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NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON NUCLEAR WASTE

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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.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE

120TH ACNW MEETING

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Nuclear Regulatory Commission
Room T2B3
Two White Flint North
11545 Rockville Pike
Rockville, Maryland

Thursday, July 27, 2000

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

MEMBERS PRESENT:

DR. JOHN B. GARRICK, Chairman
DR. GEORGE W. HORNBERGER, Vice Chairman
DR. RAYMOND G. WYMER
MR. MILTON N. LEVENSON

STAFF AND PARTICIPANTS:

DR. JOHN T. LARKINS, Executive Director, ACRS/ACNW

MR. HOWARD LARSON, Acting Associated Director, ACRS/ACNW

MR. RICHARD K. MAJOR,, ACNW Staff

MS. LYNN DEERING, ACNW Staff

MR. AMARJIT SINGH, ACNW Staff

DR. ANDREW C. CAMPBELL, ACNW Staff

MR. MEDHAT EL-ZEFTAWY, ACRS Staff

ROBERT A. NELSON, NMSS, Division of Waste Management, NRC

JOHN T. BUCKLEY, NMSS

STUART A. RICHARDS, Office of Nuclear Reactor Regulation, Division of Licensing and Project Management, NRC

LARRY W. CAMPER, NMSS, Division of Waste Management

CHERYL TROTTIER, Office of Nuclear Regulatory Research, Division of Risk Analysis and Applications

TOM L. FREDRICHS, Office of Nuclear Regulatory Research, Division of Licensing and Project Management, NRC

WILLIAM R. OTT, Office of Nuclear Regulatory Research, Division of Risk Analysis and Applications, NRC

PHILIP D. MEYER, U.S. Department of Energy, Pacific Northwest National Laboratory

GLENDON W. GEE, U.S. Department of Energy, Northwest Pacific National Laboratory

SLOMO P. NEUMAN, University of Arizona, Tucson

PETER J. WIERENGA, University of Arizona, Tucson

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P R O C E E 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

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

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

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

[Laughter.]

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

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

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

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

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

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

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

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

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

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

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

A broad spectrum of activities is associated with

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

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

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

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

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

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

support decommissioning of their facilities.

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

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

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

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

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

You can see that we have a rather complex program

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

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

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

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

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

ISCORS also maintains a website at ISCORS.org for members of the public to have access.

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

has not been finalized at this point.

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

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

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

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

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

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

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

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

DR. WYMER: These are all reactors?

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

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

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

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

NRC contracted with Oak Ridge National Laboratory

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

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

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

I will turn this presentation back over to Bob.

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

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

MR. NELSON: We will get into those.

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

DR. WYMER: Okay.

DR. HORNBERGER: What is a loose material site?

MR. BUCKLEY: I'm sorry?

DR. HORNBERGER: Loose material.

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

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

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

DR. CAMPBELL: So this is the old standard.

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

MR. NELSON: To the SECY, Attachment 3.

MR. BUCKLEY: Correct.

MR. NELSON: To the SECY.

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

MR. BUCKLEY: Correct.

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

MR. BUCKLEY: Correct.

DR. HORNBERGER: And the sites with 25 millirem,

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

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

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

[No response.]

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

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

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

January.

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

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

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

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

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

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

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

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

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

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

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

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

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

unsaturated media.

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

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

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

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

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

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

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

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

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

[Pause.]

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

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

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

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

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

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

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

[No response.]

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

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

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

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

happen.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

expenses.

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

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

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

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

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

to proceed on that.

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

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

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

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

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

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

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

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

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

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

When a plant enters the decommissioning phase one

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

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

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

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

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

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

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

That completes the two slides I have.

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

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

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

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

DR. WYMER: That isn't entering decommissioning?

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

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

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

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

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

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

DR. WYMER: Okay.

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

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

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

DR. WYMER: Okay.

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

DR. WYMER: Okay, my apologies.

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

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

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

out in the future.

CHAIRMAN GARRICK: Yes.

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

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

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

CHAIRMAN GARRICK: Right.

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

spent fuel actually.

CHAIRMAN GARRICK: Right.

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

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

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

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

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

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

Larry, am I wrong on that?

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

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

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

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

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

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

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

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

MR. CAMPER: Exactly.

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

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

CHAIRMAN GARRICK: Right.

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

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

CHAIRMAN GARRICK: Okay. Thank you.

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

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

Do you have any perception that might be coming

into the U.S. picture?

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

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

MR. LEVENSON: You have heard no discussions?

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

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

MR. CAMPER: We know each other.

[Laughter.]

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

The activities in the environmental review area include preparation and review of Environmental Impact Statements, or EISs, review of Environmental Assessments prepared by the Staff.

Presently it is estimated that EISs will be

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

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

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

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

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

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

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

decommissioning sites.

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

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

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

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

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

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

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

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

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

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

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

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

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

MR. NELSON: Yes.

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

MR. NELSON: Larry.

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

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

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

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

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

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

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

MR. CAMPER: I'm sorry?

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

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

DR. WYMER: Yes.

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

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

they do have one.

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

DR. WYMER: That helps. Thanks.

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

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

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

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

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

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

DR. WYMER: Thanks, Larry. That helps.

Sorry. Go ahead.

MR. NELSON: That's all right.

Any other questions on that topic?

[No response.]

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

In the next fiscal year we plan to conduct a

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

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

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

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

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

closure.

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

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

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

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

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

developing similar schedules and managing to those schedules.

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

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

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

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

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

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

requests to release solid material.

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

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

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

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

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

So that --

DR. WYMER: Or vice versa?

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

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

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

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

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

This has gone a long way to bring the integration

necessary to bring all these complex pieces into play.

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

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

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

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

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

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

That plan is tentatively scheduled -- the revised

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

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

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

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

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

What's the status of the report?

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

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

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

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

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

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

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

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

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

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

But when you talk to a lot of the facilities

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

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

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

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

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

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

cases learning as we go there.

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

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

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

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

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

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

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

Outside of those that I had identified, I think

that those are the real challenges that face us.

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

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

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

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

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

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

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

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

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

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

project for decommissioning.

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

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

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

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

CHAIRMAN GARRICK: Thank you, that's good.

DR. WYMER: George?

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

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

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

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

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

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

DR. WYMER: Milt?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MS. TROTTIER: Right. I understand that.

DR. WYMER: So we will talk about that.

MS. TROTTIER: Okay.

DR. WYMER: Thanks.

MS. TROTTIER: Oh, Cheryl Trottier from Research.

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

CHAIRMAN GARRICK: Well, I want to comment on one

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

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

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

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

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

MR. NELSON: Yes.

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

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

MR. NELSON: I am not aware of any interagency

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

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

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

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

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

CHAIRMAN GARRICK: Thank you.

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

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

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

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

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

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

CHAIRMAN GARRICK: Yes.

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

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

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

So, they really are quite clean.

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

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

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

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

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

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

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

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

[Laughter.]

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

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

MR. NELSON: Thank you for your time.

CHAIRMAN GARRICK: Thank you.

[Pause.]

CHAIRMAN GARRICK: I think what we would like to

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

[Recess.]

CHAIRMAN GARRICK: We'll come back to order.

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

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

[Laughter.]

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

[Laughter.]

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

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

MR. OTT: First, with a little introduction.

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

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

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

CHAIRMAN GARRICK: You have made us feel better already.

[Laughter.]

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

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

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

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

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

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

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

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

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

MR. MEYER: Thank you, Bill.

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

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

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

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

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

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

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

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

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

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

their licensees and by the NRC Staff.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

state.

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

DR. HORNBERGER: What does isoptropy mean in one dimension?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

that they're trying to use.

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

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

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

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

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

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

CHAIRMAN GARRICK: Okay.

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

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

[Laughter.]

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

CHAIRMAN GARRICK: Yes, that's right.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MR. MEYER: Okay.

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

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

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

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

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

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

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

MR. MEYER: Right.

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

DR. HORNBERGER: Ray, do you have anything?

DR. WYMER: No.

DR. HORNBERGER: John?

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

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

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

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

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

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

release from the source in water.

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

CHAIRMAN GARRICK: Right.

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

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

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

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

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

Do you see any problems in doing that?

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

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

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

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

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

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

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

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

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

DR. HORNBERGER: What about rooting depth?

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

uptake.

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

DR. HORNBERGER: Those are unknowns.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

What perhaps surprised me to some extent, and

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

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

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

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

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

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

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

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

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

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

CHAIRMAN GARRICK: Do you distinguish between the

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The two elements are conceptualization and

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

another one somewhere here.

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

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

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

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

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

So these three devices were installed on each plot

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

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

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

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

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

DR. HORNBERGER: Right.

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

DR. HORNBERGER: It looks like Biosphere 3.

[Laughter.]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

So far we have regular variability in infiltration rate. After flooding 200 days more or less you reach the 3 meter depth and we have not yet reached the 5 meter depth except in one plot. It seems to break through. Breakthrough of bromide has occurred at Plot 5 at half a meter and at Plot 8 at one meter, but no bromide observed at other points and the early bromide breakthrough in Plot 8 indicates fractured flow.

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

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

Thank you for your interest.

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

[Laughter.]

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

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

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

knowledgeably about.

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

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

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

DR. HORNBERGER: John?

CHAIRMAN GARRICK: Well, I am not going to talk

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

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

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

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

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

CHAIRMAN GARRICK: Yes.

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

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

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

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

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

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

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

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

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

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

CHAIRMAN GARRICK: Well, this is --

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

CHAIRMAN GARRICK: It was designed that way

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

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

MR. MEYER: Right.

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

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

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

[Laughter.]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[Laughter.]

MR. NEUMAN: I know you don't.

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

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

And I'm really grateful for all of the support

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

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

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

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

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

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

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

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

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

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

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

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

MR. NEUMAN: Can I try?

DR. HORNBERGER: Slomo?

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

I cannot speak for the need for research by the

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

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

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

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

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

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

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

[Laughter.]

MR. NEUMAN: And I can say that again.

[Laughter.]

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

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

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

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

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

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

DR. HORNBERGER: Phil?

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

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

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

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

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

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

Thanks very much. Thank you, Mr. Chairman.

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

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

REPORTER'S CERTIFICATE

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

Mark Mahoney
Official Reporter
Ann Riley & Associates, Ltd.

STATUS OF THE DECOMMISSIONING PROGRAM

ACNW BRIEFING JULY 27, 2000

Decommissioning Branch
Division of Waste Management

OBJECTIVES OF BRIEFING

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

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

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

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

- 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

- 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

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

WEST VALLEY OVERSIGHT

- 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

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

- 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

- 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

- 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

- 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

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

Staff activities include:

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

STREAMLINING OBJECTIVES

- 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

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

- 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

- 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

- 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

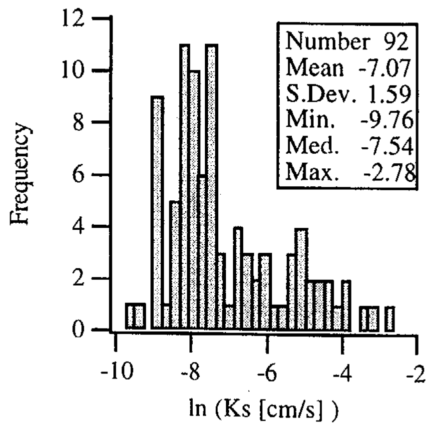
Relationship to Other Projects

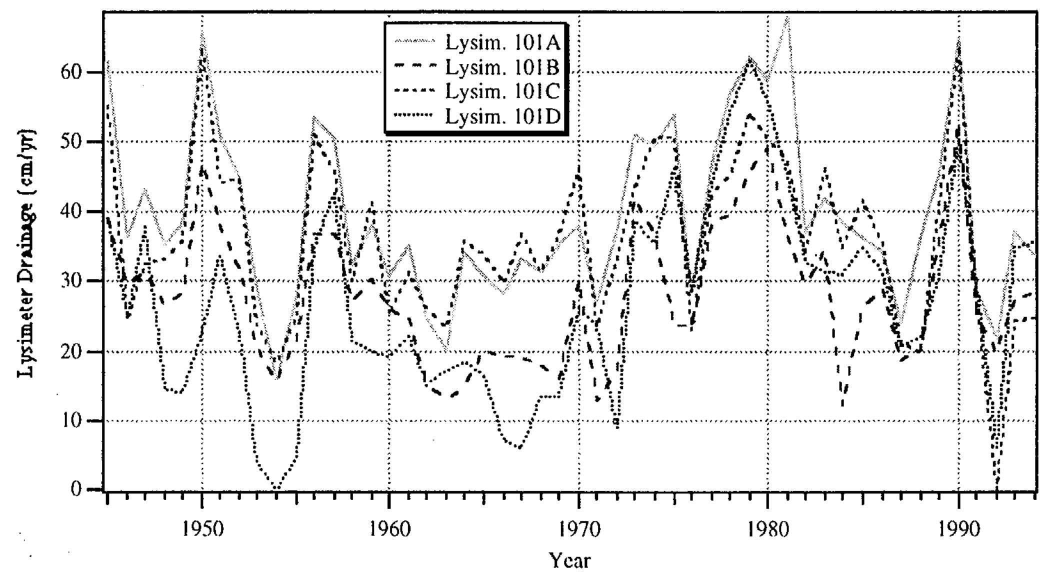
- Information on generic probability distributions for soil parameters incorporated in DandD and RESRAD default parameter distributions
- Information from the Maricopa site monitoring project used in test cases
- Current Univ. of Arizona project on conceptual model uncertainty complements this project's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

Why Is Hydrologic Uncertainty Important?

- 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



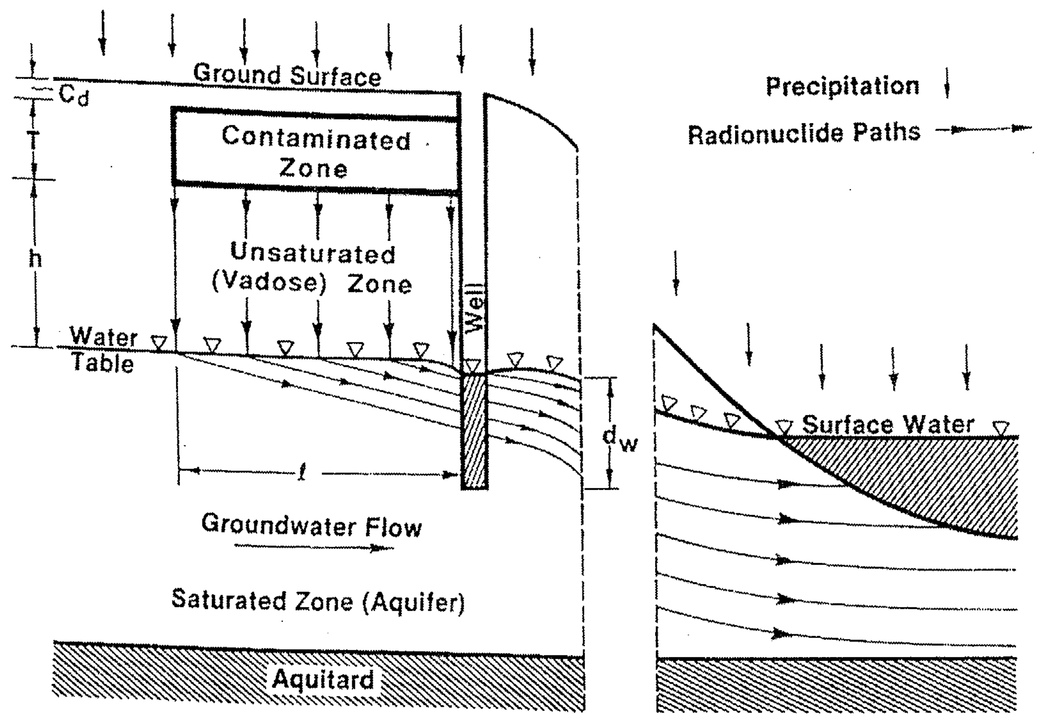


Sources: Las Cruces Trench Experiment, USDA Coshocton Ohio Facility

Battelle

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

- 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

- 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

- 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

- 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[1] and P. J. Wierenga[2]
Principal Investigators

[1]Dept. Hydrology and Water Resources
College of Engineering and Mines

[2]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

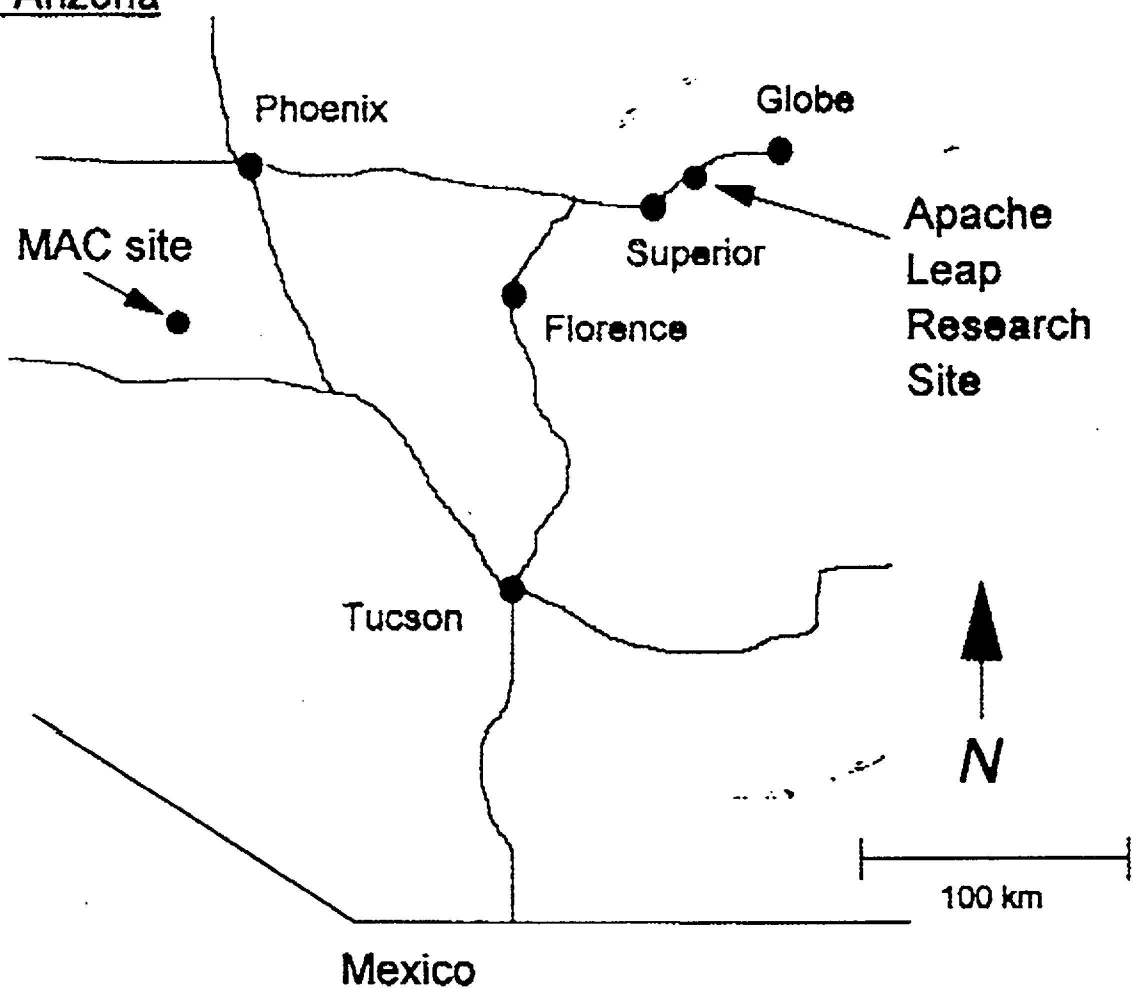
Conceptual Model Testing

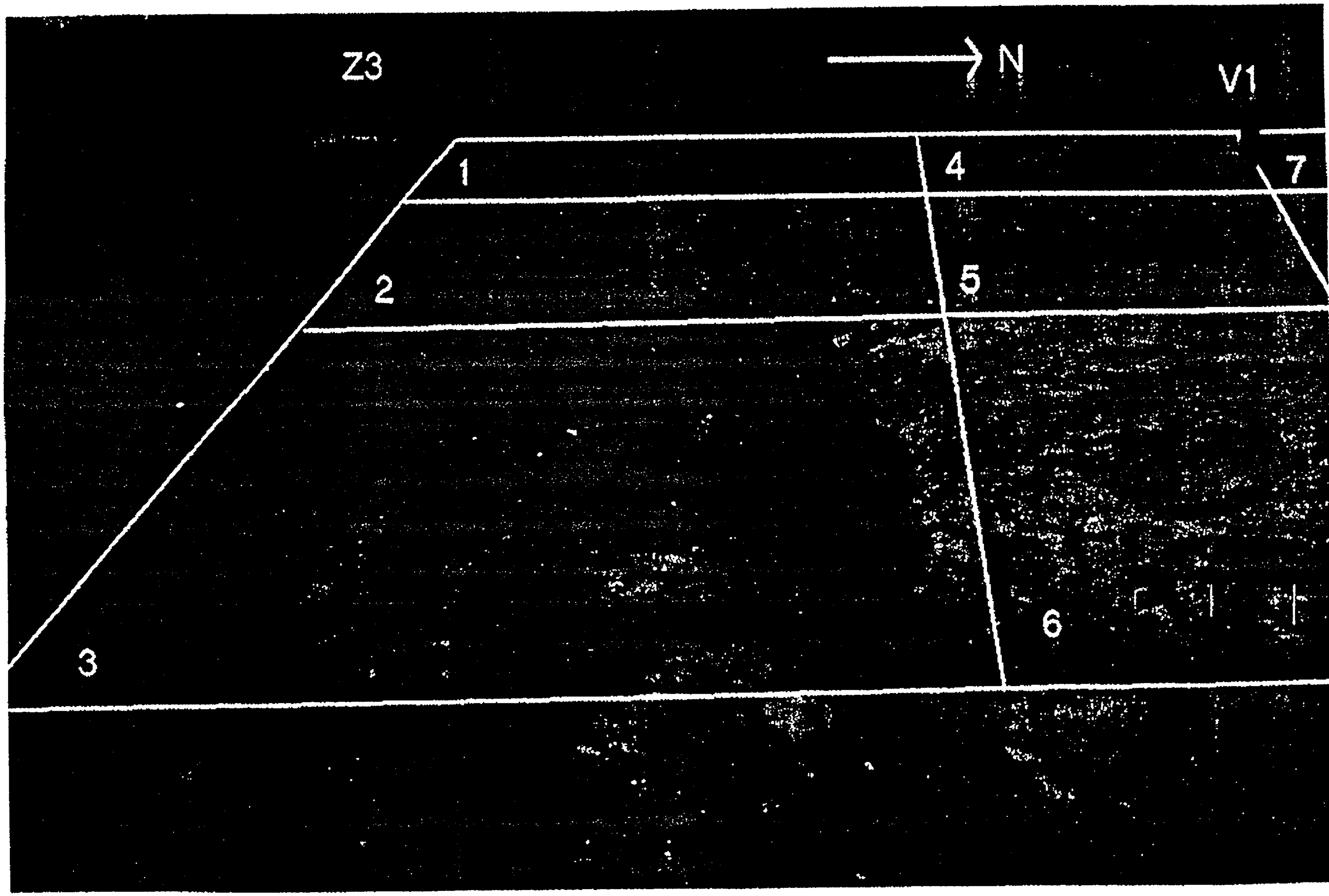
Field infiltration experiments at the Apache Leap Site

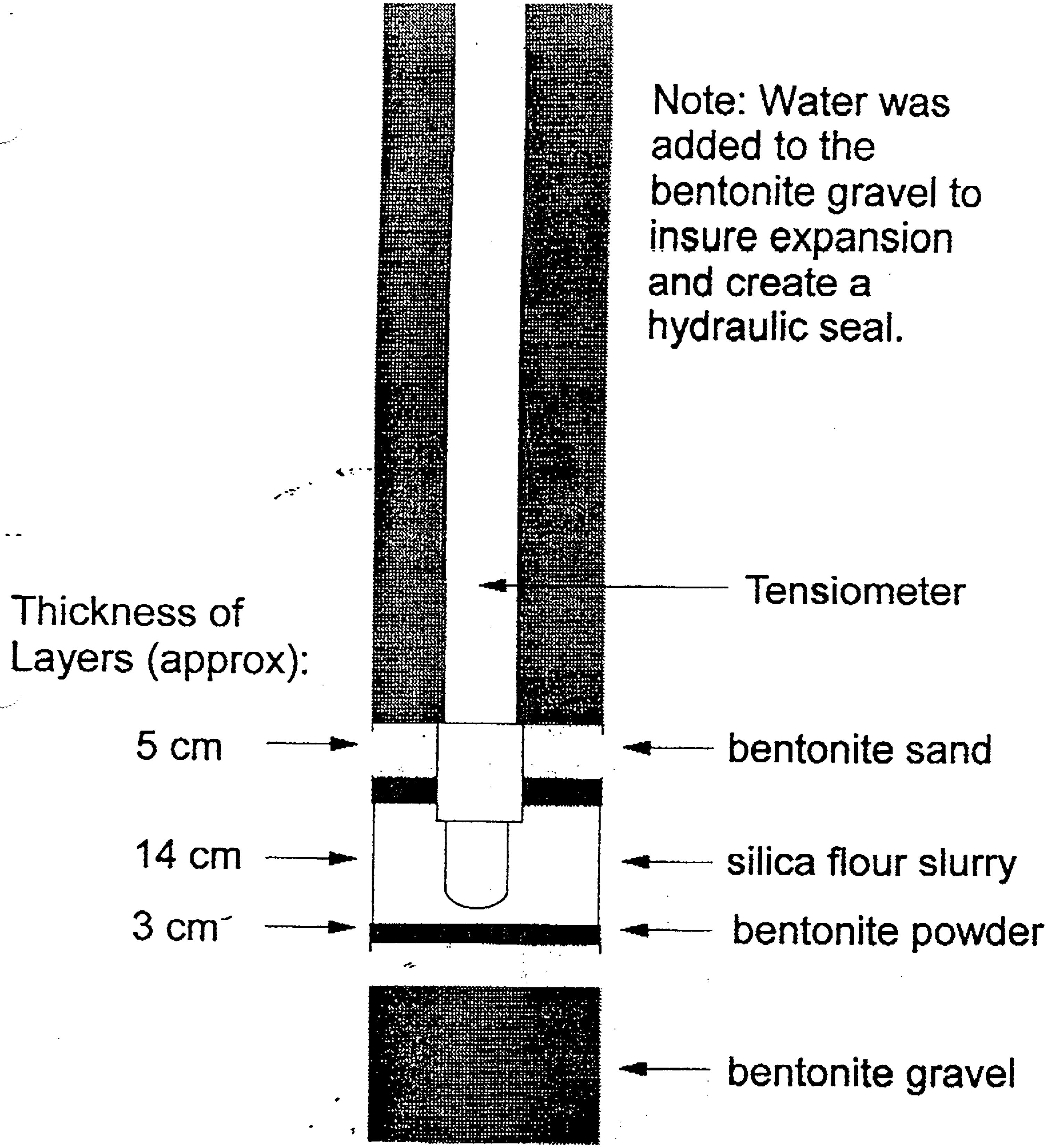
P.J. Wierenga, S.P. Neuman,
M.T. Yao, C.J. Mai, and R. Rice

University of Arizona
Tucson, AZ

Southern Arizona




Z3
N
V1
1
2
3
4
5
6
7



Schematic for Deep Tensiometer:
Backfill: Bentonite. Contact Material: Silica Flour.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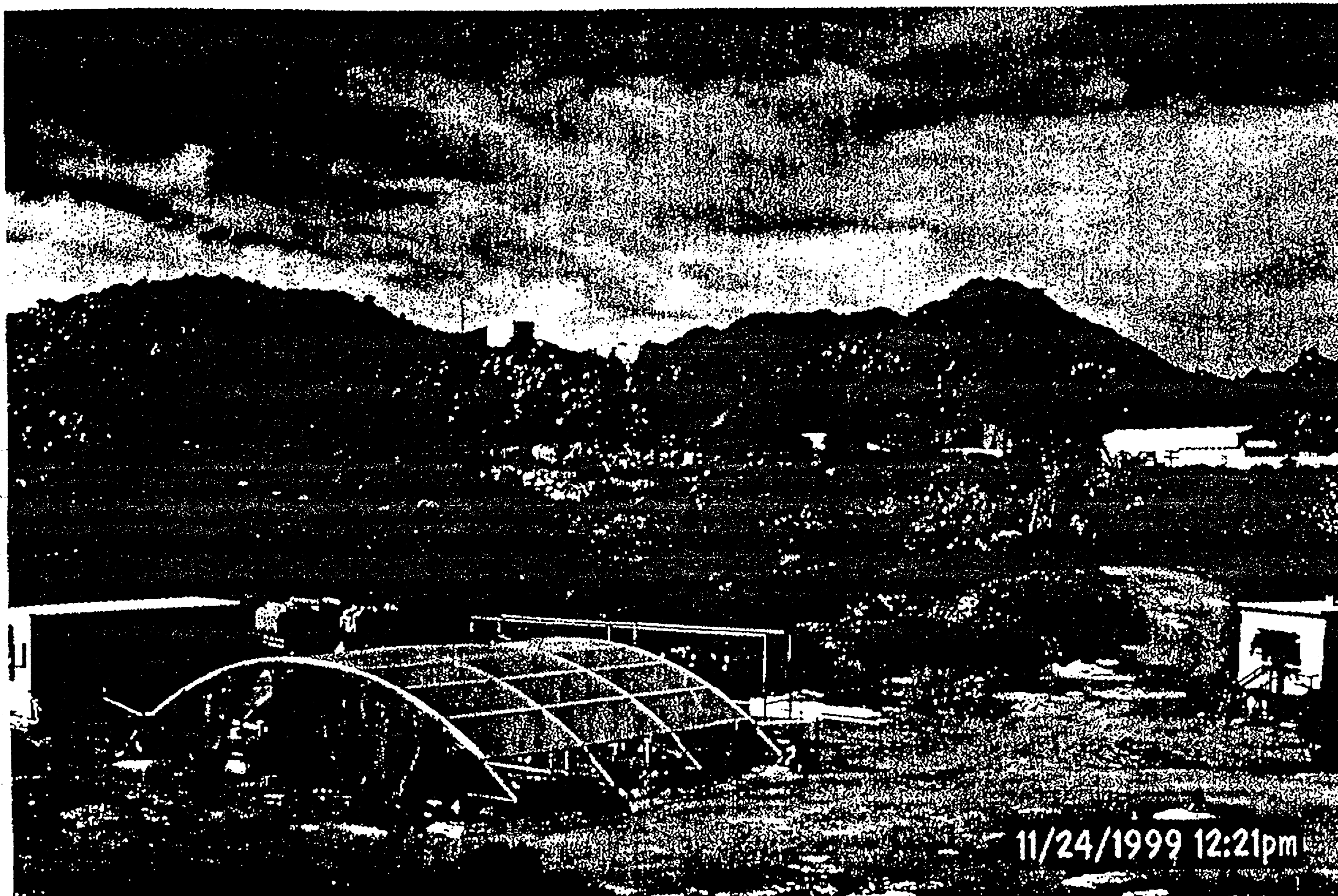
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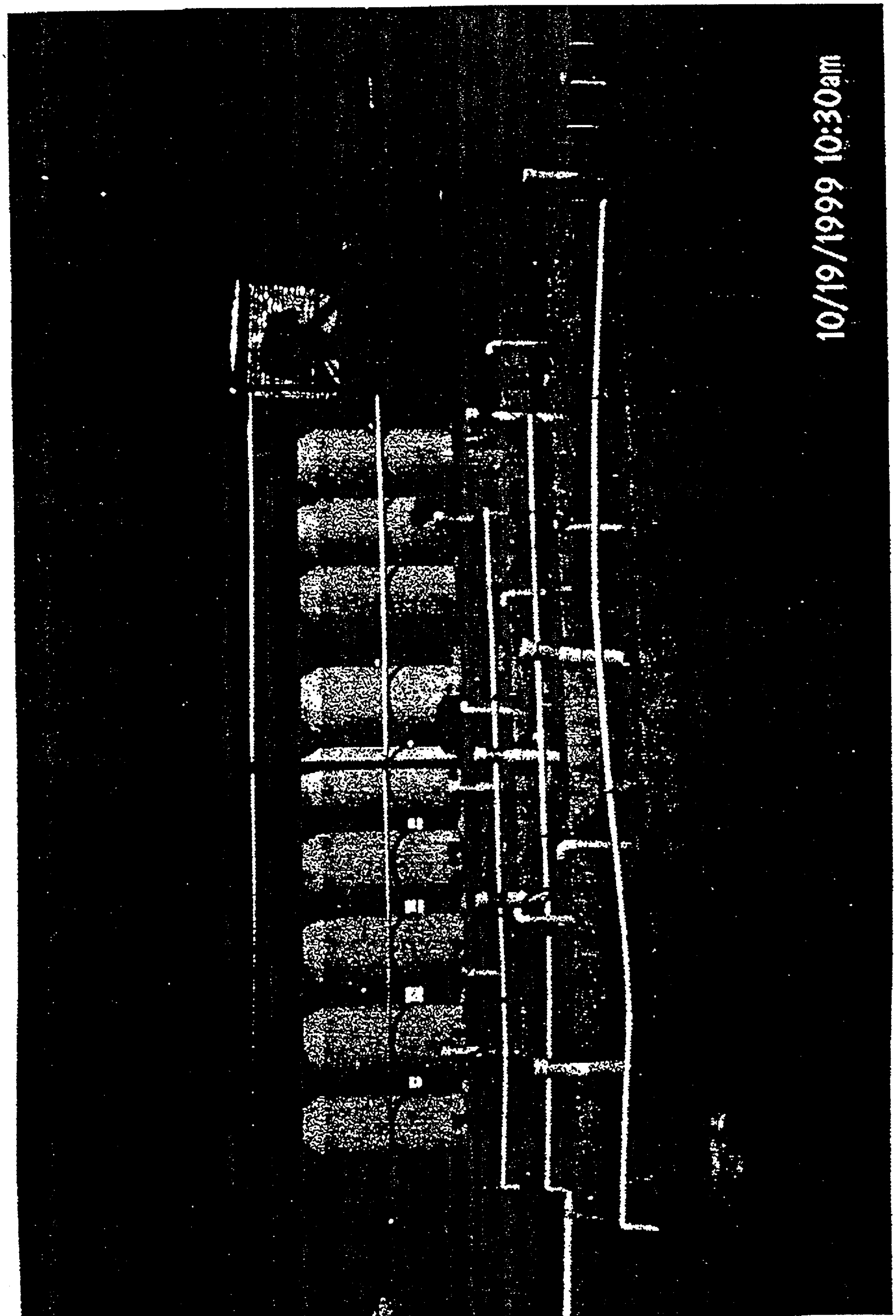
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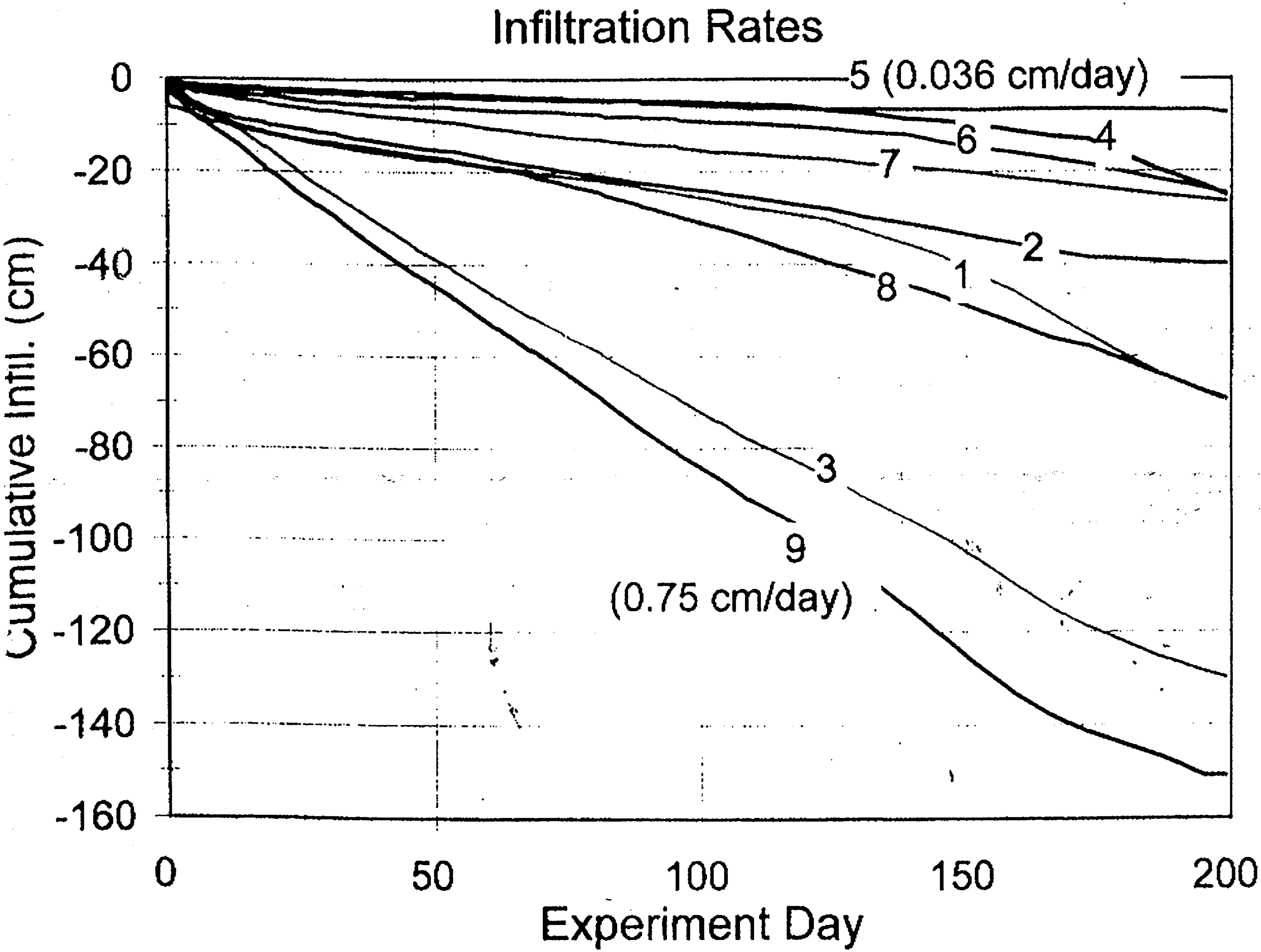
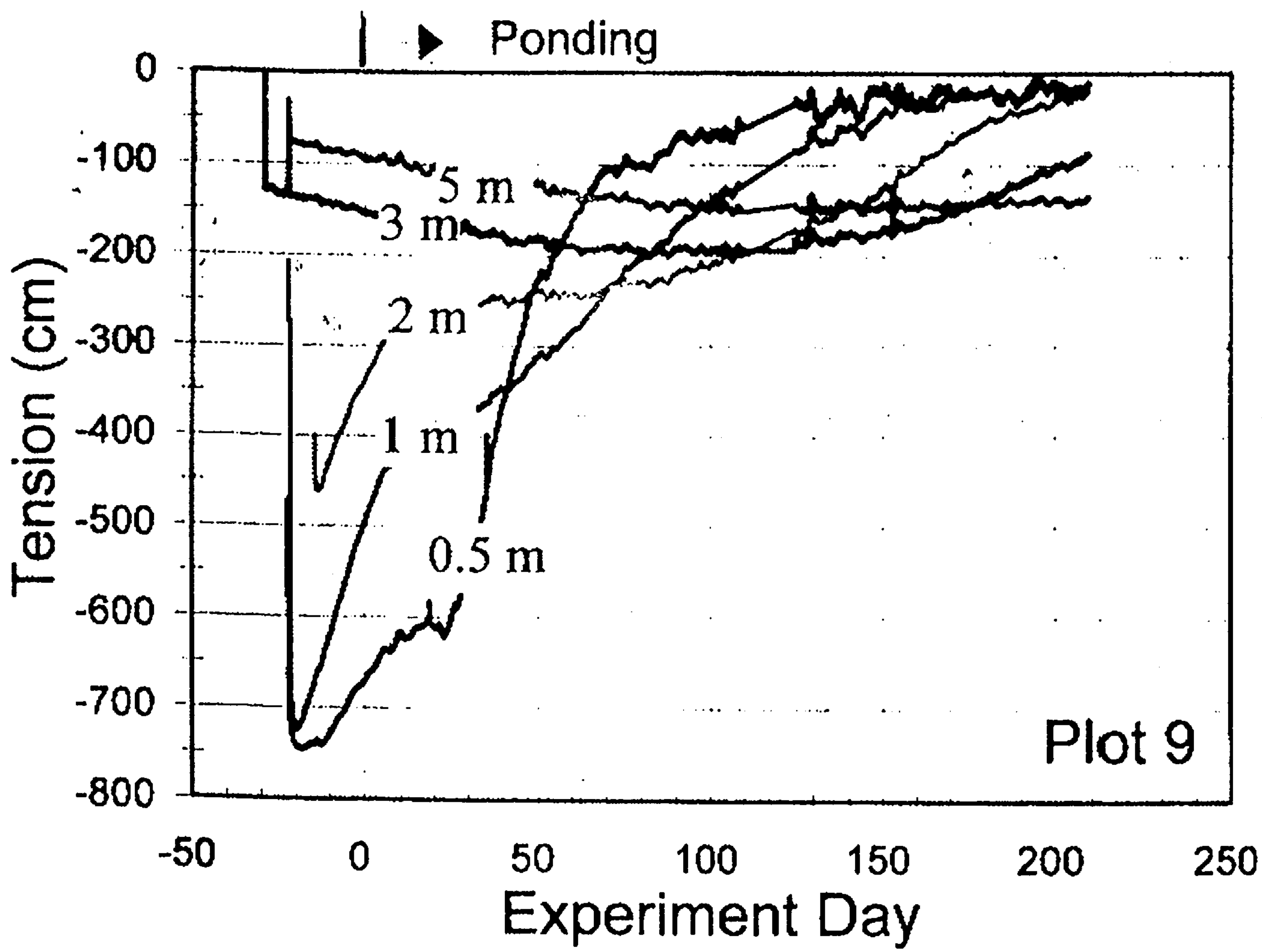
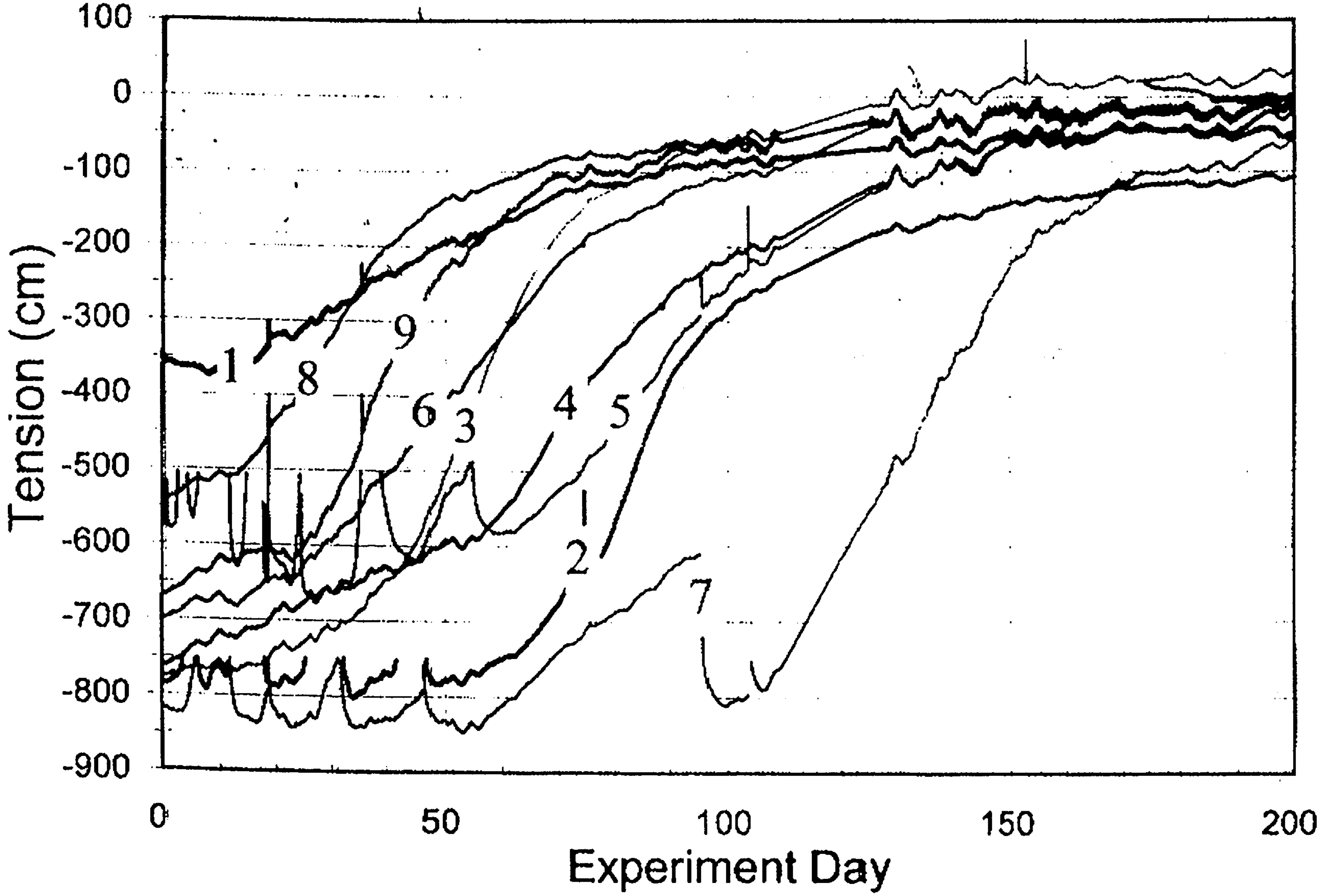

Infiltration Rates
5 (0.036 cm/day)
6
4
7
2
1
8
3
9
(0.75 cm/day)
Cumulative Infil. (cm)
0
-20
-40
-60
-80
-100
-120
-140
-160
0
50
100
150
200
Experiment Day

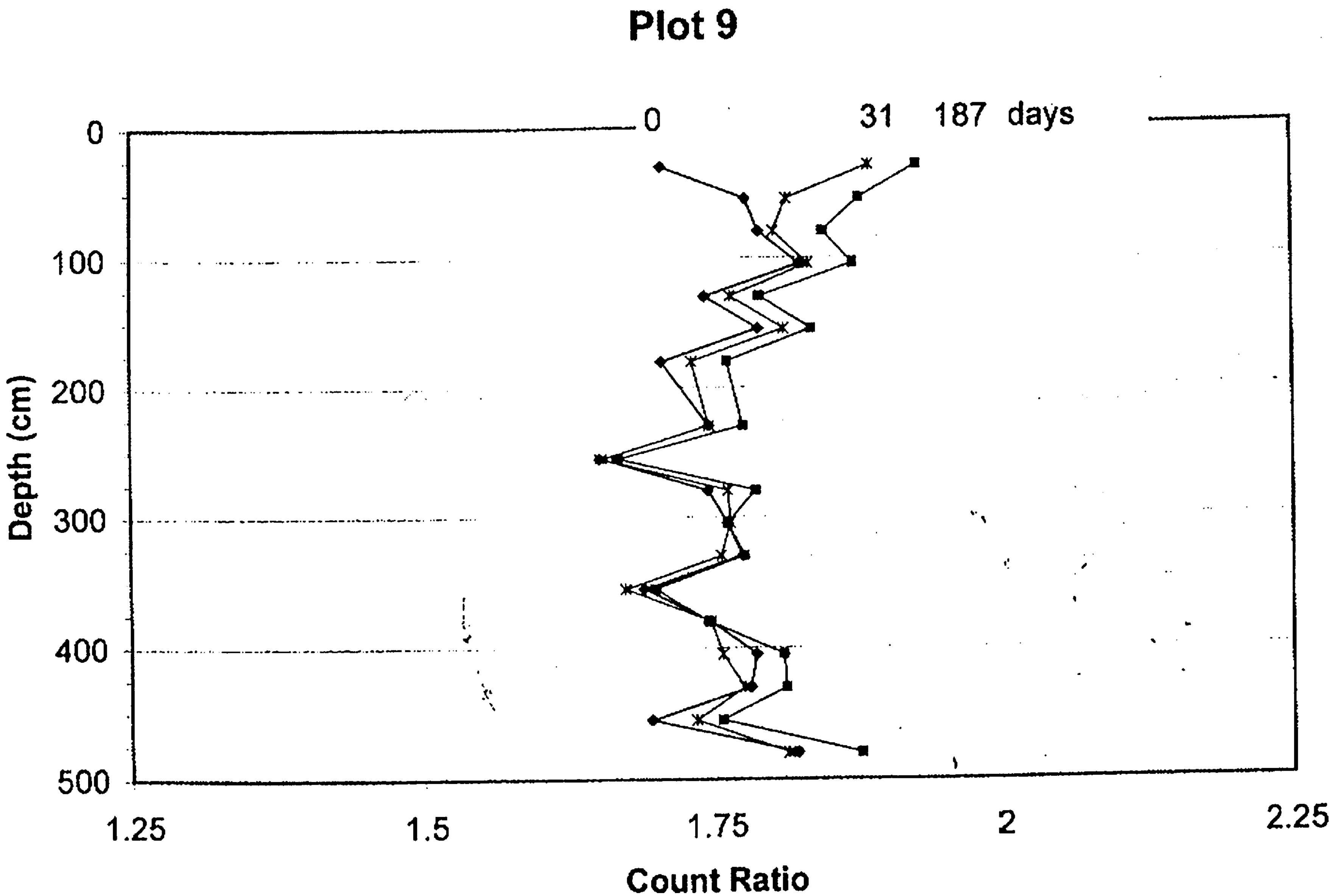


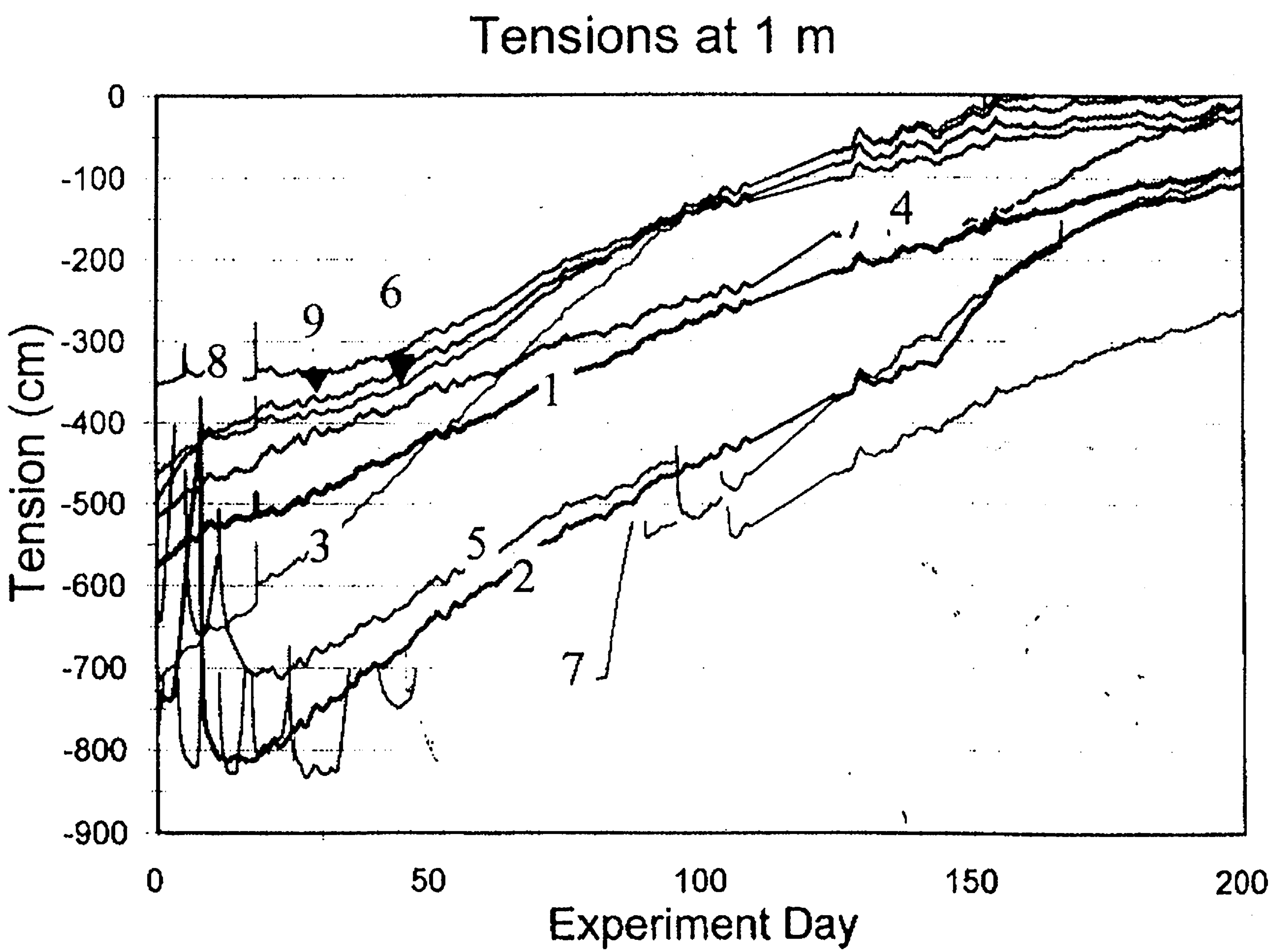
Ponding
0
-100
-200
-300
-400
-500
-600
-700
-800
Tension (cm)
-50
0
50
100
150
200
250
Experiment Day
5 m
3 m
2 m
1 m
0.5 m
Plot 9

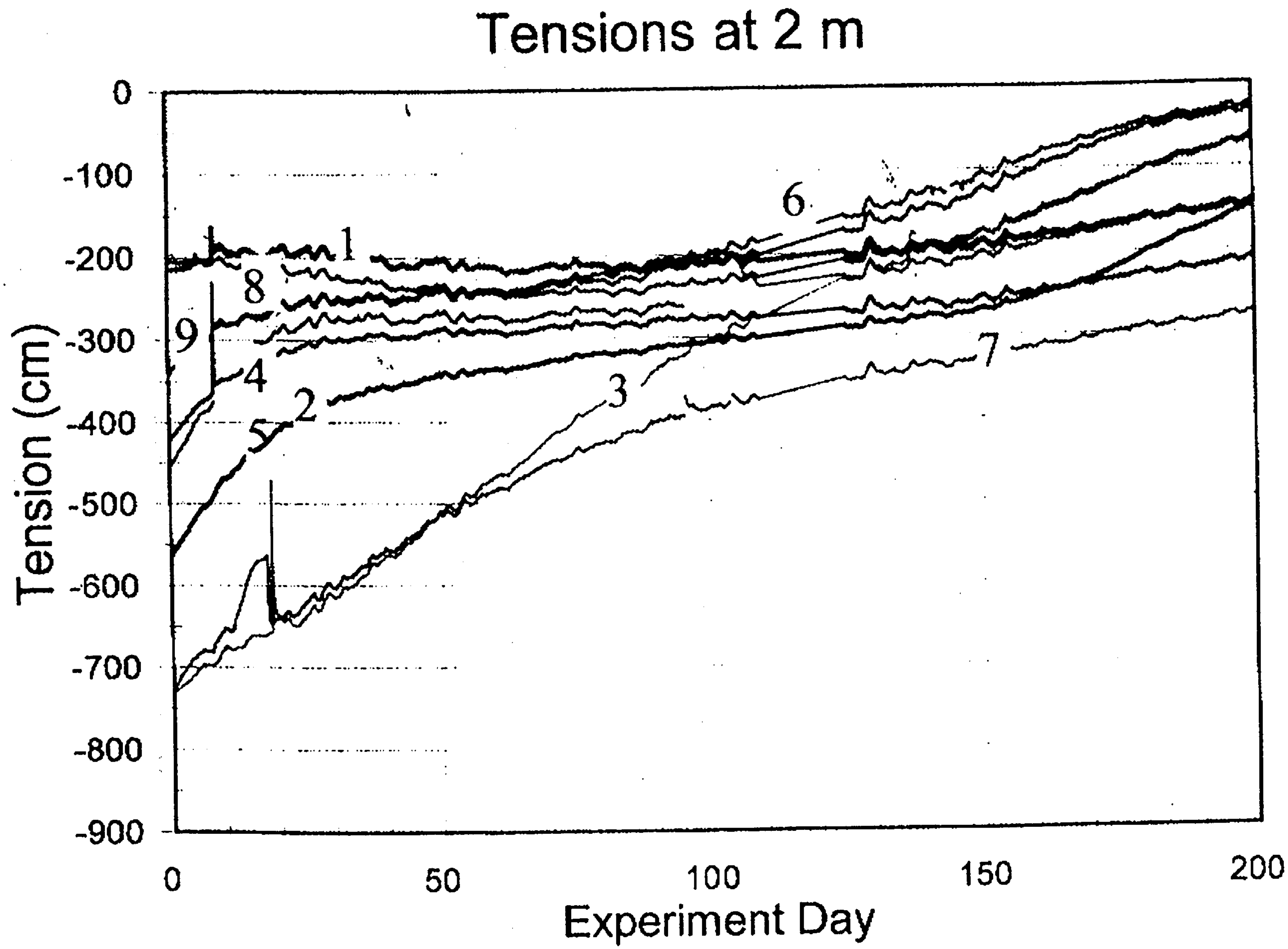
Tensions at 50 cm



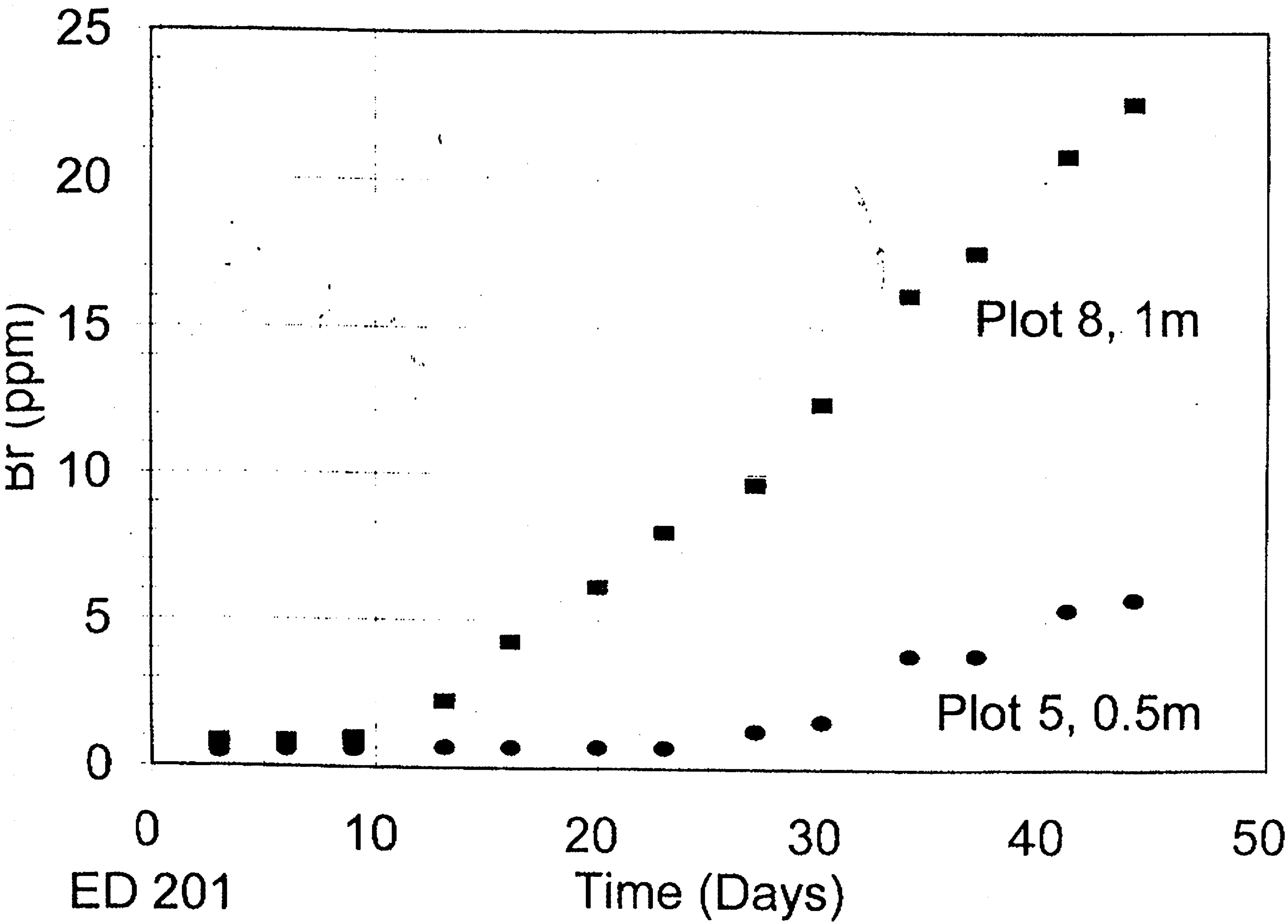
TEL:301-415-5368



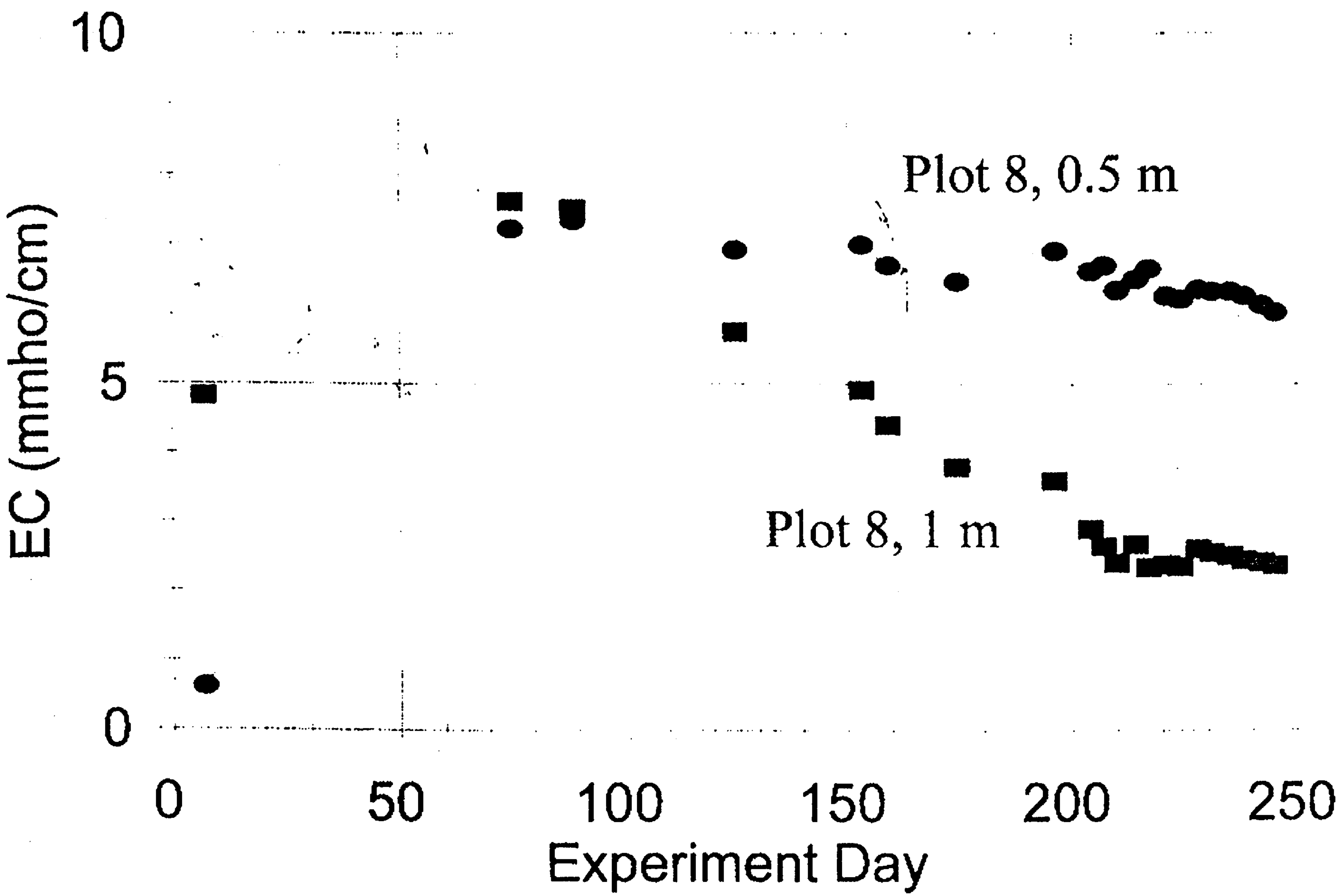

Tensions at 1 m
Tension (cm)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
Experiment Day
0
50
100
150
200
1
2
3
4
5
6
7
8
9



Tensions at 2 m
Tension (cm)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
0
50
100
150
200
Experiment Day
1
2
3
4
5
6
7
8
9



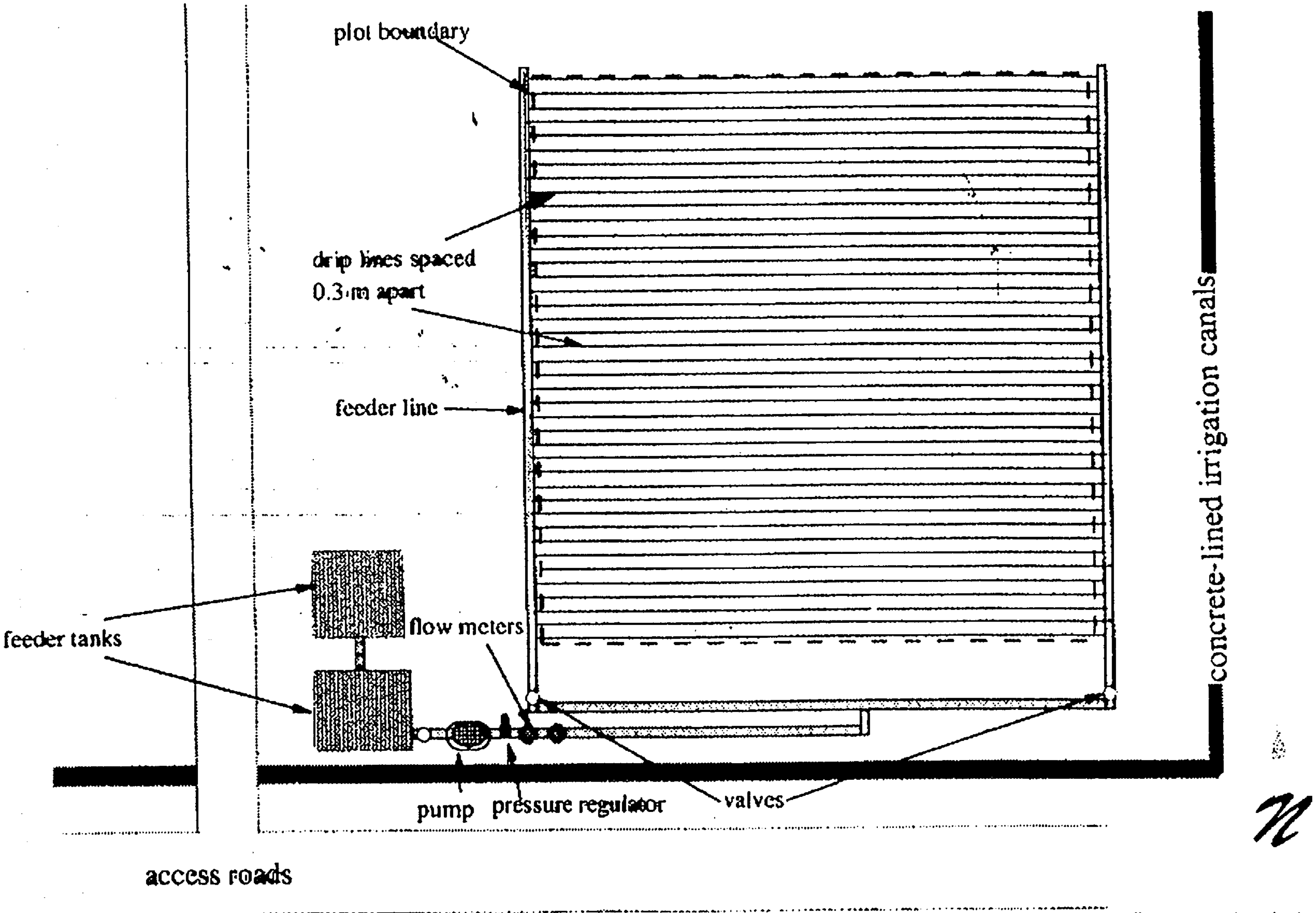
ED 201

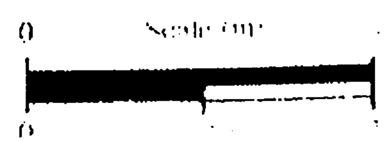


10
5
0
EC (mmho/cm)
Plot 8, 0.5 m
Plot 8, 1 m
0
50
100
150
200
250
Experiment Day

Data Summary

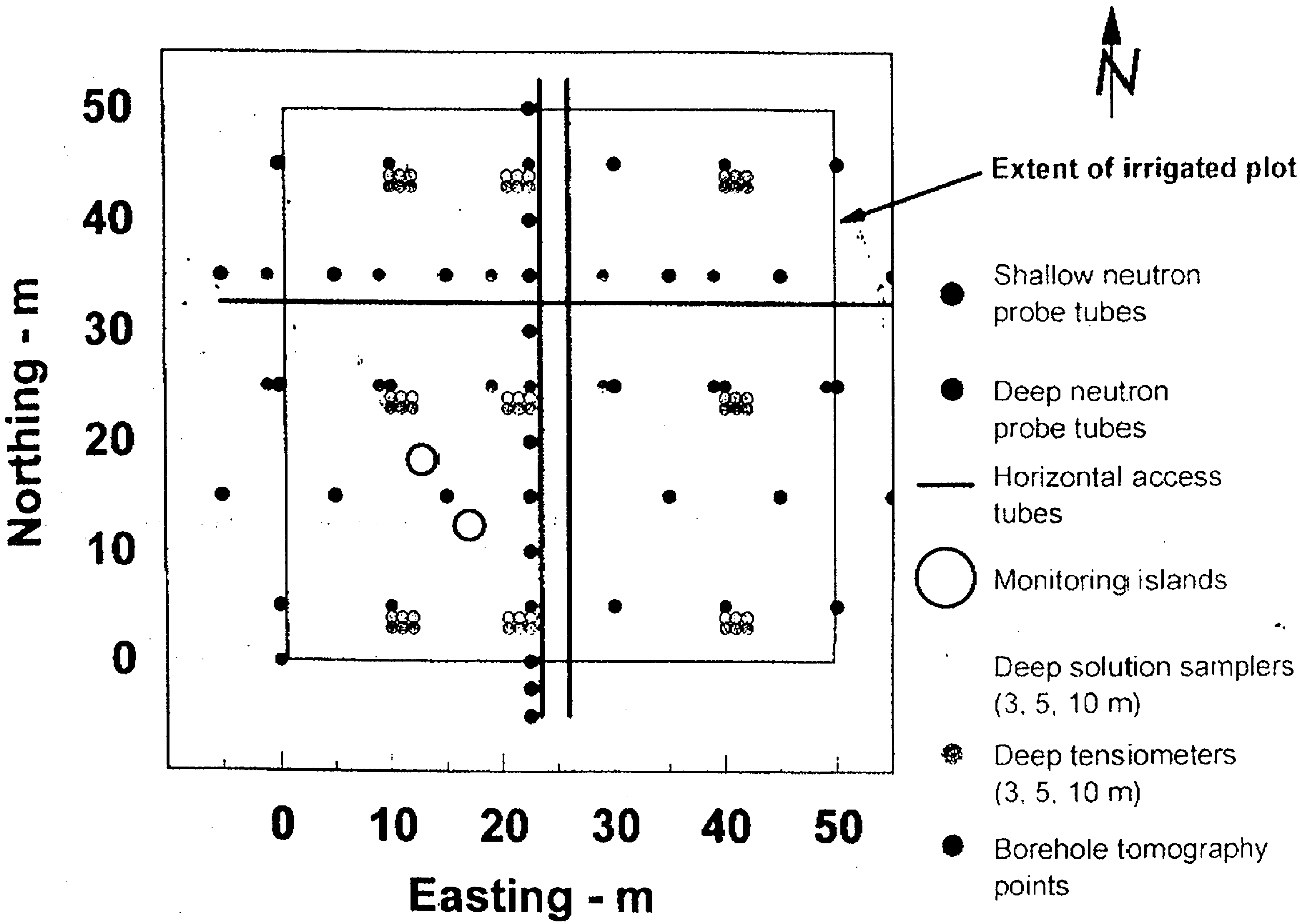
1. Water is infiltrating at a rate varying from 0.036 cm/day (plot 5) to 0.7 cm/day (plot 3, 9)
2. After flooding for 200 days the water front has reached the 3 m depth in nearly all plots
3. The water front has not yet reached the 5 m depth, except for plot 6
4. Bromide breakthrough occurred in plot 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





Irrigation System

MARICOPA SITE


N
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
Northing - m
Easting - m
50
40
30
20
10
0
0
10
20
30
40
50

19