schedules for decommissioning sites based on staff and contractor resource availability
- Use of project management software/Gantt Charts

# CHALLENGES

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- Dose Modeling Guidance
- Clearance Rule
- Restricted Release Cases
- Innovative performance oriented approaches
- Partial site releases
- Finality

# Hydrologic Uncertainty Analysis for Dose Assessments at Decommissioning Sites

Presentation to the U.S. Nuclear Regulatory  
Commission Advisory Committee on Nuclear  
Waste

Philip D. Meyer and Glendon W. Gee

27 July 2000

**Battelle**

U.S. Department of Energy  
Pacific Northwest National Laboratory

# Motivation for Research

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- Undertaken in response to NRC/NMSS User Need
  - Support the development of guidance for implementing radiological criteria for license termination
- Dose assessments rely on simplified models
- Models are formulated using limited site-specific data
- The result is that predictions of dose are uncertain
- Consideration of uncertainty is consistent with NRC's risk-informed approach

# Research Objectives

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- Formalize and document a hydrologic uncertainty assessment methodology by extending methods previously developed for hydrologic analyses at LLW and SDMP sites
- Provide practical tools to assist NRC staff and licensees
- Evaluate methods using the DandD, RESRAD, and MEPAS dose assessment codes

# Relationship to Other Projects

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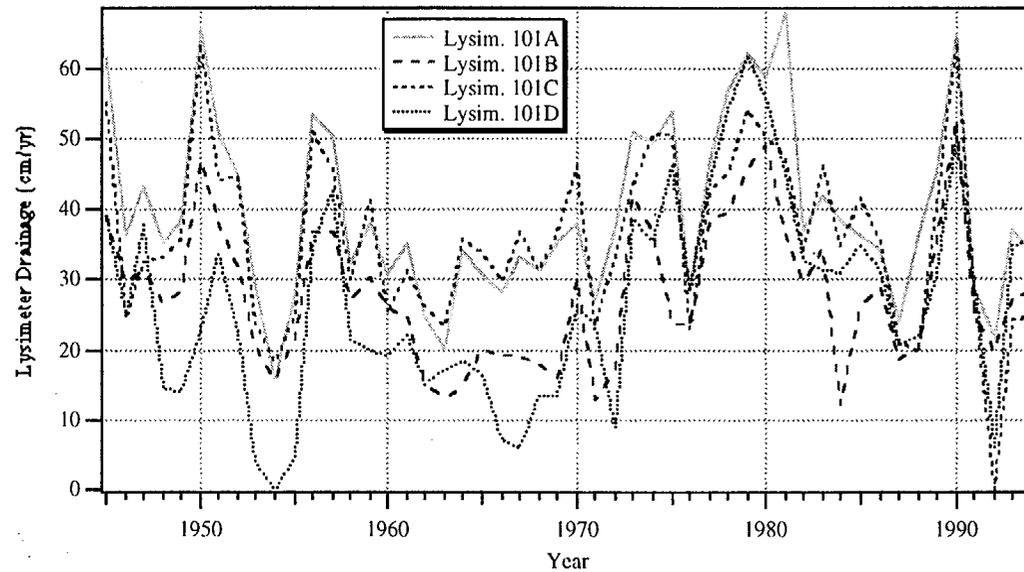
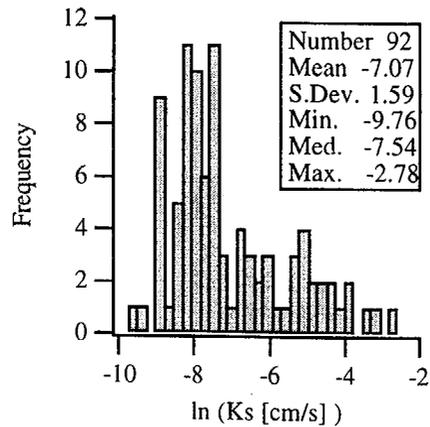
- Information on generic probability distributions for soil parameters incorporated in DandD and RESRAD default parameter distributions
- Information from the Maricopa site monitoring project used in test cases
- Current Univ. of Arizona project on conceptual model uncertainty complements this project's emphasis on parameter uncertainty

# **Why Is Hydrologic Uncertainty Important?**

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- Dose depends on hydrology
  - Source term is a function of the net infiltration rate
  - Travel times are determined by the net infiltration rate
- Net infiltration is often difficult to estimate accurately
- Hydrologic properties often vary spatially and temporally
- Codes use simplified models of hydrologic processes

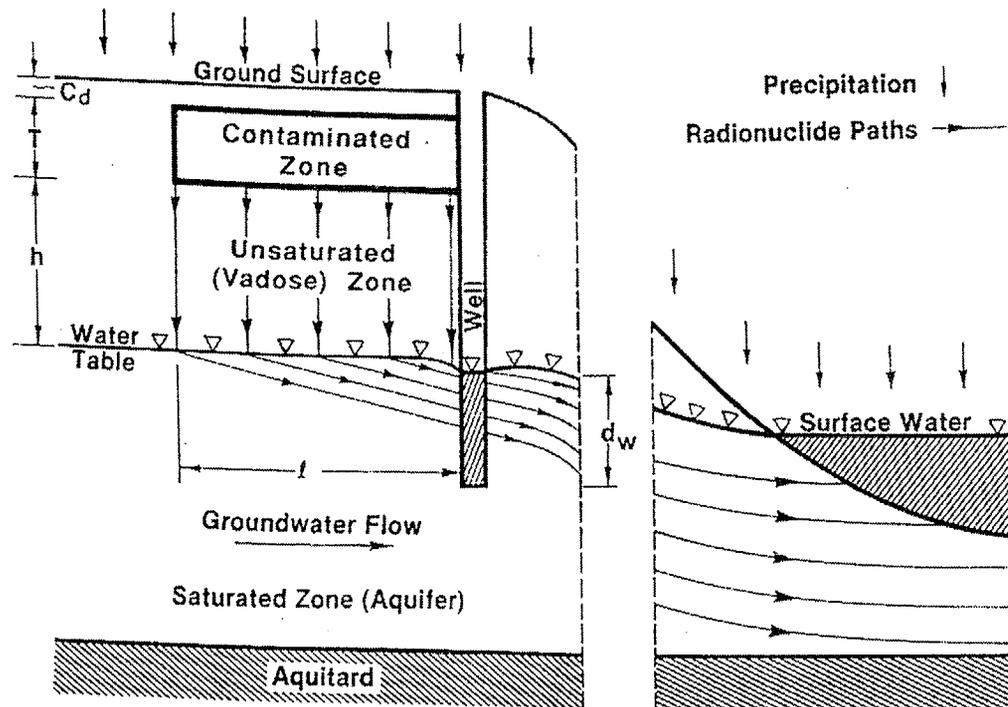
# Hydrologic Spatial and Temporal Variability



Sources: Las Cruces Trench Experiment, USDA Coshocton Ohio Facility

# Model Approximations

- One-dimensional, steady-state, unit-gradient flow
- Homogeneous, isotropic soil properties
- Linear, equilibrium adsorption
- Numerical approximations



From RESRAD documentation (Yu et al., 1993)

# Hydrologic Uncertainty Assessment

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- Assess code's conceptual model(s) and identify hydrologic parameters
  - Simplified codes use lumped parameters
- Identify sources of information for parameter probability distributions
  - May need to combine generic information and site-specific data
- Apply sensitivity analyses and statistical correlation measures to Monte Carlo simulation results to evaluate critical parameters

# Project Status

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- Simplified transient water budget model developed to provide a better estimate of net infiltration
  - Uses available climatic data and simple soil representation
  - Mathcad code delivered to NRC staff
  - Water Resources Research paper in press
- NUREG/CR-6656 provides information on conceptual models and parameters (of DandD, RESRAD, and MEPAS), uncertainty analysis methods, and data sources for parameter values and distributions

## **Project Status, continued**

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- Training session provided to NRC staff in February 2000
- Application of uncertainty assessment methods to hypothetical test cases is currently underway
  - Demonstrate application of the methods to a realistic decommissioning site
  - Evaluate sensitivity and statistical correlation measures

# Remaining Work

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- Definition of effective parameter values
- General applicability of Bayesian methods
- Interpretation of uncertainty assessment results when using simplified and/or conservative codes
- Relationship between conceptual model uncertainty and parameter uncertainty for simplified codes
- Best use of statistical correlation measures
- Research to be completed in October 2001

# Literature Review

(letter report 3/31/1998)

## **REVEALED:**

- **Analyses (flow/uncertainty/PA) typically limited to single conceptual model**
  - **Type I Model Error:** Rejecting (through omission) valid alternatives
- **Critiques/litigation often find fault with conceptual model**
  - **Type II Model Error:** Adopting (not rejecting) invalid model
  - **Potentially devastating**
- **Models based on single hydrogeologic concept**
  - **Underestimate uncertainty** by under-sampling valid model space (**type I error**)
  - **Introduce bias** by relying on invalid model (**type II error**)
- **Resulting uncertainty/bias may be significant**
- **No established literature/methodology on**
  - **Systematic conceptualization**
  - **Concept uncertainty**
- **Arbitrary simplification seldom produces conservative models/assessments**

- The **opposite** is often true

**University of Arizona  
developing Methodology that**

- ✓ Addresses these and related issues
- ✓ Focuses on **hydrogeologic conceptualization** and **uncertainty**
- ✓ Is **generic** but of **practical** use to NRC licensing staff for
  - Decommissioning Reviews
  - In Situ Uranium Recovery Facilities
  - LLW and HLW disposal sites
- ✓ Is **supported** by **real-site data** covering range of technical problems facing NRC licensing staff
- ✓ Includes **systematic** sequence of **logical review questions** with **analytical methods** appropriate for NRC review and evaluation
- ✓ Provides **systematic framework** for **identifying** and **quantifying uncertainties**

Our work **benefits** from

- ✓ **Collaboration with PNNL** (who focus on **multimedia model parameter uncertainty**) through sharing of
  - **Ideas and methods** (e.g. Bayesian inference)
  - **Databases** (e.g. ALRS and Maricopa Environmental Monitoring Site)
- ✓ **Joint organization of special Fall 2000 AGU session on predictive uncertainty** with Mary Hill of USGS

Our project will **culminate** with

- ✓ **Transfer of methodology** to NRC licensing staff and Agreement State regulators through **training seminars** at NRC Headquarters that
- ✓ **Include practical examples** to illustrate methodology and identified tools and criteria for determining acceptance

**Expected Completion Date:**

At **current** budget level, **September 2002**

**Methodology Adopts  
Holistic View of Uncertainty  
(Appendix A, 11/30/1999 Draft Methodology)**

**Predictive Uncertainty**

**= Sum of Uncertainties due to**

**Conceptual/mathematical model structure**

**Model inputs/parameters**

**Stochastic variations on unresolved scales**

The three are intimately linked:

**Averaging/Abstraction**

- **Reduces parameter variance but**
- **May introduce bias due to scale effect**
- **Increases structural/resolution errors**
- **May render calibration/verification  
difficult**

**Project must address all three error  
components within a unified theoretical  
framework.**

## **Proposed approach transcends Traditional Approach to Hydrogeologic Model Uncertainty Analysis, where one**

- **Postulates deterministic model structure**
- **Postulates parameter uncertainty model**
  - **Type A (data-based probabilities)**
  - **Type B (subjective confidence levels)**
- **Reduces parameter uncertainty/bias by**
  - **Estimating parameters (via inverse method)**
  - **to render model compatible with observations**
- **Assesses estimation uncertainty**
- **Uses probabilistic method**
  - **Linearization**
  - **Monte Carlo****to assess model predictive uncertainty**

**Traditional approach does not account for**

- **Structural (conceptual-mathematical) and**
- **Stochastic (resolution/scale/randomness of spatial heterogeneity)**

**aspects of predictive model uncertainty**

## **Proposed Holistic Approach to Hydrogeologic Uncertainty analysis focuses on**

- **Integrating structural and stochastic aspects into traditional framework where feasible**
- **Developing novel (nontraditional) methods to account jointly for all sources of predictive uncertainty**

## WORK TO DATE

- ❖ **Literature Review** (letter report 3/31/1998)
- ❖ **Draft Methodology** (letter report 11/30/1999)
- ❖ **Large-scale long-term infiltration experiment of water and tracer in unsaturated fractured rock at ALRS (ongoing).**
- ❖ **High-resolution 3-D pneumatic tomography at ALRS based on cross-hole air injection tests (completed)**
- ❖ **Equivalent pneumatic parameter assessment at ALRS based on cross-hole air injection tests (completed)**
- ❖ **Quantitative explanation of very strong corresponding scale effect at ALRS (ongoing)**
- ❖ **Value of information for predicting saturated-unsaturated water flow and tracer transport at the Maricopa Environmental Monitoring Center (ongoing)**
- ❖ **Testing proposed methodology against flow/transport data from saturated fractured rocks at Fanay-Augeres in France (completed)**

- ❖ **Testing proposed methodology against unsaturated flow/transport data from Las Cruces Trench Experiment in NM (pending)**
- ❖ **Accounting for structural (conceptual-mathematical) model uncertainty (ongoing)**
- ❖ **A new geostatistical model for multiscale (fractal) heterogeneities (ongoing)**
- ❖ **Deterministic (forward/inverse) solution of stochastic flow-transport problems (ongoing)**

# **TESTING OF GROUNDWATER FLOW AND TRANSPORT MODELS**

U.S. Nuclear Regulatory Commission  
Research Contract NRC-04-97-056  
T.J. Nicholson, NRC Project Manager

S. P. Neuman<sup>1</sup> and P. J. Wierenga<sup>2</sup>  
Principal Investigators

<sup>1</sup>Dept. Hydrology and Water Resources  
College of Engineering and Mines

<sup>2</sup>Dept. Soil, Water & Environmental Science  
College of Agriculture

The University of Arizona, Tucson

- **Object of Study:** Groundwater *flow and transport models/analyses* used in performance assessment (**PA**) of
  - ✓ **Decommissioning** reviews
  - ✓ *In Situ Leach* (ISL) **Uranium recovery** facilities.
  - ✓ Low-level (**LLW**) and high-level (**HLW**) radioactive waste **disposal** sites.
  
- **Motivation:** NRC staff has identified *conceptual models* of site **hydrogeology** as *major source of uncertainty* in **PA**.
  
- **Objective:** *Develop/test method/strategy for selecting/evaluating competing conceptual models* of subsurface flow and transport and their *uncertainty*.

Program Review: Hydrology  
Nuclear Regulatory Commission

Conceptual Model Testing

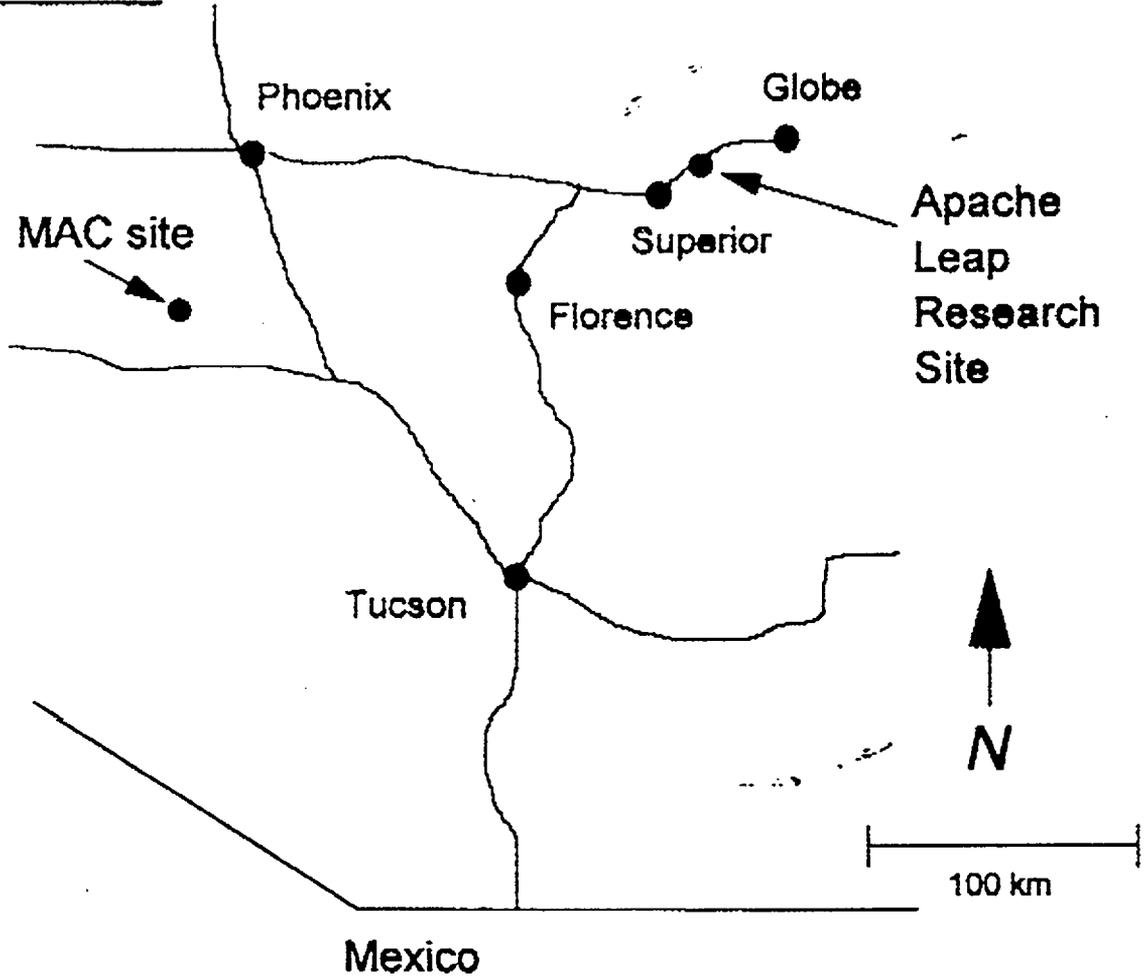
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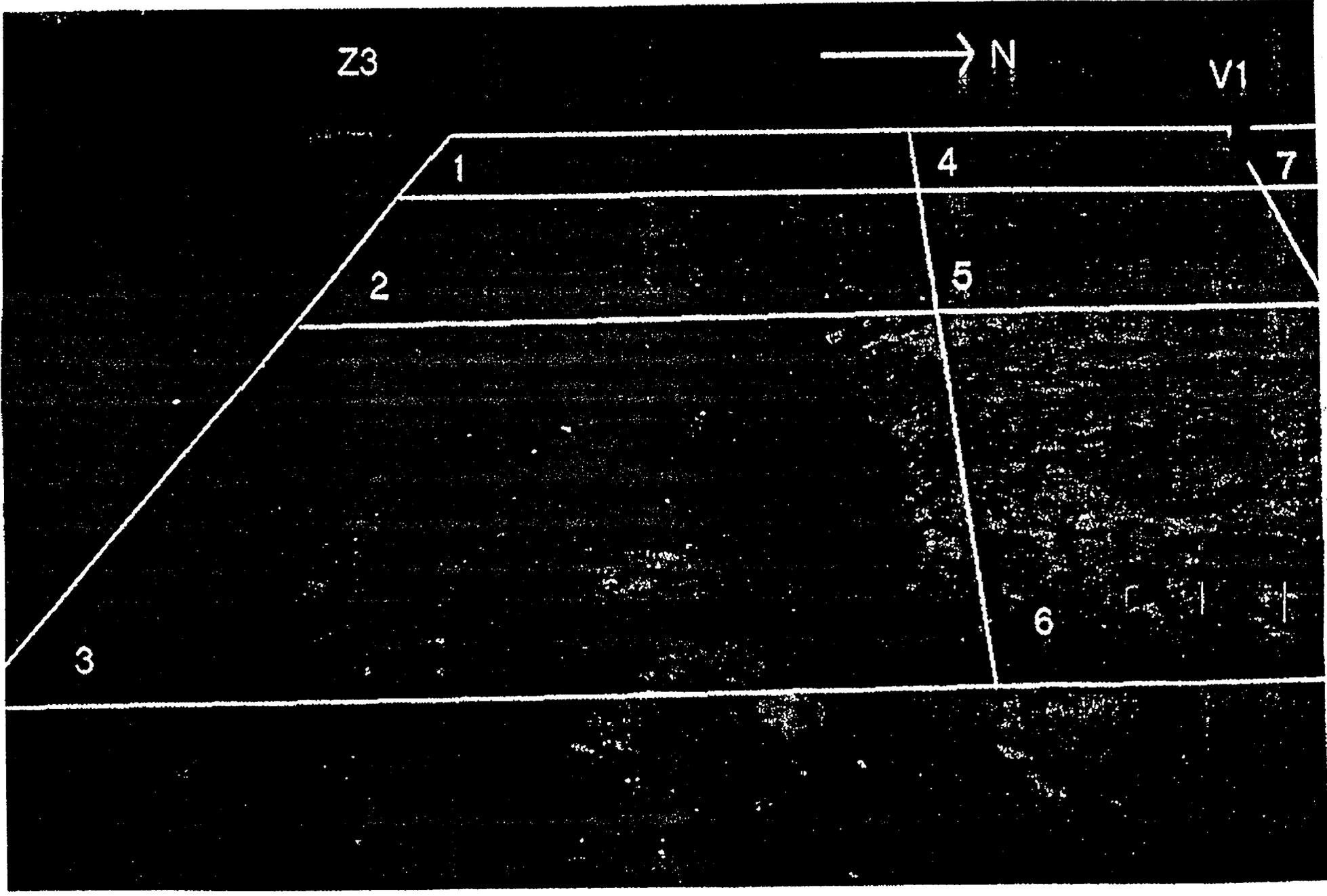
Field infiltration experiments at the  
Apache Leap Site

P.J. Wierenga, S.P. Neuman,  
M.T. Yao, C.J. Mai, and R. Rice

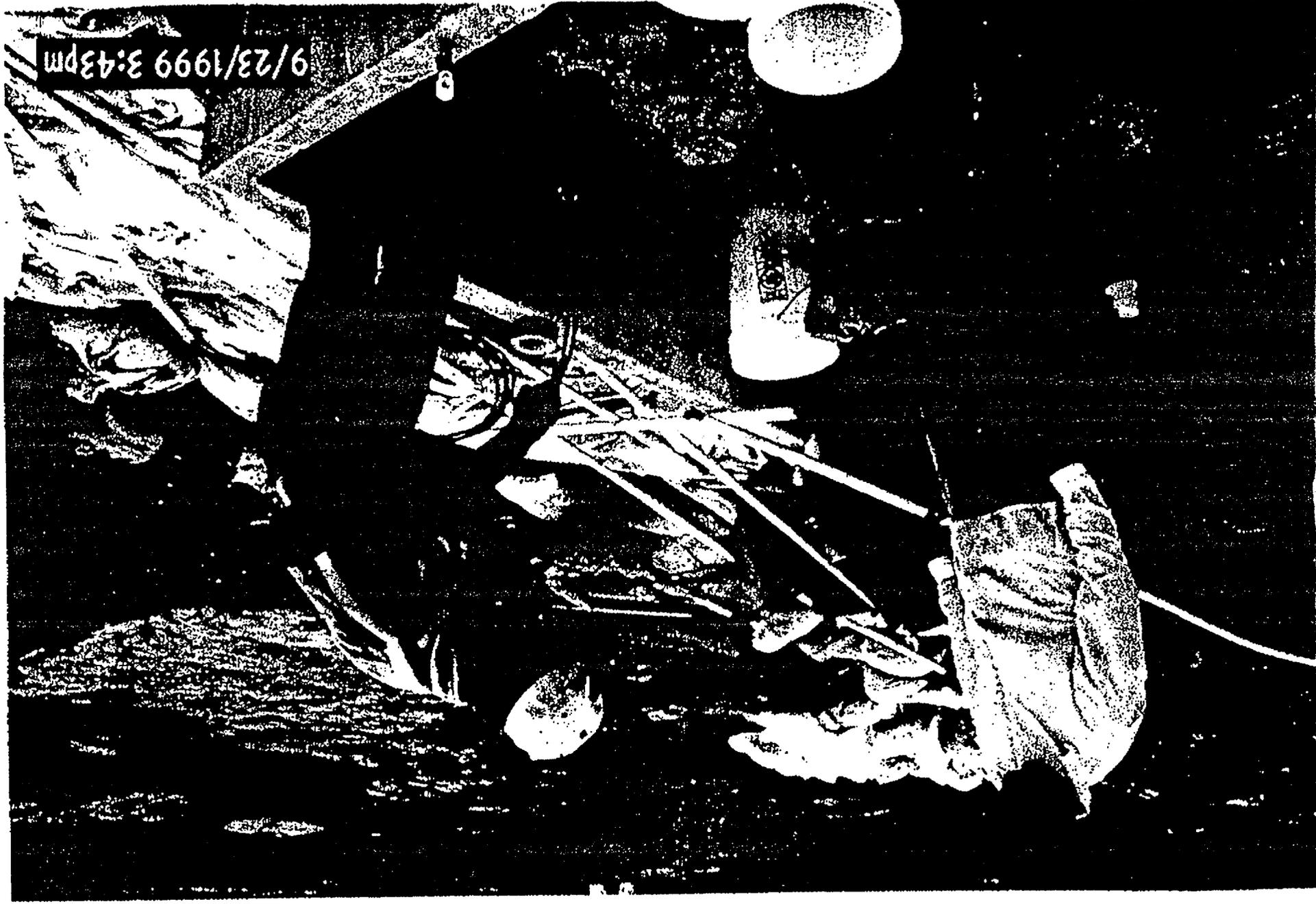
University of Arizona  
Tucson, AZ

Southern Arizona

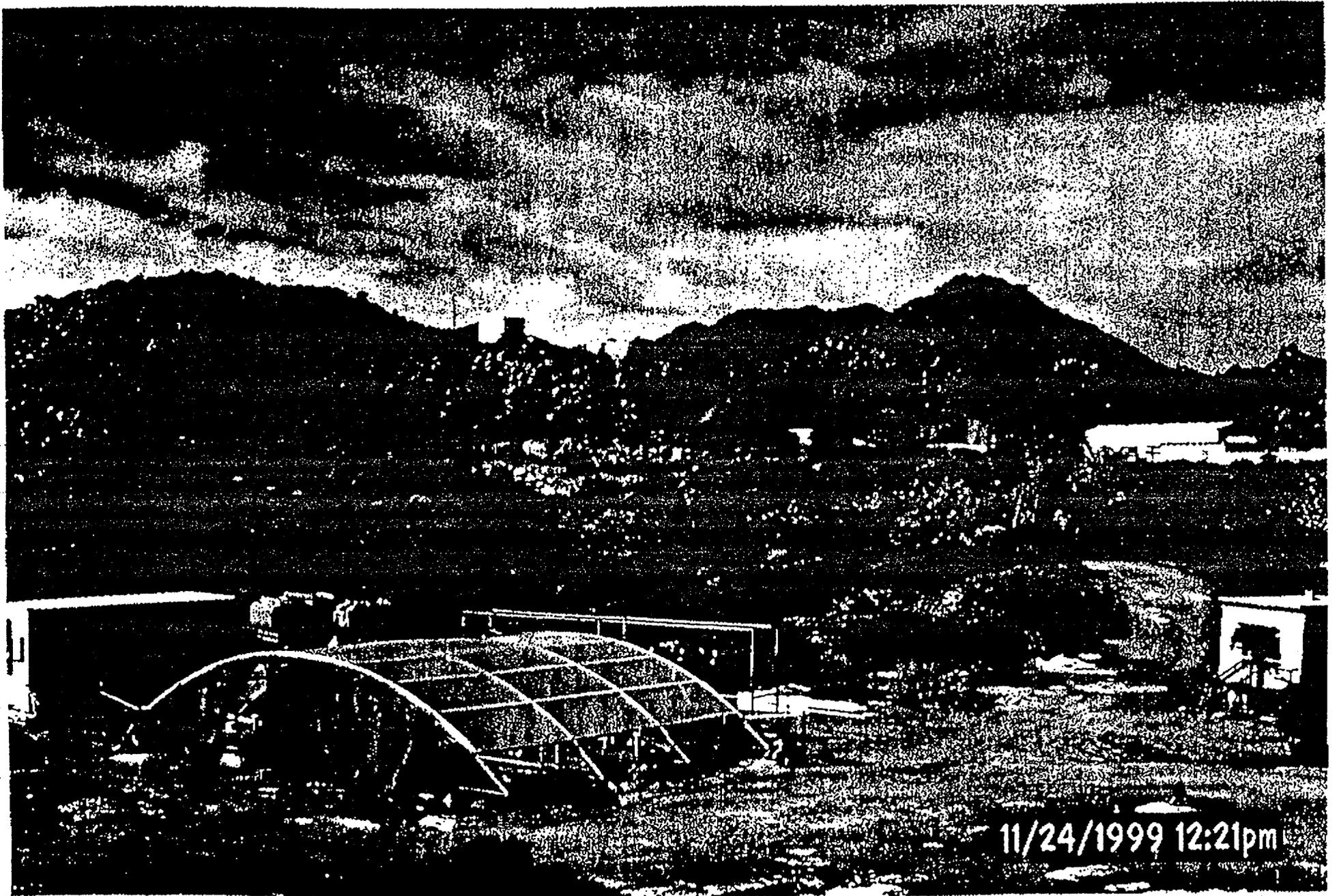




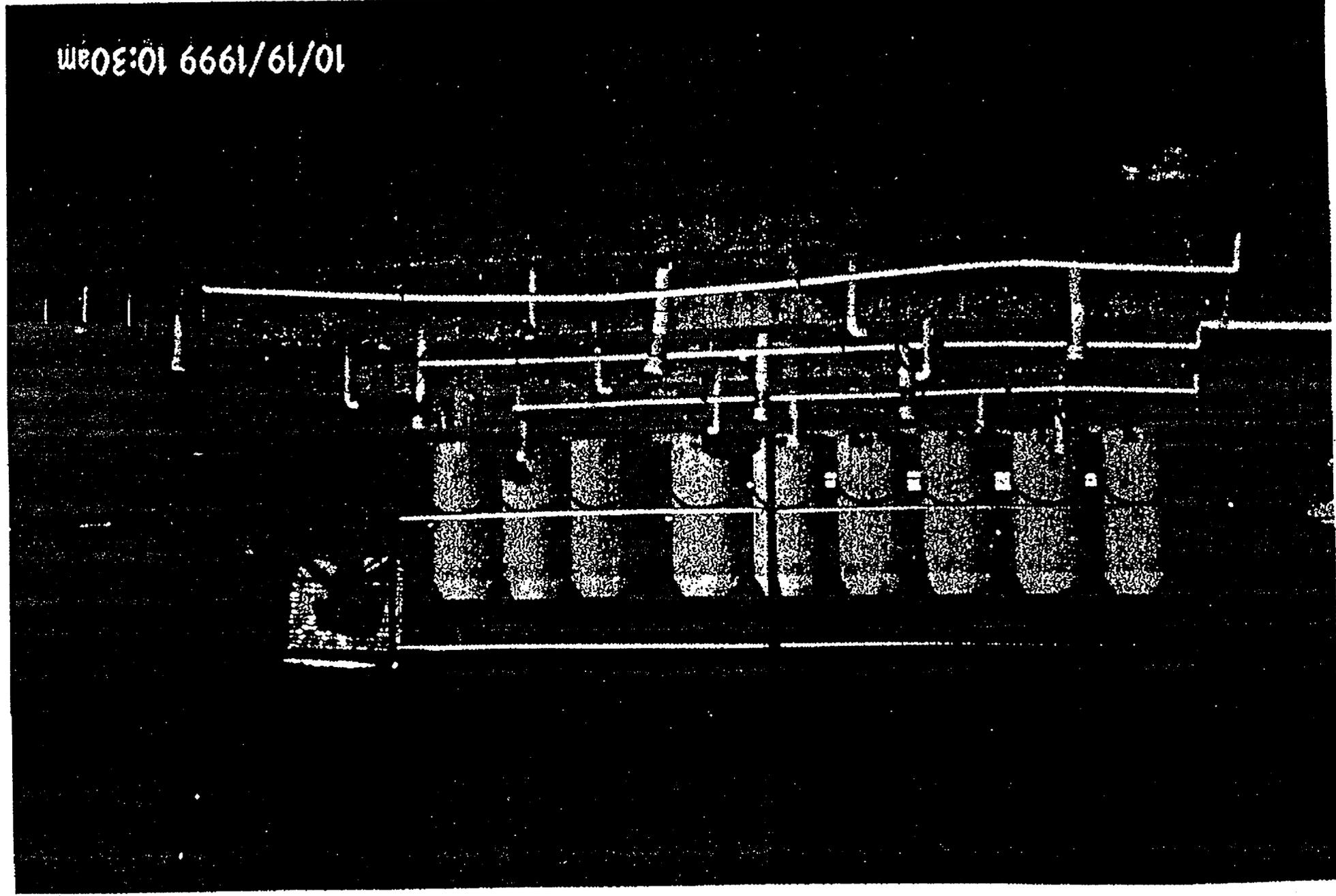




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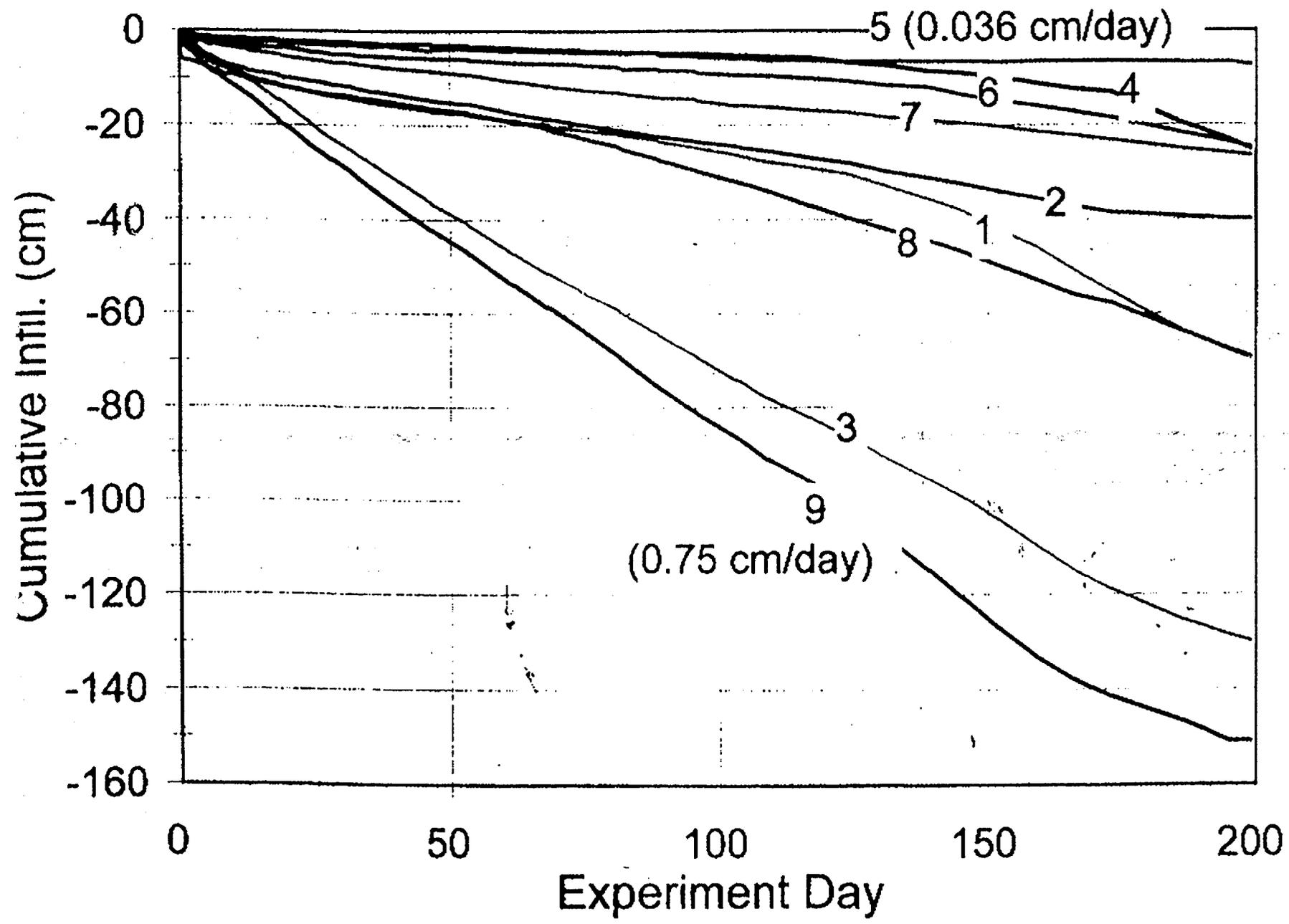


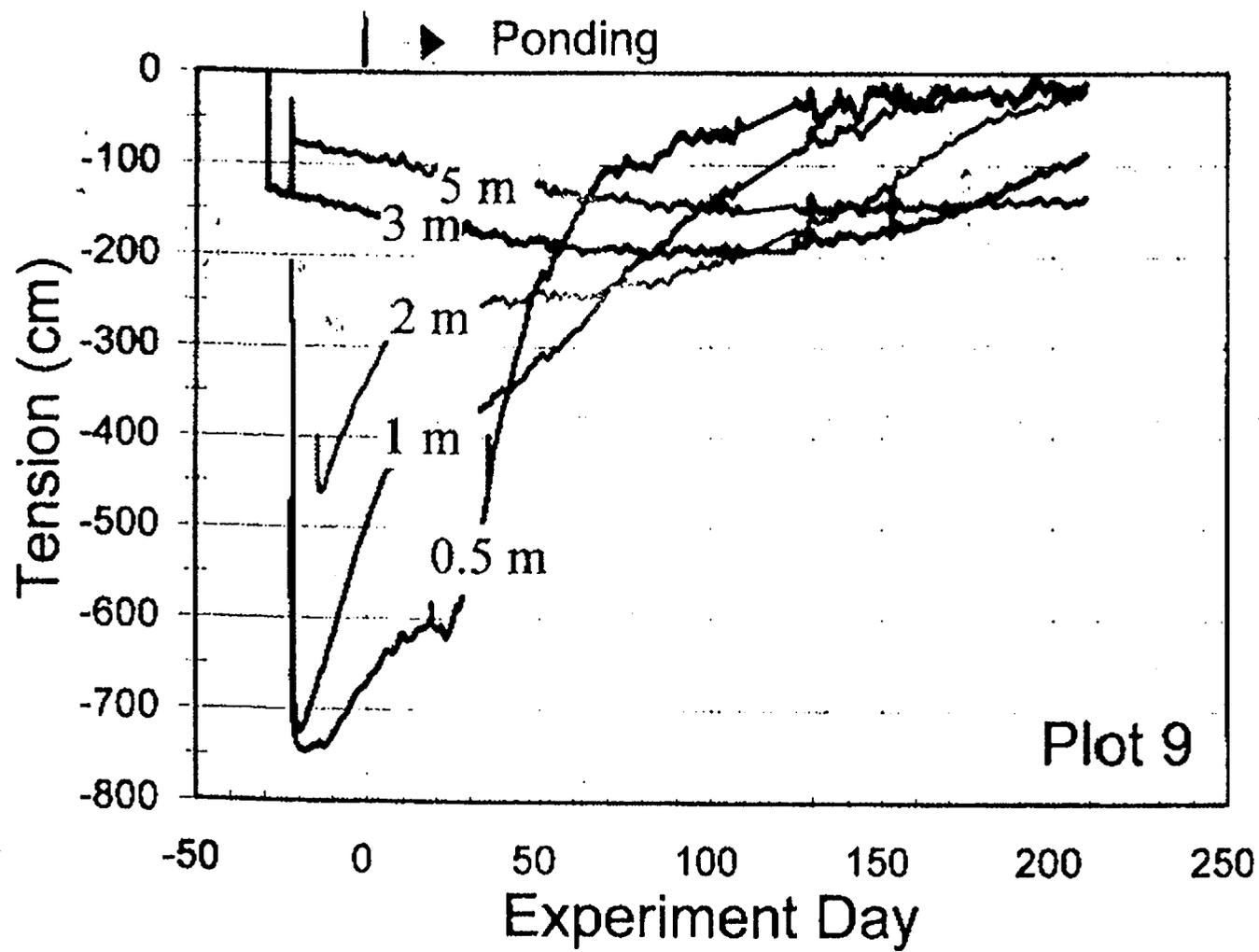
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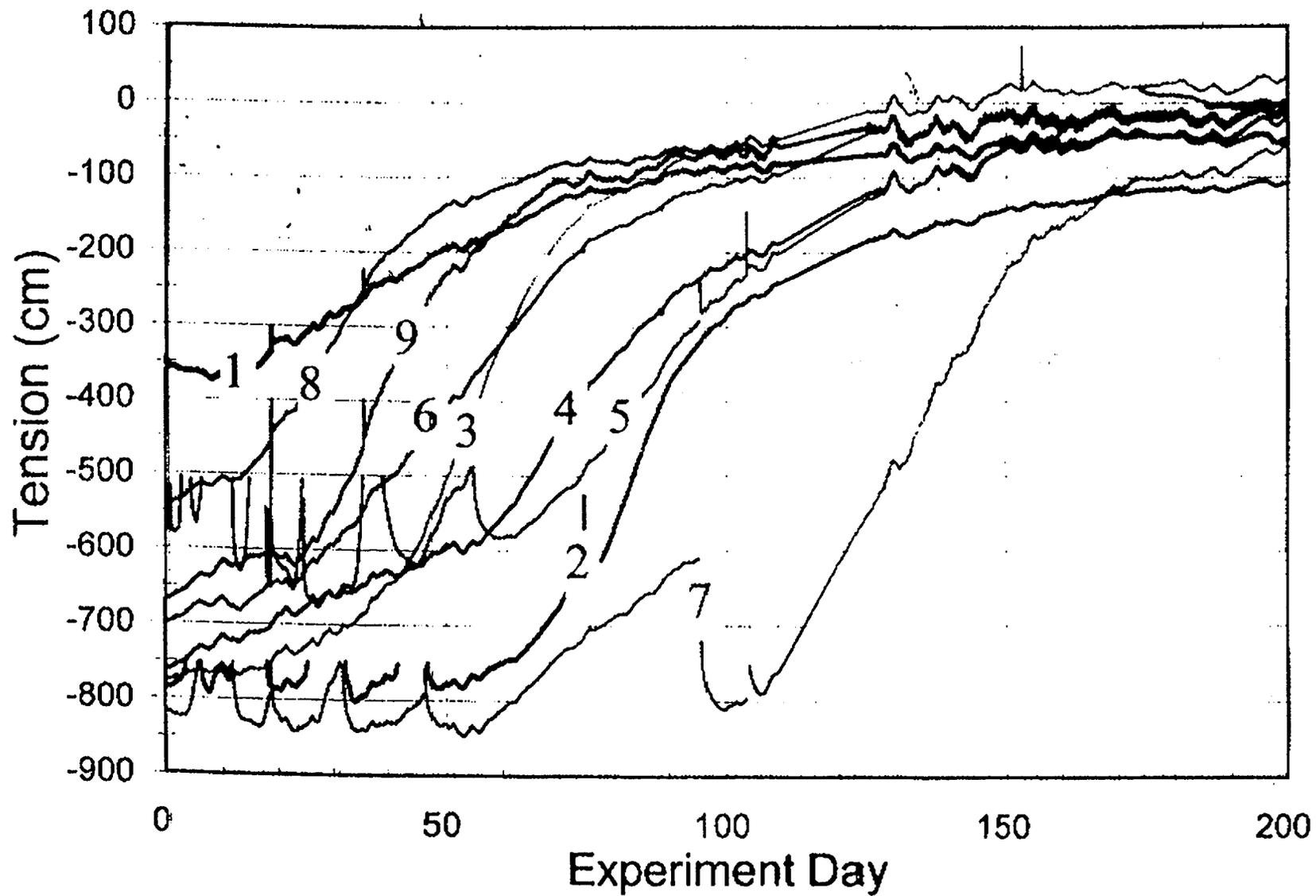
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# Infiltration Rates

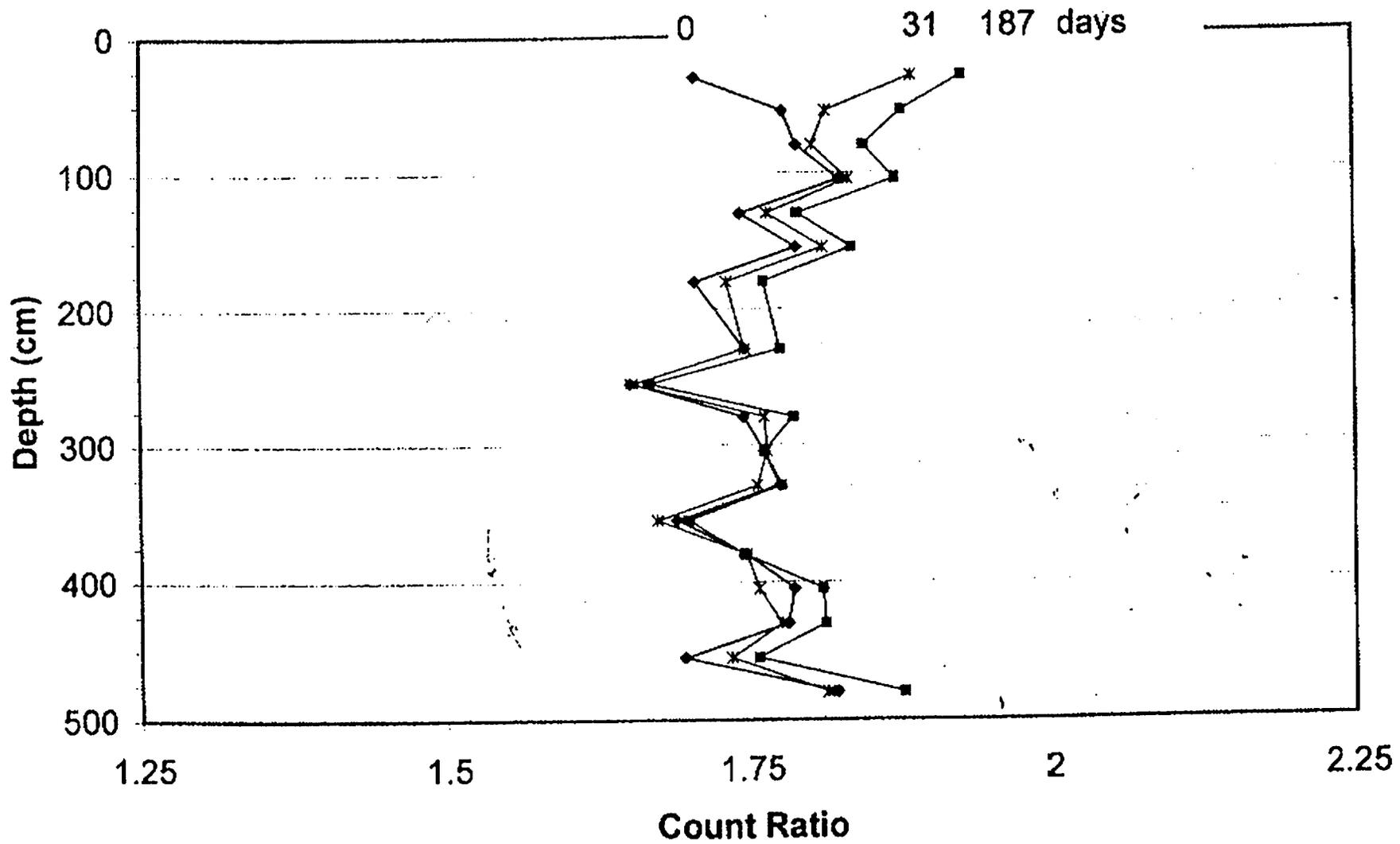




### Tensions at 50 cm

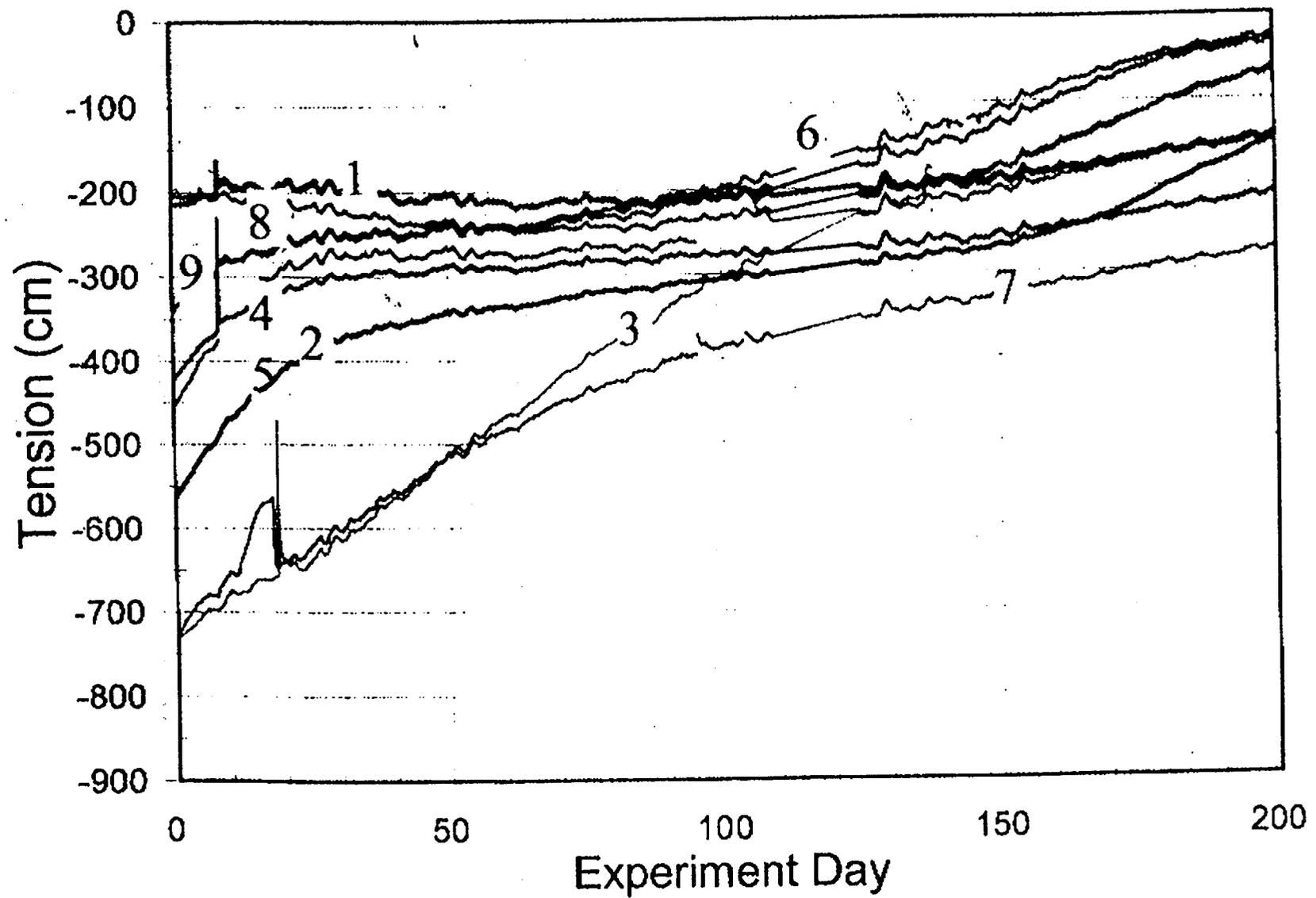


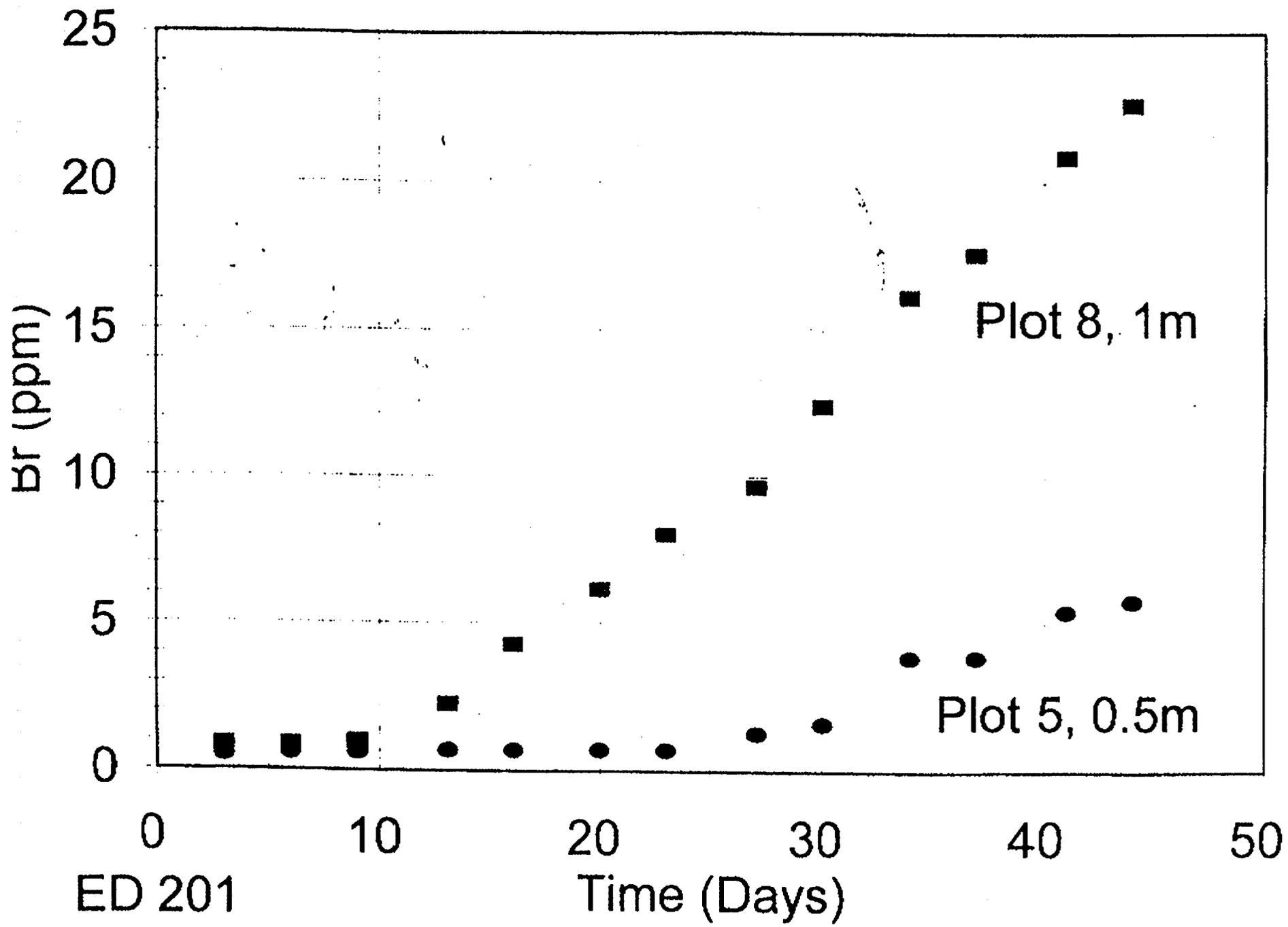
### Plot 9





# Tensions at 2 m





EC (mmho/cm)

10

5

0

0

50

100

150

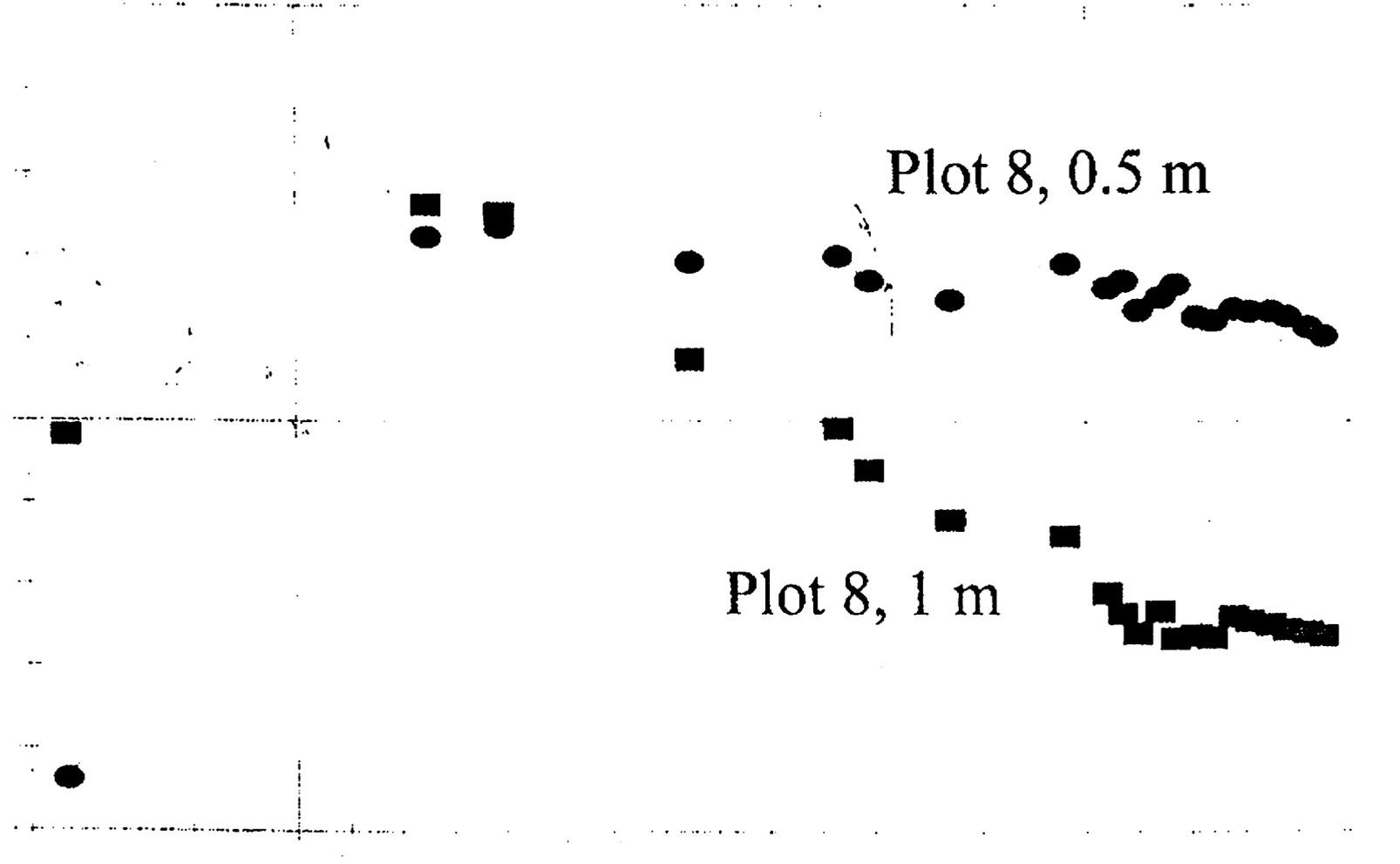
200

250

Experiment Day

Plot 8, 0.5 m

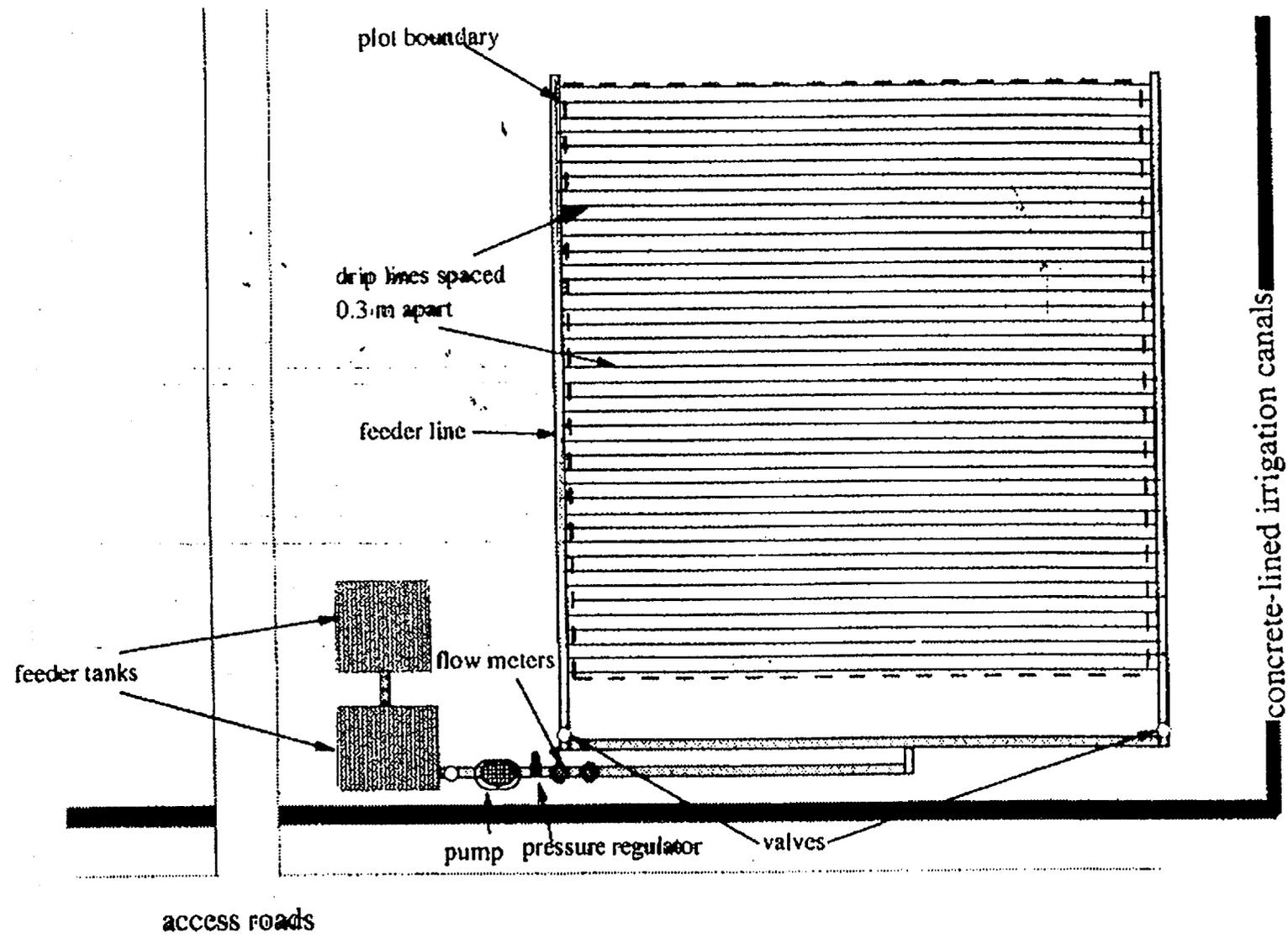
Plot 8, 1 m



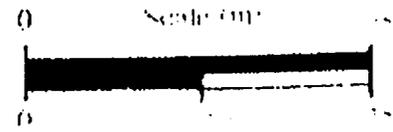
# Data Summary

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1. Water is infiltrating at a rate varying from 0.036 cm/day (plot 5) to 0.7 cm/day (plot 3, 9)
2. After flooding for 200 days the water front has reached the 3 m depth in nearly all plots
3. The water front has not yet reached the 5 m depth, except for plot 6
4. Bromide breakthrough occurred in plot 5 at 0.5 m, and in plot 8 at 1 m. No bromide observed in other plots and depths at 45 days after bromide application
5. The early bromide breakthrough in plot 8 indicates fracture flow

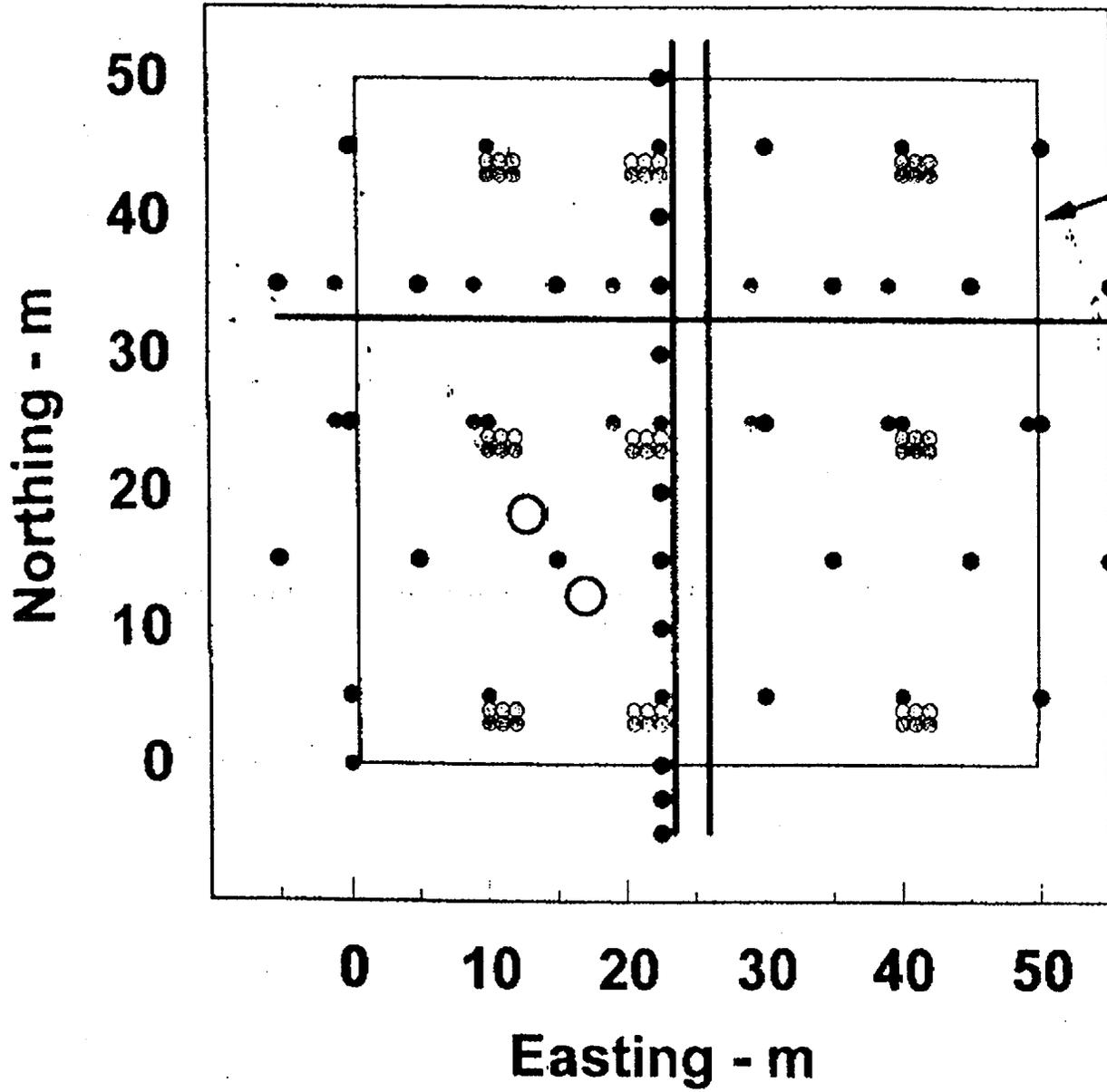


*W*



Irrigation System

MARICOPA SITE



Extent of irrigated plot

- Shallow neutron probe tubes
- Deep neutron probe tubes
- Horizontal access tubes
- Monitoring islands
- Deep solution samplers (3, 5, 10 m)
- Deep tensiometers (3, 5, 10 m)
- Borehole tomography points



