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

APRIL 23, 1997

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste on APRIL 23, 1997, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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91st MEETING

ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

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WEDNESDAY

APRIL 23, 1997

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ROCKVILLE, MARYLAND

The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Paul W. Pomeroy, Chairman, presiding.

COMMITTEE MEMBERS:

PAUL W. POMEROY	CHAIRMAN
B. JOHN GARRICK	VICE CHAIRMAN
WILLIAM J. HINZE	MEMBER
GEORGE M. HORNBERGER	MEMBER

ACNW STAFF PRESENT:

JOHN T. LARKINS	Exec. Director
MICHELE KELTON	Tech. Secretary
RICHARD K. MAJOR	
HOWARD J. LARSON	
LYNN DEERING	
ANDREW C. CAMPBELL	
RICHARD P. SAVIO	
CAROL A. HARRIS	
SAM DURAISWAMY	
THERON BROWN	

ALSO PRESENT:

CHARLES FAIRHURST
STEVE FRISHMAN
LINDA LEHMAN
HEATHER ASTWOOD
BOB NELSON
JOHN GREEVES
JOHN AUSTIN
MIKE BELL
MARGARET FEDERLINE
RAY WALLACE

A-G-E-N-D-A

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

(8:37 a.m.)

CHAIRMAN POMEROY: The meeting will now come to order. This is the second day of the 91st meeting of the Advisory Committee on Nuclear Waste.

Today the committee will first hold discussions with several representatives of the State of Nevada on issues pertaining to the proposed Yucca Mountain Repository; secondly, review a screening methodology for assessing prior land burials; third, discuss current events with the NRC's Director of the Division of Waste Management; fourth, discuss the defense-in-depth philosophy as it relates to radioactive waste disposal; fifth, prepare our reports and secondly discuss committee activities; and lastly, discuss committee activities of the future agenda.

Mr. Howard Larson, two to my right, 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 from members of the public regarding today's session. Should anyone wish to address the committee, please make their wishes known to one of the committee staff.

It is requested that each speaker use one of the microphones, identify himself or herself, and speak with sufficient clarity and volume so that he or she can be readily heard.

The committee is very pleased to have with us today two guests: Professor Charles Fairhurst -- Professor Fairhurst will address the committee laster this afternoon -- and Professor Ken Foland who will, I think, be participating in the meeting for part of the day today.

If any of my members have any opening comments? If not, let's proceed to the first agenda item, namely, Nevada Perspective as to the Difference between DOE's Viability Assessment and the Site Suitability Determination for the Proposed Yucca Mountain Repository.

I believe Steve Frishman is going to comment also on 10 CFR Part 960, the site-specific siting guidelines for Yucca Mountain, as well as the 10 CFR 60 subsystem requirements. Steve, it's always a pleasure to have you here; we're glad to see you, and please, if you're wired --

MR. FRISHMAN: Thanks. I appreciate the invitation and I'll be talking for a while on the subject that you mentioned and then Linda Lehman will be talking on some additional topics that we think will be of interest to you.

First of all, as always. I didn't bring any handouts. Last time I brought you some but I just couldn't find any more of them real handy. I know how much you like the garlic and the alfalfa that I brought. And I hope you got good use out of that garlic.

CHAIRMAN POMEROY: Actually, we deeply appreciated that, Steve. As you know, the committee went out to the Amargosa Valley after your presentation and I'm really glad that you brought that particular aspect, particularly the garlic which I enjoyed greatly.

MR. FRISHMAN: Well, I hope that you did find that informative because I think it definitely helps with the considerations of critical group, because that's going to have to be considered. And I think you were in the middle of the dilemma of what is a critical group when you're talking with the people there.

CHAIRMAN POMEROY: Absolutely.

MR. FRISHMAN: Well, I wanted today to go through some things that I know some of you have heard from me, or part of from me in the past, and I wanted to kind of link it all together because things are happening fast.

As you're well aware, programmatically, everything seems to be sort of tied to everything else, and I'd like to give you sort of my version of how I

unwind it all, and the part that I see in it, and where I see the potential pitfalls for people who are trying to understand what the program is doing as it stands still and moves forward all at the same time.

MEMBER HINZE: Would it be appropriate, Steve, before you get too far into this, to explain to us just a bit, what the Nuclear Projects Office is about these days, without the DOE support?

MR. FRISHMAN: Well, we're selling pencils on the corner.

MEMBER HINZE: Is there anything left of the Research Program?

MR. FRISHMAN: There's very little left of it. We had to terminate contracts with all of our contractors and just recently we brought Linda back on as a technical contractor. And Linda has some pretty specific work to be doing, but at this work we don't have sufficient funds to be doing any independent research through contractors as we have done, you know, ever since we first opened the office back in the mid-'80s.

So what we have done is, we have compiled all of the independent technical work that we've had done for about the past ten years. And we're going through that and trying to make sure that we understand that and have that in a useful form. And we do expect that we will be

in a better situation again sometime soon.

As you know, we have filed a legal challenge over the denial of our funds from two years ago, and I think there's a fair chance that we'll prevail on that. We also are in the Administration's budget proposal for the next fiscal year, and Lake Barrett encouraged the House Committee that had its first hearing on that proposal to fund us and affected counties because he felt it was an advisable and worthwhile thing to be doing.

So I think at this point we're at a low point in terms of funding, but I think it will improve again. Also, the program has changed sufficiently to where if we do get additional funds for technical contractors we're probably going to have to be working in a slightly different way, and I think we're going to have to respond much more to the emphasis on total system performance assessment.

We already have some of our own thoughts and have had, you know, considerable discussion about where the high sensitivities are in TSPA, and we think we have a fair amount of independent work behind us already that will feed into our ability to review various aspects of TSPA.

As with your meeting yesterday on igneous activity, I know one of our contractors or a couple of

them, have been pretty active in the pursuit of information in that area, and I think from listening yesterday it sounds as if our work had been useful, in terms of understanding or at least laying some bounds in the area of the effects of igneous activity.

I was glad to hear yesterday, the extent to which Gene Smith's work sort of plays in the thinking and I recognized from listening to John Trapp that that work, one way or another, if we get into a licensing situation, that work is going to have to be recognized and dealt with.

And we have similar work in other areas that we'll be bringing forward as necessary and as the program moves forward. And you'll hear some of that today from Linda.

MEMBER HINZE: Two questions then, Steve. Are you preparing a bibliography of these internal reports, and are you preparing a summary of the research that --

MR. FRISHMAN: We have listed almost everything in our Agency bibliography right now that is available on paper, and I believe also available on our Home Page. Plus we have summaries of some work on our Home Page and we're probably going to be putting more on all the time.

The Page is becoming something that's very

useful for us internally because it helps us find things and not have to live quite so much out of our vertical files as we used to. It's also very useful to other people.

MEMBER HINZE: Can you give us the address? I'm afraid I've forgotten it -- if I ever did know it.

MR. FRISHMAN: I'll get it to you after this.

MEMBER HINZE: Oh, that makes me feel better then, if you have to get it.

MR. FRISHMAN: I have it on "favorites". I don't have to worry about the address any more. But I will get it to you.

MEMBER HINZE: Thanks.

CHAIRMAN POMEROY: Steve, one of the things we run into of course, is that there is this much greater emphasis on TSPA and PA in general. And we see it as still a very vital role for the geosciences in the next few years as well, and I'm sure you probably will touch on that some in our discussion.

MR. FRISHMAN: Yes.

CHAIRMAN POMEROY: But I wonder, are you thinking in terms of possible future support of some of your tectonics activity, that I thought was very useful in the past?

MR. FRISHMAN: Yes, we are.

CHAIRMAN POMEROY: The University of Nevada, Reno?

MR. FRISHMAN: Yes. It was with great regret that we let go what we let go. In fact, we held on probably a year longer than we should have if we were going to really sharp pencil our own business and try to sort of get through the situation we're in right now. So yes, we want to recapture everything that we can.

CHAIRMAN POMEROY: Great.

MR. FRISHMAN: Well, I think probably the key word that leads to most of the discussion that is going on now surrounding this program -- on the Hill, in the technical world, in almost all of the interests associated with this program -- the key word is suitability.

And that's kind of interesting because the word suitability appears in the Nuclear Waste Policy Act of 1982, was never amended out, but it's also never been defined. Suitability does have, in the Nuclear Waste Policy Act, a very specific meaning. And that is, that it's used in sentences where the Secretary makes determinations such as the suitability of the site for a repository.

Well, the only standard the Secretary has in the Nuclear Waste Policy Act to determine suitability is the guidelines which are 10 CFR 960. If the Secretary's

going to make an accountable decision, the guidelines are the only basis for that accountable decision.

And that decision under the Waste Policy Act is the decision to recommend to the President that the site go forward for a license application for a repository. So if the Secretary determines under the current Act, that the site is suitable -- meaning that the site is not disqualified and is also found qualified, that is -- two findings must be made. It is not disqualified and it must be qualified -- meaning it must meet the qualifying conditions of the guidelines.

If the Secretary makes that finding then the Secretary has a basis to recommend the site to the President for submittal of a license application to the Nuclear Regulatory Commission.

The word is, unfortunately, attached in people's minds to all kinds of other things. Suitability is, throughout -- and I guess I can recall talking to you about suitability in the past, I've talked to the Technical Review Board about suitability in all, you know, over the last five to seven years.

But we still have this sort of misunderstanding out in the world about the difference between the meaning of suitability in the Act -- even though it's undefined -- and the fact that suitability as

relates to this program in most people's mind, is something that's in the eye of the beholder.

So now we're in a situation where it has become even more muddled, and that's because the Department has invented a process that they call viability assessment. Viability assessment is not in the Nuclear Waste Policy Act. Viability assessment is something that it took about six or so months to develop in concept at the Department, and it took them another six months for Dan Dreyfuss to figure out what to call it.

Viability assessment is something that the Department doesn't do. The Department intends to prepare some reports so that somebody else can make a viability assessment -- once again, viability undefined -- so viability then becomes in the eye of the beholder.

The viability assessment work that is going on within the Department right now consists of producing four reports and those four reports will be delivered to the Congress and to the President. Those four reports contain information on the following.

The first is the, as they put it, the critical aspects of the design of the repository and the waste package, and as I understand the words "critical aspects", it's primarily emphasizing elements for which there is not a precedent in licensing.

So it won't be a complete design -- and percentage-wise it's hard to tell what it will be -- but it should be enough so that the basis of the design can be used in the next report, as a portion of the next report, which is the total system performance assessment. You can't do the performance assessment unless you have some minimal amount of design.

And as I understand it, the schedule for that -- and this probably should be of interest to you because it will give you sort of a leg up on it, too -- in September of this year, the design people are supposed to hand off to Abe Van Luik's shop a design sufficient to be used in the TSPA for the viability assessment.

I was just asking him yesterday, they were supposed to, in March, have handed off a preliminary, and he was called in from his day off last Friday from what he said, to find out that it won't be till May. But that design will supposedly be sufficient to use in the TSPA, which is the second report.

The third report is what the Department estimates in terms of a schedule and cost and sort of process, to get to a license application. What does it take from the time of the viability assessment which is scheduled for September, 1998 -- what does it take to get from there to a license application in terms, essentially,

of time and money? It's a license application plan. And that would include the development of the environmental impact statement for the repository.

And the final of the four is a next rendition of a total system lifecycle cost. Meaning, what does the Department expect the entire repository program from 1982 to closure, cost? They did one a couple of years ago that represented quite a difference from the one that they had done a few years before that.

I won't give you my cynical guesses about what the next one's going to look like. But we're interested in that and you know, we think that that will probably have a great deal of bearing on the Hill, on how people view the viability of the Repository Program.

So now, laying out something like this at this point, when the plan is for a license application to be submitted in 2002 -- the Secretary makes the recommendation if the Secretary has a basis for it in 2001 -- license application submission are 2002.

There's not really anything wrong with doing something like a viability assessment at this point. There's been nearly $3 billion spent on Yucca Mountain already; probably take a couple more to get to 2002.

And it seems if this were essentially a business endeavor, it's reasonable at this point to stop

and take a look at these elements and to make a business decision. And if you recall, Dan Dreyfuss has always referred to the viability assessment as essentially a business evaluation.

But under the circumstances I think there's a great danger that the viability assessment is going to be misunderstood and is going to be used in a way that does not really improve the situation.

If you paid attention to the debate over S.104 on the Senate floor you heard Senator Murkowski -- the Chairman of the Senate Energy and Natural Resource Committee -- you heard him talking about 1998 when the site will be found suitable. And thinking that 1998, the viability assessment is the on/off switch for Yucca Mountain.

And he's not the only one who misunderstands it. In fact, almost everybody in a position to make any decisions misunderstands it. So the reason that I wanted to bring it up to you was partly to get you thinking about how you as an Advisory Committee to the Commission, are going to want to deal with the concept of the viability assessment.

And also, knowing that you're going to be meeting with the Commission fairly shortly, this may at least encourage you to think about it to the extent that

you might be able to give the Commission some guidance on how to deal with the viability assessment because it's an area that is going to be tremendously misunderstood, misrepresented.

And I think it's not out of the question that those who misunderstand it most on the Hill, one way or another are going to be asking the Commission what they think about the viability of Yucca Mountain.

So it's certainly a situation where I think your advice will be helpful, primarily to assure that the Commission, when asked a question like that, has an answer that is constructive to the system rather than one that just furthers the misunderstanding of the terms.

So my suggestion is that, if possible, first of all you don't refer to the viability assessment. And I know that's very difficult to do since it has become a term of art already. But what I mean by don't refer to it is, in September 1998 you're going to see essentially, a basis design for repository and waste package, you're going to see a total system performance assessment.

Now, those don't have to be called part of a viability assessment; those are work products. Those are work products of the Department in the Yucca Mountain project and repository program. So if you want to look at those and review them in any way you feel is reasonable --

they're milestone reports, milestones that the Department itself has set up -- and I think from your standpoint and from the Commission's standpoint, that's probably about as far as you ought to go.

You look at them in terms of they're being milestone reports, and make your decisions about the extent to which you want to review those and the extent to which you want to comment on them; no different from other reports that have been flowing through the system since 1982.

But to get caught up in the viability assessment concept is to be caught up in the suitability problem, because I recall that there have been times in Congressional Hearings where representatives of the Commission have been asked to give answers that are sort of in terms of the misunderstandings that are within the program.

And I particularly remember a time way back when, in 1987, leading up to the decision that put us in sort of this impossible position of having only one site and no alternatives. I remember Hugh Thompson was asked, do you think any of these three sites are licensable? And he said, yes, I'm sure one of them is.

And then it was Senator Ford who said, you wouldn't care to save us a couple of billion dollars and

tell us which one, would you? But the Commission was caught, and that was a very difficult situation. And I know we had a meeting with the Commission just a day after that, and Hugh's comments disturbed me to the point where I brought it up in the meeting with the Commission.

Where, you know, how can you have a representative of the Commission sitting here and sort of furthering the misunderstandings of the program and speaking without basis? I would not like to see the viability assessment sort of fall into the same kind of thing, and there are members of Congress who are going to want to know specifically from the Commission and from many other people, do you think this site is viable?

Well, you have no basis to say what it is. First of all, you don't know what viable is. About all you can say is that we are reviewing the technical basis for decisions that might have to be made later and milestone reports. That's as far as you can go.

And I know it's a difficult situation politically, to be in, but I think that's the only situation that the Commission can be in without essentially prejudicing its future in a licensing process if one ever comes up.

And that's how serious I think it is. So I wanted to lay at least that out for your thinking, and I

know some of you have heard me say this or something similar in the past, but I think we're getting to sort of a crunch point, and I know that the staff is sort of looking at what it needs to relative to the viability assessment.

And I think it would be well for the staff to at least consider the same advice that I've given you about what to do and what not to do.

MEMBER HINZE: Steve, certainly there is that chance for a misperception, and that is from the Senate to the President on down. But the DOE has made it clear that this is not a suitability decision. What I would like to know from you is, what you think is going to be done between 1998 and 2001 in terms of data acquisition and analysis of the Yucca Mountain site that will change it to a point that will reach suitability analysis?

MR. FRISHMAN: Okay, well that was going to be sort of the basis of the next thing I wanted to talk about.

MEMBER HINZE: Sorry.

MR. FRISHMAN: No, you've turned it around. But you turn it around, but you'll hear my answer what's not going to be done, that concerns me.

MEMBER HINZE: I'd like to hear what's going to be done.

MR. FRISHMAN: Okay, well I can tell you and then I'll go into the discussion of that. And this has to do with the guidelines and proposed changes in the guidelines.

The only data collection that I see the Department has any emphasis on in the period from -- well, from even now until a license application -- primary emphasis is on collecting data that would support some type of a thermal loading decision, or thermal loading design.

That's the primary missing piece from the Department's point of view in total system performance assessment, and it's also the primary piece of design for which right now, there is -- well, we've argued this out before -- I say essentially no basis; Abe would say there is at least some basis for the current design.

And the current design is a pretty high thermal load and that high thermal load is one for which I haven't seen any demonstration that it contributes to performance rather than it's detrimental to performance.

If you recall in 10 CFR 60, thermal loading is seen as a potentially adverse condition, and it's seen as the -- the heat from the waste is seen as something that can cause problems and you have to figure out how to deal with it.

The Department is viewing thermal loading as a design factor and one that, at this point they're claiming -- and I think somewhat optimistically -- will actually enhance performance of a repository if you know, the design is right. So that's where their real emphasis is.

Now, there's one other area where there was a lot of emphasis and a lot of people have felt there is a great deal of importance and understanding -- the Department may or may not do any further data collection or try to work that out -- and that's the steep hydrologic gradient just North of the site.

And if you recall the current design evolution has expanded the emplacement area now farther to the North, meaning getting closer and closer to that steep gradient. And the Department had talked in the past about drilling another borehole to try to get some additional data to try to understand what is going on there and at least be able to have some data that says that it won't affect performance.

At this point you can make speculation about the extent to which it could affect performance. The Department has some, I call, almost back of the envelop work, where it insists that any disruption of that gradient that would result in essentially, the 1000-foot head right over about a 2-mile area being reduced, I think

there's some possibilities regarding performance.

But at this point the Department is using some work that they had done to say, you know, it probably won't affect performance, but they're also at this point not planning to collect any further data.

So the simple answer to your question is, the main thing that they're going to be doing, other than sitting at their desks, is trying to collect thermal data. The problem as regards the suitability determination -- meaning the Secretary's recommendation in 2001 -- is that the primary data collection that will be going on is in the heated drift, which is a relatively short piece of drift.

And in 2001, it is far from certain that there will be enough data collected that analysis will be credible. And also, one of the key questions that we have asked in the past and still are not satisfied with the answer, is the same one that we ask about the single heater block that's, how can you demonstrate that this test is representative?

You know, here's a drift in one portion of the repository block, admittedly there is a very large portion of that block that doesn't even have a drill hole in it, but at the same time the Department is trying to maintain that this particular location and the thermal testing is

going to be representative of the entire repository block.

So the problem that we have is, at the time of the suitability determination -- meaning the application of the guidelines to the site to determine whether to go forward with the license application -- the biggest, probably most important piece of data that can be collected is, essentially an area of unknown because Linda's going to be talking about the other big problem that they have having to do with flux -- groundwater flux.

But the biggest area where they can do something about, they're not going to have convincing or complete data and analysis, or demonstration of representativeness at the time that that decision is made. This is a real problem, I see.

So suitability is still -- you know, once they get to suitability as understood in the Waste Policy Act, an application of the guidelines is still, from my perspective, going to be very iffy.

And that's regardless of whether the guidelines are revised or not. I think it's worse if the guidelines are revised. As it stands now -- John.

VICE CHAIRMAN GARRICK: Steve, help me understand this a little bit. Is your concern not so much with the fact that they've identified thermal loading as an important issue for which we need to collect data, but

is your principal concern the way they're going about doing it?

MR. FRISHMAN: My principal concern is that they're going to make a decision without having a credible database behind that decision. And that's only because they are not taking -- they are going to make the decision before the work is sufficiently mature to support a decision.

Probably, I think the Technical Review Board has estimated maybe another five or six or seven years or a little bit more. Maybe you'll know enough to make a decision.

MEMBER HORNBERGER: How would that come about? Fourteen more heater tests, or exactly what in your estimation, would be required to get to a suitable database?

MR. FRISHMAN: First of all, I think we need to, you know, understand what the, you know what the physical and chemical reaction is to a heater drift. And that in itself, is a pretty massive task, especially since we have demonstration already that with the single heater block that it's very difficult to get data on essentially the evolutionary chemistry of the groundwater; the equipment itself failed.

But I think the design of the test in one

place, if it's done well -- or the tests -- and we gain some understanding of what happens in the near field, then I think at least it needs to be duplicated in another part of the repository area that does not have identical characteristics and where you can make -- take the step that you're making an effort to do the tests.

And something that maybe collectively, is much more representative of the block than just a single area that -- yes, shows some fracture, you know, shows a certain degree of welding and saturation -- when we know from what little tunneling has been done -- and five miles is very little tunneling -- we know from what little tunneling has been done that there is great variability in this block, much greater than was originally anticipated.

So at least some duplication of drift heater test, and something at repository scale rather than the block, which I have a lot of problems with -- the block out in Fran Ridge which I think, from my perspective, a waste of money, and a year-and-a-half ago the Department thought the same thing.

So more thermal testing, and while the additional thermal testing is going on, not only to gain understanding of the near field and the sort of evolution of the near field based -- through a thermal pulse, both rising and falling -- but also a credible effort to show

that your overall tests are representative.

VICE CHAIRMAN GARRICK: Yes. So your concern is really -- is twofold. One is that even if they were doing over a much broader region of the block, what they're now doing in the heater block test, you would have some concern because of the scope of the experiments, is that correct?

MR. FRISHMAN: Correct. Yes.

VICE CHAIRMAN GARRICK: So you're concerned about the scope and the extent of the testing itself?

MR. FRISHMAN: Right, and if we want to come sort of subtier into that, there's still a great deal of question on the extent to which the data is really valid when you do a very fast thermal pulse as opposed to a slower thermal pulse. And that primarily has to do with what happens to the chemistry.

So we're in a situation -- and you've heard me say this, I guess, sine the first time I ever talked with this committee -- and that's, this is not an unsolvable thing in terms of this type of a problem where a decision is going to get made before there's a credible database to make the decision.

This is just one more time in which the schedule has driven science sort of off to the side. And if science suffers, the decision then will suffer, and it

probably won't further the program in any way and probably will result in the same thing that has happened in the past, and that's that, you know, hurry up and make the decision so then we can get in trouble and have delays and have to wait for another decision.

And I can see the same kind of thing happening, only I think the Congress is probably just about running out of patience. I'm not sure how much longer that the project would even be funded, if we were just in another cycle. Here's the great decision, but the decision is accepted only by the Department of Energy as being a credible decision, so therefore we fall back and review again. So that's the danger.

VICE CHAIRMAN GARRICK: Yes, I don't mean to push this, but I'm really trying to understand what the State's fundamental issue here is. In your judgment, is there a way to do the thermal loading experiments that would be satisfied to the State in a manner that would also satisfy Congress in that we don't get ourselves into a 10-year program?

Because you put a very serious constraint on this with respect to your concerns about a thermal pulse, or a thermal transient with a short time constant, and the significance of that in terms of the actual performance of the repository.

I guess what I'm struggling with is, how could we design an experiment -- and we're only talking for the moment about thermal loading -- that would indeed, meet the requirements of the State --

MR. FRISHMAN: Well, at the risk of sounding glib and probably losing what little credibility I have with you even today, I'll tell you that they shouldn't have to do it at all. What they should do is apply the current guidelines and just qualify the site.

VICE CHAIRMAN GARRICK: I see. Okay.

MR. FRISHMAN: Rather than try to change the guidelines. Because there's enough information right now to where if you applied those guidelines, you could remove yourself from the site -- and this is part of what I wanted to talk about in terms of revising the guidelines.

Because what we're being asked to do in the revision of the guidelines is essentially reverse the major principles of the regulatory world of geologic disposal that's been there since the very beginning.

And the reason for that is, at least in part, because of serious doubt about whether the site will survive in these qualifying conditions of the current guidelines -- especially having to do with groundwater travel time.

So with the changing guideline that is

proposed, this is again, not only sort of an intellectual issue for you to consider, but it's one where, once again, your advice is going to be important to the Commission. You're well aware of the 960 guidelines and I won't go through that at all.

You're also well aware that the proposal to revise the guidelines for the Yucca Mountain site is one that essentially says, to do a performance assessment and if the site meets the standards of EPA and the NRC, then the guidelines have been satisfied.

Now, they do not contain recognition of the requirements in the Nuclear Waste Policy Act for what guidelines ought to be, which is factors which qualify and disqualify the site, and many of those factors are named -- and geology shall be primary.

So legally the guidelines don't match up to the Nuclear Waste Policy Act. Technically, there's this problem with the guidelines because the Department is doing the guidelines -- is attempting to revise the guidelines as part of its overall program plan.

And its overall program plan has this problem in it that I just described to you and that's, the program plan itself doesn't allow sufficient information to be gathered in time to apply the guideline. So they sort of fail from just a technical rationale standpoint as well.

The idea of using a total system approach also causes some other problems in the regulatory world. Now, as you recall, the waste isolation strategy that the Department is using relies, among other things, on dilution. If you recall, the EPA when it wrote 40 CFR 191 made some very strong statements about not having a standard that permits reliance on dilution.

Also relying on dilution is a step back, philosophically, in protection against pollution in almost all regulation in this country. So the reliance on dilution becomes built into the total system performance assessment, and therefore gets imbedded in regulation.

Now, 10 CFR 60 has subsystem performance requirements which include groundwater travel time, and pre-emplacement groundwater travel time rather than waste particle travel time. And the reasons for that have been strongly stated throughout both NRC documentation and not too far in the past, DOE documentation.

And total system performance assessment says that that's an irrelevant factor, and in fact in some of the rationale in the Department's work they say that given the situation at Yucca Mountain, very fast groundwater travel time may in fact, be an advantage.

Well, very fast may be an advantage for what they think is good repository performance, but I'm not

sure that they can really make that concept stick, because I don't think that they can demonstrate the type of performance that they're talking about under thermal loading anyway.

So we had -- and I know many of us recall -- sort of the evolutionary thinking in the whole concept of geologic isolation. And it involves such things as very slow groundwater movement because that was going to be the mechanism that resulted in loss of waste isolation.

Another component of it being the concept that, we call it geologic isolation and therefore in the long term -- and that's what our real concern is. Our real concern is in the very long term -- that you are able to understand geology well enough to rely on geology as a primary barrier.

And what we see in total system performance assessment is more and more emphasis on reliance on an engineered barrier for a longer and longer period of time. This again, is sort of contrary to the concept of geologic isolation.

And also, just to repeat so that the list keep sorts of rounding out, the reliance on dilution as a barrier was far out of anyone's thinking in discussion of geologic waste isolation. And these are just a few of the concepts.

So what the guidelines do is sort of wreak havoc on the concept of geologic waste isolation as it was, you know, first thought maybe doable as far back as the mid-'50s. So that's something to consider.

Now, much more to your immediate concern is, if you recall, anytime that there is a change proposed in the guidelines by the Department of Energy, the Nuclear Regulatory Commission, under the Waste Policy Act, must concur on that change before the change can be promulgated.

Now given this, the last time the Commission went through concurrence it was understood -- and I think it's still understood -- that the only basis that the Commission has for concurrence is that the proposed guidelines are consistent or at least not inconsistent with 10 CFR 60 and other Commission rules that would apply -- such as for preclosure. The Commission really has no other basis.

Now, given the proposed guidelines as they are, 10 CFR 60 as it is -- not as you might hear later today; it could possibly change -- but as it is because the Department intends to finish this process of promulgating revised guidelines by the end of this fiscal year. And you certainly won't have revised 10 CFR 60 by that time.

In fact, there certainly will not be an EPA rule by that time. So what's the Commission to do? Because if the Commission does not concur the guidelines don't get promulgated. And if you look at it in realistic terms, the Department doesn't need the guidelines anyway at this point.

As the Department people have said over and over, the viability assessment is independent of regulation. What they're going to do is, for working purposes, they're going to get anybody who wants it, a total system performance assessment, that says -- that those to whoever it is or the risk to whoever it is they finally decide they're going to do in the absence of regulation -- they're going to say, this is what it is, this is what we think the uncertainty is, you decide whether it's worth continuing.

Now, if you have that you don't need any regulation. You know, rational people would want to compare it to something, but you don't have to have any regulation, because at some point that number's going to change anyway and there will be regulations and we'll have a better feel.

(Pause for technical adjustment.)

MR. FRISHMAN: Okay, well that was probably a good time to pause anyway, to think about, what is the

Commission to do in concurrence? And it may be that the Commission needs to figure out a way to withhold its concurrence, but also make it clear that the Department doesn't need the guidelines promulgated at this point anyway.

The guideline's use is for making a suitability determination that's not planned until 2001; it can't be used until there's an EPA rule and also until the Commission at least has conformed Part 60 to whatever the unknown EPA rule is. So at this point the Commission could very easily withhold concurrence and say, we're not withholding concurrence in any way that is detrimental to the Department's program.

When the program evolves to the point at which guidelines are necessary, we can then make a determination with information -- meaning the only basis that the Commission has, which is 10 CFR 60 -- to determine whether the guidelines are consistent or at least not inconsistent, with the Commission's own rules.

The tricky part is to avoid the perception that the Commission has somehow damaged the program, when the reality is that in doing that, the Commission will not have damaged the DOE program.

I think to get into some of the other options for how to act, only invite trouble -- such as conditional

concurrence. Conditioned on what? But I think a withholding of concurrence that just stops the process, explained properly, does not damage the Commission and certainly does not damage the Department.

So that's an area where I think in your capacity as advisory to the Commission, it's a very difficult question and I offer at least one suggestion on something that you could report to the Commission in order to help them decide where they have to be.

I think you have already heard my interest in not doing away with such things as the subsystem performance requirements; and it's not just groundwater travel time. I think there is value in substantially complete containment and I remember, you know, all of the sort of, discussion with the staff that went on and all of the actual work that went on at the Center on, what is substantially complete containment?

And I recall people like Joe Bunting saying, it's real simple. It means you've got complete containment. But that's I guess, very hard to sort of understand, that you have to have complete containment and you have to demonstrate a package that will give that to you.

And also I think there's value in retaining the release limits, and in retaining those release limits

what it requires is sufficient work to demonstrate that you have an understanding of the site in terms of its performance -- an understanding of the site to the extent that you can put on a credible, technical demonstration that materials will be contained at some defined level of containment.

And you're going to have to understand releases pretty well to do dose calculations. So if there are some internal, sort of stopping points, these are worth having, because if the site can't meet those then it needs to be known early rather than late.

So I think the subsystem performance requirements are important in part, because they're the drivers requiring some minimal level of understanding of the site. You have done sufficient work to be able to convince other people that you can meet these.

And if they were different, you know, quantitatively if they were different, the importance would still be there; that you are able to make a credible demonstration that you can meet some quantitative standard. And not just dose that comes out of the end of the 16 linked black boxes that Abe works with.

I guess I only wanted to make one more point that is sort of a step away. It's an area that we have discussion going on with the staff all the time and we

will probably continue to be discussing with the Commission next month when we meet with them -- and that's my old saw: issue resolution.

I don't want to go into the recent communications that we've had about it. I just want to let you know that we still have a considerable level of concern over issue resolution, but I also wanted to -- or moreso, wanted to point out another area of concern that I think probably you ought to be aware of if you're not already.

And we saw an example of it yesterday that you probably didn't even notice unless someone would point it out to you. And that has to do with the staff sort of reducing its effort in the area of quality assurance. And this I know is in part, a response to the staff's funding problems, but it's also an area for which, in a licensing situation, the staff can make no excuses.

The staff people in the areas of the KTIs now, are being essentially relied on to make sort of a quality cut within their own area. And if you'll recall in John's presentation late yesterday about what his plans are for continuing with his section, you saw that he had one page on quality of data.

And what that means is that John and his people have, not only the responsibility for the technical

work that is necessary for them to do, but they become sort of, oh by the way, take a look at whether the data's qualified, too -- rather than having a Quality Assurance organization that would do that and would do it in a much more disinterested way.

John would hope that the data is qualified, but to have his people have to make a separate and sort of, concerted effort at being objective within an area where they really have an interest, I think is -- at least leads to potential compromises in quality assurance. And my view is that, and has always been, that if the Commission staff did nothing pre-licensing other than quality assurance, it would still have done its pre-licensing job.

So those are just sort of the areas that I wanted to walk through with you and bring them to your attention in the sense that the major things that I've talked about -- viability assessment, guidelines, and the staff approach to quality assurance -- these are three areas where things are happening right now.

The Commission may need some advice and I try to sort of limit my discussion to these things that fit very much I think, within your responsibility to at least think about and maybe make some recommendations to the Commission, and hopefully consider some of the suggestions

that I've made.

CHAIRMAN POMEROY: Steve, we certainly will consider those. One of the things I'd like to ask you -- and I presume you may not want to answer this right now, but --

MR. FRISHMAN: Well, I'll let you know if I don't want to answer it.

CHAIRMAN POMEROY: -- there is a solution that may be imposed by Congress on -- or, an additional factor that may be imposed by Congress, and I'm sure that you probably have thought some about the technical basis, or what you would like to see in the way of a technical basis, for any independent spent fuel storage facility, if indeed it came to that -- if indeed, that was imposed.

And at some point I think this committee would like to hear your thoughts on what the technical problems of that would be.

MR. FRISHMAN: Okay, and I thought about whether to discuss that today or not and then I figured that we probably wouldn't have time. But I will tell you one thing, and that's that I think -- the Commission has a rule that deals with --

CHAIRMAN POMEROY: Part 72, yes.

MR. FRISHMAN: Part 72, Independent Spent Fuel Facility -- has siting requirements that go with that --

CHAIRMAN POMEROY: That's right.

MR. FRISHMAN: -- and makes very clear that there are standards for seismicity, and I think the Commission probably should do more than, you know, when Congress is discussing a site in Area 25 of the Nevada Test Site, someone from the Commission ought to say that there's a potential problem with licensing a facility such as this at that location, rather than sort of hemming and hawing.

And if you look at the Senate Bill, the drafters of the Senate Bill understood that there was a problem, because there is language there that once again, forces the Commission to essentially change its rule to meet the directive of Congress which has licensed this thing.

If you look at 1270, the House Bill, the House Bill says, license it under existing regulations -- meaning Part 72 -- which means that it is very likely that a license would not be possible at that location.

So that's my thought on that for the moment.

CHAIRMAN POMEROY: Okay. Great, Steve. But if you do have further thoughts on it though in the future, we would like to hear them.

MR. FRISHMAN: Okay. And I think as things progress, yes, we have some thoughts on independent spent

fuel storage. They're policy-based and I probably won't burden you with those, but there are also some that are technically-based, and those I think, as time goes on, may fall into your realm.

CHAIRMAN POMEROY: Thank you. I'll introduce Linda --

MEMBER HINZE: Can I ask a question, please?

MR. FRISHMAN: Oh, no.

MEMBER HINZE: You know, it's fine to talk about the subsystem requirements and the integrity of the geological site. And you too, have suffered through the pains of trying to deal with groundwater travel time as it is currently in Part 60.

Have you and your group considered what might be modifications to 60 to make the groundwater travel time or its akin viable, if you will?

MR. FRISHMAN: Well, I think there's reason for a groundwater travel time standard, and a pre-emplacement groundwater travel time standards, and I don't particularly, you know, have a -- I'm not particularly wed to any particular number of years.

I think it is important if you can demonstrate it early, or if you can demonstrate it in an early period of time, only because it means that you understand what the system is and you know, I think the concept was there

before the recognition of thermal loading.

I think it makes it more difficult after a thermal pulse, to try to relate pre-emplacement groundwater travel time to thermal pulse groundwater travel time, but I think it's reasonable to have the applicant have to go through trying to persuasively demonstrate that they understand what that's going to be.

Because in the long run it's going to be groundwater travel that makes the difference in dose, if dose is a standard. And it's going to be, you know, groundwater travel that makes the difference overall, in whether you can say that we have geologic isolation or not.

So I don't know that there is a modification that could satisfy anyone other than, if you want to fool with the years, fool with the years. And I'm not sure what good that does, because the concept is going to be just as difficult for performance assessors to deal with and for hydrologists to deal with, as it is now.

To throw it out because it's difficult, I think is irresponsible, when it is there for very good reason and reason that has sort of stood in scientific thinking since the mid-'50s, and there's no reason to change it that I now of, other than the fact that it's a problem at Yucca Mountain.

MEMBER HINZE: Perhaps your colleague will have some thoughts on that.

MR. FRISHMAN: Well, she'll help you understand the problem.

MEMBER HORNBERGER: Steve, before you go, since you got off on this let me try to get a clarification from you. Everybody agrees that the dose is going to be through groundwater and therefore, some understanding, some level of understanding of subsurface transport is needed.

But what I'm unclear about is the argument that if somebody goes through a total systems performance assessment which has to include groundwater travel, and calculates -- for the sake of argument let's even assume low doses -- exactly what is wrong with the concept of the geological barrier being in place, having gone through that assessment?

In other words, why does it matter if the groundwater travel time is 100 or 1,000 or 20,000 years?

MR. FRISHMAN: I think it matters primarily because it's a -- in those terms -- it's a measure of the extent to which you have achieved isolation. And yesterday -- and I've been watching this evolve just over the last few months and it's disturbing to me -- yesterday if you noticed, most of the discussion about the recipient

of the dose, and most of the calculations that were done, dealt with 20 and 30 kilometers from the site.

You know, it was just a couple of years ago that we were talking about five kilometers, and we had reason to talk about five kilometers because that was the rule -- no more than five kilometers. And now, because of a number of things that have happened, the five kilometer calculation is the one that is rarely made anymore.

And 30 kilometers is there because that's the distance that somebody measured to the people who are there today who might get a dose. And the rationale for that is something that we can discuss some other time. But if you notice, you know, groundwater travel time is not a problem if you have, you know, if you set all your boundary conditions right.

But all it does is says that you are willing to accept less and less certainty of isolation, and in fact, less and less isolation itself.

CHAIRMAN POMEROY: Other questions? Steve, thank you very much. I did want to say that, you know, when you appear before us we are very informal, and the reason for that is that we've all known each other -- several of us have known each other for a very long time. I know that you don't mistake that informality for a lack of appreciation of your coming here or of our respect for

your views, and we certainly want to encourage the State to continue to bring its views before us as they develop.

MR. FRISHMAN: Okay, well I appreciate that, and I appreciate the lack of formality, because I think for the positions that I bring to you, we need to be able to discuss them at the time, and I appreciate the fact that we are able to do that.

CHAIRMAN POMEROY: Our next presentation as part of the State's presentation, will be given by Linda Lehman who is President of Technical and Regulatory Evaluations Group, Incorporated. I think that's a change, isn't it?

Linda's going to be speaking to us today on the value of State oversight, particularly in relationship to unsaturated flow models. Linda, it's been a long time since we've seen you and it's a pleasure to have you back, and I hope that continues in the future.

MS. LEHMAN: Thank you. Well, I might say that I'm very happy to be back, too. First of all, I'd like to thank the committee and committee staff, Lynn and Howard, for giving me the opportunity to discuss some of the ways that I believe that the State's Technical Oversight Program has been valuable in the Yucca Mountain project.

Yesterday you heard from Gene Yogodzinski and

we believe in the State that his contribution has been valuable to the debate on volcanology. And it's largely been through his persistence and his belief in the numbers that they've generated, that they have at least been able to convince the NRC to take a serious look at some of these numbers. And we're very happy and pleased to see that John Trapp and his group are seriously looking at those numbers.

Today I'm going to discuss some of my contributions to the State's research program in the area of hydrology, and as with Gene's work, I believe that the persistence has paid off, at least with respect to the unsaturated zone models that we've developed for the State.

Because now, only recently in the past year, the Department of Energy has now accepted some of the concepts that we put forth in 1991 in terms of boundary conditions and flux rates that we developed early-on in the program.

Also, in 1994 the NRC apparently took the State's work seriously and authorized the Center to take a look at some of our assumptions that were used in the models, and that work was presented at one of the Dan Evans' workshops -- I believe 1995, early 1995 -- and the Center did support the assumptions that we had used.

I hope that history will repeat itself with respect to some of the work that we've done on the saturated zone modeling. And I hope it will be less painful and acceptance will come quicker than it did with the unsaturated zone model. And as you know, as I mentioned earlier, it took over five years for the Department of Energy to finally accept some of these numbers and boundary conditions and I believe that this reluctance on the Department of Energy to consider the State's models has only resulted in detrimental conditions to the program, to the Yucca Mountain program in general.

So if one thing comes out loud and clear in the talk that I'm going to give today it should be that outside review should be done and is critical to the program.

The State of Nevada has had access to data that was generated within the program, and I believe that we have seen this data through a different pair of glasses -- to borrow a Russian phrase -- than the Department of Energy has.

And I believe that had the State's work been taken seriously by the Department of Energy early-on in the project, that a very different set of data would have resulted from the site characterization work. A database would have been generated that would have been more

useful, more oriented toward the processes of concern -- fracture flow for an example, versus matrix flow -- and resulted in a database that would be more useful for this next TSPA-VA assessment.

Instead now, I believe that the Department is relying very heavily on their expert elicitation panels to come up with the numbers and the values that are needed to fill in the data gaps.

So today I'm going to briefly go through a history of the State Oversight and present the research that we've done over the past ten years or so with respect to saturated zone and unsaturated zone hydrology.

And I know that for many of the committee members a lot of this is going to be repetitious because you've heard it before. Some of the newer members probably have not heard a lot of this work. So I'm going to try to run through it briefly.

MEMBER HINZE: At least you didn't refer to gray beards.

MS. LEHMAN: Now, now. I'm getting gray myself; I can't do that. But it has been about two years since I've been really involved in the program and had an opportunity to speak to you all, so I'm very thankful to Lynn and Howard for making that happen.

As you all know, the Nuclear Waste Policy Act

of 1982 provided the State technical oversight, and the funds for that review were to be provided from the Nuclear Waste Fund. The 1987 Amendments Act, as Steve mentioned earlier, narrowed down to only one site, Yucca Mountain, and also allowed oversight to occur from the local affected units of government.

In 1995, October, the Department of Energy withheld these funds from the State, based we feel, on the recommendations of some Congressmen who had been influenced by the Nuclear industry. And also in 1997, the Appropriations Act further prohibited any funds to be given to the States or affected governments for oversight.

The action was justified within the Congress by implying -- and we believe falsely implying -- that the State was responsible for a lack of progress on the Yucca Mountain program in not issuing permits as rapidly as they had hoped. Of course, we found later that after the permits were issued, that the Department still wasn't quite ready to proceed.

There also is a widespread understanding that the State's technical reviews were not really valid and were only offered as stalling techniques to the program. And I hope to show you today some examples that this is not the case.

So the question that I'd like to put forward

to you today is whether or not these actions on the part of Congress were in fact, responsible actions or correct, and maybe talk about what are some of the costs involved with denying State oversight -- or not taking it seriously.

The State of Nevada oversight funds ranged from one to two percent of the Nuclear Waste Program budget, and the funds were utilized for reviewing program documents and technical site investigations, as well as we also had the opportunity through this funding to look at data and do some independent analyses of the contractor and laboratory work. The State also used the funds for socioeconomic and transportation studies.

Because we were funded we were able to have access to information which probably otherwise would not have been forthcoming to us. A case in point was the information that was provided on the unsaturated zone through the INTRAVAL process. And I guess I'd like to stress that unless you have the data and you have the ability to work with it, that you are just really at the mercy of presenters.

And the Department has had some very credible and very strong presenters in the past, and now I think it's recognized that you have to have access to the data and do your own analyses in order to judge whether or not

their work is correct.

We've also been able to participate in the regulatory activities of the NRC and the EPA with those funds.

In most of the other Department of Energy projects -- especially in environmental remediation -- I've been involved as an expert witness on a number of sites: Rocky Flats, Mound, Portsmouth, many of the sites. And in those areas the Department actively cooperates with the States involved. The State of Ohio, State of Colorado have had active roles in all of those programs.

And I've even seen films made by the Department of Energy that say yes, this is wonderful, we really think this has helped speed the process. However, Yucca Mountain project I say is an unfortunate exception to this cooperative role that DOE has had with other states.

DOE has never really accepted the role of the State in technical oversight, especially in the geological sciences or geotechnical sciences. In fact, DOE only provided funds to the State after it was ordered to do so by the U.S. Circuit Court of Appeals.

And also I found, and have been very frustrated by the fact, that despite all the presentations in front of review groups and committees such as yourself,

we seem to have very little effect on the direction of the program.

In fact, only now after the tunnel has been bored and there was chemical evidence to support the State's models, that the Department of Energy finally did accept and adopt some of the things that we had urged since 1991.

So as I said, today I'm going to speak about the hydrology, unsaturated zone and saturated zone, and you heard yesterday from Gene on the volcanism. I believe Dr. Hinze asked earlier about compiling the State technical work, and one of the tasks that I've ben assigned in my new contract is to pull together some of these examples.

Today unfortunately, I only have my examples, but hopefully I'll be meeting with all the other contractors next week in trying to pull together a presentation that involves the other examples. Also, I've been tapped by the State to pull together a review plan for the TSPA-VA and put together a technical review team for that, in the hopes that we have funding.

So first I'm going to talk about the State's unsaturated zone model and its relevance to groundwater travel time and flux rates that are now being used by the Department and the TSPA.

Historically, the State has had a lot of disagreements, I guess, about the concepts and numbers that have been used in the performance assessments and hydrology codes that were used at Yucca Mountain.

Some of these things I've listed here; whether or not it was matrix versus fracture flow, which was dominant; dimensionality questions; distribution and amounts of infiltration; equilibrium assumptions -- equilibriums between fractures and matrix; boundary conditions; and some of the parameters themselves that were used in the models.

The initial model of the unsaturated zone that was put out by the Department dates back to, I believe, early in the 1980s. This particular one is from 1988. Where you can see -- maybe I'll try to use a pointer -- the Department largely used no-flow boundary conditions on either side of the block, had uniform and steady infiltration into the top of the block, and essentially one-dimensional flow through the unsaturated zone.

These flow and flux rates were limited by the tightest beds, because it's essentially resistors-in-series calculation and this was very limiting, and that's why all along you've seen flux rates that have been very small.

In fact the typical infiltrations used in the

TSPAs -- and this held through until the very last one -- was a mean of one millimeter per year. Despite our urging and despite evidence of infiltration at other parts of the site that were somewhere from three to five percent of the rainfall that fell on the site -- which would have equated to about five millimeters per year of infiltration -- Department consistently came with a mean of one, or in later models even less than one. We commented on this every year, and every year the numbers got lower instead of higher.

The alternative model that I developed in 1991 basically did away with this no flux boundary condition on the Solitario Canyon, and urged that there was 2-dimensional flow through the PTn unit and probably the Calico Hills nonwelded units. Infiltration could also come in where the PTn was absent, not just where it was fractured.

And there's an area to the West which we felt could allow significant infiltration to penetrate directly into the repository horizon, and at this point the repository is closest to the surface. There's only about 500 feet or so here that's away from the surface.

We also felt that infiltration was focused into faults, arroyos, or bottoms of the canyons, and that it was not uniformly distributed.

I'm going to go through these next slides really quickly. They just illustrate infiltration into fractures which would give relatively rapid transport versus infiltration into the matrix. Some of the values that we calculated for saturated conductivity based on the matrix would have been 1 X 10^{-10} meters per second, versus 1 X 10^{-2}, if they had infiltration fractures.

Again as I said, the difference between 1-D vertical flow versus vertical and horizontal flows.

MEMBER HINZE: Is there any -- what's the basis of the Ghost Dance Fault being a conduit?

MS. LEHMAN: The Ghost Dance apparently has a surface expression and it's downslope, so I think it could potentially transmit water. I believe that probably more water is coming in from the West, and later I'll show you some calculations we did on how much water could come in through those various pathways.

MEMBER HINZE: Do you have any subsurface evidence of the Ghost Dance being a high transmissivity zone?

MS. LEHMAN: We have evidence in the saturated zone and like you know, I've been out of the program for the past two years so I have not been able to assess any of the tunnel information at this point in time.

As I mentioned earlier, the uniform

infiltration assumptions versus focused infiltration, the Department has recently gone to looking at the distribution of sediments to determine what the infiltration rates are based on the trasmissivities and permeabilities of the sediments on the surface. I don't know that they have gone as far as looking at the amount of infiltration into the fault zones.

And there was the issue of whether or not the fractures had -- what types of interactions occurred between the fractures and the matrix, and most of the models that are used today require full, 100 percent saturation in the matrix before you can have fracture flow.

Of course, I believe that we've seen now in the tunnels that that's not necessarily the case, and in the last TSPA there was a fudge factor sort of built in -- which was an interesting approach -- which I believe the number was 93 percent or 95 percent saturations they would allow flow to occur in the fractures, and I was happy to see that the NRC picked up on that and questioned, well why is it 93 percent? What is your basis for that?

The issue of transient versus steady state infiltration is also important, and as you will see later on when I discuss the saturated zone, we see fluctuations in the water table that I believe are attributed to

movement through the unsaturated zone and represent recharge events. I'll talk about those more later. They are about frequency on the West side of the mountain at about three years, and about two-and-a-half years on the Eastern side of the mountain.

And one of the things that I think still needs a lot of work in the TSPA is linking the saturated zone information to that in the unsaturated zone. They are not independent even though everyone likes to model them as such. But they are linked and the saturated zone is going to give us clues about the behavior of the unsaturated zone.

So there's still a lot of work that has to be done, and even under the thermal pulse water will be brought up from the saturated zone in some of these convective cells.

I talked also about the no flow boundary conditions along the faults and how we would like to see specified flux, so our pressure boundary condition is assigned at the Solitario Canyon and now the Department has moved their boundaries.

And their overall site scale model by Bo Bodvarssen has moved this no flow boundary condition significantly farther West so that we don't have a no flow condition right at the Solitario.

Now, the State also was able through the funding, to participate in the INTRAVAL Unsaturated Zone Working Group which was put on by the Swedish Nuclear Inspectorate and involved about 12 countries. Unfortunately, what happened in the Unsaturated Zone Working Group was that hardly any other countries participated -- in fact, no other countries participated in the Unsaturated Zone Working Group.

So it was basically Department of Energy, the Center, and eventually the State of Nevada was able to get their two cents in on the analysis of those data.

As many of you know, that the exercise was to take your models and calibrate them against them against the water content profiles that were measured in shallow boreholes in the unsaturated zone, and then to perform a blind prediction of the water contents at depth at UZ-16 using our calibrated models.

The location of that study was on the Eastern side of the Yucca Mountain repository block, and you can see the positions here of the shallow holes and UZ-16; they're located close together.

The State did a number of models. We used matrix flow models, one-dimensional models, 2-dimensional models. I found that our matrix models just simply could not match the profiles as well as the fracture flow

models.

And we chose to also indicate in our work that the solutions to this problem were non-unique and that modeling and calibrating against water content alone was not acceptable because it was not a unique solution and that you needed other supporting data which gave you some sort of time history, or history of evolution of the water in order to determine whether or not your model was correct.

This is the schematic of the fracture geometry, a very simple geometry that we used. The fracture wasn't even fully connected. It went through the upper unit, Tiva Canyon, terminated in the PTn unit, and then resumed again in the Topopah Springs. So water that came in had to essentially move through the matrix in the PTn unit and then go back into the fracture.

Now, these were some of our calibration runs against the water contents, and these are error bars for the data. And our best run we felt, was this run F-4, the solid line. This is the PTn unit which is wetter. The upper unit, the PTn, and then going into what we had into the Topopah Springs.

And with those calibration runs our prediction of what happened with depth, that UZ-16 down to a depth of about 500 meters, our best prediction was this line, and

which was generated from a flux rate of eight millimeters per year.

So our analyses of flux back in INTRAVAL, which was three to four years ago, somewhere between five and ten millimeters per year, we felt were our best estimates of flux. And only now we're seeing the Department used that.

The Department of course, objected very violently to those numbers so we undertook a study to see just how much runoff was available for infiltration -- especially in Solitario Canyon and also in the wash where those boreholes were placed.

This model is a University of Minnesota model from Soil Physics Department Agricultural College, Dr. John Neiber. It's called depression focused recharge model, and it basically uses a bowl essentially, approach, to figure out how much rainfall is going into the units; how much can escape evapotranspiration and runoff and actually make it down as deep percolation?

The model uses statistics from actual rainfall numbers that are generated by the Climate Center from NOAA. And the numbers we used in this were from Tonopah, Nevada, which is North of Yucca Mountain. And the numbers were actually a little bit less than the numbers for Yucca Mountain.

But even with this, and varying various parameters, we came up with very large amounts of water that could be available for infiltration. For example, in Solitario Canyon our numbers ranged from 121 millimeters per year to over 300 millimeters per year would be available to infiltrate into the deeper units.

In the wash where UZ-16 was located our numbers ranged anywhere from about eight millimeters a year to 160. So we felt that our eight millimeters per year infiltration was acceptable.

The Department now has a new model which they published in March. This is from Martha Pendleton's presentation. And as you can see, they have moved the boundary condition farther to the West. They're looking at evapotranspiration and infiltration, hopefully, in two dimensions along here as well. So we feel like things are improving, at least in terms of that model.

Now I'd like to present to you some of the saturated zone work that we did, and this is relevant, as Steve said earlier, to the calculation of dilution. And I believe that if this model is considered seriously, that the dilution numbers are going to dramatically change, as you will see.

MEMBER HINZE: From the unsaturated zone viewpoint, have you or the state thought about what might

be accomplished from a hydrologic viewpoint by an East-West drift, and if there is a location that would be most useful for those studies?

MS. LEHMAN: I was of course very interested in seeing what happened very close to the Solitario Canyon Fault. I am not certain now that any of those drifts are going to be completed that come very close to the fault because now the repository is forced to be up very close against the Solitario Canyon and really we don't have much information on that side. So I would like to see some information gained on that side of the block.

MEMBER HORNBERGER: Linda, what kind of information do you envision?

MS. LEHMAN: I would like to see some hydrologic tests done. I guess I like to use the example of Stripa. Stripa took a long, long time to figure out what the actual hydrology was in the drift, because the drift is disturbed. I think that we're looking at similar things at Yucca Mountain. At least we should take a similar approach to realistically try to find out what's going on there. Unfortunately, factor flow has only really come into the program in the last year since they analyzed the chemistry.

But Stripa was at least a 10 year project trying to find out what was going on. Then they tried to

apply what they learned at Stripa to the hard rock laboratory and also had a lot of problems. So I think to fully understand what's going on there is going to be a long-term type of process.

MEMBER HORNBERGER: Of course as you know, Stripa is a lot wetter than Yucca Mountain. They still had problems.

MS. LEHMAN: It's saturated zone, also.

MEMBER HORNBERGER: Yes. I mean you are not going to collect dripping water out of Yucca Mountain, or are you? Is that what you envision?

MS. LEHMAN: Well, I can't say whether we will or we won't. If you believe in saturated zone theory, you shouldn't be. But I think a lot remains to be done to understand that hydrology.

Actually, our work on the saturated zone began in the late 1980s. I believe this was 1990 or 1991 that we initially published some work which we called cosine components in the water table fluctuations at Yucca Mountain. As I was mentioning a little bit earlier, we found that there were about 10, I believe 10 water table wells that we looked at. We wanted to do a Fourier series analysis on the fluctuations, but since the data were not evenly spaced in time, we had to develop a cosine fitting methodology to assess that.

When we did, we found that two wells on the west side were responding at the same frequencies essentially, the same lags, and three wells on the east side. What was striking was the alignment. They sort of all lined up parallel to the Solitario Canyon Fault. So you can see this linear structure that perhaps had some control. As I said, things get wetter towards Yucca Mountain so the frequency was lower here, I means towards Las Vegas. So the frequency here was about two and a half year period versus about almost a three-year period on the west side of Yucca Mountain.

This response we felt was indicative of recharge. We had hoped to be able to get at recharge by looking at this. Of course we had a very difficult time getting information. At one point, I kept a computer program which was a data base of unanswered data requests, some of which were 10 years old. So we never really felt we had the data to pursue a lot of this further.

But this was our first indication that the flow field at Yucca Mountain was segmented and different on one side of the mountain than the other. In fact, the chemistry which was done at Desert Research Institute, Nancy Matuska, indicated that the chemistry was quite different on one side versus the other side of the mountain.

We also then later on analyzed the responses to the water table to the 1992 series of earthquakes that occurred at Little Skull Mountain and the California earthquakes that occurred. One of the things that struck us was the fact that down in the Amargosa and near Devil's Hole, we had a very different response between adjacent wells. We started looking at that.

Basically we had four types of responses. We had an upward movement of the water table and then a quick relaxation back to its original position. Other wells indicated a quick rise and then a very very small bleeding off back to the original level or never returning to the same level. We had the exact opposite with lowering, coming back and lowering and being sustained.

What gave us the clue about fault structures and control was the fact that Devil's Hole had responded exactly differently than one well very close to it. We started looking then well is there a fault there, why is one responding completely different than the other. That led our analysis to look at the structures.

What we found was basically in the north and northeast trending faults such as Solitario or the normal faults that pretty much we had indications that the water table dropped in those wells. But yet the wells on the compressionals, where you had for example, here is a

transform fault illustration that I have used that in the shearing zones and at least parts of these shear zones which are moving past each other, we saw rises in water table. We did document that in the report.

So again, that led us to the belief that the saturated zone is strongly controlled by fault structures and tectonics. These were some of the wells that showed incremental changes and that never went back to their normal position. Some of the changes were quite large. I believe AD-11, that number is not correct based on some updated work from the USGS. They called us and said well that reported value probably isn't right.

But others are fairly significant. When you look in terms of the flat gradients that we have there, except in a couple of the locations, the seven foot rise in water table can cause a reversal in water table directions in some areas. So I think these tectonic linkages have not been fully explained yet and need a lot more investigation.

The other thing that we looked at in the saturated zone was the distribution of temperature, believing that the temperature could tell us something about the flow rates and flow path. As you can see, we have a very cold water spike, 30 to 32 degrees, which comes down exactly coincident with the strike of the Ghost

Dance Fault.

We also have a high heat area which is very near the volcanos, and seems to trend along the strike of the Solitario Canyon Fault.

In our later modeling, we felt that this thermal difference was going to be significant, and that even for pre-emplacement conditions we felt that the gradients were steep enough across this small area, which is like 10 degrees C over just two kilometers, that these things would have to be considered in any saturated zone model. I would like you to compare that with the potentiometric surface of the saturated zone.

In all of the models that you will see generated by the USGS, you have flow field that looks like this, across Yucca Mountain just at right angles to these potentiometric surface lines.

This was a 1984 depiction of the water table. Since that time, the USGS went back and revised their numbers. They made corrections based on elevation, temperature, density. They corrected these levels for all of those parameters. They then published their revised map.

When this came out, I thought well, what happened to this little embayment that was on the north side, the 730 contour line. I am going to put it back up

again and just point it out to you, this embayment right here. As you will see, that kind of disappeared. So I thought this is very strange. I decided to look into the data that generated this map.

What we found was that in the report they actually acknowledge that even though they had revised these numbers, they didn't use them. I believe it's the red numbers were the old numbers and the black numbers were the new numbers. They systematically did not use or didn't believe their new data because they didn't find any physical reason for this to be there. That is in their publication. You can see that for yourself.

But also in their publication were the revised data points. So we took those revised data and plotted them. As you can see, there are these embayments, some of which are very very large. These embayments happen to be exactly coincident with some of the fault zones, the Drill Hole Wash Fault, the Sundance Fault. We don't know if there's a fault here or not. We have no evidence, but I am assuming there is because of the similarity to the others and sort of saying perhaps there is a fault here that causes this embayment.

Now the model that's put here indicates what we believe is the actual flow field rather than just this movement across. We believe there is movement across, but

we also believe that the water is coming primarily down these fault structures and drill hole wash, moving down the Ghost Dance and perhaps out this other hypothetical fault that we have assumed to be there.

So this is a very very different picture than what the USGS is using and what ople are assuming for their calculations of dilution Depending on where this repository goes, if they are going to avoid the Ghost Dance, perhaps the Ghost Dance is the best place for dilution. We may have high numbers of dilution there, but certainly in other parts of the repository block, you may not have the dilution that you had hoped to have, especially if you have fault controlled systems, then most of your movement will be in the faults.

I was recently at a meeting where Russ Patterson from the Department of Energy asked me now to on behalf of the state to review some of their saturated zone work. I think they are finally taking some of our work seriously. I am going to be meeting with him next Monday to see what information now is available on the saturated zone. He has asked me to be available to some of his technical people to discuss some of this work in the saturated zone. So I am certainly encouraged by that.

So in summary, I just want to say that I believe that DOE's failure to take the state's work

seriously early on has resulted in the majority of the data being collected for an incorrect underlying conceptual model, and that being matrix flow versus fracture flow. There is really essentially no data base available on the fractures at this point.

I think it will result in a delay in the program as the Nuclear Waste Technical Review Board is saying, to get the data you need. It's going to take six or more years. I also believe that that's the case. Unfortunately, it allows these viability assessments and safety assessments to be based on a meager and what I feel is an inadequate data base. That's it.

CHAIRMAN POMEROY: Great, Linda. Thank you all for staying within time.

MS. LEHMAN: Well, I'm over a little.

CHAIRMAN POMEROY: Not bad. My colleagues have questions.

VICE CHAIRMAN GARRICK: Linda, I would like to hear you comment a little bit, maybe philosophically about the treatment of data.

If you establish parameter values in the context of probability distributions, and of course those distributions represent the state of knowledge that exists relative to that parameter, what experience has indicated with that type of analysis is that very often you can get

by with meager data in some areas. At least it puts it in appropriate context.

One of the things I have not heard you talk about, nor the state models for that matter, is how they treat the issue of meager data or how they address parameters that have uncertainty.

In contemporary risk analysis, we have found that if we are careful, and if in fact we input parameters probabilisticly, and if in fact those distributions can be supported, and even though in some cases there may be great uncertainty in them, and the model properly propagates them through on the model, we very often find that in many cases the meagerness of the data is not very relevant.

Would you comment a little bit on how the state has analyzed the data in the cases of limited information and whether or not you have had any success in employing such techniques in your models?

MS. LEHMAN: Well, as you know, the state's budgets have been very very small. So we don't have the luxury of employing these type of models such as Latin Hypercube or a stepwise regression and some of those. But in some of the Monte Carlo type analyses that I was trained on when I was a staffer here at NRC, the distributions we had to know the shape of the

distribution.

Now you can change those distributions and you can come up with your uncertainty, and it can be propagated. But to me, if you have the wrong underlying model that you are looking at then how valid is your distribution?

VICE CHAIRMAN GARRICK: Well, that's my point. My prefacing comment was assuming that you A) have a model that is one in which you have high confidence, and B) that it can be demonstrated that you have input the parameters in those models with a rational, some sort of a rational and systemic basis. Obviously you can make any model bad and you can input any information wrong.

But it is a method that if properly employed, it can save enormous time and money in terms of just how much information we need to make a decision. I sometimes believe that we just simply do not -- and I know NRC is as guilty of this as any agency. We just simply do not employ that way of thinking enough in our decision making process. The time has come, it seems to me, to give some serious thought to that type of analysis.

I just wondered in your own experience whether there is any movement in that direction.

MS. LEHMAN: Well, what I would like to say is that in order to have some confidence in the numbers that

we're plugging into these distributions, you need some field or ground truth. We essentially have none on a lot of the very important parameters such as matrix fracture interaction, codings on fractures, how fast does the water move down the fracture. All of that now is guess work, and anybody's guess is as good as anyone else's, but we simply do not have anything, nothing that's been measured in the field to support any numbers that go into there now. That is a definite concern of mine.

But I agree that those types of analyses are valuable. I think that we have to go to that, especially if we had large fields of data, would be nice too. Then you would know your actual distribution and you wouldn't have to guess what those were.

MEMBER HORNBERGER: Linda, could you comment on what kind of data you think are necessary in the saturated zone? I mean you pointed out some of your analyses on again, on alternative type of model. What do you think has to be done to reconcile which of the alternative models are appropriate?

MS. LEHMAN: Actually, we did write a report on that. Carl Johnson and I did a report in 1995. It's not fresh in my mind unfortunately, but as I was mentioning before, I would like to see what's going on at Solitario Canyon both in the saturated and unsaturated

zone. I think that we need to now go to instead of a distributed, and I am trying to remember the words that Department of Energy used.

They had two types of field programs. One was sort of a statistical approach, where they covered the area, you know, with boreholes. Then the other was called features based, or large features based systematic approach. I really feel that that large features approach was much more relevant to the situation. I would like to see that continued and have more information generated along these features and factors rather than in the intact blocks.

MEMBER HINZE: A specific question. Is the C-well complex one of those fracture zones that you outlined?

MS. LEHMAN: Unfortunately, I have had some of the data from the C-well complex, but we have had no funding to analyze it. So I believe that there are fractured areas there as well.

MEMBER HINZE: Does that fall within one of those embayments that you --

MS. LEHMAN: I don't know. It might fall within the very lower one and over farther. It's fairly far to the east as I recall.

CHAIRMAN POMEROY: Linda, I just had a couple

of questions. You may not be the right person to ask this, but one of the things that I would certainly be interested in is having someone like you take a look at the isotopic observations in the ESF. I don't know whether the state has any plans to look at those, particularly their association with faulting, but I certainly would be interested if that were possible.

MS. LEHMAN: Hopefully yes. If we get funding to do this TSPA, then we will have to use the actual data and we would very much like to review that.

It is my understanding that a lot of these, what do you call them, hits of chlorine-36 do occur either on faults or fracture zones.

CHAIRMAN POMEROY: And there are plans for the state to do a TSPA?

MS. LEHMAN: Well, that's the way we're proceeding, provided we get funds. As I told you, I am in charge of putting together a technical review team for that. I definitely will try to involve the University of Nevada and people that are experts in geochemistry as well.

CHAIRMAN POMEROY: We would very much be interested in that also.

Linda, one last question I have, because as you know we have, at least a few of us have followed what

you have done for a long period of time. I particularly thought the tectonic work that you did was extremely interesting. I am curious, there obviously is interaction between you and the NRC staff.

MS. LEHMAN: I would like there to be.

CHAIRMAN POMEROY: Well, that's the question. Is the NRC staff responsive to you, listening to you?

MS. LEHMAN: I believe that they have been.

CHAIRMAN POMEROY: Is there something we should do to enhance that communication? Because they have -- we don't have much influence on DOE, but the staff has more perhaps.

MS. LEHMAN: Well, I think the best place to approach that is through the technical exchanges. I believe that the NRC staff has been very supportive of me. In fact, I am not sure if it was Tom Nicholson who actually told the center to look at some of these assumptions, but certainly someone did.

I would like to have easier access, but I don't know that that's possible because the NRC has to keep an arm's length from the state. Then we have to go through proper channels and I would like to have more interaction on what the NRC is going to do in terms of their performance reviews so that I could make the most of the money, the limited funds that we have. I don't want

to do a lot of duplication of effort in reinventing the wheel. If the NRC staff is covering certain points, then maybe we can focus on other ones. So I would like to have that kind of a conversation.

CHAIRMAN POMEROY: Well we'll certainly take that into consideration, Linda. Thank you very much for the time and effort that goes into this always.

MS. LEHMAN: Thank you.

CHAIRMAN POMEROY: We appreciate your views and we appreciate the state's views. We would like to continue to hear them in the future.

With that, let's take a 15 minute break until 10:45. At that point, we will return to our discussion. We should be talking about screening methodology. I would rather take the break now and talk about screening methodology after. So we'll return to that at that time.

(Whereupon, the foregoing matter went off the record at 10:37 a.m. and went back on the record at 10:51 a.m.)

CHAIRMAN POMEROY: I would like to reconvene the meeting. Next item on our agenda is a review of the NRC staff's final branch technical position on the screening methodology for assessing prior land burials. This is a briefing to discuss primarily the disposition of public comments.

Heather Astwood is going to give the presentation. Welcome back, Heather. I apologize for the delay here. I know you have a tight schedule. We'll try to stay as close as we can to the schedule.

MS. ASTWOOD: Okay. Sounds good.

MR. LARSON: Front.

MS. ASTWOOD: Front where it says on, that one. For something a little less detailed than the last presentation you had. As he said, I am here to talk about the screening methodology. As you recall, Mike Weber and myself came and briefed you on the actual methodology and the steps involved in the methodology in October. You wrote a letter with some comments and we responded to those comments.

However, in the October meeting, we agreed to come back and let you know what the public comments came back to say, and if we would have any revisions to the methodology. So that's what I am going to present today. We are not looking for a formal written letter. This is simply a follow up to the meeting in October as we had said before. However, if you feel you find something that deserves a letter, then feel free.

CHAIRMAN POMEROY: We'll try not to.

MS. ASTWOOD: Well, I hope not. Just to give you a quick overview of the talk, I am going to go briefly

over the background and the screening methodology. I have the slides available to go deeper into the screening methodology if you have questions. So we can do that. Then I will get into the public comments and the changes that we are going to make.

For background, the timeliness rule came out in 1994, which implemented a schedule for decommissioning to be placed on the previous decommissioning rule. Licensees had to come in to us with a specific schedule for how they were going to decommission and when they were going to decommission.

In Information Notice 96-47, the NRC staff sent out to all licensees our interpretation of the timeliness rule and how that applies to on-site burials. There were several questions about what an unused area is. Is that a burial ground or not. So we sent them our information, our interpretation, and said yes, burial grounds are covered under the timeliness rule and you do need to submit to us information about your decommissioning.

We briefed you on October 22, and the on-site screening methodology was sent out later in October for 90 days of public comment. It's a draft up until this point. Actually today, it's still a draft. We will publish it final after this briefing. Up to this point, it is still

a draft.

As for the screening methodology, like I said, I have several other slides to go more deeply into the methodology. Once I go through this slide, then you can let me know if I need to continue.

The reason we developed the screening methodology is because these burials, most of which we were concerned about were old 20.304 and 302 burials. There are potentially hundreds of those burials out there. The regulations at the time did not require the licensee to submit any information to us or ask us permission to do it. They simply did it. So there could be many hundreds of burials out there.

Also, because of the variety of licensees who performed these burials, there's a wide range of risks associated with certain burials. Some of the burials are what we would consider hazardous to public health and safety, would need to be decommissioned in some fashion. Some of them are not because of the low levels of materials placed in them or the types of materials placed in them.

So because of this range, a simple methodology to evaluate that risk was needed. We need something that could be applied simply and quickly to decide where that burial fell. If it's something that we do need to look at

more closely and spend a lot of time and money on, or if it's something that just is not a risk to the public.

For that reason, we developed the screening methodology. It has three steps. That's about as simple as you can get. We have the review of the records. Licensees are asked to go back through their records and determine what they buried in their burial trenches, what's there.

They then used that inventory basically in step two to calculate a screening dose from ingestion. They would take the entire inventory that they have estimated is in the trench and assume that that entire inventory leeches into the groundwater in one year, and that an individual drinks groundwater from that. I mean drinks their water from that contaminated groundwater source.

This is very conservative as you can tell. We assume that the entire inventory is there in the first place. Many of these burials are 30 or 40 years old. Some of the stuff has leeched away. We do account for decay, but not for migration. So you are getting a very high quantity of contaminant in a very small quantity of groundwater.

If their calculations for all isotopes summed up for the screening dose is less than a screening of 100

millirem, then they pass the screening methodology and do not have to do any other actions as far as remediation. They do have to send us their calculations and the information and state that this is what they have done to pass the screening.

If their dose is over 100 millirem, then they have to either come to us or do step three. Step three is a little easier. They go to their burial ground and the records and try to estimate the size of the trenches and the volume of contaminated soil and waste in the trenches, and come up with a concentration, microcuries per gram of soil in the trenches.

They then use that concentration along with appendix B in part 20 to back calculate kind of a screening dose again, for a resident farmer. Again, if that screening dose for all isotopes summed is less than 100 millirem, then they pass. If it is over 100 millirem, that kicks them into they did not pass the screening, but they have to come into NRC for site-specific evaluations. Come in and give us the work you did for this screening and actual depths of groundwater, actual distance to the resident, actual situations at your site, site specific samples, et cetera.

MEMBER HINZE: Could I ask a question, if I might here? Your comment about taking into account decay

but not migration triggered. I realize that this is just the first pass, your evaluation would consider a lot more things.

I am just wondering if there is any consideration in these early steps to look at what might be happening in any wells, the groundwater derived from any wells that are in the vicinity?

MS. ASTWOOD: This does not consider any site-specific information. This is simply a generic. If their calculations, they have done this, they have a problem with the screening, they can't complete the screening for one reason or another, yes. Of course we would look at that information.

MEMBER HINZE: But my point is that the migration of this of course may lead to concerns. I guess that's taken care of in the second pass then.

MS. ASTWOOD: If it's currently leaking and that it couldn't get into the public?

MEMBER HINZE: Right.

MS. ASTWOOD: Yes. That's definitely a concern in another aspect.

MEMBER HINZE: Okay. Thank you.

CHAIRMAN POMEROY: I guess you can clarify something for me too. I know you are going to get to the comments themselves. I presume you are going to talk

about the University of Washington sometime. But and I don't know whether this is true in that case or not, but let me ask it hypothetically then.

Somebody has made a burial that was certainly legal and within the rules and regulations at that time. If somebody then fails both step two and step three under this requirement, even if it's still an active site, are you now going to require remediation of the burial or is this a case by case consideration?

MS. ASTWOOD: Yes. That kicks into the case by case. The burials that are allowed to be done now if it's an active burial, the evaluations for the safety of that burial have been done for their license. It's in their license. Yes, you can dispose of this quantity over this period.

This is to assess burials that have not been ever looked at by NRC in the past. These licensees could just dump the stuff and we don't know what's there. We need to evaluate them.

As far as if they are still active, that would just have to be looked at on a case by case basis. Just because you don't pass this does not mean you have to remediate. You just have to come to us with another justification on why you should not have to remediate. That is looked at.

CHAIRMAN POMEROY: So you decide whether it needs just more characterization to handle or some remediation?

MS. ASTWOOD: Yes.

I can now go through detailed step one and step two slides if you would like to, or I could skip onto the public comments.

VICE CHAIRMAN GARRICK: Just a clarification again on that. You said on no migration, but you do account for decay. You may have also explained the issue of dilution. What is the position on dilution?

MS. ASTWOOD: We took a volume of groundwater that would supply a family of four for one year.

VICE CHAIRMAN GARRICK: Oh I see, I see. We diluted the entire concentration into that.

CHAIRMAN POMEROY: Heather, I don't think we want to -- hearing no objection to this, I'll go forward. I don't think we want to go into the detail. We have seen that before. I think we remember most of it. So I would like to go right on and just consider the comments.

MS. ASTWOOD: If you have any comments along the way, we can always go into it.

So in your package, you should skip onto page 10, I believe. It goes into your comments that you submitted to us, since these were first. Again, you

submitted your comments to us in a letter in November. We responded in December. In our response, we agreed with your comments. We felt that they did need to be addressed. Your comments where specifically it said that we should complete independent audits, we should pay particular attention to sites that may have unique problems, uranium or no records or things like that. We should understand the risk and contributors to risk when we do these evaluations.

We do agree with these. They did not change the methodology as far as the calculations that we do or the information that we ask for, but these things will be incorporated in a follow-up document which is a policy and guidance directive, which we will write to the staff to describe to them how to apply this screening methodology, how to do the reviews, what to look for, and things like you should understand the risk and be careful of the uranium and the chlorine-36. So those will be addressed in a separate document.

As for the public comments, you I think received copies of the comments that I did receive. I received five sets of formal written comments. I also have received many, many phone calls with individual questions and things like that. But as far as formal comments, we only received five from three agreement

states, which is interesting.

The general feel of the comments was that they agreed with the idea of the BTP. They felt that something like this was necessary. They wanted to use it, but they felt it was way too conservative, which I agree with. Everybody has told me it's way too conservative. We do understand that, but that was developed for that purpose so that we would not skip over sites that could potentially be dangerous. So we are not going to make it less conservative. I understand that does cause a problem with some people, but we are going to leave it that way.

Several of the commenters talked about the migration of carbon-14 and tritium. They wanted us to give them some leeway to account for the migration of C-14 or not to make it so prominent in the calculations because of the long half-life of C-14, many sites that have large quantities do not pass the screening. The dose is just too high. You can't get the dose down using this methodology.

We considered giving them a break as far as the migration. We are not going to. The reason being, there are two. One is it's very difficult to determine what factor to place on that migration. All these sites are very different. The migration of C-14 is affected by the other chemicals in the trenches, the types of soil,

depth to groundwater, I mean all of the parameters that go into KD affect this C-14 migration rate. So it would be very difficult to pinpoint a number such as okay, take 25 percent of your volume of C-14 or 50 percent of your calculated volume of C-14. So it would be very difficult to pin down what break to give them.

Second of all, we did not want to start giving exemptions to things in this BTP. This is a very conservative BTP, we realize that. They will have to come in for site case by case evaluations, but it is much better for those exemptions to be made case by case by an NRC person who has looked at all of the other contributing factors and risks at that site, rather than to give a generic exemption which in some instance would be harmful. So we are not going to change the C-14.

VICE CHAIRMAN GARRICK: Do you have any sense at all as to how many of these sites would meet the screening criteria? The thought being that what if 90 percent of the sites do not. Then the case by case approach seems to really get out of hand.

MS. ASTWOOD: That's true. We have had at least five or six licensees who have either sent something in or called me on the phone saying we have gone through the screening methodology and we have had problems, and these are our results. Three of them did have problems

with carbon-14. One of them had problems with carbon-14 in step two, but could make it in step three. The others could not make it through at all.

I do not have a sense for what percentage will have a problem. I don't think it will be 90 percent. I had gone through past records and done several of these calculations on my own and several of them passed from ones that we have seen in the past. We can always go back and reassess our evaluations if that turns out to be the case.

VICE CHAIRMAN GARRICK: Thank you.

MS. ASTWOOD: Several commenters felt that more site-specific data should be used. Look, we have well data that shows there's no migration. We have soil samples that say this is the concentration, et cetera, et cetera. We have allowed them to use concentration information in the BTP if they wanted to. If they wanted to use specific concentration in step three, they could. But for other site-specific information, we are not going to allow them to do that. That's really more for the case by case basis. If they do not want to do the screening and just sent us that information, that would be fine too.

There were several that said that case by case follow-ups after doing the screening. Methodology would make things inconsistent which is funny to me because we

have been doing it case by case ever since we started doing this. This is making it better, not worse.

That is the case. I mean if the regions do it, it will be slightly different than if I do it. However, most of the on-site burial requests or evaluations do come through Division of Waste Management. Up until recently, I have been doing most of them. So there is some consistency involved in having it go through the same division.

It would also be difficult to make something that is more prescriptive because of the differences in these sites and the different scenarios that could occur at each site. It would be difficult to write something that's generic.

The final one, there were lots of questions. I received many many questions about the timeliness rule and how that applies to burials, and does my burial fall under the timeliness rule and what about this building, and what about this action. I agree those are issues that need to be addressed. They are being addressed in other information notices and other papers concerning the timeliness rule, but that really wasn't applicable to this BTP.

This BTP was made for something very specific. If they determined by the timeliness rule that it's for

their site, then they can use it for their site.

Mixed waste guidance also is not part of this. We even make several statements in the BTP saying this is not for mixed waste. If it's mixed waste, go talk to your state.

That's really a summary of the comments that we got. I know you have the comments in front of you. If you have additional questions about something that a licensee said, you can ask. We had one, I remember, that said we made a statement in the BTP that said you could not use the burial limits that originally came with 304 because you may have exceeded those limits. I got chastised for assuming that licensees would do something wrong. That was not my intent.

So basically the bottom line is that no revisions will be made to the BTP based on the public comments. We will include things in the policy and guidance directive based on your comments.

The last thing that we will do is we'll attach NUREG-1500 to the BTP and put in a statement to say where you can get it. It is out of publication. They can not get it from the publication people. So we will send them to somebody in Waste Management who will be able to provide that information. That was one fault that we found, that the licensees just were not able to obtain

that as readily as they would have liked.

Next we would like to publish the BTP in a final format in the Federal Register notice at the end of June. We have as I said, several licensees have used the screening methodology and run through the calculations and sent us the information. However, we stated that we were not going to make any final decisions based on this BTP until it was final, until we looked through these public comments and made sure that we weren't going to change it.

So now that we feel we're not going to change it, we would like to go ahead and publish it as a final document soon, so we can go ahead and make evaluations for those licensees that have sent things in in a timely manner.

We are also going to develop, as I said, the policy and guidance directive, and some guidance for inspectors on what to look for, what questions to ask, and maybe look at the records that the licensees have used for these calculations.

Last, we need to develop a data base to keep track of all of this information or a data base that's connected to or can work with a data base that keeps track of the timeliness rule information, when licensees submit information so that we know who has and who has not complied with the timeliness rule, and that we won't have

this problem in the future, that we will know who has on-site burials and who does not.

That is really a quick and dirty presentation on on-site burials. Do you have questions?

CHAIRMAN POMEROY: I wanted to still get clear on this. One of the things, a lot of this is going to be applicable to hospitals, universities. Is the nature of this going to be work extreme hardships on some of those institutions?

MS. ASTWOOD: If they have to remediate?

CHAIRMAN POMEROY: If they have to remediate, particularly since they buried it legally and they may or may not have a current burial license.

MS. ASTWOOD: Yes, it could. That was one of the concerns we had, was that the site by site evaluations that we were doing in the past were taking a lot of money. We were requiring licensees to do a lot of work that may or may not have been necessary. Remediation is expensive and it could put some hardship on these licensees.

The aspect of it being legal or not, yes. It was legal at one point but that regulation was rescinded because we realized there are potential dangers with these burials and that it could be a threat to public health and safety. We had stated that we may go back and look at these.

CHAIRMAN POMEROY: But there is an intent to look at the relative risk of this?

MS. ASTWOOD: Yes.

CHAIRMAN POMEROY: On each individual basis?

MS. ASTWOOD: Right.

CHAIRMAN POMEROY: Using some sort of risk analysis, I presume.

MS. ASTWOOD: Yes. Unless they pass the screening.

CHAIRMAN POMEROY: That's correct.

VICE CHAIRMAN GARRICK: Just a simple question. What level of activity do you anticipate to implement this as far as the NRC is concerned? How many of these a year? Do you have any measure at all? Is it five people, one person, a half a person?

MS. ASTWOOD: In the past, we have gotten requests to evaluate these when they were uncovered during an inspection or during the decommissioning process. Somehow they would come up. We would do five or six a year about. We expected when the timeliness rule deadline dropped that we would get flooded with requests, and we haven't. So either these people are not being notified or they don't realize that they have to send something in, or they just simply aren't out there as we had expected them to be.

VICE CHAIRMAN GARRICK: One follow-on to Paul's question, which I think is a very good one. That is, many of these are probably small operations. What happens if they just come and say if they are in a situation where they have to remediate, that they just simply can't do it. They can't afford it or they have gone out of business or whatever.

MS. ASTWOOD: That's a very hard situation to be in. We try to make the person responsible for the burial pay for the burial. But there have been instances where that person is gone or they have sold the property and it had to be the owner, current owner of the property. We try very hard not to do that, but NRC has no funds to clean these up. If it is a threat to public health and safety, it --

CHAIRMAN POMEROY: So we probably really haven't heard the end of this story yet on a lot of these sites.

MEMBER HINZE: You had a binary situation. Either you had records or no records. Being part of a university, I can see a condition where you are some place in between. How do you --

VICE CHAIRMAN GARRICK: No records and very poor records.

(Laughter.)

MEMBER HINZE: How do you decide whether you have sufficient records?

MS. ASTWOOD: That is going to have to be based on the licensee's justification. We have asked them to look at their records and make the best evaluation they can and submit that information to us. If they said we had two records and this is what it said, we would probably say no, that's not sufficient. But it is really going to have to be the call of the reviewer, is there enough information there, does that seem reasonable. Which is not different than what we do right now.

MEMBER HINZE: I would say you are going to get some of those probably.

MS. ASTWOOD: Yes.

MEMBER HINZE: Have you?

MS. ASTWOOD: No. The ones I have seen have very good records, which is probably why they could turn around and give us the information so quickly is because they did have very good records.

CHAIRMAN POMEROY: Has this operation always had the authority to impose penalties on, what I would consider penalties, on people who have done something legally?

MS. ASTWOOD: I don't know.

CHAIRMAN POMEROY: I know you can't give me a

legal answer to that, but it's interesting to me that somebody can do something legally under the prior burial before we revised the rules and then 20 or 30 years, 40 years later somebody can come back and say well, what you did was legal but now you are going to have to spend a million dollars to fix it up. That is almost a question that has to be decided on a case by case basis in a legal court unless you have some legal authority to do that. I presume you must.

MS. ASTWOOD: I am going to have to turn that to Nelson. I'm not sure what our authority is.

MR. NELSON: Excuse me.

CHAIRMAN POMEROY: Can you just identify yourself?

MR. NELSON: I'm sorry. Bob Nelson. Division of Waste Management, NRC staff.

It really stems from the decommissioning rule and that established requirements for licensees to decommission their sites. Then the interpretation that formal burials, the legal interpretation that formal burials were considered unused portions of a licensee's property. That combination of regulation and finding established the legal framework from which we are operating.

I not being a lawyer, I'm not going to get

into much more depth than that. But this provides some amplifying comments. Many of these are going to be very case by case. The idea of this methodology was to screen out as many simple cases as possible, while keeping the methodology very easy to implement without incorporating a lot of science like groundwater transport, basically a back of the envelope type calculation that essentially anyone that has basic math skills can implement.

The what do we do with the rest is case by case. Some of those can be very simply handled once we have the additional information from the licensee They can be dispositioned quickly and would not require any extensive analysis. There are going to be those cases where we don't have adequate records or there are limited funds by the licensee to remediate the sites. In those cases, we are going to have to do an assessment of what needs to be done.

A good example, I just received one today. This is a 304 burial. The licensee's license has been terminated. Disposed of 328 pounds of depleted uranium. The records are pretty accurate in how much, but it doesn't say where. It says in a dump. So in this case, we don't even really know where to go to look for it. It was a number of years ago, so even if we knew what municipal landfill it went to, assuming it went to a

municipal landfill, it would be buried under mountains of other trash. So this is a good example of a case analysis where we are going to have to look at a risk-based approach to assessing what needs, if anything needs to be done with this particular case.

All of these are going to be different like that. Not knowing how much, what isotope, where, and almost every one of these is going to have to have a unique look.

MEMBER HORNBERGER: In that case, just as an example that you just used, I am curious. It sounds to me that this could become extraordinarily complicated to do the analysis. How in the world would one calculate risk without knowing where the depleted uranium went or without having any site-specific data on a municipal landfill?

MR. NELSON: At this point, I can't answer that question. I said I just got this one today. I was reading it during the previous presentation, so I am not sure how we are going to address this one. But I just used it as an example. This licensee no longer exists, been transferred to another company and I think now the state has acquired the property under a CRCLA transfer. So now we have the state owning the property. It's a very complicated situation and it is going to require some unique thought. As a result, some of these are going to

be resource intensive.

To answer a previous question, what do we anticipate. I don't know. I can tell you what we have budgeted. I think it's about a half an FTE per year for on-site disposal requests. So I suspect that's probably going to be not enough. But that's what our going in plan is anyway.

CHAIRMAN POMEROY: Heather, I don't know what your time frame is, and you can escape from this question if you want to by virtue of the time, but this is a form of burial, but currently we have some radiological criteria for decommissioning, a proposal that seems to be subject to some contention between EPA and the NRC. This is a conservative, these screening methodologies are conservative calculations, but are you looking for something that's consistent with what we are proposing for this radiological criteria?

MS. ASTWOOD: Yes.

CHAIRMAN POMEROY: The answer is yes?

MS. ASTWOOD: Yes. The reason it is consistent is because of the level of conservatism we put into the scenario. If you actually took the sites and these concentrations and ran them through a complex dose analysis, you would come up with five, 10, 15 millirem, instead of -- you know, if they are less than 100.

Because you simply are not going to have everything leaching into the groundwater in one year. You aren't going to have one individual drinking all of their water from that contaminated water. You know, things like that.

CHAIRMAN POMEROY: Other questions? Heather, thank you very much.

MS. ASTWOOD: Thank you.

CHAIRMAN POMEROY: We appreciate your coming down and doing this for us. We, as John has so succinctly pointed out, we certainly are interested in this as it goes on, and particularly the kinds of burdens it poses.

I could see in Nelson's example, for using it as an example, that some small hospital might be responsible for excavating all the landfills in the county. One could get into a disaster situation with something like that. So we would encourage you to come back and give us a progress report perhaps in a year or two.

MS. ASTWOOD: Great. I would love to. Thank you.

MR. NELSON: Bob Nelson again, NRC staff. We have not closed the door on this BTP if as we go through and analyze some of these things we find ways we can improve it and make it keep the simplicity but add refinements to it that allow us to exclude more sites,

we'll certainly do that. I think we need some experience with applying this methodology first though before we start tweaking it a lot.

CHAIRMAN POMEROY: I think this committee is very strongly in favor of flexibility in approach. I think you are certainly going to need it. Thank you, Heather, and thank you, Nelson, both for coming down.

Just a moment while our next speakers come into the room.

(Pause)

CHAIRMAN POMEROY: I think anywhere you can find a chair. Our next subject on the agenda is a discussion with the Director of the Division of Waste Management at NMSS, John Greeves.

John, it is always a pleasure to have you here and we are deeply appreciative of these monthly discussions. They keep us in the loop, basically, on where things are.

I think you've had conversations about what you would like to talk about and rather than my saying what you are going to talk about, why don't you take the floor.

MR. GREEVES: The monthlies have a good effect on me and force me to look into a couple of things, maybe.

CHAIRMAN POMEROY: Is that good or bad?

MR. GREEVES: It is good because it sort of reminds me of some of the things that I need to rearrange on the radar screen. I find it healthy; I like this format.

So, with that, I have a list of seven items that I thought were worth some discussion at this point. We may not get to all of them, but just to give you some insight. I think they are the ones you would expect and maybe adding a couple.

I want to talk to about the decommissioning rule; I don't think that was on the list but it is very high on my radar screen and I suggest you might want to consider looking closely at that.

Regulation of DOE is a big ticket item so I want to address some points on that. John Austin will be with us and he can follow-up.

The status of legislation. This is receiving a lot of attention on a lot of fronts so I want to give you a little bit of insight at my level.

And of course, it is being pushed and pulled at much higher levels. So, I thought it would be a useful topic for us to spend some time on.

Conventional waste management, I think we have done well on that front. I think it is moving along and we will give you a little bit of insight on where that is.

Low level waste decommissioning, I have some general comments that I want to pass on. I have read with interest a couple of your letters and can give you a little bit of feedback in this forum.

The status of the DOE siting guidelines, I know that you have been briefed on that so I will just give you the latest update on that.

And, time permitting, there are a couple of points on Yucca Mountain site characterization. Maybe you are fully up to speed on that but staff pointed out a couple of things they thought would be worth passing on to you.

So, that is sort of the platter, and depending on time we will certainly get to the first five.

The decommissioning rule, I know that you have been following it, lots of people have been following it, but I want to make sure you are aware that this is to the Commission, it is now a public document which is a bit of an unusual situation.

The staff recommended and a piece on this rule making was sent up, there have been questions on it, meetings with Congressional staff and there has been some controversy, and the Commission decided they would make it a public document which is unusual.

Normally, these are pre-decisional documents

so it was placed in the public document room.

So, I don't know how familiar you are with the final product, but I individually am pleased to have that target in front of us.

It is what I characterize as graded approach. It essentially starts with an unrestricted release limit of 25 millirem. Add to that ALARA and the rule effectively sets up a process where -- The large majority of our licensees as we all know are small licensees. You clean them up and they can get out and go on with their life.

So, I think this 25 millirem standard is a reasonable standard that can be dealt with efficiently in a regulatory environment. So that is the start of the grading process.

Above that there are provisions for restricted release. Up until now, the regulations read unrestricted release and that was part of the problem.

If you go back to 1988 and read it, it says decommissioning, unrestricted release. And that is what we have all been struggling with.

So, this proposed regulation steps up and allows restricted release. Again, the doses to the public are restricted to 25 millirem. However, there is a cap of 100 millirem so that you can put institutional controls on

the whatever the site is. We usually think in terms of land and buildings when you get into this category.

So, there is a 100 millirem cap using ALARA techniques below the 100 millirem cap.

Whatever these restrictions are, they need to be enforceable. There has to be some sort of financial assurance mechanism where appropriate to make sure that you have the wherewithal to implement them.

Also, when you are going for restricted releases you need to take into account the views of the local population. The 94 Rule talked about site-specific advisory boards and in fact we are doing those types of things now in the way that we approach sites.

So, effectively, the final rule did not call specifically for this thing called a site-specific advisory board, but it does require the licensee to get input from the local level, document that input and explain how he has dealt with that input to the NRC staff.

So, it is basically a requirement that he has to go through. So, that is the next level of graded approach.

The third level is a 500 millirem cap, again plus ALARA below that and that can only be applied where it is technically impractical to meet the lower standards, where it is prohibitively expensive or there is net harm.

That is the set of hoops that you have to address.

A second set is durable controls. There may be other ways to provide durable controls but I individually think in terms of state or federal control in terms of the durable control. So that provision is put in here for anything that would be in this range.

And a third provision which is a five year recheck is similar to what you will find in the Superfund/RCRA area where EPA calls for these five year rechecks. You go back in and you make sure that those provisions have not fallen away in the last five years.

So, again, it is an increasingly restriction type of approach and I view it as a graded approach that I think will help the division address these sites that come in all sizes and shapes.

So, that is the rule. I think your staff is somewhat familiar with it and I encourage you to take a look at it.

All of these provisions result in releases of less than 25 millirem. The restrictions are in place to make sure that you don't exceed a 25 millirem standard.

There is also another provision in the final rule. It is called an alternative criteria that has a view of criteria that are less than 100 millirem. It was put in there -- I don't really have a site in mind that

this would apply to. It would be a rare and unique approach.

By the same token we don't want to look at granting exemptions, so this provision was added to the rule making process and it is intended to be the rare case when for some reason you can't quite meet a 25 millirem dose criteria.

That is the rule and as I said, high on my radar screen. I invite you to take a look at it and I know that you have already and you provided comments on it.

CHAIRMAN POMEROY: Can I interrupt you and just ask a couple of things?

One of the things that is unclear to me, we have read the exchange of letters between the Chairman and the Administrator and we have heard about the results of the discussions on Monday I think?

MR. GREEVES: Correct. There was a meeting on Monday.

CHAIRMAN POMEROY: What are the implications, if you can John, with regard to our non-inclusion of the drinking water standard, which non-inclusion we support and have supported in a letter to the Commission.

But what is the implication of that, of not including those?

MR. GREEVES: Let me finish the few points that I was going to say. It is pertinent. Just let me finish up my notes.

There is clearly debate on this topic. And the debates as I read them are centering, in part, around the 15 versus the 25 millirem issue.

We did have a meeting with the EPA on Monday and there is a statement that EPA provided. If you don't have it I will provide it.

CHAIRMAN POMEROY: Got it.

MR. GREEVES: I recommend you read it. It shows where the differences are. There are statements that some of the elements of the standard that we have are not adequate.

So, looking at that and evaluating it is one set of implications.

The other piece in that process is the groundwater issue that you have raised. For completeness, there was a meeting on Monday and there were two other issues that were raised in the meeting.

One was this public information process. I don't think the reader quite understood that we do have this public information process and we do think it will work. It is just a little bit less formal than what is in the proposed rule. But that is one of the issues that EPA

did identify when they read the draft.

The last one is the alternate criteria. They had an impression that the alternate criteria would be easy to achieve. In other words, I can't meet 25 so let me jump to 30 or 50 or whatever and that certainly is not the intention.

So, that was kind of the character of the meeting and it sounds like you already had a pretty good background on that.

As far as the implications in it I think it is a little bit dependent on who you ask. You will get different implications.

I will tick off some of the ones that I think are clear.

If NRC comes out with a rule, say the one that is proposed, and later, as I understand it, if EPA comes out with a standard that is more restrictive an implication is that we would have to comply with that standard. So, that is one implication.

Licensees may be looking over their shoulder, not sure of what they will have to deal with; is there another shoe that's going to fall somewhere down the line?

Another implication is putting sites on the Superfund list. I am not an expert in terms of how big an implication that is.

We have sites on the Superfund list right now and we are treating those sites just like we treat all of our sites. The exchanges on these sites, I think, have been quite smooth with EPA. They have a point of contact and we work with them on the issues.

So, from my vantage point, there hasn't been a problem with those few sites we have on the list. I think putting sites on the list is a problem.

So, those are two implications of that process.

Other implications, this rule, these criteria, I think will have an impact in other areas.

We have a high level waste rule that is out in front of us and some of the same issues are being discussed there. DOE has many more sites that we do. There are potential implications there, certainly.

So, I don't know whether I am answering your question.

CHAIRMAN POMEROY: You certainly are, John, perhaps even more than I anticipated.

MR. GREEVES: Well, I have been thinking about this. This is a national issue in many ways.

CHAIRMAN POMEROY: I guess I was thinking, is this going to throw a very large load suddenly on your division or on all licensees?

MR. GREEVES: In some ways I find that I throws some relief at me.

I was up to West Valley two weeks ago. The day before I went up there, the rule was put int he public document room. It allowed me to speak to the issues. What is on your mind, NRC? What is the decommissioning criteria?

You are quite familiar with the West Valley site and that site has some of everything.

So, it gave me the opportunity to speak to that local citizens task force. Let me speak to that group with this as background. Otherwise, Mike Weber and I were just going to go up there and just point to things like mill tailings; mill tailings allow long term institutional control. And that is all we would have been able to do.

But with the rule out in the public document room we were able to speak much more directly about what is in this proposed rule. Because a big piece of this rule is how do you use institutional control techniques; how can they work for you.

They are used extensively, as I understand it, on the EPA side and that basically gives them a big leg up in terms of solving some problem sites.

So, it is sort of a change, it is a paradigm

change. For example in Part 61, we have these things called, don't count on institutional control beyond 100 years. That puts a certain kind of burden on you and the licensee. How am I going to get this process, what is the design?

So, I feel some relief in the sense of having some regulatory rules that make the job much more do-able, for lack of a better word.

So I feel, in some ways, a relief to have these kinds of tools available to us. It is frustrating to have to focus on this thing called unrestricted release because we know in a number of cases, you can't do that.

Maybe I have over-explained myself.

CHAIRMAN POMEROY: No, I think that is great, John. Thanks.

MR. GREEVES: So, I am sure we are all going to keep an eye on this.

CHAIRMAN POMEROY: Right, in fact your staff has offered to come in. We are going to have a briefing on low-level waste performance assessment use in a generic sense. They suggested that they would like to broaden that to include a briefing regarding the final decommissioning rule and other aspects of it that we had asked questions about such as different criteria in different parts of the Agency and how we were tightening

those things up.

We are going to take them up on that offer, but not in the immediate future, perhaps at the end of the year or something like that.

MR. GREEVES: That topic is the first one I spoke to so that should give you a sense of--

MR. LARSON: John, just a quick question. It is out for public comment or just published?

MR. GREEVES: No, no.

MR. LARSON: You said it was out.

MR. GREEVES: Let me be real clear. A rule was out in 1994 and got public comments. The standard practice is that the staff evaluates those comments, comes forward with a recommendation on the rule, passes that rule up to the Commission, and the Commission decides.

MR. LARSON: Yes.

MR. GREEVES: And they don't, prior to that decision put that document -- it is basically a pretty decisional document.

MR. LARSON: Yes, I have it right here.

MR. GREEVES: They chose to put it in the public document room; it is not out for comment that I know of.

CHAIRMAN POMEROY: But we can discuss it among ourselves.

MR. GREEVES: We had a public meeting on Monday discussing it.

CHAIRMAN POMEROY: Okay. Let's go on, John.

MR. GREEVES: The second topic that I thought we should spend a little time on is the DOE regulatory aspects. I think you are probably aware that in December Defense Secretary O'Leary announced the intention to submit legislation for NRC to regulate nuclear safety at the DOE.

If you look at the material that is handed out when you go to briefings, you get the picture that it is expected that there would be a two year legislative phase. There is a lot between the idea and the implementation and it does require legislation.

So, the rest of the things that you will see, is that they envision placing DOE facilities under NRC regulation gradually over a time period.

The first phase would be a one to five year kind of program occurring after this legislative phase. All the nuclear engineering and energy research would be transferred to NRC during that first five year phase.

The second five year phase would be the regulation of the environmental management facilities.

The last of this at the end, would be the defense program facilities, after a ten year period.

The sense that I get from this is that the nuclear energy and energy research facilities are much closer to what NRC does now. It would be much easier to accommodate them. The compliance issues are less of a problem.

So, again, it is a graded approach to absorbing a rather large piece of work. On the other end are the defense programs where you have a lot of these clean-up issues.

So, I think it is a sensible approach and those are the kinds of things you will hear when you go to meetings in terms of how would this take place.

There is kind of a theme when you go to meetings of how does all this fit together. The prime question is what is the cost of doing all this? And no one can afford the bounding costs that you might have seen.

So, the picture that you get is that the DOE facilities will be ramping down, about 600 facilities that they have, over a ten-year program, they will be cleaned up with time. So, the number that NRC will eventually inherit or regulate would be smaller as time went on.

So, at the end of the 12 years there would be a reduced number and this helps the budgets, amazingly enough.

So, again, taking on the easier facilities early, reducing the number, cleaning up sites at the end of 12 years, I think I have seen numbers in the range of $75 million. If you were to look at the whole package it would be much larger than that.

But nobody seems to be able to pin these dollars down very tightly. The Commission had a briefing on this and it was not an issue that you came away with a real understanding of what the costs were.

CHAIRMAN POMEROY: I understand that there is also a number floating around for FTES, new employees, a fairly large number that represent something less than 50 per cent but not a lot less than fifty per cent of the Agency.

Are people working on the concept of how this is going to happen.

MR. GREEVES: Yes. Maybe I am going a little bit too slow, but let me get through that.

CHAIRMAN POMEROY: Sure, go ahead.

MR. GREEVES: There is also interest in conducting a pilot program, maybe one of the laboratories.

So, those are topics you will run into when you go to various meetings. Tom Grumbly, before he left the department, did brief the Commission recently and these topics came up in that briefing.

It turns out that the Commission is forming a task force to address these issues. The Chairman recently signed a letter to Secretary Pena identifying that we want to move forward in this area.

For example, we are looking for an MOU to address these issues. There is a task force charter that the NRC has put in place and Carl Paperiello is set as the head of that process and John Austin is identified as his deputy.

There is a side implication to that. John is not available to me to do the work that I would like him to do.

CHAIRMAN POMEROY: Right.

MR. GREEVES: So, if you see less of John in the high level waste program, you will understand. I hope you got the word that Mike Bell has moved over and we are moving up a section leader on Mike Bell's side, to cover those positions. There is always a little trickle-down problem.

So, Carl, with John Austin as his deputy, will be working this task force. Virtually all of the offices are part of this task force; NMSS, NRR, OGC, Research.

An early focus of the task force will be the budget issue. So, I am probably better off not identifying even the numbers that I have heard. It is one

of those things that has to be an early focus. In fact, the group met yesterday.

At this point, I would like to turn to John, who had the meeting yesterday, and see if he can give us a few little insights pertinent for this meeting here.

John?

MR. AUSTIN: Thank you, John. John Austin, NRC staff.

The task force did hold its first meeting yesterday to introduce everyone to the group.

The top priorities of the task force now are to finalize the charter. It has been reviewed by the offices, but we thought it important for the members to have a buy in to the charter which identifies many of the tasks that have to be accomplished on the way to crafting proposed legislation.

Another priority discussed was identifying the issues that need to be addressed in proposed legislation and in documents supporting what that legislation would call for.

We have formed five groups within the task force to look at things such as funding for the group activities, to examine regulatory approaches and structures if we were to get oversight of the DOE facilities. There is one for the pilot program. One for

external interactions.

There is significant interest in the state on what happens here, both agreement states and non-agreement states because things like accelerators are on the table to be addressed one way or the other, as far as the NRC is concerned.

And finally, we have an administrative support group which is preparing things like Gant charts on tasks, who is assigned various tasks, interrelationships among the tasks and we are fairly far along on that. We distributed both the draft charter and the schedules and assignments to the task force members with the request that we get feedback by Friday.

There will be a briefing of the Chairman on May 1, on status and activities of the task force. The Commission has asked for a status report by the end of June along with another briefing by the department and NRC staff by the end of June.

It obviously is receiving very high level attention and interest and the urge to the task force members is to get on with it and identify these issues and develop proposed resolution of them.

So, we are really marching out very, very quickly. We are being inundated with tickets with very short time fuses on them.

I thought Yucca Mountain was going to be a challenge and I think this assignment will be an equal challenge.

CHAIRMAN POMEROY: I think you are right on target there, John.

MR. GREEVES: That is it in terms of the DOE oversight issue.

The next one on my list was the status of legislation and I know all the people around this table have been following this process.

As far as the latest information, on April 15, the Senate did pass Senator Murkowski's amended version of S. 104 by a vote of 65 to 34.

The S. 104 passed calls for EPA to set a risk standard in the range of 25 to 30 millirem, as I understand it. It also calls for NRC to define all implementing assumptions including the critical group issue, so I think we are all please to see something like that.

It also addresses a compliance for 10,000 years, identifying do not assume human intrusion for that type of an approach.

It has a provision where the NRC would report to Congress on an analysis of the repository beyond 10,000 years.

When I read the bill, a lot of it is addressing the interim storage issue, so you will find a lot of information on transportation and interim storage issues

CHAIRMAN POMEROY: That was really referring to repository, that requirement that NRC report to Congress.

MR. GREEVES: Right. All those comments that I mentioned earlier about the repository.

CHAIRMAN POMEROY: Right.

MR. GREEVES: But the rest of the bill addresses storage and has a provision that there be no construction, for example, until the President has an opportunity to determine whether the site qualifies or not and designate an alternative site.

I understand it also would exclude Hanford, Savannah River and Oak Ridge from consideration.

So, it has evolved some. I don't know whether you have been following the bill, but these issues of what is the standard, how long is the compliance calculation in terms of time horizon, how do that. It has evolved some since the bills we have had in the recent past.

On April 10, in the House, they introduced HR 1270. This is a bill that is similar to HR 1020. There is a long history to these bills; I don't know whether

you have been keeping up with them all.

But, there is a hearing scheduled on this HR 1270 for Wednesday of next week, April 30, and the Chairman will be testifying at this hearing, as I understand it.

The HR 1270 would require the NRC to promulgate an overall performance standard of 100 millirem to the average member of the general population. I think this is essentially the same kind of wording that we have had in this bill in the past.

It proscribes, EPA would not be promulgating any standards for Yucca Mountain.

And NRC must assume that DOE's post-closure oversight is effective.

And NRC would evaluate compliance for 1,000 years against a reasonable assurance kind of standard. For 1,000 to 10,000 it would be a likely compliance.

So, these are the kinds of words that you will find in these bills, and somewhere along the line I expect they will merge. But the latest is that there is going to be this hearing next week and the Chairman would be testifying.

So, we are in the process of analyzing the implications of these and it is really a process that we are in the middle of, so I don't have anything else to

offer. I just wanted to make sure that you were aware that these bills were out there and being discussed.

CHAIRMAN POMEROY: We are trying to follow those fairly closely, John, and although I know that you don't talk to the President too often and neither do I, a long time ago I saw something that held out the possibility that he would veto such a bill as the bill was at that time, a year ago.

Do you have any sense at all whether those conditions have changed or not changed?

MR. GREEVES: I individually haven't detected anything that changed that view. I think the merits of the bills is the key.

CHAIRMAN POMEROY: Yes.

MR. GREEVES: And I think a big piece of it is the storage issue.

CHAIRMAN POMEROY: Yes, that is right.

MR. GREEVES: And I am not an expert in that area.

CHAIRMAN POMEROY: This provision in the senate bill for giving the President the opportunity to determine whether he is going to designate a site for the repository is certainly a concession to that.

MR. GREEVES: I think our focus has pretty much been on the repository in terms of these standards,

how would we implement them?

CHAIRMAN POMEROY: I hope though, that somebody is looking at the question of what would happen if they were, ISFSI approach taken in the future as an interim possibility and particularly the geologic and seismological characteristics of siting such a facility, if it is done in the western United States at NTS.

MR. GREEVES: Those issues would be addressed and the spent fuel program office would have the responsibility in terms of the project. There is a discussion of a topical report on a generic type of approach which would be addressing those kinds of things, at least on a generic level. Then once a site was named, they would have to get real specific about what the geologic and seismic issues were.

At this point I am down to the Waste Convention. Mike Bell was able to go to the last meeting. I had to go off to another meeting and give another paper.

So, at this point, I would like to turn to Mike and get an update for you on the Waste Convention.

MR. BELL: Yes. Thank you, John.

I think the committee has been receiving some more recent trip reports and has had some visibility at the Waste Convention.

But basically, just to refresh your memory,

over the past two years there have been a series of meetings at the IAEA headquarters to develop an international convention on the safe management of radioactive waste.

Representatives from over 50 countries and several international organization have participated in these meetings.

At the last meeting in March, the group of people who had been drafting the text of the convention basically reached a point where they thought they could do as much as they could. There was a consensus on a large number of issues covered in the convention text.

There were a few issues that I will go into a little later where there wasn't consensus but there was a large majority in favor of the final position that was reached. We didn't think that additional drafting groups would be able to make any further progress on resolving these two outstanding issues or getting complete consensus.

In these meetings, John and I participated in all seven of the drafting sessions. The U.S. delegation usually consisted of several people from the DOE and EPA representative and the delegation was led by Dick Stratford from the Department of State.

The convention is a very broad document. The

idea is to come up with an international instrument that basically countries would agree on for managing all of their radioactive waste, whether commercial or military, whether naturally occurring or man-made.

In fact, one of the more contentious issues was in some countries, spent fuel is reprocessed and in some other countries, spent fuel is considered a waste, and how to deal with the spent fuel issue on a consistent basis was one of the areas that, in the final text, there was still not unanimity.

In fact, if you had a chance to look at it, the convention text has a provision in it that deals with spent sealed sources including radium sources.

As you can see, from this list of issues, it presents some challenges now for the U.S. government to proceed and comply with the provisions of the convention, because it affects DOE activities, activities regulated by NRC, activities regulated in some cases by our agreement states, and even things regulated by states but under EPA authority rather than NRC jurisdiction.

I guess some of the significant issue I already mentioned. Spent fuel; let me go into a little more detail.

Because some countries plan to reprocess spent fuel, they don't consider it a waste. There were a few

countries that did not want to have spent fuel dealt with in any way in a convention on radioactive waste management.

There was a much broader view that argued that basically spent fuel, whether it was going to be reprocessed or disposed of, presented the same sorts of safety considerations when it was being handled in storage, up until the time that it was reprocessed and those sorts of activities should be treated in an equivalent way, no matter what the fate of the spent fuel was going to be.

A few states who reprocess were won over in the end by treating spent fuel and radioactive waste in parallel chapters in the report and titling the convention, the Joint Convention on the Safety of the Management of Spent Fuel and of the Management of Radioactive Waste, and having parallel requirements that would apply to spent fuel management and radioactive waste management.

That satisfied some, but not all, of the countries that had difficulties.

Another contentious or difficult issue to deal with was the military waste issue.

The U.S. was arguing strongly that basically defense wastes or wastes from military applications, when

it became a waste, was managed and about to be disposed of, presented the same kinds of hazards as equivalent kinds of commercial wastes. And, for the same sorts of reasons, ought to be dealt with in the convention.

Some of the nuclear weapons states, because of national security and classified information, were uncomfortable with this.

The final text that was arrived at, basically puts waste from military or defense sources under the convention in two instances.

One, when it is turned over to a civilian agency; in our case, the DOE, for management or disposal.

Two, when the contracting party, the country, voluntarily opts to have it covered under the convention.

This satisfied the weapons states and seemed to have the acceptance of most of the non-weapons states.

Much of the rest of the world is concerned when they have a neighboring country that is generating radioactive active waste as a result of defense activities, that those things are being managed safely and somehow won't have impacts across the border that would affect either the public health and safety or the environment.

I would say that 100 per cent of the non-weapons states want military waste included in this

convention.

The whole issue of transboundary movement was another very difficult one. But basically, how do you deal with a waste management activity or facility in one country that has a discharge or release or underground pathway that would cause exposures in a neighboring country.

A formulation was arrived at that did, in fact, did have consensus of the group in that area.

It did, in fact, bring into the convention a change to the siting requirements that would require that when siting of waste management facility, a country consult with a neighboring country that could be affected by the operation of the facility being sited.

Now in the U.S., that brings up a curious situation because of our agreement state system. Many other countries where the radioactive waste is a federal or national activity, it's not a problem. But in the U.S., we have our agreement states who regulate many low level waste uranium mill, uranium milling operations and things like that.

And in the siting of the new waste management disposal facility, it does create an obligation for the U.S. to consult with Canada or Mexico regarding the impacts of a facility that might be sited by an agreement

or state compact and regulated by an agreement site that we otherwise wouldn't have a role in.

One of the biggest concerns all through these negotiations of the U.S. delegation was to not impose new requirements and to minimize impacts on NRC, the agreement states and our licensees and because of this concern throughout the latter stages, at least of the negotiations, we had a series of meetings with the Nuclear Energy Institute, the Low Level Waste Forum, the Conference of Radiation Program Control Directors. John, the paper he was presenting in March at the last meeting, was at Waste Management '97 on the present status of the waste convention. In order to make licensees and agreement states, other affected, potentially affected entities aware of the upcoming convention and to get any comments, feedback that they might be able to give us on things that they saw that would cause them difficulty that we could then take back to the negotiations and try to get the text modified to lessen the impact.

One of the biggest potential impacts is on the reporting requirements of the convention. The way this convention would be implemented is through periodic meetings of the parties. It's anticipated that probably about once every three years all the contracting parties would meet. Each would prepare a report on waste

management activities in their countries that would identify facilities, give inventories of waste that is stored, disposed of, deal with how they regulate waste management, including such things as discharges from facilities which is one aspect of what waste management that's also covered in the convention.

One of the largest potentials, I guess, that we saw for having impacts was by requiring information to be collected and reported on that wasn't presently obtained under NRC or agreement state licenses. We think that we were successful in either limiting the reporting requirements to things that we already have available to us, or there actually is the phrase as available in the reporting requirements so that basically some kinds of information may be reported on by some countries, but not others, if that kind of information is not available.

Now, we're at the stage where essentially the group drafting the convention has completed its work and given the text back to the Agency. The next step is the IAEA Board of Governors will meet in June to consider whether or not to go forward with that text or in theory because of lack of complete consensus on some of the issues like the spent fuel, the transboundary movement, the Board could decide to say well, we know you thought you had gone as far as you could, but why don't you try

another drafting session and see if you can't move a little closer to consensus.

MEMBER HINZE: Could I ask a question about that transboundary. Does that include oceanic shore --

MR. BELL: I guess I probably should have dwelled on another aspect of transboundary movement because as I mentioned, this as one of the more contentious issues. It deals with shipment, for example, from one country to another and the rights of intervening countries that this shipment may pass through. It also applies to the case of, for example, where reprocessed waste and plutonium is shipped from France back to Japan and it passes through the territorial waters of countries along the way.

These were some of the more contentious issues and it's another area where there's not total consensus in the final text. Some of the countries were primarily countries where shipments would pass through either navigable waters or across their land, wanted more control over the passage territory.

The -- so as I say, some of these issues that consensus was not reached may lead the document not to proceed pass the Board of Governors.

But if the Board of Governors agrees with the drafting group that this is probably the best document on

how we would deal with these issues that can be developed at this time, the next step would be the IAEA would convene what's called a diplomatic convention in late summer, either late August or early September that would review the text, perhaps modify it to some degree, but if the diplomatic convention was satisfied at consensus, the text of the convention, it would then be open for signature at the IAEA general conference in late September.

We have recent experience with the convention on nuclear safety which was a parallel document developed through the IAEA to put down international principles for safety of the commercial nuclear reactors. From the time that was open signatory, until it was ready to go into effect was about a two year period to get the necessary signatures.

In order for -- in the U.S. under our system, in order for the west to become a party to the Convention, it does require ratification by the Senate. You may know that the Convention of Nuclear Safety even though the U.S. was a leading proponent of that, like the Chemical Weapons Convention, the Senate has still not ratified it. So the Convention of Nuclear Safety is, in fact, going into effect without the U.S. as a signatory.

Eventually, presuming we do get ratification

by the Senate, basically we would then have this process where early in the next century the first meeting of the contracting parties to the convention on the Joint Convention on the Safety of Spent Management and Radioactive Waste Management might have its first meeting. It would likely fall under present NRC organization at least, this division to pull together much of the report on the commercial aspects of spent fuel regulation.

At that time, we would still expect DOE would be pulling together the part of the report that held with their activity.

The international program staff is preparing a paper to go to the Commission identifying a number of the issues it ought to consider and in fact, the NRC Commissioners will need to agree basically that the State Department should go ahead and represent the U.S. at the diplomatic conference and essentially proceed with approval of the text of the convention and I guess there would be an opportunity if the ACNW has an interest, for example, to identify the issues or comment to the Commission in the June-July time frame to make its views reflected in the Commission as a final input to the State Department.

CHAIRMAN POMEROY: We'd certainly like to be kept in the loop on that if that's possible.

MR. BELL: Sure.

CHAIRMAN POMEROY: Is that it?

MR. BELL: That's it for the information part. If there are any questions, I'll try to answer them.

CHAIRMAN POMEROY: Do you have questions for Mike? We turn it back to John.

MR. GREEVES: Just the one point I think Mike made is if the U.S. is not involved in the planning meetings on these things, we have no participation in figuring out how this follow-up is going to occur. So for all the chemical, the nuclear safety and the radioactive waste, if they aren't passed in time for us to participate in that first planning meeting, lots of things happen in that first planning meeting that sort of set the mold for impacts on various countries, so I think it's important for countries to get their ore in and so I just share that with you.

CHAIRMAN POMEROY: John, I think we all want to hear the next three times and our time frame is running a little short because we want to get together with Margaret.

MR. GREEVES: I'll move quickly.

CHAIRMAN POMEROY: Yes, we'd like at least the opportunity to ask you questions about all three --

MR. GREEVES: I'll pick up the pace and stop

and you can ask some questions.

CHAIRMAN POMEROY: Great.

MR. GREEVES: On the low level waste in decommissioning, I really was intending to just talk about a few things, including the direction setting issues. I know you followed, you've commented on them and first, I think we've all read the final direction setting issue on low level waste. It's not the Option 2 that you highly recommended which was an aggressive program. It's the option 3 approach which is do what we're doing now, and frankly with the pressures on the budget, I'm not sure how we're going to even maintain that level of effort. So I see tougher times ahead. You touched on a couple of issues, greater than Class C waste, mixed waste, DOE sites.

At the level we're working at, it's going to be tough to manage all of these activities.

The branch technical position, I know we're all interested in that. The staff has worked very hard on that. We have a staff requirements memo that sets out an expectation that it will be out for public comment and we will summarize those comments in August. Well, you can do the math and that means we've got to get it out now and so the staff has presented to me a document that I have confidence in, so I'm putting it through that process and

I would look forward to your view on that document when we put it out for the, I believe it's the 90-day comment period.

I looked with interest on your letter on time frame. Frankly, the first time I read it, I really don't think I understood and I talked some with your staff and got a few clarifying comments. I read it a second time and I think it's quite a thoughtful piece. You obviously have been thinking about this for a long time and I'd like to view it as an early comment on the branch technical position. We're going to get a number of others. So I think we will fold that into the considerations on the branch technical position.

I understand we're talking to you about the document in October, so we may want to talk about scheduling issues because if we need to summarize something for the Commission in August, and we're talking to you about something in October, I don't know, we may need to make some adjustments.

Another direction setting issue is on decommissioning. You commented on that one. And the final one comes out that we will do some workshops. There should be a pilot plant process and it turns around on the transfer to EPA issue. You highly recommended that we not transfer sites to EPA and the final products ends up

being, that would be last resort approach, which is actually consistent with what we've done over time.

It opens up the question of institutional controls, sort of touches on the decommissioning rule and just heads up -- we are talking to DOE about what would be the transfer mechanism for some of these sites that need durable institutional controls to DOE, so I expect you'll hear more about that. DOE has asked to be a participating party on some of our environmental activities, on these difficult sites. So that's the end of that discussion.

Let me just keep moving and maybe we do all the questions at the end.

As far as the guidelines, you were briefed in March. The Commission gave us an SRM on April 16th that approved the staff's recommendation of a no objection type response. I think you have to read the paper to understand exactly what all this means, so I'm not going to go into it here.

I understand DOE has issued another extension to mid-May in terms of comments on these guidelines and the staff did provide two clarifying comments to the Department on April 17th. I expect that you have copies of those. I won't go into them.

The last item that was on the list was Yucca Mountain site characterization highlights. I think we all

know they're about 10 feet away from what they call hole out and they have completed, I understand, the mapping of the south portal. They've also performed some work in Alcove 6 for the North Ghost Dance Fault drift. And they continue monitoring a single heated test result. It's been a while since I've been out to the facility. I think probably my staff can give you a lot more details on this kind of a topic in a follow-up meetings.

So with an accelerated pace that got me through the last -- it's fine with me too.

CHAIRMAN POMEROY: Are there questions for John on any of these, but particularly on the items 5, 6 and 7 that he's just reviewed for us?

MEMBER HINZE: Well, I would like to ask, it appears to me that the exiting of the TBM is somewhat later than anticipated.

Is there some specific reason for that or is this really on schedule?

MR. GREEVES: I'm not giving a reason. I think that's really a DOE question to answer. I understand it's within feet of exiting.

MR. BELL: Well, I think what Dr. Hinze meant was that it was originally scheduled for I think the 25th of March and it's about a month behind that schedule. Actually, for about the last week they did it within a few

feet of pull-out and I understand that part of the most recent delay is just their arranging some sort of a ceremony and to record the event.

MEMBER HINZE: What I was concerned about was the condition of the ground.

MR. BELL: Now, last few hundred meters they were making very slow progress because they were in poor ground. Much of the time was either in Category 3 or Category 4 ground.

And it's much slower going to go up a slight incline when you're in poor ground than when you've got a little gravity component helping you, so it was basically crossing the same kinds of terrain they did in the north ramp, but this time going slightly uphill rather than slightly down.

MEMBER HINZE: Thank you.

CHAIRMAN POMEROY: Mike, could I just ask a question about Alcove 6, the alcove into the Ghost Dance Fault? Have they gone into the Ghost Dance Fault or are they still simply doing testing with drill core?

MR. BELL: Let's see, is there a DOE person in this? My understanding was -- Ray, do you know, Ray Wallace from the USGS?

MR. WALLACE: Ray Wallace, USGS. What's going on in Alcove 6 and northern Ghost Dance Fault Alcove is an

excavation across the fault zone. It was already penetrated by a horizontal borehole and they'll turn around and drill some more boreholes and test through that.

CHAIRMAN POMEROY: Could you give us any idea of what they're running into? Are they at the Ghost Dance Fault itself now with the base?

MR. WALLACE: Since they resumed, they've only moved about, I think, 9.4 meters, so I don't think they're quite across.

CHAIRMAN POMEROY: Yes. Thank you, Ray. Other questions for John?

I know there are a number of other questions, John, but --

MR. GREEVES: They'll catch me on the side.

CHAIRMAN POMEROY: John, I want to tell you how much we have appreciated it. I know it takes time out of a busy schedule to come down here and do this, but again, it's appreciated. Thank you.

With that, we will now adjourn for a one hour break and after -- at 1:30, back on schedule, we will continue our discussion of defense-in-depth.

(Whereupon, at 12:35 p.m., the meeting was recessed, to reconvene at 1:30 p.m., Wednesday, April 23, 1997.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:39 p.m.)

CHAIRMAN POMEROY: The meeting will come to order.

The next item of our agenda this afternoon is on a continuation of the discussion of defense-in-depth. Dr. Garrick is our lead member.

So John, you're on.

VICE CHAIRMAN GARRICK: Okay, thanks, Paul.

As all of you know, this is a continuation of exploring being done by the committee on different viewpoints concerning the existing subsystem requirements and what changes, if any, ought to be considered in the new world of risk-informed performance-based regulation.

As you also know, the defense-in-depth concept is something that this committee has written letters about in the past expressing their strong support. It has been a kind of a basic and fundamental tenet of regulatory practice for many, many years used first in the reactor game and then picked up on other types of facilities, including waste facilities.

The issue has to do with whether or not, given a performance requirement, it impedes or interferes with the flexibility of the analysts and the designers in achieving a certain performance goal; and therefore, can

become counterproductive possibly, at least that's the view of some, with respect to achieving and meeting performance goals while, at the same time, coming closer to optimizing the design to do that.

We all know that there's a number of options available to us. One, of course, is to opt for complete flexibility and just regulate in terms of a risk-based standard. Another, of course, is a standard plus quantitative subsystem requirements that would be more appropriate to what we now know about repositories.

We could have a variation on that as another option and think in terms of qualitative subsystem requirements. Another option would be a standard plus a requirement for a risk-based analysis of the effective of individual barriers.

That is to say, we have a performance requirement, and we continue to think and push and regulate in terms of multiple barriers; but rather than suggesting that each of these barriers has to meet a certain specific requirement imposed on the applicant, to quantify what the effectiveness of the different barriers are in quantitative terms.

Or, of course, there's always the option of the status quo.

So I think that Charles is going to give us a

little bit of his perspective on this issue both from the standpoint of the current regulatory framework and from the standpoint of some of the things he's observed in his international activities.

So with that, I think, Charles Fairhurst, we will ask you to take the floor.

DR. FAIRHURST: I'm left-handed, you see, and I put it on the wrong side.

Thank you.

I'm suitably wired and I will now proceed -- or attempt to.

Well, it's -- as I say, it is a pleasure to be here, and I know a number of the people in the audience and some around the table. It's a delight to have a chance to talk to you again.

I also must apologize a little bit in advance because when I got here, I realized that I wasn't quite aware of how public, if you like, the audience was, and a couple of things I wanted to discuss actually from European programs which I thought would illustrate certain things, and I'm going to have to do it by waving my hands rather than showing you pictures because I've not cleared them directly with the people who -- I don't think there would be any objection to me showing them, but I don't want to take that risk.

So the next step is to turn this power on here.

Pardon?

CHAIRMAN POMEROY: On the front, on the left.

DR. FAIRHURST: Ah, marvelous.

Thank you.

This is -- in lack of directive, I chose a title something like this. And it's significantly influenced by the recent work that has been done at WIPP. I recognize WIPP is not a high level waste repository and there's some very significant differences; but frankly, I think the achievements at WIPP in focusing on the nature of the problem of that repository have been quite impressive.

So --

VICE CHAIRMAN GARRICK: I should point out that -- just for those of you who don't know this, that Dr. Fairhurst was the recent past chairman of the National Academy of Sciences Committee on the Waste Isolation Pilot Plant, so he speaks from considerable firsthand experience.

DR. FAIRHURST: But I think it is true to say that -- and I don't like to sound like a mutual admiration society -- but John, as you know, has been on that committee and he has very strongly pushed towards the

development of this performance assessment.

And I think it is one area, frankly, in the world where other countries look to us for direction on how to do it. So it is being looked up to. Some other aspects, which I'll get into later, are not.

(Laughter.)

And Lynn Deering was very kind to send me the minutes and viewgraphs of the previous meeting, and so just to try to pick up where that left off, these are three slides taken from there talking about the difficulties that NRC experienced with their Part 60 subsystems criteria.

And I recognize a few of them because this one leading to suboptimal performance was one that I know was part of the Yucca Mountain -- the TMYS committee's criticism. And I won't go into many more detail, but I think you're all familiar with them, those criticisms.

The other slide that was interesting to me in there was this one. After all this criticism, the Commission concluded -- made these two conclusions. That if they were to adopt the EPA standard as the sole measure of performance, it would have failed to convey in any meaningful way the degree of confidence which you'd expect to be achieved, etc.

Frankly, I don't quite understand these two.

And if, during the discussion -- if somebody would like to say what additional confidence would one get by these. The confidence -- and I think there is one.

Charles McAughey, who's head of the geotechnical -- well, head of the program for Switzerland with the NAGRA people, he is a very strong proponent of this, if you like, multi-barrier approach which he calls near field, intermediate field, and far field.

But he comes down at the end -- he says it's nice to give people a warm feeling in the tummy. In other words, there's certain things you can do by engineering with a high level of confidence over a short term which, in the political scheme of things, give you a powerful ally sometimes in convincing the public that this is an iterative thing.

And if you can get confidence for 500 to 1,000 years on something, then maybe they'll be willing to let you try it for 100; or you and your descendants try it for 100 and then review. Because the whole concept of 10,000 years as now with Yucca Mountain, possibly a million years, is one that we all throw up our hands in trying to convince everybody in a scientific way.

But, after all, the problem is to isolate it for that length of time. And the options now are the ones that John has just actually summarized. And I was -- that

was one I passed over before.

When the high level -- rethinking high level waste came out in 1990, I was the vice chairman of the Board of Radioactive Waste Management, and I was called by the press and asked a number of leading questions which they got, unfortunately sometimes, answers that they picked on with great glee and published.

And NRC wrote into the Federal Register something which was a little cover letter to the National Academy, and it said when the vice chairman of the Board of Radioactive Waste Management misinterprets in such a public way the NRC position, we think we have a problem. And I was the one who was guilty of that.

And it was this question of the maximum life of a canister, and I had happened to say that NRC did not allow one to go beyond a thousand years and that this was, compared to what people were doing in other counties, a significant constraint.

And of course, what NRC had done, they had added from the original statement comments about that in the event that one can demonstrate something, NRC will be encouraged. But I was interested when I then went to talk to Frank Parker, who was the chairman. He said well, thank God you made that statement because I thought the same thing and I didn't get criticized for it.

So there is a statement in there that -- even though those statements are in, there's a general belief that at a thousand years you're going to have a dickens of a time to get anything beyond that and it would take a major process. Now, that may or may not be true, but that's the impression.

And from here, let me move to a somewhat more philosophical point of view because I think it does underline this whole question of uncertainty of geological systems. This what you might call a snapshot historical note that when the problem of radioactive waste isolation came up, there were many options considered: shooting this out into space; and even though some people don't consider it quite geological isolation, sub-seabed disposal.

And there were a variety of commissions -- what do you call it? Anyway it was one of the Carter Administration's general review which led to -- that's a marvelous thing to look at for all the options that it shows there. And one of them, of course, was putting it on a remote island in the Pacific with winds that don't fall below about 75 miles an hour year round and so on so that you can't possibly find anybody who would live on there.

But the idea was, of course, that one has to

isolate these wastes from the biosphere for 10^4 to 10^5 years at the time. It gets stretched out a bit. And so one had to look for stable structures with a stability that you could guarantee or hope to guarantee for the order of a million years or more.

And so geological -- one immediately turned to geologists and people who were looking at structures that had, over the period of several billions of years, had at least been in existence; not always the same, but that -- there was no -- any manmade structure had that sort of durability or demonstrated durability.

But it put us into an interesting no man's land because the geologists and geoscientists were quite comfortable talking in very general terms and used -- as you know, one of the things with geoscientists, and I consider myself partially one, not wholly -- but one of the points about them is that for any existing structure or any idea, there's usually about ten or a dozen theories of how it evolved.

And nobody's terribly concerned which one is the right one because they all seem plausible, and there's nothing really riding on which one is right. Even the topic of, for example, plate tectonics was in hot dispute until just a few decades ago. We're not -- and it's had an amazing impact.

So this is a range in which, if you like, the geoscientists, or at least the large group of them, structural geologists particularly, were quite comfortable. On the other hand, engineers, and I put myself somewhat in that category, even including Roman engineers who built some marvelous structures, some of which are still in existence close to the thousands of years ago -- but the general time frame in which an engineering structure is designed is of the order of 100 years -- 50 to 100 years.

And that includes nuclear power plants. When you come to such things as, for example, large earth -- large dams, it's true that they were designed also for 100 years. But in many cases, economically, people are still relying on them but they don't put any money into fixing them up. There are serious states of disrepair, but they're still being used.

And the engineers who designed them will wave their hands and say well, we didn't guarantee those for any more than 50 to 100 years. So you have engineers who look for fairly quantitative structures, but they want to do it usually with fabricated materials.

And this is a very important distinction because most materials that you fabricate, whether they're steels or concretes, you can do a test in the lab and you

can get a very good idea of how it's going to perform on a larger scale.

When you come to geological structures and geologic isolation, what we're being asked to do now is to give some -- make quantitative or pseudoquantitative evaluations and predictions over a period of time which is not very familiar to the geologist -- to the engineer, and is also an area that the geologist will say hands off, I'm not quite happy with numbers.

And that's a fair amount of the problem. That's why I think it's even written into the law, whether it's the EPA, 40 CFR 191, or whatever, that what one is looking for is a reasonable expectation. We know you can't be sure. An uncertainty comes in in a significant fashion. And it's how you deal with uncertainty that becomes important.

The other fact which goes unnoticed quite a lot -- and here I'll say something that sounds a little self serving. But if there's one thing that I've sort of noticed in different countries, and maybe it's the -- it is that the geotechnical people have taken a stronger role up front and have had a stronger responsibility early on.

I think in the U.S., this came out of the nuclear community perhaps by default saying how do we solve our -- the problem that we created. So you've got a

lot of nuclear engineers and scientists who were involved in reactor design and reactor safety trying to like move into saying how do we deal with this geological thing.

If you go to Sweden or you go to Switzerland, you'll find that there's a stronger component of geotechnical people in there punching all the time about the reason to take special precautions when you're dealing with geologic materials.

Let me give you one example. Earlier in the game actually, it was a colleague of mine who worked for the NRC and may still be here -- I won't say who it is, but he came from Boeing. And he came in because -- he was brought in because he was an excellent modeler to numerical modeling.

And he was doing finite element analysis and trying to work from what he had learned out of designing aircraft structures into looking at geological structures. And he told me, he said it took me 15 years of working here to really begin to appreciate some of these subtle differences.

And one of them is this fact that you just don't -- can't say with certainty -- the same level of certainty what you find in the lab may be entirely different in the field, etc. And so the other fact that is not -- the fact that I was about to mention is not very

well realized very often is that when you deal with an excavation in rock, you're dealing with an excavation to material that's preloaded.

If you build and airplane or a car or whatever it is, you build it out of components, you put it together, and then you drive it or whatever. You apply the forces after the structure is built. And when you go into a geological excavation, it's loaded by gravity and by tectonic forces, ar the very act of creating an excavation to look into the thing disturbs the environment so that the near field is changed.

Now you get the term disturbed rock zone. But it has changed in a significant fashion. And yet, a lot of the information that we're going to gather about designing this is going to be obtained in that near field region. When they do experiments, they call them underground research labs. And so, there are -- recently, for example, in the underground research lab in Canada, who did -- the people, by the way, did a superb job there.

I don't know if you know, they went down to -- in the granite and went down to 240 meters, and that's where they were going to do their experiments. But just below that was a thrust fault, thrust zone. And it was the U.S. DOE that provided the funding for them to go through that thrust fault down another 150 meters.

And what they found below there was quite a remarkable surprise to everyone. They went from a horizontal stress field that was of the order of -- laterally, some were in the range of 20 megapascals, which at that depth was not too bad -- and go through the fault, and suddenly it jumped to 55.

And they found in there granite that is unfractured -- unjointed granite. Nobody believed it existed. The Swedes, everything they had done in their program was based on fracture flow, etc. If you look at the Canadians, they're designing their repository on the notion that you can talk about diffusion and slow speeds.

They're not -- they have no fractures in there. People won't believe them, but that's the way -- you read the report, that's their application for -- and so I'm just pointing out that there was an amazing revelation about possibly that most of the excavations that one knew about in the world at these depths made an association with mineral deposits.

Those mineral deposits are, by definition, areas where there's something of an abnormality in the fracture system in the earth's crust and minerals have got in there. And so, if you look around that, you might have the wrong interpretation. One sees a lot of underground labs going on right now around the country -- around the

world.

But -- so, I don't know how much detail I'll have the opportunity to talk about some of those implications of really understanding what one is dealing with with a geological structure. This morning, Linda was talking about the stripa experiment and saying they had had a ten year program to try to characterize the fracture flow.

Well, the interesting thing is, they haven't answered it yet. The answer is not -- nobody knows why. There are various hypotheses that one of the problems was that -- I think you know that there was a drift in which one sort of pre-excavated the drift by dri[illegible] six bore holes, each -- I think, were they 100 meters long?

Yes; and then they measured the water inflow to each of the bore holes and gave it to all of the hydrologists who were doing 3-D fracture flow, etc., and said predict for us how much water will come into the tunnel when we excavate it around the line of those -- and everybody predicted there would be an increase in the amount of water inflow.

Not a fantastic one, but some increase. In actual fact, it went down by a factor of eight. And so it indicated they weren't in a position to prediction. Then the Canadians acknowledged that when they were driving

their shaft, they had done a similar experiment. For them, it went down by a factor of four.

The latest word is that, you know, Jane Long is suggesting this is due to dropping the pressure of the ground water so that you get an exhalation of dissolved gases, and that inhibits the inflow. But it's not a very well accepted idea.

But I'm just trying to indicate that this process which has been perhaps -- and I'd include myself -- not as well recognized as it should be, is that the kind of problem that one is posing to the geoscience and geotechnical community is one where the information has been evolving very rapidly and is still not there.

We don't have enough information. I doubt if we will ever have it. And so the notion of uncertainty is absolutely implicit. And whatever kind of rules we bring about or introduce, significant uncertainty has got to be a part of it.

Now I'll come back to that point in a minute because -- but let me switch now to the notion of this review. And I think this is actually a fairly prominent Canadian geotechnical individual who came up to me about three years ago.

And he said, "Charles, you've been associated with a lot of interesting things in your life and

important things; but nobody, nowhere, have I seen anything written that was better than this for the geotechnical communities."

And he pointed out -- and if you want, this is Morty Morgenstern who is the president of the National Society of Soil Mechanics. And he said that is the best document I've seen as far as laying it out for what it is, as far as the geotechnical areas. And I agree with him. It's beautifully done.

What went into that was a document I think -- and a very clever staff person got it down to that and it was readable, and it's very well done.

And here are some of the things that -- I'm sure you've all seen it, but just to me, summarizes the situation we have. There's no scientific or technical reason why we can't do it or why a repository cannot -- there doesn't appear to be any.

But the U.S. prescriptive approach -- and these are not my words -- is poorly matched to the technical task at hand. The U.S. is the only country that has taken the approach of writing detailed technical regulation before all of the data are in.

I don't like that term "all of the data." We'll never have all of the data. And so I'd like to substitute somewhere "before a sufficient understanding."

And the program is bound by requirements and may be impossible to meet. And this is the important one.

The alternative approach emphasizes flexibility, time to assess performance and a willingness to respond to problems as they are found, remediation if things do not turn out as planned, and a revision of the design and regulations if they are found to impede progress towards the health goal already defined as safe disposal.

The Swedes have -- maybe it's -- a lot of regulation or ideas in other countries are not written down. You sense it in talking to them. They introduced this term of remediation if things do not turn out as planned. So they were saying it's fundamental you're going to go in there, you'll either find a fault that you don't -- didn't anticipate there, and that fault is transmissive.

Or if it's in a seismically active region, it looks as though it could be an active fault. And so what they would do, and the French will do the same -- the French call these sacrifice zones. They will say nowhere in an ore body, as mining, do you find ore all over the place. In some places, this ore is low grade, so you're going to leave it there because it's not economic to mine.

And so when you go underground, you shouldn't

expect to have to be able to lay out a nice rectangle array of excavations and say if that won't cross the fault, that's too bad; that's where we're putting the canisters. Well, you don't do that.

As you design as you go, say I'll move away from that. How far do we have to move away from a fault in order for this not to be significant? If it's 100 meters, that's the rule. And so the notion of observing what you find and designing in an evolutionary fashion as you go is what you have to do if you want to really optimize a design for a repository.

And so it may not be possible, in the way in which it's not always possible to say what a mine will look like when you're finished, to lay out the design in the beginning. And believe me, you can in general; but you have to have the proviso in there that you can modify it and it will -- provided you do it right, it can be acceptable.

This, by the way, is not from the rethinking, but it's sort of an engineering principle which I think is useful to restate. I stuck it in there. But if the performance of a system depends on a contribution from components whose behavior cannot be adequately determined or defined, then the design should be changed to eliminate any dependence on that component.

That again is flexibility of design. And what it talks about is, in essence, what do you mean by a robust design. You have that proviso, and it has to be a proviso in the regulations. Doesn't mean an inferior -- it means a superior design.

And the other one is the question of geologic modeling, or today we might call it performance assessment or part of performance assessment -- is that you learn over time, you start -- how to achieve assurance about the long term isolation of waste.

The first thing that one does, and in fact is done and now it's quite commonplace in geotechnical engineering, is to develop some sort of numerical model. And you usually have very little information at that point, but the first -- sit around the table, five or six people who have looked at the project for a while, will work out what's our best guess at this stage of the game of what this looks like.

And say now okay, so we have a very elementary -- and as I say in the performance assessment part, there may be certain segments of that in which you have no information at all. And so you put a shunt in there. You put something in that says I take no credit for anything in that link, but I want to acknowledge the link exists because it might be that we need to do some work on that.

And then you look and see does it make any difference; what are the critical components of your lack of understanding. And once you've identified those, then you know how to plan the next step in the evolutionary process, whether it's field exploration or additional data from the lab or talking to other branches, other types of scientific or technical people.

And so this objective of designing as you go using models to do it is profoundly different from predicting the long term behavior in advance. Saying lay it out, tell me what you're going to get. I can tell you -- I'll tell you what my goal is, but I can't tell you how I'll get to that goal.

And what we have found is that frequently, even a construction of the model informs you tremendously about certain types of things. And I'll come to one of those examples later. It's the one I wanted to say something more about.

But finally, as far as the rethinking report, there were a few shocks or, if you like, a few references to NRC as well as DOE and others. But these are the questions you're asking right now.

What modeling evidence is necessary, obtainable, or even feasible?

To what extent is it necessary to prescribe

design rather than allowing alternatives that accomplish the same goal?

This one, what can be done to accommodate design changes necessitated by surprises during construction? And I've tried to suggest that that is an element that must be taken into account.

And what new strategies such as features like copper containers might be allowed or encouraged as events dictate?

These are things that are suggested, and this was a -- George Hornberger was a member of the group. You know George. This is a rather nice group of people from around the world who I think was including -- well, if you read it, not only engineers and scientists, but people dealing with ethical questions, etc., and social issues.

But let me -- I'll try to -- this is where I'll do a bit of the hand waving. I wanted to say well, we all know what the prescriptive approach in the U.S. is. And again, please understand that I don't think that one needs to get away entirely from that partly to get some level of assurance. But I had hoped we'd have some discussion of that.

This is the one I would hope -- that I had hoped to talk about. In France, although they were not prescriptive, anything that was written by -- about ten,

15, maybe 20 years ago now, a very capable, eminent geoscientist named Goguel put together a commission which was asked to say how should we search for repositories in France.

And they made a few general statements. And one of the general statements was don't look for one in a seismically active region. And Steve Frishman might be interested in this because it would suggest that Yucca Mountain falls into that category.

But understand, this was 20 years ago. And the reason I say that is that it's easy to be -- have 20/20 hindsight and be wise and criticize; but at that time, I don't think many of us would have made many different decisions than people making them at that time. It's a question of understanding the evolution and doing the best with what we know now.

Well, what the French have done, somewhat different than the U.S., they said before -- some of you may know him, Christian Batai. He was appointed to go around all the communities that looked as though they had a reasonable chance of formations that would fit and talk to the group, the mayors, the local community leaders and everything, and find out which communities would be willing to accept a repository if indeed their area was found to look geologically promising.

And it was a given that an underground research lab would be established there as a first step. And if things continued, they would actually expand that research lab into the facility. And you may know that about ten years ago, the French were very much into salt. And it was up in Brittany they had some rather nice salt deposits.

And the -- when they went there, they wanted to do some drilling. The farmers brought their tractors out and lined the route and sealed off the roads, and they got the message that there wasn't a great deal of enthusiasm for that in that area.

And so they have ended up actually with three sites, three potential sites currently. One is in the Champagne area not far from the Nonce City close to the German border in the east in the Paris Basin. Beautifully simple. And one of the guiding principles of one of the leaders of this group in France is the first rule of a geologic repository is choose a geologically simple site.

If it's complex, we're never going to get it approved because we won't get through all of the problems. So that was a big attraction, clay, indurated clay.

The second one was in the Massive Centrale in the sort of southern part -- south central part of France in granite. And the third one is again in an indurated

clay and sediments, but in the south not far from Marseilles, and it looked promising.

But you may know that that region is indeed seismically active. And so there was a concern about what was going to happen if somebody brings this up. And this is the one picture I can show you because it's a map. I mean, it exists outside of the --

(Laughter.)

But this is -- down here would be Marseilles and the Mediterranean. And I think you know -- and over here are the Alps, and over here is the Massive Centrale, and over here are the Pyrenees. And so you've got this build up thrusting this way. There's the African plate pushing through the Mediterranean up this way.

And then, of course, the Alpine Arogeny up here. And there's this fault called the Neam Fault here. And this is showing the dip. It's a thrust fault. And if you look in the region, there are several faults which are reasonably close to being identified as boundary faults. They go right down to the basement below the sediments.

And the proposed repository is here. But because there's a lot of seismicity around here, there was a concern this may not be the right place to be. And the debate's still going on, but we had to do a very quick analysis for them.

And so there was this well known -- well, the person -- the professor who was in charge of drawing the new structural geology map of France, and it just came out about a year ago, and he was talking -- we were chatting about this possibility which he called protected lozenges.

He said in the three dimensionally jointed massive rock, isn't it possible, even in a seismically active region, to have something that may very well be protected by boundary faults because you know that seismicity is likely to occur on existing faults?

And is it possible within that region there's a block big enough for a repository, and is that the case here?

Well, the analysis that we did -- we got some geological sections and we were able, we think, to identify a system of faults that bound this region. And the Neam Faults and this one, they're both thrusting in the same direction. And the major principal stress is coming in this direction.

And when we took the cross section, we found something that was really an unanticipated -- at least to me it was unanticipated because I thought this was going to be a block of -- large blocks. But in the sediments -- and this is where I would love to have shown you the diagrams -- the sediments are inclined upwards from here

up to here.

And they're really quite remarkably uniform. In other words, there's no much folding or faulting which you would have anticipated some folding and faulting in between here and here. There's some minor, but most of the layers, even though inclined, are uniform.

And right down here, you'll notice that region there. That's a dyeper. That's salt. And when you find out where that salt comes from, it's actually at the same time extruded, and it's in at the top -- just above the basement of rocks and the upper sediments. And that's down at a depth there of about eight kilometers going up to about five in the Massive Centrale.

And I think you know, if you have salt at that depth, the temperature -- it's very fluid. And what appears is that this whole block is sitting on this layer almost like a lubricated layer. And if you try to build up the stress in here, what it does is you've got a contrast of the basement rock here and the basement there, and you try to push it.

And this stuff here will just float away. It's own weight, it will just push away. And all the stress will go down into contact with the basement. And that's where the contrast is. And that will slip, and that will be seismically active. And that's where you can

find a seismicity in the region.

But at the same time, the material in between looks like almost an ideal place to put it because you know that it's protected from seismicity. And so this is why I say that -- I try to say be careful how one is prescriptive.

A statement like that, not in seismically active regions, might rule out -- and we're a long way from saying it's ruled in -- but it might rule out an actually first rate -- something that can either be first rate or, from an engineering point of view, can be made first rate.

And that's nothing to do with the U.S. prescriptions, but it's with statements made by others about how you rule out certain categories. But in addition to a significant amount of work that's been done by the world community over the last quarter of a decade or so, another place where there's been a remarkable change has been in, if you like, the numeracy (sic) of the geotechnical and geoscience community and also the advance of computers.

And I think that the modeling and interpretation of structures in terms of computers is something that's a major advance. And so, things that were done 25 years ago, there's no comparison with what we

can do today and what we should do today.

One other thing that I can point out, and I don't know whether this is one that you dislike, George, but -- and I'm not putting the diagram up. But I like this, and it shows the creativity of, I think, the Swedish engineers and the very much engineering approach. They came from a mining background.

And this question about -- for example, should you insist on a ten thousand year travel time? I'm not saying you should or you shouldn't for the moment. But sometime ago, Tom Cotton put together a report I think for the GAO in which he actually was advocating regional repositories in the United States saying you shouldn't have just one big one, you should put one here, one there, one there; and you should design repositories -- the focus then would be on linking it to where the nuclear waste was generated.

And I'm not sure all of this has come to pass, but the big problem with transportation today doesn't -- wouldn't surprise me if at some point somebody re-raises this issue. You know, the old all the waste is generated in the east, why are you sticking it in the west; and why do we have to transport it all over there.

And maybe one has to find a smaller scale repository and say it's not perfect, but can it be

engineered properly?

What the Swedes did, they said look, when you look at this ground water travel, it's a function of two variables, not one. It's a function of the hydraulic gradient, as well as the transmissivity of the permeability. And so we have spent all of our time thinking about how to characterize the permeability of transmissivity of a fractured mass.

And as we said before, we're not making much progress. We're having a lot of trouble. I don't think you can scale it. I don't know how you do it. I know what you can try to do, but maybe this comes back to this notion if an engineering design requires some parameter and you can't fix it, well you better make something that doesn't require it.

And so what the Swedes said -- well, we know we've got no floor if we eliminate the hydraulic gradient. If you make the gradient zero, then the floor will drop off. So what they said was they advocated a design in which you -- a very different type of repository, but the waste was put in an interior excavation, a cavern; but around the outside shafts are noticed that they are -- and then they put spirals, tunnels around.

And from those spiral tunnels, they would drive vertical connecting holes, bore holes, so that you

in essence created what is the hydraulic equivalent of a Faraday cage. You eliminate the hydraulic difference in potential across here. And then, in the inside of that, they did the standard mining excavation.

It's something about two meters wide. And they stomped down and filled it with Bentonite or a Bentonite-quartz mixture. And said now, we've got no hydraulic gradient, and we've added a significant impermeable barrier. And what happened was, of course, this was brought up at the time that Sweden was deciding what it was going to do.

Could it design a safe storage facility, and the Swedes don't have as much waste to deal with as ours, so this looked moderately feasible. There are actually some questions about it. You have to be very careful how you excavate this and underneath here, otherwise that central plug will drop on you and so it's not easy to do.

It has to be carefully done. But the point I'm trying to make with this is simply don't prescribe things such that you destroy the creativity of the bright engineer or scientist to look at a problem in an interesting way and say how do we solve that.

And I'm amazed at how infrequently somebody just says well, we've got all this problem, we're spending hundreds and hundreds of millions of dollars of

permeability; and somebody says well, what the hell, why don't we get the gradient?

I'm not saying it's easy, but I'm just -- the fact that somebody raises that other issue means you employ the creativity.

Anyway, what happened with this, it was patented and SkB bought it from the guy who designed it. They had a lot of money invested it, SkB's design. But some of us know about it. The other point that bears another look -- I think you know that the Swiss design is to put the canisters in line with the tunnel.

And there's a lot of discussion about the seismic resistance of canisters in a repository in a seismically active region. And I can assure you that if you want to do a calculation of the shock resistance of something like that with a cladding -- with a, you know, Bentonite or whatever around it in the center of a tunnel, it can be made very robust.

And I suspect in the Canadian program the problem that they know of course have got with this very high stress environment at 420 meters deep, and they were going to put the vertical placement of the canisters, is that if you do some simple sums, you get a factor of three more or less augmentation of the stress field by creating the first opening, so you're getting up to three times 55,

about 160 MPA.

And then you put a vertical hole in the floor to drop your canisters into. You give another factor of two or three. And then you turn the heat on or you let it warm up, you're going to have a pretty badly beaten up region there. So it looks, even though they have followed this in the floor design, I suspect it will very much turn -- change to one of these.

So this is -- it's a useful design for -- particularly for -- so, what am I actually suggesting? I feel that it's absolutely imperative -- in fact, it's almost a basic tool, is that you start off with a performance -- system performance assessment. You have to do it. There's no other way.

And since the word -- down at WIPP, we eliminated the TS and just called it PA, performance assessment. And that's okay. But when one talked about total system performance, I wonder where the total begins and ends. Because -- and this was put in the rethinking high level waste.

To put the thing into context, I know comparative risk is a dirty word to a lot of people and it never gets anywhere, but I do think it's important if the purpose of this, which the main purpose of it is to inform the public, is to start off possibly by saying what are

the alternatives?

What if we leave this stuff where it is for five hundred, a thousand, or ten thousand years? And what's the risk of that? The next one, although I don't think it's a major case of transportation, is a pseudorisk of no matter how little you say that risk is, the public won't let you transport it.

And then we come to the geological risk. And I think a total system must somehow at least start to build an integrated picture like that.

When it comes to particular media and looking at how the performance assessment goes from there, there are a few things that I'd like to mention. Salt and clay, particularly salt and coming from the WIPP experience -- something that to me was a very important lesson was if you look around the rest of the world, everybody's concerned about the performance of the repository or potential performance and the undisturbed condition.

Yucca Mountain, we're looking at ground water travel time. I just heard this morning John Greeves saying that human intrusion would probably not be considered, and I think that's smart.

But at WIPP, this salt, the performance, was so fine, so excellent, that if you read our report, you may not -- you'll see that every -- almost every chapter

and a wide variety of opinions and ideas about repositories, everyone signed off and said under undisturbed conditions, the following concerns are irrelevant.

And so what happened then -- so they concentrated, because of the resource possibilities of WIPP, of any salt, of what is the likelihood of a human intrusion; and so the whole thing was focused on that. And the focusing of attention, one is now at the point -- and this is a syndrome of the scientific community and I suppose others -- we all pretend that the problem we're looking at is the total problem.

And then you'll take a piece of that and everybody focus on that. And I left a meeting yesterday where DOE in its wisdom had chosen in its performance assessment to do some very conservative assessments to say if we pass with this, we don't know the real behavior, so we're going to make some assumptions.

And one of the assumptions was that this repository in salt will compact -- the waste will compact with a residual porosity of 20%. And based on tests in the lab, they took these 50 gallon drums of junk -- transuranic waste, and loaded it up to lithostatic pressure. Found that it compacted to leaving a residual void volume of about 20% and said that's it.

So they put in that permanent porosity, and then they have some very conservative figures about rates of brine inflow and the permeability of the brine itself -- excuse me, that the salt itself -- I think we all concluded that it's essentially impermeable. But there are anhydride layers in there which have some permeability.

And we took some very conservative values in that. By taking very conservative value of that, they got enough water in there to corrode all the canisters and create gas which filled these voids. And then they came to -- they made the next statement that this waste will corrode and deteriorate to the consistency of fine sand.

Now how you get a burnt out motor to corrode to the consistency of fine sand or a -- you know, a lab jacket, I don't know. But that's what they said. They said boy, that's so conservative. But then, when they started to consider human intrusion, you have a gas -- a repository pressurized to lithostatic pressure with gas.

The moment you tap into that, everything in that repository comes out. And here is something which, in my view, it's (a) the human intrusion scenario is an invented one. This other scenario is invented by well-meaning people who didn't know what the long term behavior of this stuff would be, so took what they thought was a

conservative assumption.

But the whole approval process or licensing process for WIPP is now hung up on that model and saying that one in the magnesium oxide performance. It's not a secret. And if I talk to George Dial, he'll say it's costing him a half a million dollars a day to hold that whole thing up because they've got everybody ready to go or get moving and they can't.

And they've got every state in the Union where there's waste pounding them. And so this is where again it's -- I'm trying to illustrate, not criticize; because I don't think I would have done any better. But in looking at a standard, I think that when we do performance assessment, it's critically important to start -- what is the reasonable behavior that the best informed says is going to happen, and then put your uncertainties -- how bad could it be, how would it be -- put those as bounds on reasonable behavior.

Because if not, the -- taken to extreme positions, this is what is not the prescriptive approach of NRC -- but we criticized in our WIPP report DOE for taking these extreme positions because they can come back and bite you in this way.

Because now what everybody's focused on is not even human intrusion. Some of this quotes Spaulding's

model which is a total fiction, in my view, and that's a personal opinion. I just got back the other day from visiting some salt mines in northern Austria which were operated by the Celts 1200 B.C.

That's 3,000 years ago. And you can go into that mine, and you can see artifacts of cloth, clothing, chicken bones actually as well, if any of you like chicken for lunch -- and a lot of bronze and, in another mine not far away, steel implements. And you talk to the curator of the museum, and he says those things didn't have a single tarnish on them, and the rope was as strong as when it was made.

They cut the timbers in order to make some opening to get into, and that timber -- you'd think you were cutting this years growth. It was beautiful. So it was all preserved. And yet we have to -- we're saying that stuff degrades to fine sand. It just doesn't happen. So it's a very interesting actual analog.

So the point I was trying to say, what are the components of anything we do in performance assessment. I really would ask that we engage the geotechnical community -- say what is your best estimate of what that will be, and use that as the linkage going through, and then how uncertain -- not take the extremes.

Oh, I might mention here this -- I was going

to say that the different types of rock brought in for different purposes -- there are a couple of things that one has not said much about, but I think NRC will have to address it one way or another. And even if you don't want to, this is how you deal with human intrusion.

I think it's going to come because it's being brought up in another context. And so once it's up, it's up. Europeans generally are trying to push it aside and say, you know, we've got human -- they believe they've got institution controls for four to five hundred years and feel that they can push it back.

The other question is this one of retrieveability. I think retrieveability has a number of important potentially negative connotations about what would otherwise be a very good solution. Trying to keep salt open for 50 years is not tough. I don't think it's difficult to do, and I think if you didn't have it but required somebody to show that they could actually take transuranic waste, at least, out without having to hold this open for a length of time would be a big problem.

I'll come back to this ground water travel time. This is somewhat of an anecdote. My first contact with radioactive waste was actually in a project proposed I think by Dow Chemical for Savannah River waste. And this was -- of course, you know a lot of that was slurry.

And so they had what I thought was a marvelous design.

They just took a series of underground inclined tunnels with an incline -- I figure it wasn't very steep -- but inclined tunnel, parallel tunnels. And they were just going to take this waste slurried and pump it down the shaft and let it fill up in a dilute form with cement so it would solidify.

And of course, by being inclined, you got nice contact with the roof and floor, and you got immediate contact. And the -- it looked like a marvelous solution. It was very simple. It was going to take five years working very carefully to put this material down into the waste and get underneath the Savannah River Plant in triassics and so on.

Again, this -- there were a couple of faults there that I thought looked good for protecting it. But it was -- this proposal was knocked down, or this idea was knocked down, because this shaft would go through the Tuscaloosa Aquifer. And there was great concern at the time. They said that what if there had been an earthquake at Charleston many years ago.

What if there's an earthquake at the time that this stuff was being pumped down? Now this was the same time that we were putting men on the moon. So the notion of shock isolation was not foreign to the U.S. community.

And so we had a good idea of how to isolate that.

The problem would have been resolved. They would have had to worry about off site transportation. But the real kicker of knocking it down was when they looked at the model for how fast this waste would migrate. And there was the ideal porous permeable medium, and it was going to take a quarter of a million years, I think, before it moved very, very far.

And M.K. Hubbert was one of the reviewers. And he said yes, but this is a fracture zone, and I will take and take a single fracture, parallel plate fracture, and take it from the repository to the bottom of the Tuscaloosa, and it will get there in 100 years. Or it was some number like that.

That was the -- and nobody could refute the argument. And this was part of the difficulty, and I don't think -- still think we've got that problem of how, wher you're talking about ground water travel time, how do you define it. Do you define it as fracture flow or porous permeable medium?

And that argument is so much at the forefront of the geotechnical -- one of the geotechnical issues right now that I think you'll be in court a long time trying to defend something that stipulates 1,000 year travel time.

So I don't think -- I'm not even sure I want to show this because I don't really quite believe that you should eliminate the prescriptive requirements. What I would say is that the way in which they're currently formulated, I think there is very good value in saying if we're going to design -- after all, it's an engineered problem.

If you're looking to design an engineered solution, let's have several steps in there the way John just said about getting a risk assessment for each component. But there are things you can do which are within the context of a thousand or ten thousand years of extrapolating and understanding performance.

And there is a particular need in some ways to repair or to make sure that you've got the excavation damage zone which runs out one of two radii of the excavations -- that you make sure that performs well. But if that doesn't perform well, although -- you're missing an opportunity.

There are things you can do with backfill, there are things you can do with shock isolation to eliminate a number of problems that you may be tagged with in certain areas. So that is a very good one to show people that you have designed the initial installation so -- and I think once you just take away the 1,000 year

1 imber for a canister and just say show us what you can do
2 with a canister.
3 Put a canister in as a component. And then,
4 beyond that, this intermediate field, there are things one
5 can do. One might be able to prescribe certain things
6 where you can actually do some monitoring over that scale.
7 Because monitoring is something that also gives people
8 confidence, and there's no way you can do much -- except
9 perhaps the geochemist community.
10 And I'm not saying that lightly. I think that
11 is a real contribution for the geochemists to perhaps help
12 with the far field modeling and have something for each of
13 these components. But with all that, the thing that will,
14 I think, be very useful and very valuable to the public is
15 to design a standard regulation that's in concert with the
16 rest of the international community.
17 The U.S. is -- and I think we should go to a
18 true safety standard. Dose, risk is what I mean. And I
19 think John will just -- will concur with me that if you
20 look at the release standards that are now applied at WIPP
21 and the EPA standards, I'm not knocking this totally, but
22 I'm saying that a release occurs when you, under the
23 definition, if you get migration to the so-called -- the
24 boundary.
25 But that boundary is a circle or a rectangle,

whichever way you want to do it, that extends from the -- about two kilometers each side of the repository going down to the center of the earth. And so it can pass that boundary at 650 meters below the surface, and it's a violation.

It's in violation of standard. And I say okay, well yes, you can pump into there, but what you pump up would be non-potable brine. And so what kind of a hazard is it? And so I believe that there is a great deal of margin of extra security that one would see in that kind of a repository and make it a more attractive repository.

You wouldn't have that margin of security at Yucca Mountain. And so that's why I think that you could have same releases, very different consequences. And so we are missing a further discriminant between sites if we don't put that in.

Well, I think that's about as far as I should go, John.

I'd be happy to try to answer questions if anybody wants. Sorry it took longer than I thought.

VICE CHAIRMAN GARRICK: No, I think that was very interesting.

And I trust, Lynn, that you'll get us a copy of his exhibits one way or another.

MS. DEERING: I'm working on it.

VICE CHAIRMAN GARRICK: Okay.

DR. FAIRHURST: I'll give them all to you except the ones that --

VICE CHAIRMAN GARRICK: Give us the ones you don't want to give us.

Yes, I have a couple of questions, but let me yield to my colleague here.

(Laughter.)

CHAIRMAN POMEROY: You go ahead, John.

VICE CHAIRMAN GARRICK: I think that one of the things that you're saying, Charles, is that what we really should be doing is coming up with criteria that are compatible with being able to optimize the design with respect to achieving a certain safety requirement.

And that might include some sort of subsystem requirement, but may be structured a little differently than the existing ones. And I guess I'd like to quiz you on that a little bit. And let me just kind of put out a leader.

If, in this day where we do have computers and we can model repositories and we can break it up into pieces and parts, maybe what we should be thinking about in terms of lines of defense or barriers or specifying critical points in the model, if you wish, in terms of

understanding them and somewhat agreeing on them on a site specific basis rather than prescribing a specific requirement -- I know as somebody that's worked in the reliability engineering field that we used to do something called apportionment.

We'd want to achieve a certain level of reliability, and then we would apportion that level of reliability down to the system, subsystem, and component level. And generally, that in theory sounded very reasonable; but in practice, it was usually a disaster and never worked very well.

So the question is, how can we manage our uncertainties; how can we feel -- develop that warm, fuzzy feeling you indicated without necessarily compromising the ingenuity and creativity of the designers?

And let me, as I say, just throw out a thought here. If we think in terms of what a performance assessment model is, and let us for a moment say that what we mean by a performance assessment model is a structure set of scenarios that deals with the question of what can go wrong with the repository, perhaps one approach we could take, therefore, is that if we say that a scenario has to have a starting point and an end point, and that starting point should be anchored very strongly to a specific application at our specific site, maybe what we

should be focusing on in terms of requirements is on an agreed on set of initial conditions.

Or in the reactor business, we might call them an agreed on set of initiating events. Because that becomes the fundamental building block of developing the scenarios that would form the basis of our answer to the question of what can go wrong.

Maybe, in addition to that, once you -- the regulator and the applicant have agreed on what constitutes a rational and defensible set of initial conditions -- and an example of an initial condition could be a range of infiltration rates -- then maybe we could be talking about pinch points in the model such as the source term where we might define the source term as the flux out of the region of the engineered barriers.

And of course, then you could define other interfaces appropriate to the specific site. And possibly a strategy, therefore, could be talking in terms of those fluxes in terms of what they are and their rates and what have you rather than thinking as much as we often do in terms of the criteria that are currently considered such as containment, control release rate, and ground water travel time.

So my whole point is that maybe in this contemporary world of risk-informed performance-based

analyses, we ought to rethink what the requirements ought to be, and maybe we ought to be thinking along an entirely different dimension or plane.

DR. FAIRHURST: Yes, what I -- I think the important thing, of course, is to ultimately make sure that the risk to the biosphere or outside is --

VICE CHAIRMAN GARRICK: Yes.

DR. FAIRHURST: -- that's the crucial issue.

And we move backwards as to see how you achieve that and reach that. You could define a certain release. Now I like that, except that I don't want -- and this is -- it's not an easy puzzle. I would like to make some set of -- as you call them, subsystem requirements, but not ones that are so rigidly defined that you let somebody do a subdesign for that and only that.

It may well be that, as we've said, now you can modify it if you can demonstrate, you know, there's one that you list but you don't need to satisfy it if you can demonstrate that you don't need it or something. But I think that the main problem of -- there is -- somehow you should encourage the designer to do something in the near field that will make sure that he's got the confinement that he can -- the best confinement.

For example, in WIPP, one of the big problems is not -- was that one couldn't understand very well the

solubility of plutonium because it was in different activation states. And when you asked expert elicitation panels -- what was it, six, seven, ten orders of magnitude variation.

But then they say well, we can control that a lot by putting magnesium oxide in the waste. And that was, I think, an imaginative way -- still being argued about -- but of saying well, let's try to limit that problem.

Now in reality, there was a particular solubility or group of solubility that would occur. But they eliminated a range of uncertainties by a technical option. And I wouldn't have thought of that, so I wouldn't like to prescribe in advance exactly what it is.

But I say you must take -- you must do what you can at each step of this game to -- I wouldn't say minimize. I want to say take maximum advantage of what engineering options are reasonably available. I don't know how to put it.

VICE CHAIRMAN GARRICK: Yes, yes.

Well, and I didn't know -- and I didn't articulate it very well either, but the idea here is that maybe in a time when we are able to do much improved performance assessments, one option here would be to consider some sort of criteria or guidelines that would

allow us to step-wise move through this model --

DR. FAIRHURST: Yes, yes.

VICE CHAIRMAN GARRICK: -- and agree.

For example. I think if there could be agreement on what the initial conditions are that constitute the starting point of the scenarios that you want to examine, that would be an enormous step forward. And there would probably have to be a very good reason as to why downstream, if somebody didn't like the result, you'd come back and change the initial conditions.

DR. FAIRHURST: One thing, for example. I'm just thinking on the fly now. One might say that you must demonstrate a reasonable -- that you don't adversely affect the permeability beyond a certain region. And that would perhaps push you into looking at your loading density, your thermal loading densities.

You know, at Yucca Mountain, one's talking about quite high temperatures. Everybody else is talking about keeping it below 100°C. And in certain rock types, it might be, as in for example in the Canadians, if they ever had temperatures going up to that, they'd crack it right through to the surface.

Not really, but they'd have a large damage zone, and that would not be a good thing. And so you may say -- because in fact, that is an important consideration

in their case because something like 150 meters away is a thrust fault.

And they have to make sure that they don't have any rapid communication to an enlarged radius. And so it is important for them to make sure that they don't induce a significant fracture zone outside. So for them, I think you might have a rule saying that you must be able to demonstrate the permeability beyond two radii or whatever, three radii.

That's just a site specific -- but taking something at each of the three ranges that you feel would be useful to do.

VICE CHAIRMAN GARRICK: George?

MEMBER HORNBERGER: Charles, could you say a few words on where you -- with your international experience, where does Switzerland or France or any of these other operations, where do you see them in relation to the subsystem performance goals versus going toward a risk-based standard?

DR. FAIRHURST: Well, they are -- they're all essentially moving toward a risk-based standard -- dose standard at any rate.

MEMBER HORNBERGER: Is anyone farther along than we are?

DR. FAIRHURST: No.

Perhaps the Swedes, but the -- I don't know if you know that the Swiss had the site for intermediate level waste at Wallenberg. And they had some very interesting -- 1,000 year travel time. They found negative pore pressures at depth. So in essence, there's regions where the flow field is not accommodated.

It's highly impermeable. And in some places, it appears that the flow is towards some region inwards and outwards. And so there might be areas inside there that they could locate something where the actual flow appears to be towards the repository rather than away from it.

Which, you know, it's -- and they're very excited about it because it looked like something they hadn't even thought about where the local community just turned thumbs down on the site. So they really don't know where they are. McAughey's very depressed and it was by a 50.5 to 49.5 vote.

And so -- and I think you know that in Selafield in the U.K., that was just turned thumbs down. And some people say it may get reopened after the British election. But for the moment, the British are in rather dire straits.

But the -- as far as the actual designs of the repositories, there's been lots of work been done by each

of these on site investigations and some excellent modeling being done, for example, to explain the negative pore pressures. And the capabilities of modeling these days are really quite significant for some of these.

The French are at the stage of trying to work with -- they may be, from an economic consideration, determined to knock out one of those three sites. But I think it will be the -- if it goes, it will be the granite site because a couple of people on the review committee do not like the difficulties of trying to characterize fracture flow.

They say that that is too big a problem. And the French are very pragmatic about it saying that if we could have a simple geology so that we can do our performance assessment with a better reliability than another site, we're going to take that site.

So it's the same pragmatic thing of saying if people are not going to accept it, well why even go to salt, as much as we like salt? But the French -- what they are doing is each year issuing an update on each of those three sites. And they have got a very fast schedule. I think that it's by 2005, I believe it is, they have to decide where the site is.

And then that is the site. In other words, it's not -- it's where -- if you like Yucca Mountain, it's

not to that stage yet. There's still a lot of debate as to whether it's an acceptable site. But they have to pick a site which they're going to go with.

So it's very fast. The Germans, there's some trouble, I think, with the Gahlaven site. I don't know if you know about that, but there's some --

VICE CHAIRMAN GARRICK: Paul?

CHAIRMAN POMEROY: Charles, switching gears here a little bit, as I remember, the rethinking document talked a lot about flexibility of the regulators. And we certainly concur with that. In the four options that you and John have laid out here, there's certainly options that allow a great deal of flexibility.

But if you had a set of regulations with some imaginative subsystem requirements, do you have any thoughts on how we might get greater flexibility for the regulators within those more flexible perhaps subsystem requirements?

DR. FAIRHURST: Well, that's a very tough question.

CHAIRMAN POMEROY: I know, I know.

DR. FAIRHURST: And it's one that, if you like, I'm pleased that I've not had to come to grips with it too much.

But it's a very good one. You have to decide

what is your --

CHAIRMAN POMEROY: As you know, there's a lot of problems with the existing requirements because even though there's flexibility stated in the regulations. In fact, as --

DR. FAIRHURST: The perception is that it's not, right.

CHAIRMAN POMEROY: -- has been pointed out, there's not, right, yes.

DR. FAIRHURST: One of the things that bothers me about the general U.S. approach is not just simply that it's very prescriptive, but it's written down in such a way -- and John, I better now put words in your mouth. But my view is don't give lawyers more opportunity than they have right now.

By that, I mean if you put something down that says it has to be a 1,000 year travel time, then somebody's going to say okay, is this Darcy flow, is it fracture flow, and they'll keep you in court for the next 15 years arguing about something that possibly doesn't matter.

Because it's stated in the regulations in a very -- "looks like a very restrictive way." And I don't know how to do it. But it's a thing you must show that you have optimized the design in the near field and

optimize it in the intermediate field and the far field in such a way that the overall is not suboptimal.

I don't know how -- I'd rather do it in a goosey way, if you like.

CHAIRMAN POMEROY: Okay.

DR. FAIRHURST: And I think you could sit down and decide what that is.

VICE CHAIRMAN GARRICK: Goosey. How can I write that down?

CHAIRMAN POMEROY: Thank you.

DR. FAIRHURST: I think that's one I learned from --

CHAIRMAN POMEROY: Thank you, Charles.

DR. FAIRHURST: No, and I -- I'd like to try -- because they didn't have those subsystem requirements in the WIPP, and we've managed to seemingly come to a fair degree of consensus that we understand that's a good -- and thank God for creep.

CHAIRMAN POMEROY: Yes.

MR. FRISHMAN: We promised to get you out of here at 3:00 because I know you have to catch a plane, but I wanted to give Bill a chance to --

MEMBER HINZE: There's no point in me starting with just four minutes.

(Laughter.)

DR. FAIRHURST: I'll stay an extra ten or 15 for you. No, go ahead.

MEMBER HINZE: Well, first of all, I want to congratulate you on a very insightful and provocative, thought inspiring conversation. I think this committee and certainly I have had a strong devotion to the rethinking document. It's like stability's very important to us. And we do have some opportunities this time because, as we move into this next stage, we're looking at Yucca Mountain and the Yucca Mountain only.

So the problem may be a little more tractable than going to set out a generic document. The Government usually does what I consider the least common denominator. They work with the least common denominator, and therefore come up with the worst possible set of situations.

A couple of things though. One of the things that I found very interesting with your second transparency and the bar chart of time -- as a geoscientist, I was kind of alarmed to hear you say that you felt that geologists were very comfortable in this 10^8, 10^9 region.

DR. FAIRHURST: Well, --

(Laughter.)

MEMBER HINZE: My personal expertise covers 20 million years, 1.1 billion years ago, and I'm very

familiar with that. But I would be hesitant to predict too much into the future to those time scales.

But your point was that this 10^3-10^6 range is kind of a no man's land.

DR. FAIRHURST: Absolutely, it's a no man's land.

MEMBER HINZE: And the -- my concern here is that are you saying that -- and is it your thinking that the uncertainties are so large there in terms of what we're trying to accomplish that we cannot consider a geological -- well, --

DR. FAIRHURST: No, no -- okay, no; I get your point.

No, the point was that, you know, engineering developments come on the heels of scientific discovery or scientific understanding. And when I was saying -- and I consider myself partially geoscientist too. But what I meant by being comfortable, it was a scientific, academic discussion of the origin of the earth and so on.

And it wasn't -- and it's not correct, but if you are going to look for ground water regime, you know, in some area, you'd better look at local effects. But the consequences in a quantitative sense and in a -- meeting a standard, that's a unique problem. And being asked to come up and understand how a -- you know, very few people

if they're hydrologists, in trying to supply a local community, would look for water in granite.

We are very often being asked to find sites which have such low permeability or such -- trying to measure, to verify what you've got by traditional techniques won't work. The current notion about monitoring -- somebody says okay, we can be nice and say you better do this about the near field zone.

But if you make it so good, what techniques are you going to make to verify that you've actually achieved that? And the achievement is no flow or whatever. It's not easy.

MEMBER HINZE: Well, we have faced this uncertainty problem and the increase of uncertainty with time and our consideration of times of compliance in both low level and high level waste. Just to make certain that I keep my colleague two to the left in line, I was a bit dismayed by one of your transparencies that was probably the sixth or seventh one in which you gave the human intrusion risk, the geological risk, but you didn't face the -- one of the items in that was not the engineering risk.

And I'm sure that we're all aware that there are engineering risks as well. Is that not right?

DR. FAIRHURST: Yes, engineering risks of --

MEMBER HINZE: Of the failure of the system, the canister, the engineered barriers.

DR. FAIRHURST: Oh, of course, of course.

No, no, no, no.

MEMBER HINZE: I just wanted to keep my former friend here in line. Because we will probably have a go at that.

VICE CHAIRMAN GARRICK: He doesn't appreciate that engineering is perfect at all.

(Laughter.)

MEMBER HINZE: The last thing that I would like to follow up on is the retrieveability. Did you happen to have a chance to see Nuclear Reaction last night on PBS at 9:00?

DR. FAIRHURST: No, no; I was in an airplane.

MEMBER HINZE: Well, we'll have to get you a video of that. And it looked at the totality of the nuclear power problem here in the U.S. and looked at it also from an international viewpoint. And one of the points -- and most people in the room I presume saw this. One of the points was that France had been able to achieve a real rapoire with the local residents and that this -- with nuclear power.

And also, there seemed to be a possibility of doing this for the waste site for the repository because

it was going to be used as a situation where you could retrieve the waste and monitor the waste -- where you could retrieve and monitor the waste.

And they gave that as one of the reasons why France is able to achieve this kind of coordination between --

DR. FAIRHURST: Acceptance, yes.

MEMBER HINZE: -- the locals. And there are negative aspects certainly of retrieveability. But could you expand upon what -- where you were coming from in terms of --

DR. FAIRHURST: Yes. Take salt, for example. One of the main values of salt is that it's --

MEMBER HINZE: With salt, you can't retrieve. I would hope that --

DR. FAIRHURST: Pardon?

MEMBER HINZE: I would hope we would not try to retrieve out of salt.

DR. FAIRHURST: No, but if you have a retrieveability condition, you would have to maintain that facility open. You'd have to counter the creep in order to do it.

MEMBER HINZE: Right.

DR. FAIRHURST: And I think that's possibly counter productive. It might be possible to go in and say

look, I've encapsulated this and here in these mines that are 3,000 years old, archaeologists are now opening up that area and bringing everything out even though it's been allowed to close.

So that's a different -- now admittedly, if you pull high level waste out, it's different than pulling out a few twigs. But the notion of allowing it to close and then saying if something is happening -- I don't know how you will test whether or not it's performing satisfactorily if you won't allow it to evolve.

You know, that's -- now with granite -- with the clay, it's very similar to salt. You know, you want -- in the boom clay in Belgium, for example, that stuff, you have to freeze it to stop it from closing in. But the -- well, you don't, you know.

But I'm saying that the requirement of maintaining access to something -- it may be not a big problem during a 50 year period for many things because it's the operation of a lifetime of filling it. But -- and it's interesting what you said about the French, because I'm actually on the advisory group that's overseeing it.

They are required to have a section on reversibility -- retrieveability in each one. But if you talk to them as engineers, they are not making a big issue

of it because they're not -- they're saying yeah, we'll put it in there; but we're hoping our design is such and the retrieveability period is a period of stocking it.

Not quite, but almost.

VICE CHAIRMAN GARRICK: Charles, since I have to deal with you in the future, I think I better not be responsible for you missing your schedule.

So with that, I think we want to thank you again very much for this illuminating discussion and presentation.

DR. FAIRHURST: Thank you very much. I hope it was useful. I wasn't sure what direction I had to come from.

VICE CHAIRMAN GARRICK: And Mr. Chairman, can we have a break now? Is it appropriate?

CHAIRMAN POMEROY: Yes, I'd like to thank you too, Charles.

We'll take a break for 15 minutes. Reconvene at 20 minutes after. We're through with the recording.

(Whereupon, the proceedings were adjourned at 3:12 p.m.)

C E R T I F I C A T E

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

Name of Proceeding: 91ST ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW) MEETING

Docket Number: N/A

Place of Proceeding: ROCKVILLE, MARYLAND

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.

Corbett Riner

CORBETT RINER
Official Reporter
Neal R. Gross and Co., Inc.

THE VALUE OF STATE OVERSIGHT IN THE DEPARTMENT OF ENERGY YUCCA MOUNTAIN PROJECT

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THE NUCLEAR WASTE POLICY ACT OF 1982 PROVIDES:

- REVIEW AND OVERSIGHT BY AFFECTED STATES AND INDIAN TRIBES
- REVIEW AND OVERSIGHT TO BE FUNDED BY NUCLEAR WASTE FUND

THE 1987 AMENDMENTS OF THE ACT PROVIDED:

- YUCCA MOUNTAIN, NEVADA AS THE ONLY SITE UNDER CONSIDERATION
- REVIEW AND OVERSIGHT TO AFFECTED LOCAL UNITS OF GOVERNMENT

IN OCTOBER 1995 DOE WITHHELD REVIEW AND OVERSIGHT FUNDS:

- BASED ON THE RECOMMENDATIONS OF A FEW CONGRESSMEN WHO WERE INFLUENCED BY THE NUCLEAR INDUSTRY

THIS ACTION WAS JUSTIFIED WITHIN THE CONGRESS BY IMPLYING:

- THE STATE WAS TO BLAME FOR LACK OF PROGRESS TOWARD DISPOSAL GOALS, AND

- STATE TECHNICAL REVIEWS AND RESEARCH DONE BY THE STATE WERE NOT VALID AND ONLY OFFERED TO CAUSE DELAYS.

THE QUESTION IS WHETHER THIS WAS A CORRECT OR RESPONSIBLE ACTION AND WHAT WAS ITS REAL COST?

STATE OF NEVADA OVERSIGHT FUNDS

- RANGED FROM 1 - 2 % OF DOE NUCLEAR WASTE PROGRAM BUDGET

- FUNDS UTILIZED FOR TECHNICAL REVIEWS OF:

  PROGRAM PLANS AND REPORTS ON YUCCA MOUNTAIN SITE INVESTIGATIONS

  DATA AND ANALYSES UNDERTAKEN BY THE DOE AND THEIR LABORATORIES AND CONTRACTORS

- FUNDS ALLOCATED TO STUDIES OF SOCIOECONOMIC AND TRANSPORTATION IMPACTS FROM A YUCCA MOUNTAIN SITE.

THROUGH THESE FUNDS THE STATE WAS ABLE TO:

- ACCESS INFORMATION WHICH WOULD OTHERWISE BEEN UNAVAILABLE

- CONDUCT INDEPENDENT ANALYSES OF DATA COLLECTED BY THE DOE

- CONDUCT INDEPENDENT EVALUATIONS OF FACTORS CONSIDERED TO BE OF KEY IMPORTANCE TO WASTE ISOLATION, THROUGH INTERNATIONAL STUDY GROUPS (INTRAVAL)

- PARTICIPATE IN THE REGULATORY ACTIVITIES OF THE NRC AND EPA

YUCCA MOUNTAIN PROJECT IS AN UNFORTUNATE EXCEPTION TO DOE - STAKEHOLDER COOPERATION

- DOE HAS RESISTED THE ROLE OF THE STATE OF NEVADA AS AN INDEPENDENT REVIEWER IN THE GEOLOGICAL AND GEOTECHNICAL STUDIES OF YUCCA MOUNTAIN

- DOE PROVIDED FUNDING FOR THESE ACTIVITIES ONLY AFTER BEING ORDERED TO DO SO BY A US CIRCUIT COURT OF APPEALS

- IN SPITE OF MANY REVIEWS AND PRESENTATIONS, THE STATE WAS NOT ABLE TO IMPACT OR CHANGE THE DIRECTION OF DOE ANALYSES AND RESULTS

EXAMPLES INCLUDE

- HYDROLOGY

  UNSATURATED ZONE

  SATURATED ZONE

- VOLCANISM

STATE OF NEVADA UNSATURATED ZONE MODEL

RELEVANT TO GWTT AND FLUX RATES

Model Concepts and Assumptions

1. Matrix vs. fracture flow.

2. Dimensionality.

3. Distribution and amounts of infiltration.

4. Equilibrium assumptions:

   - matrix fracture interactions
   - water table
   - infiltration - transient vs. steady-state.

5. Boundary conditions:

   - no flow
   - wet vs. dry fractures.

6. Parameter models (modeled vs. measured):

   - infiltration
   - conductivity
   - water retention properties
   - porosity.

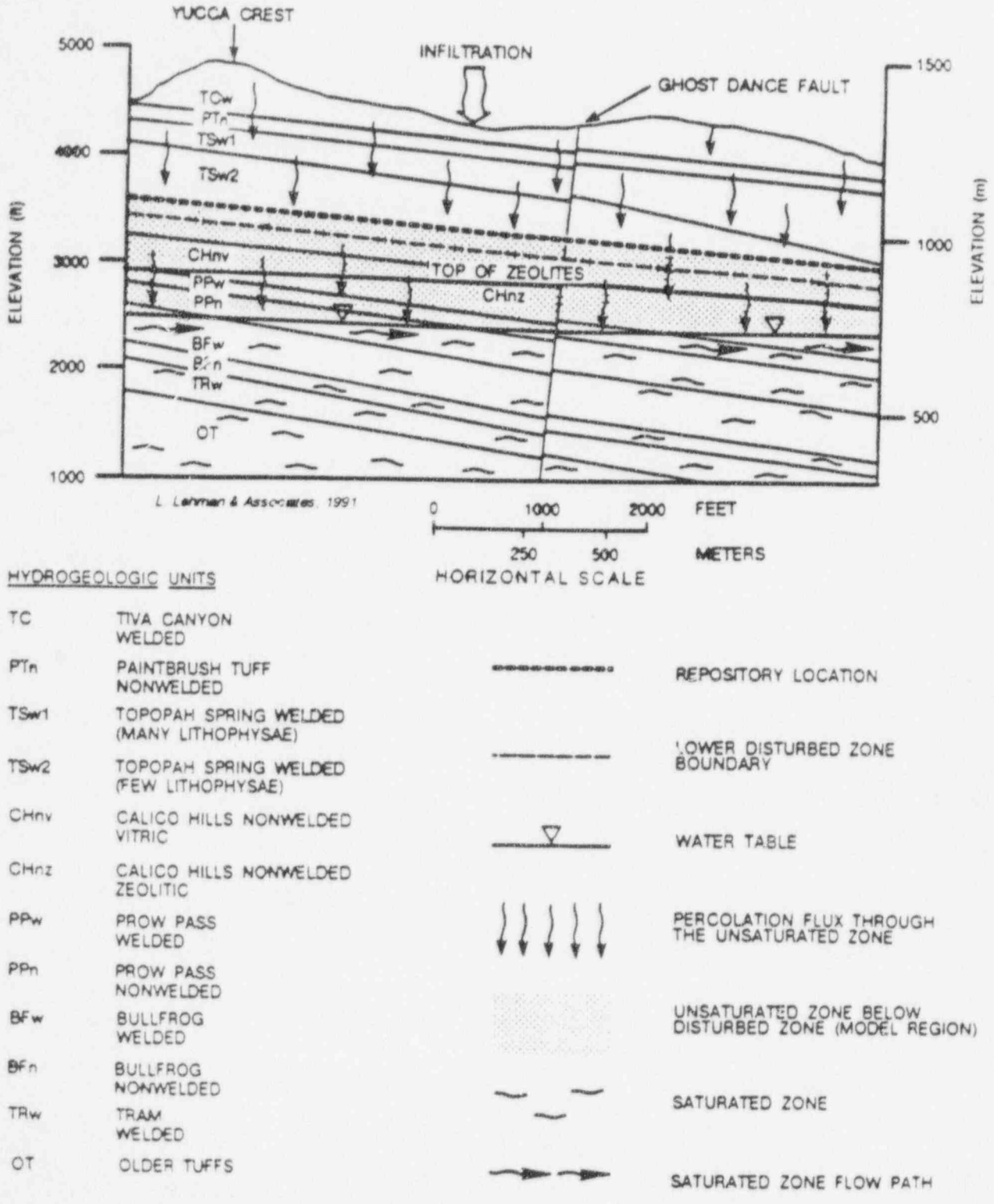
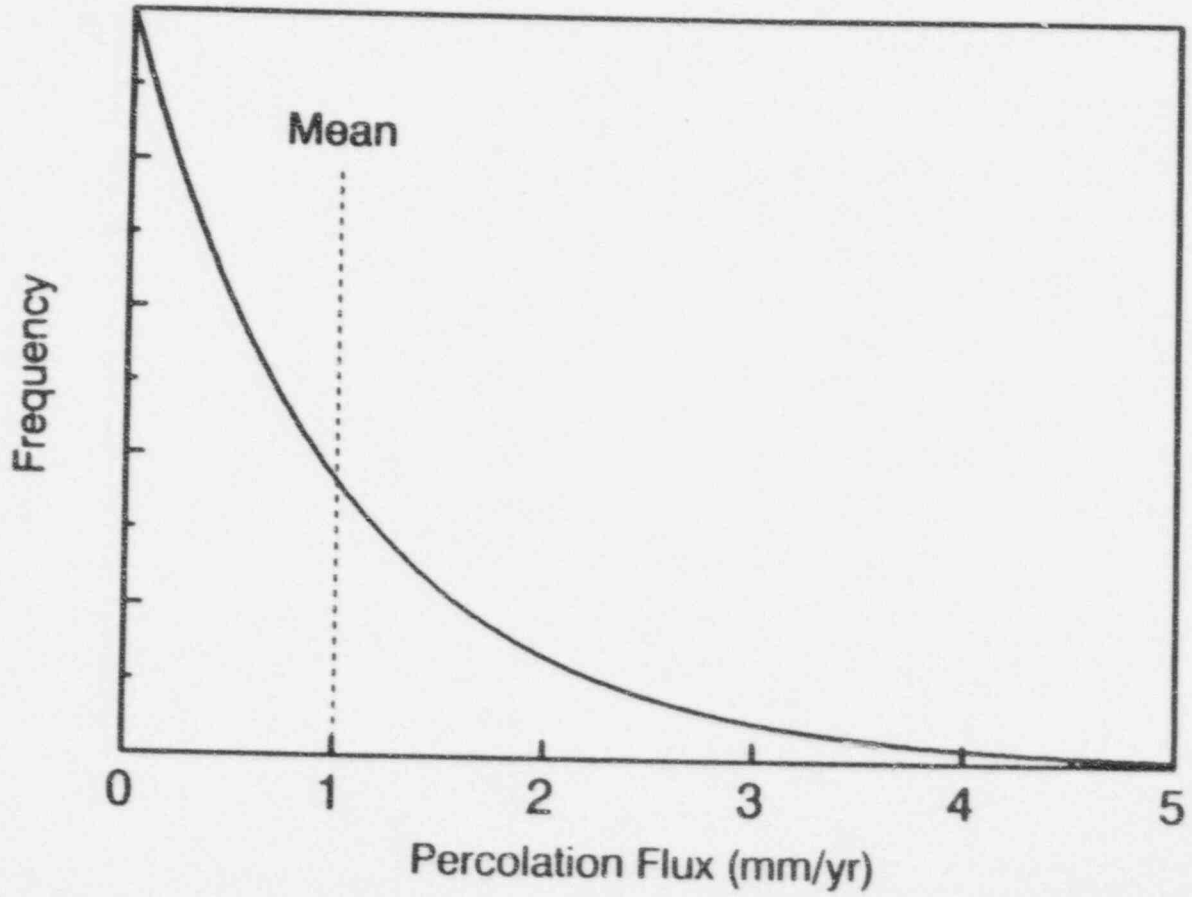


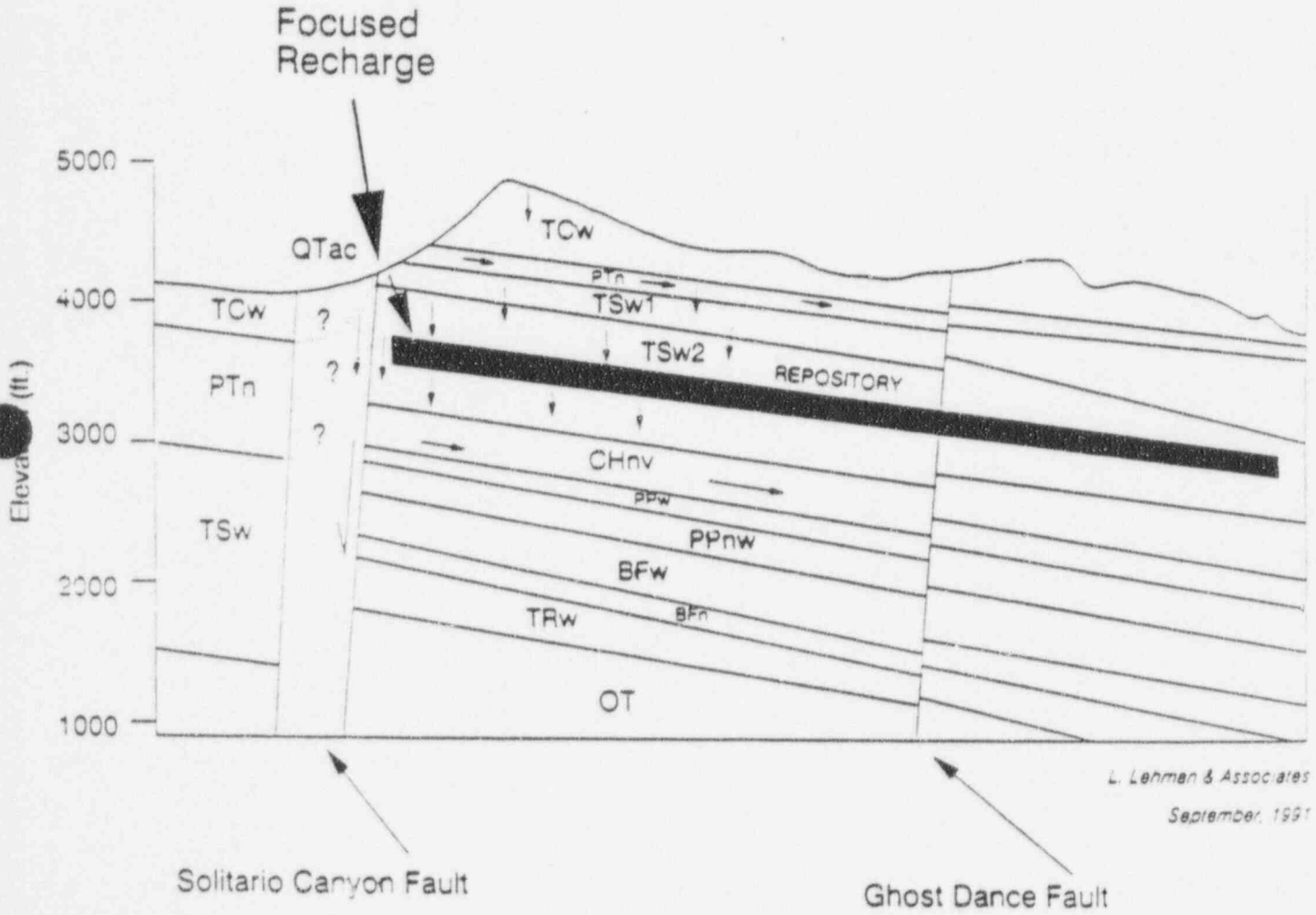
FIGURE 6: General Hydrogeologic Cross Section At Yucca Mountain. The Wavy Arrows Show The Flow Paths, Assumed By DOE, From A Potential Repository Through The Unsaturated Zone To The Water Table And Along The Upper Portion Of The Accessible Environment. Modified From DOE (1988).

Model of Infiltration Magnitude used in TSPA 1991*



* Sandia National Laboratory Report # SAND91-2745, 1992

ALTERNATIVE CONCEPTUAL MODEL UTILIZING FOCUSED RECHARGE

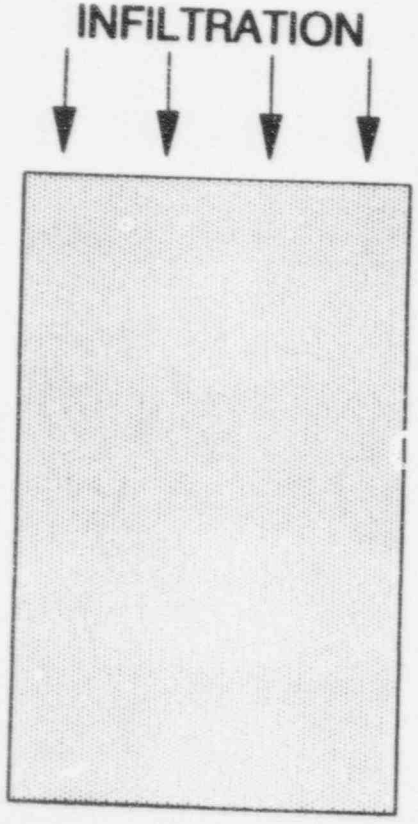


Not To Scale

0 1000 2500 Feet

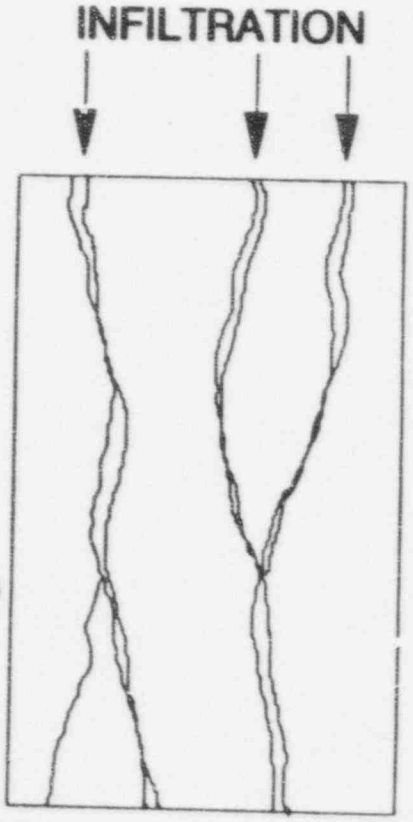
0 250 500 Meters

Matrix Versus Fracture Flow



Yucca Mt Tuff Matrix
Ksat = 1 x 10e-10 m/s
(Approximate)

Relatively slow transport

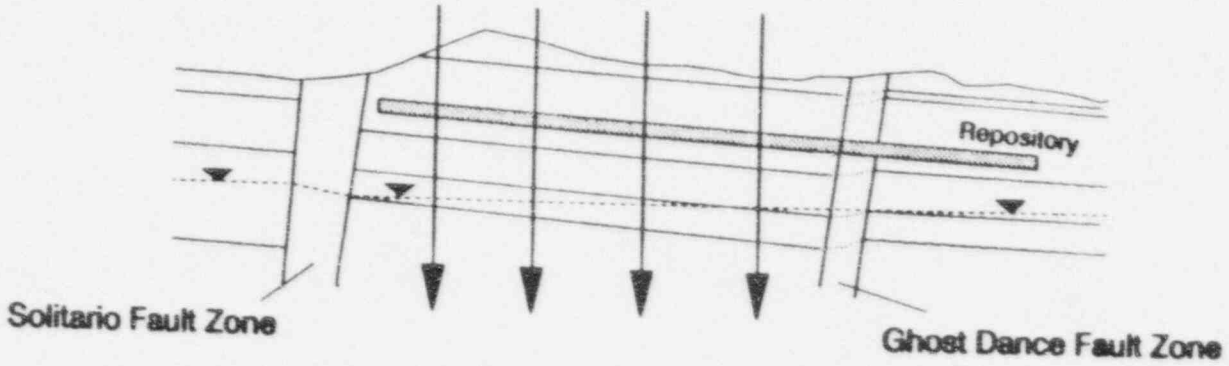


Yucca Mt Tuff Fractures
Ksat = 1 x 10e-2 m/s
(Approximate)

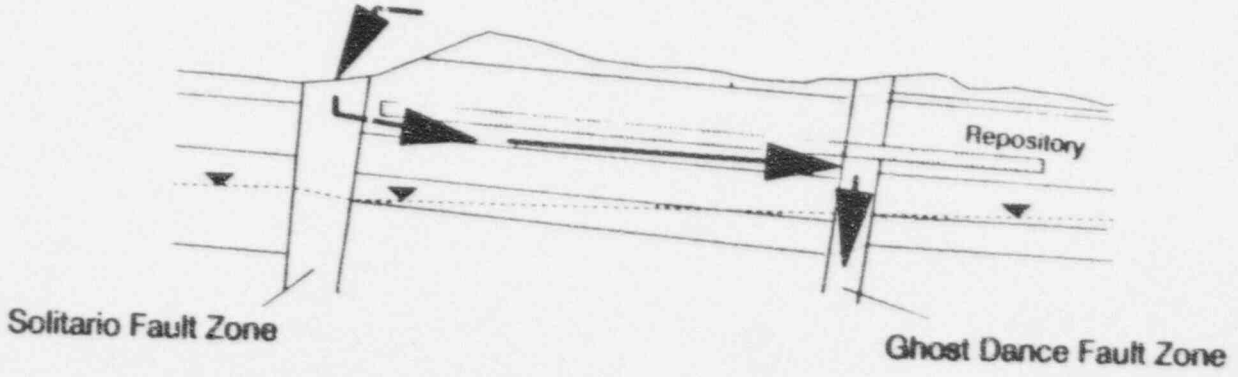
Relatively rapid transport

Dimensionality

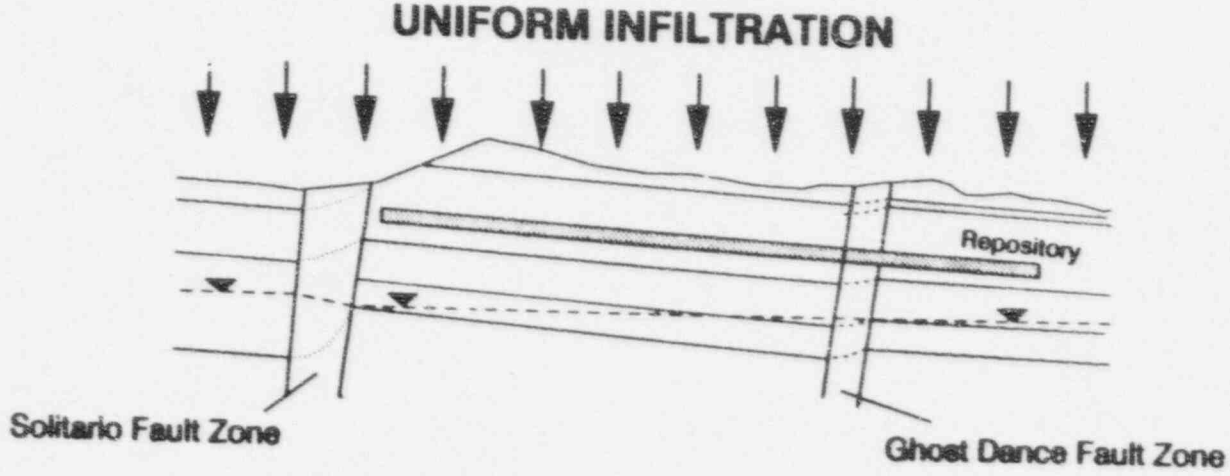
SIMPLE 1-D VERTICAL FLOW

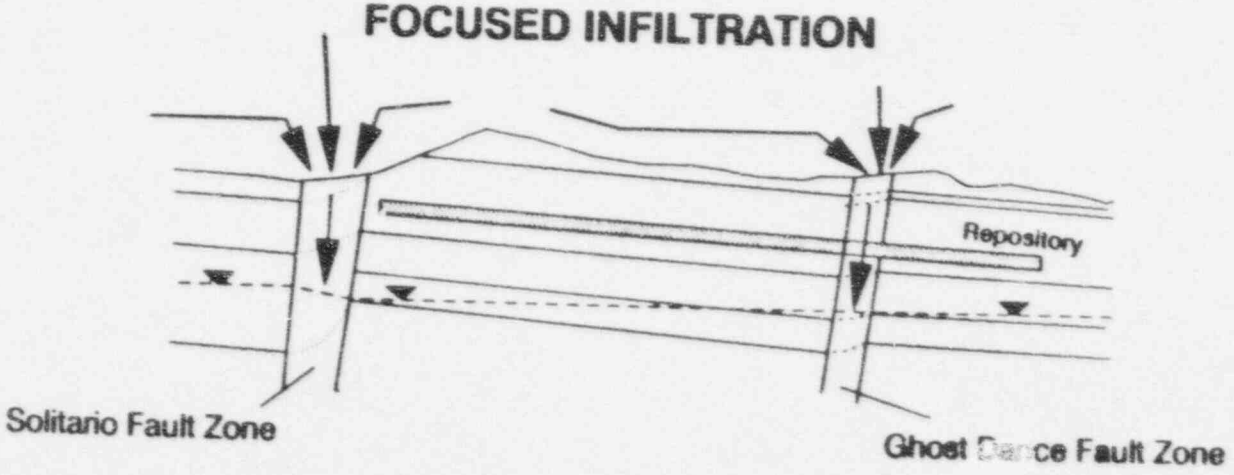


2-D VERTICAL AND HORIZONTAL FLOW



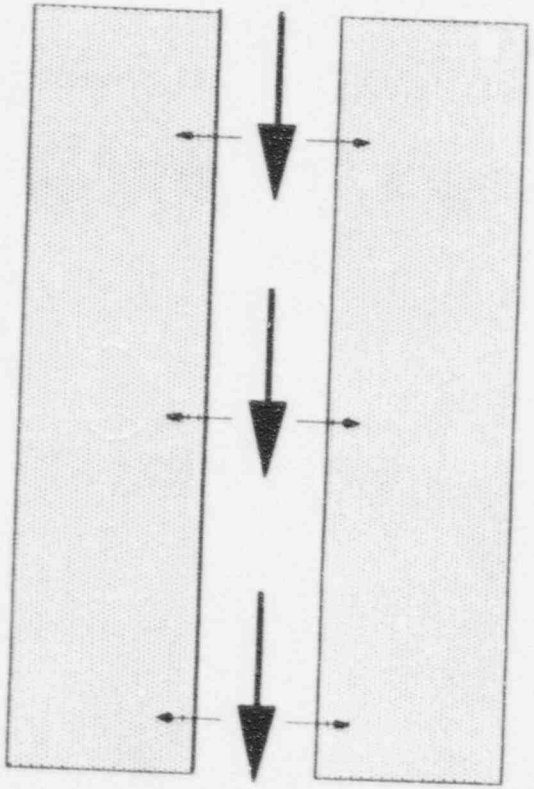
Distribution and Amount of Infiltration



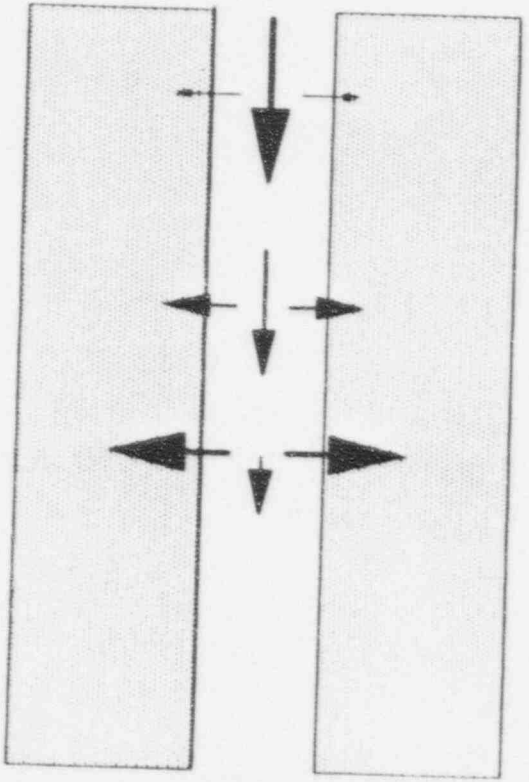


Matrix/Fracture Interaction

Little interaction

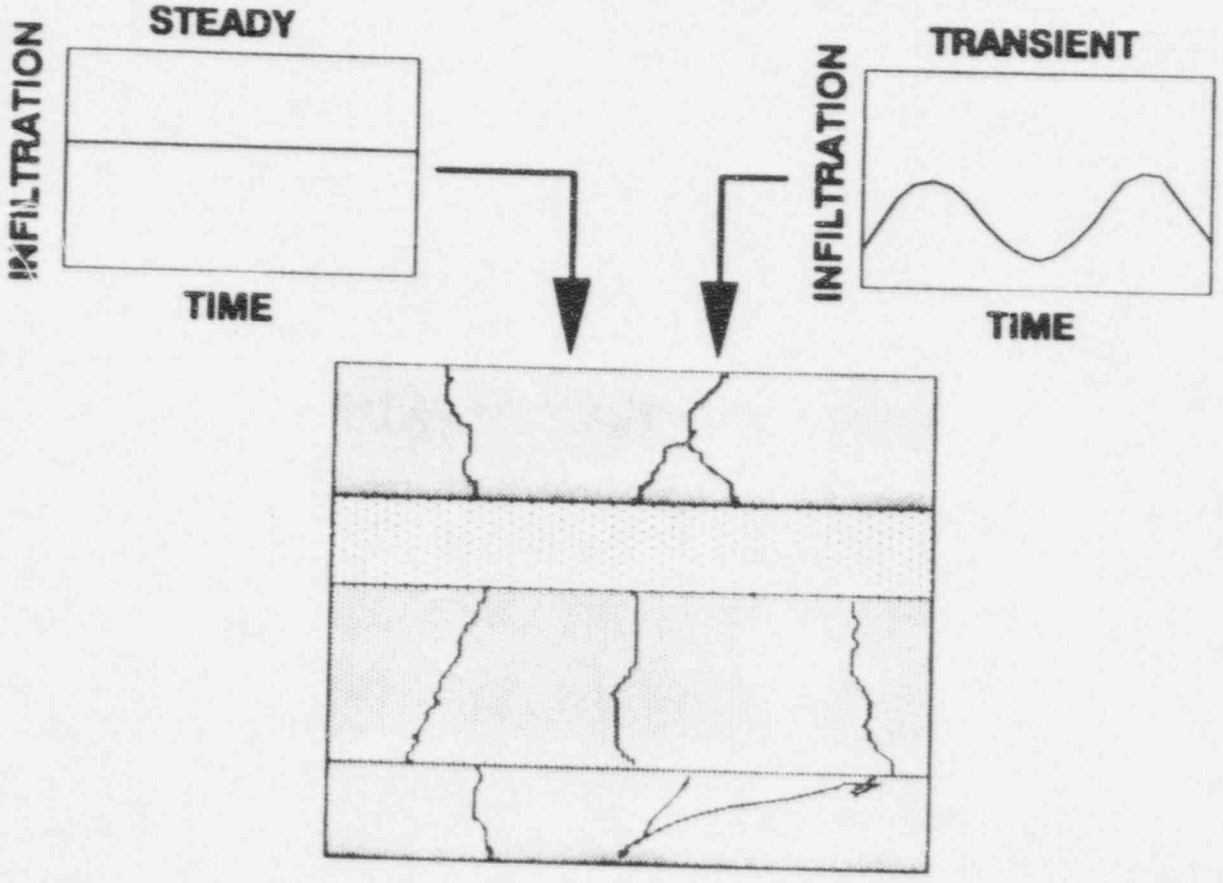


Large interaction



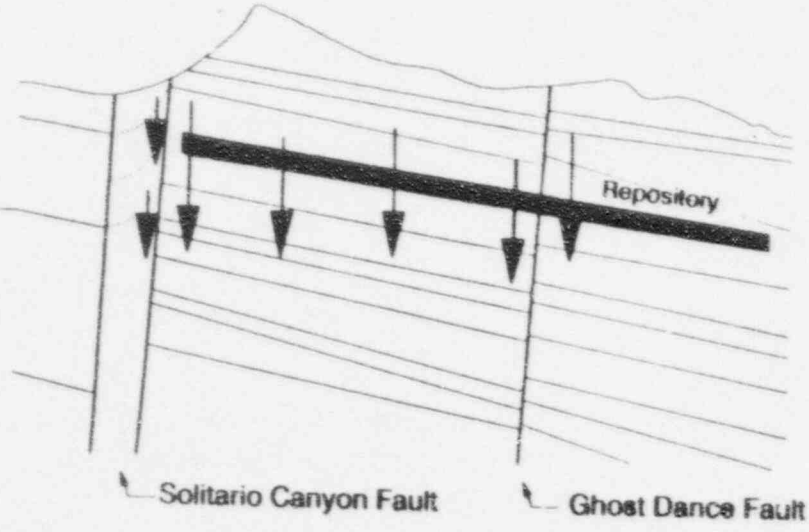
Controlled by pressures, conductivity of matrix and fractures
time spent in fracture, fracture coatings, and infiltration
assumptions, i.e. steady or transient

Infiltration - Transient Versus Steady

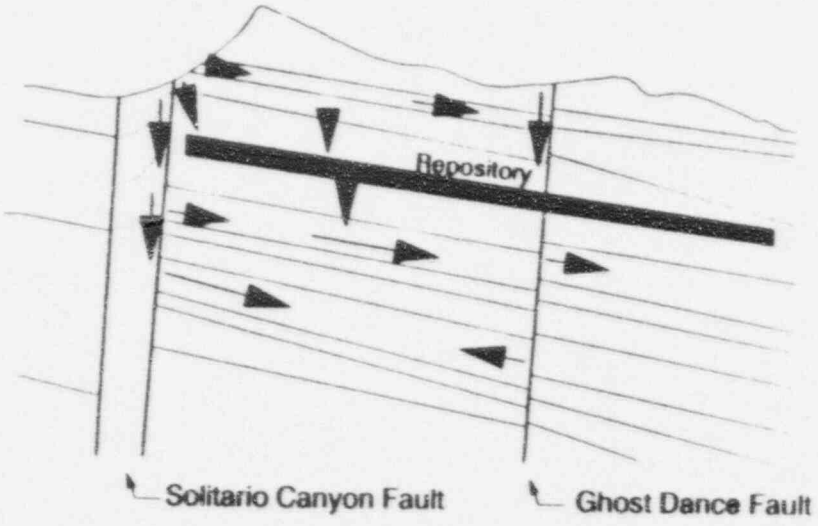


Boundary Conditions at Faults

No-Flow



Specified Flux or Pressure



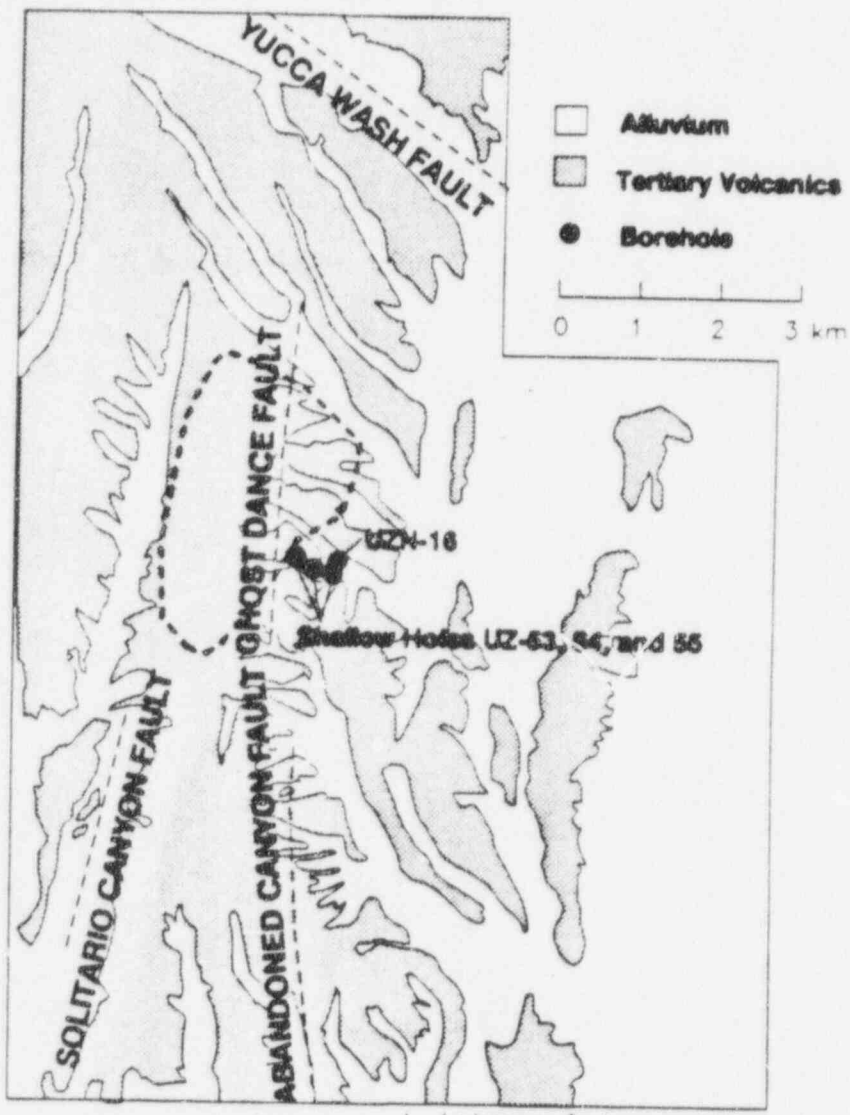
INTRAVAL Unsaturated Zone Working Group

Yucca Mountain Excercise Definition:

1. Calibrate models against water content profiles measured in shallow boreholes (100-120 meters deep) UZN-53, UZN-54, and UZN-55.

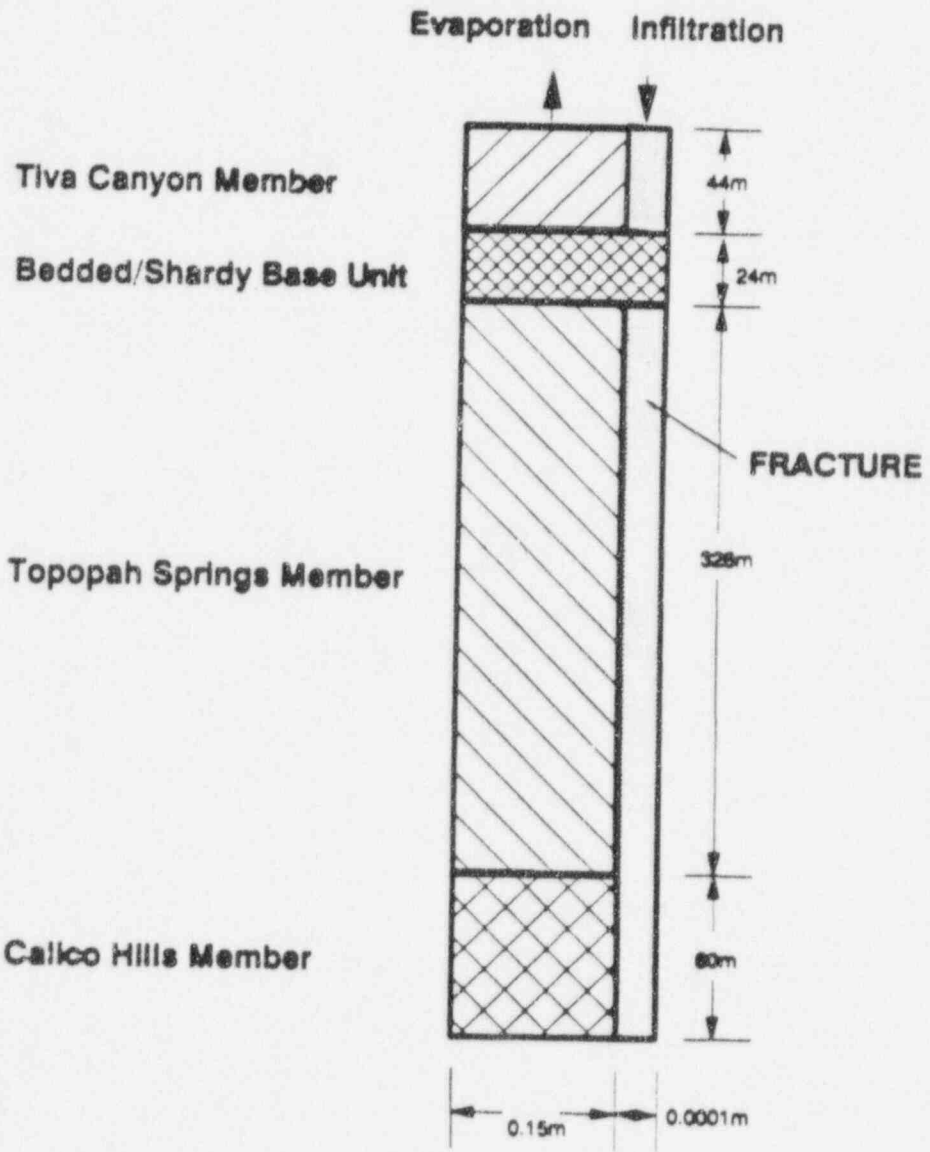
2. Perform a blind prediction of the water content profile in borehole UZ-16 using the calibrated models.

Location of Boreholes Used for Modeling Study

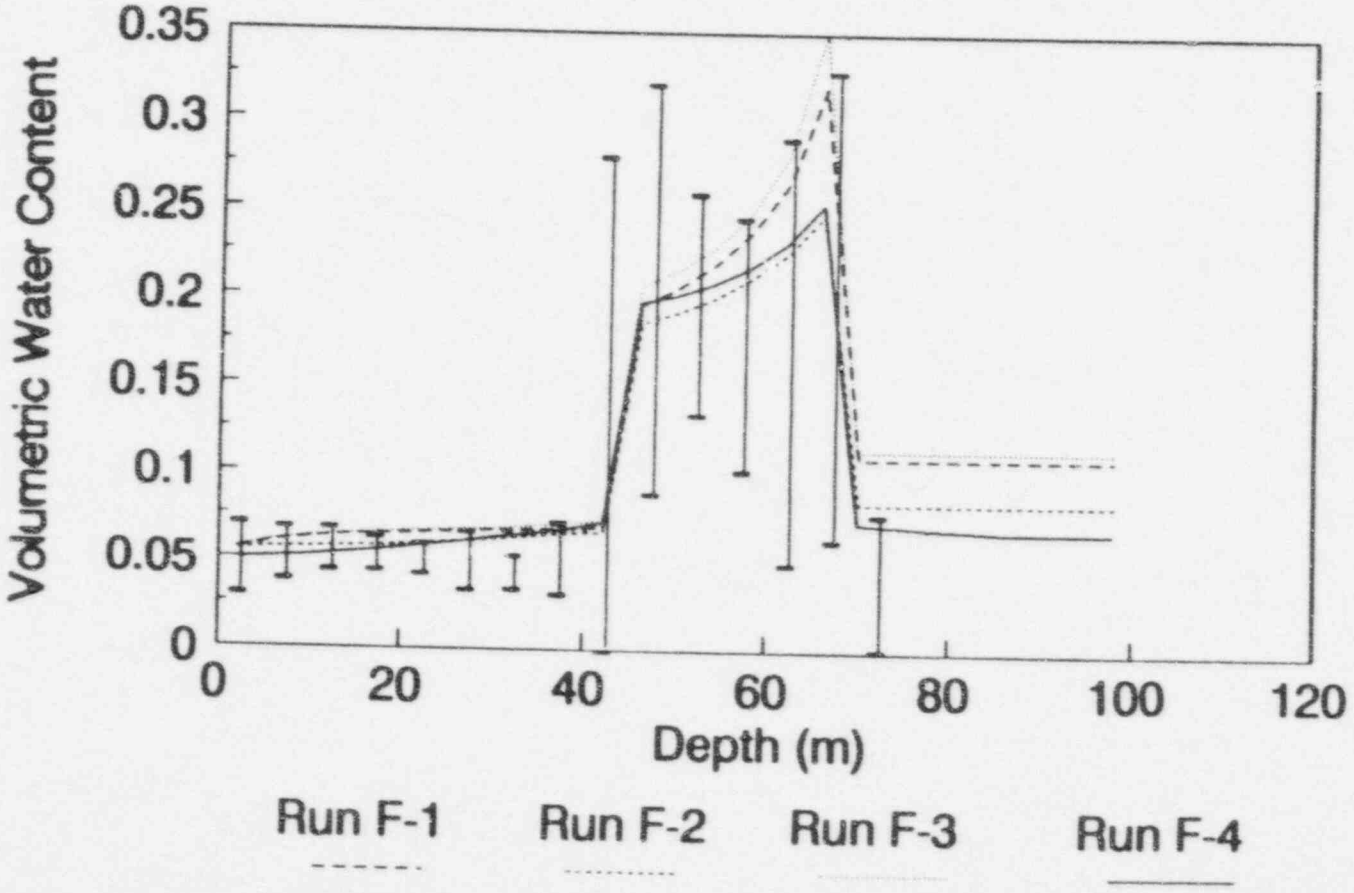


L. Lehman & Associates, Inc.
1993

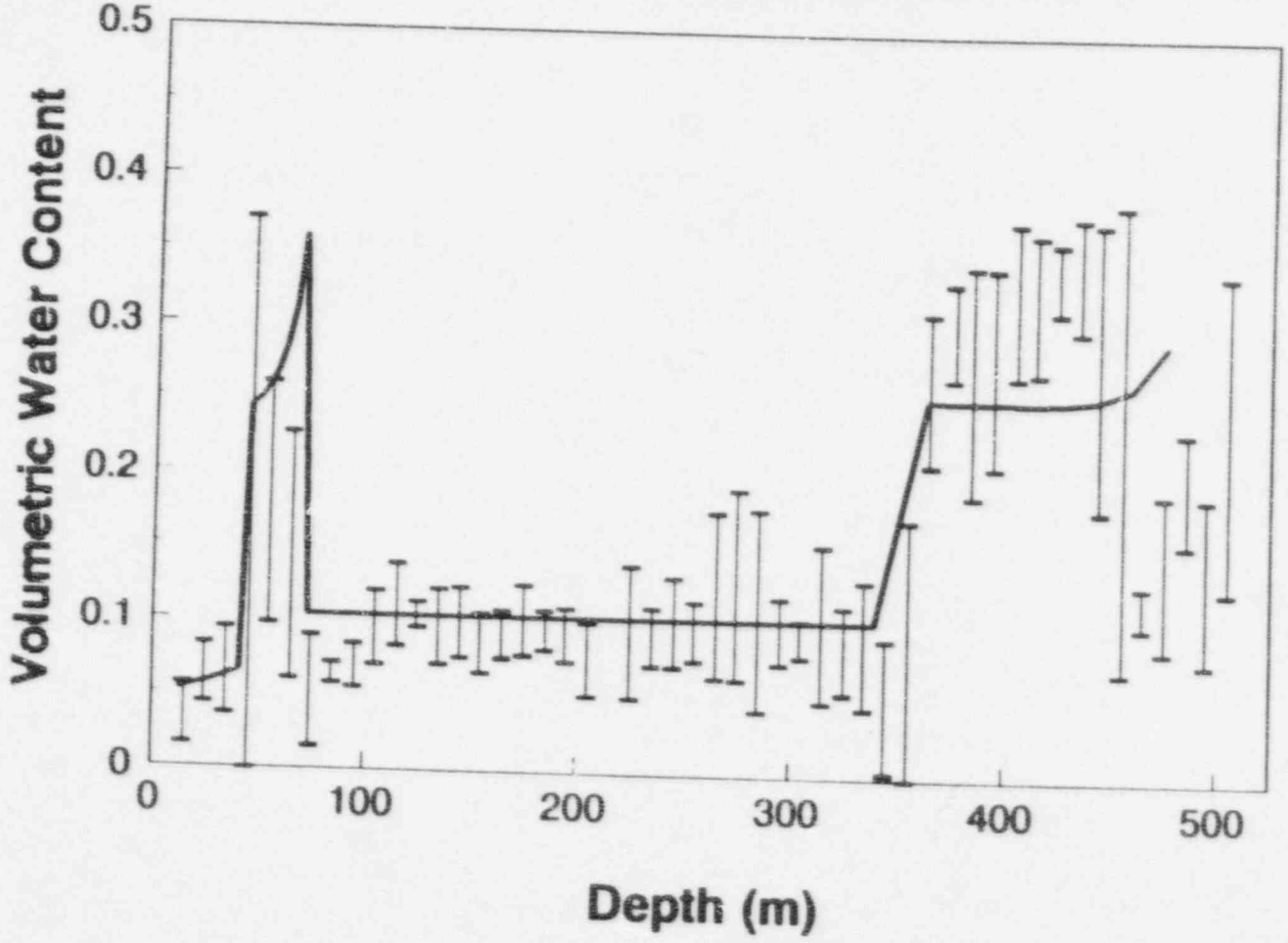
Schematic of fracture model geometry

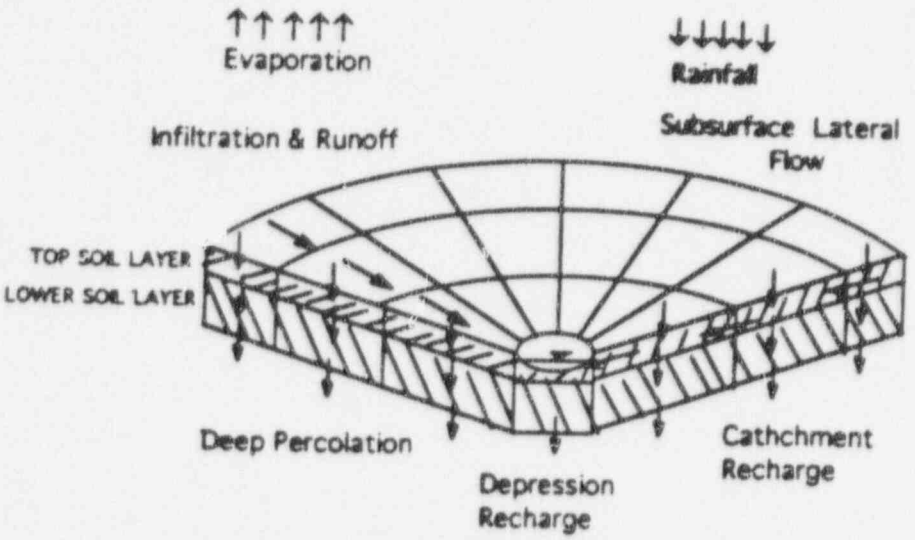


Comparison of Fracture Model Simulations with Hole Data



Comparison of fracture model predicted water content compared with UZN-16 data 95% confidence intervals




↑↑↑↑↑
Evaporation
↓↓↓↓↓
Rainfall
Infiltration & Runoff
Subsurface Lateral Flow
TOP SOIL LAYER
LOWER SOIL LAYER
Deep Percolation
Depression Recharge
Cathchment Recharge

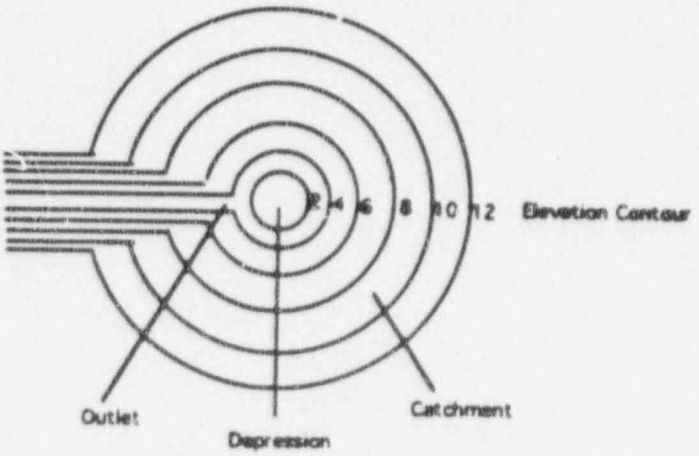
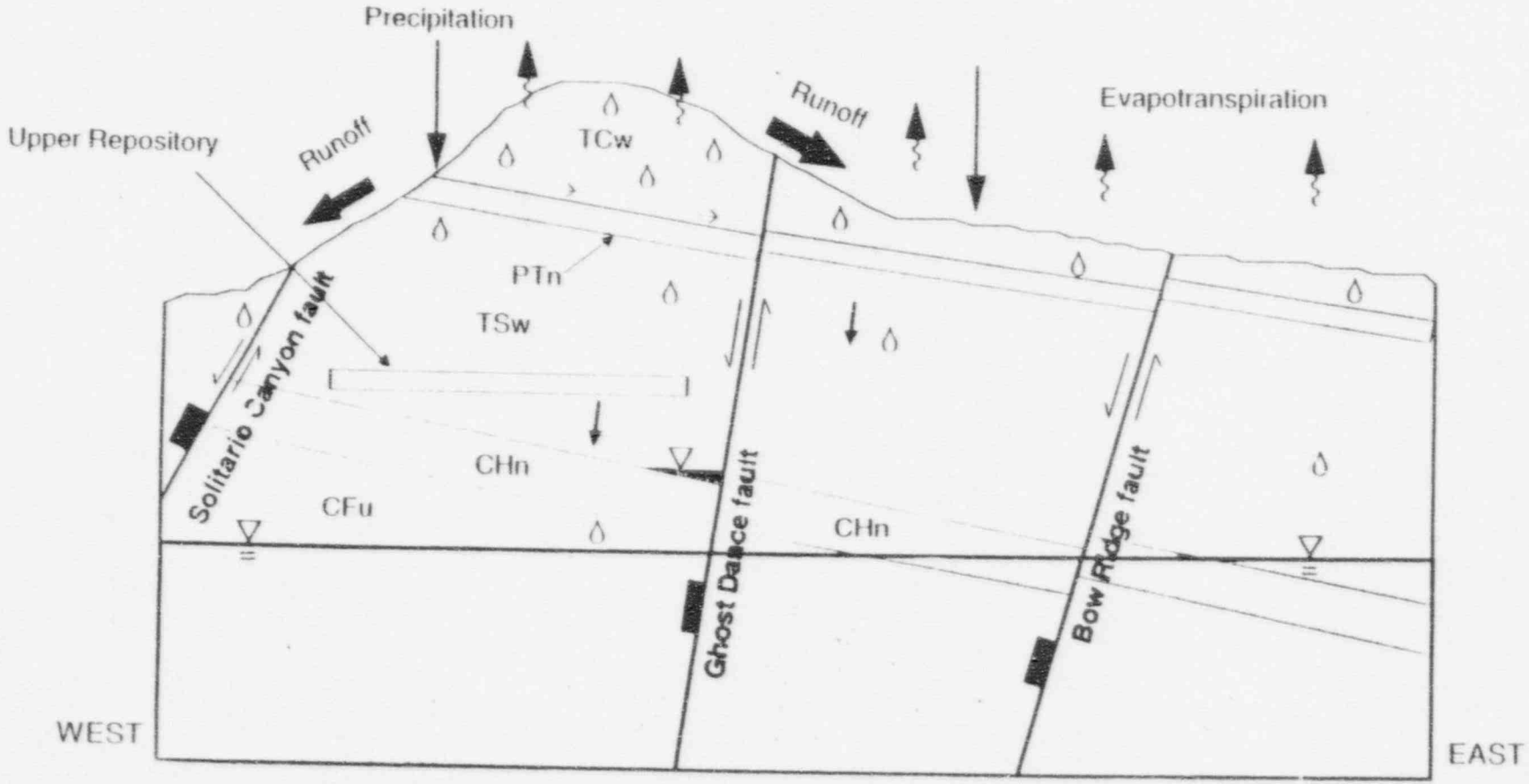

4
6
8
10
12
Elevation Contour
Outlet
Depression
Catchment

Table 6. Depression Focus Recharge Model Parameters and Result for Solitario Canyon and for Wash Where UZN-53, UZN-54 and UZN-55 are Located.

Properties	Solitario 1	Solitario 2	Hole Wash 1	Hole Wash 2
Catchment Area (m^2)	6,157,500	6,157,500	1,242,324	1,242,324
Depression Area (m^2)	1,131,000	1,131,000	253,388	253,388
Land Slope (deg)	5.7	5.7	5.7	5.7
Albedo	0.3	0.3	0.3	0.3
Outlet Height (m)	0.1	0.1	0.00001	0.01
Catchment Ksat (cm/s)	1.995E-8	1.089E-6	1.99E-7	1.99E-8
Catchment Porosity	0.15	0.15	0.15	0.15
Catchment Soil Storage Parameter (m)	0.099	0.099	0.099	0.099
Catchment Upper Limit of Stage I Evaporation ($mm/day^{1/2}$)	5.2	5.2	5.2	5.2
Depression Ksat (cm/s)	4.0E-4	1.5E-4	4.0E-5	4.0E-4
Depression Porosity	0.51	0.51	0.51	0.51
Depression Soil Storage Parameter (m)	0.099	0.099	0.099	0.099
Depression Upper Limit of Stage I Evaporation ($mm/day^{1/2}$)	5.2	5.2	5.2	5.2
Microdepression Storage (m)	0.0	0.001	0.0	0.001
Depression Recharge (m/yr)	0.308	0.121	0.008	0.160

Conceptual Model of Flow at the Yucca Mountain Site

(Modified from Montazer and Wilson, 1984)



TCw	Tiva Canyon Welded Unit
PTn	Paintbrush Nonwelded Unit
TSw	Topopah Spring Welded Unit
CHn	Calico Hills Nonwelded Unit
CFu	Crater Flat (Undifferentiated) Unit

Liquid-water flow

Water-vapor flow

Discontinuous perched water

Normal Fault

Water Table

STATE OF NEVADA SATURATED ZONE MODEL

RELEVANT TO DILUTION CALCULATIONS

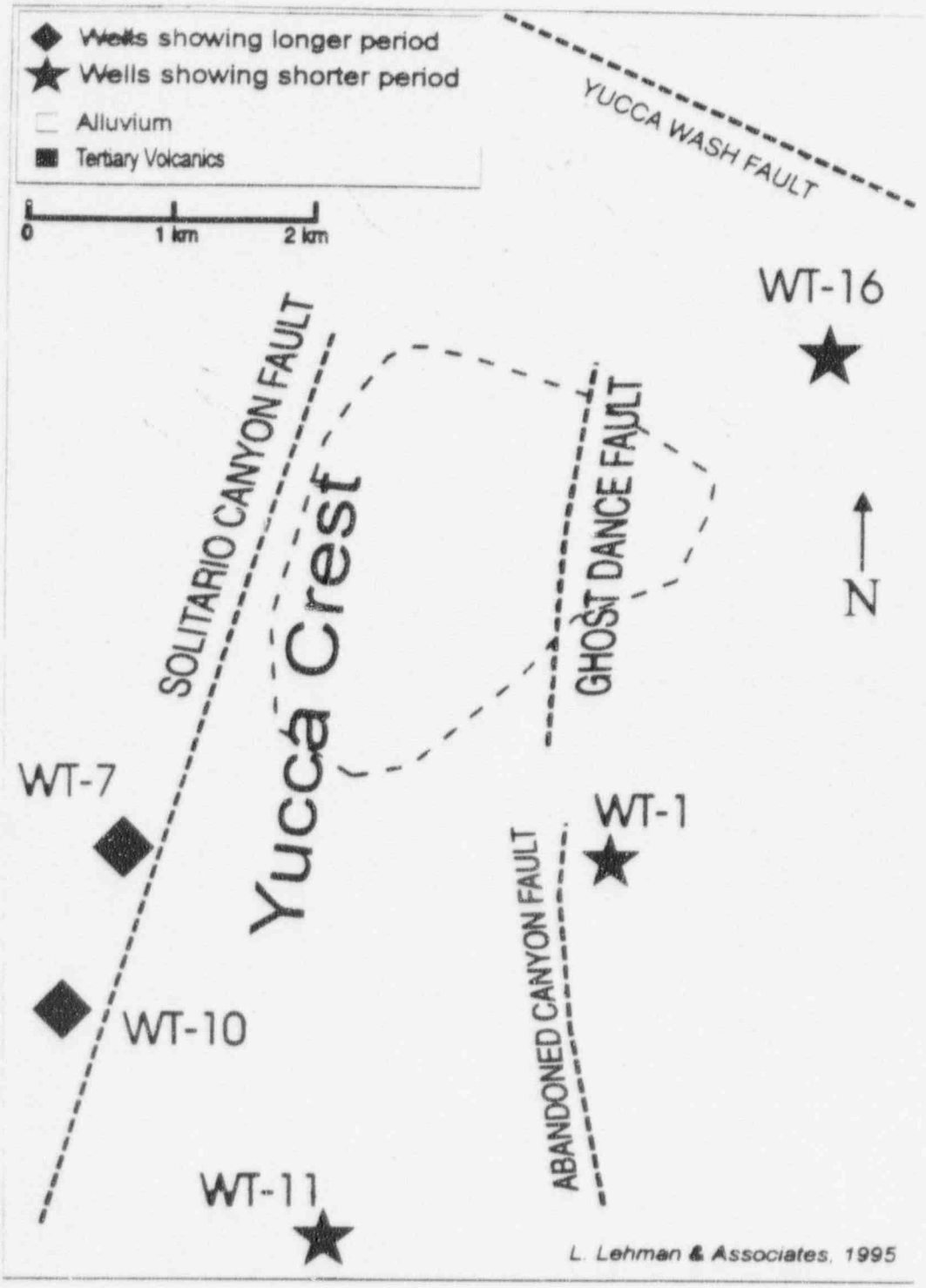


Figure 1. Water table wells that showed 2 modes of periodicity, with wells showing longer periods as diamonds and shorter periods as stars.

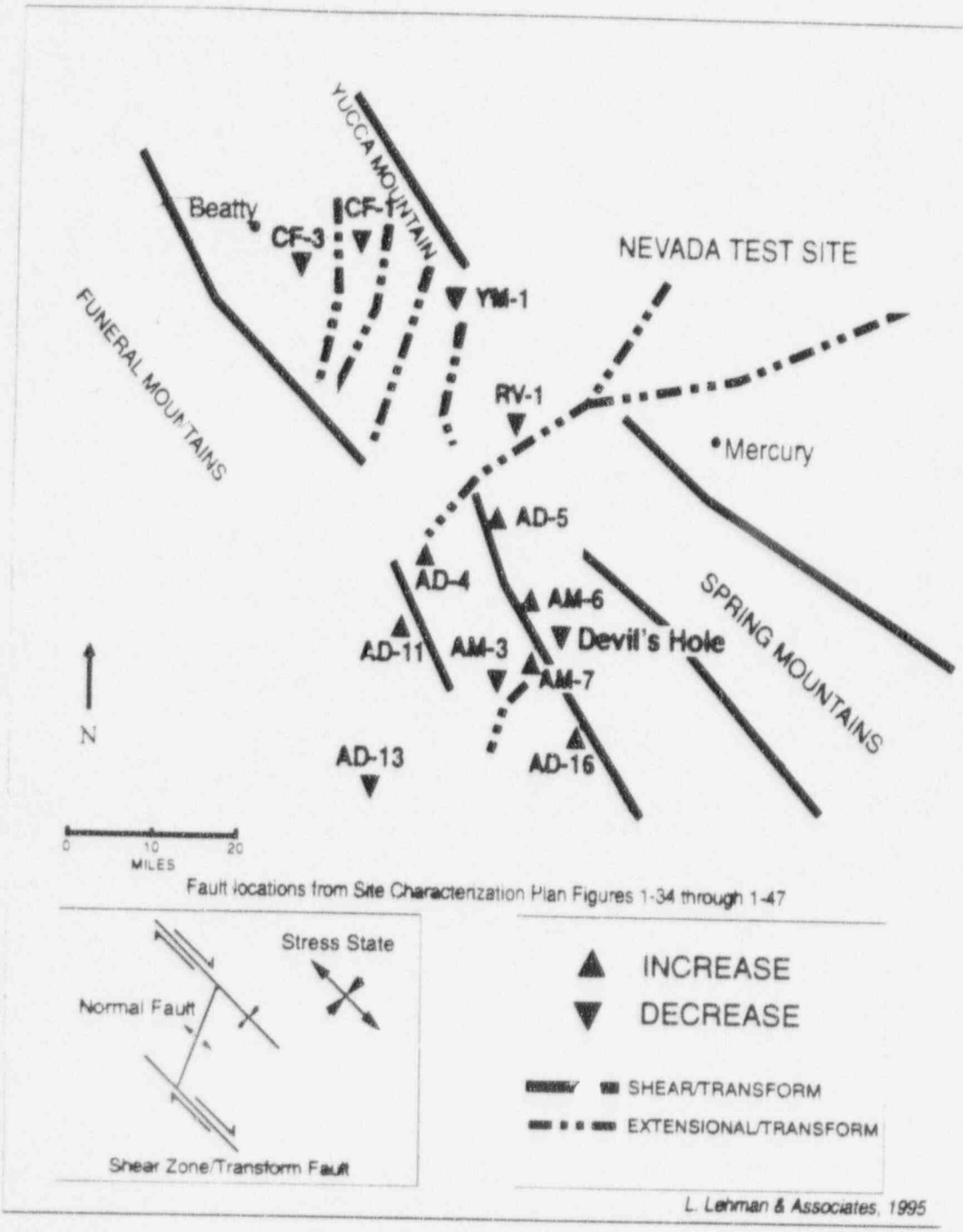


Figure 2. Well locations which showed greater than 15 cm sustained elevation change after earthquakes.

TABLE I. DOE Monitor Wells that Exhibited more than 15 centimeters of Water Level Change Between Mid-June and Mid-July 1992.

Wells showing decrease			Wells showing increase		
Well ID	Change (cm)	Geologic Unit	Well ID	Change (cm)	Geologic Unit
AD-13	-54.9	alluvium	AD-11	478.5	volcanics
CF-1	-42.7	volcanics	AD-16	167.6	alluvium
YM-1	-33.5	carbonates	AD-5	106.7	alluvium
RV-1	-21.3	carbonates	AM-7	39.6	carbonates
CF-3	-18.3	alluvium	AM-6	18.3	carbonates
AM-3	-15.2	alluvium	AD-4	15.2	alluvium

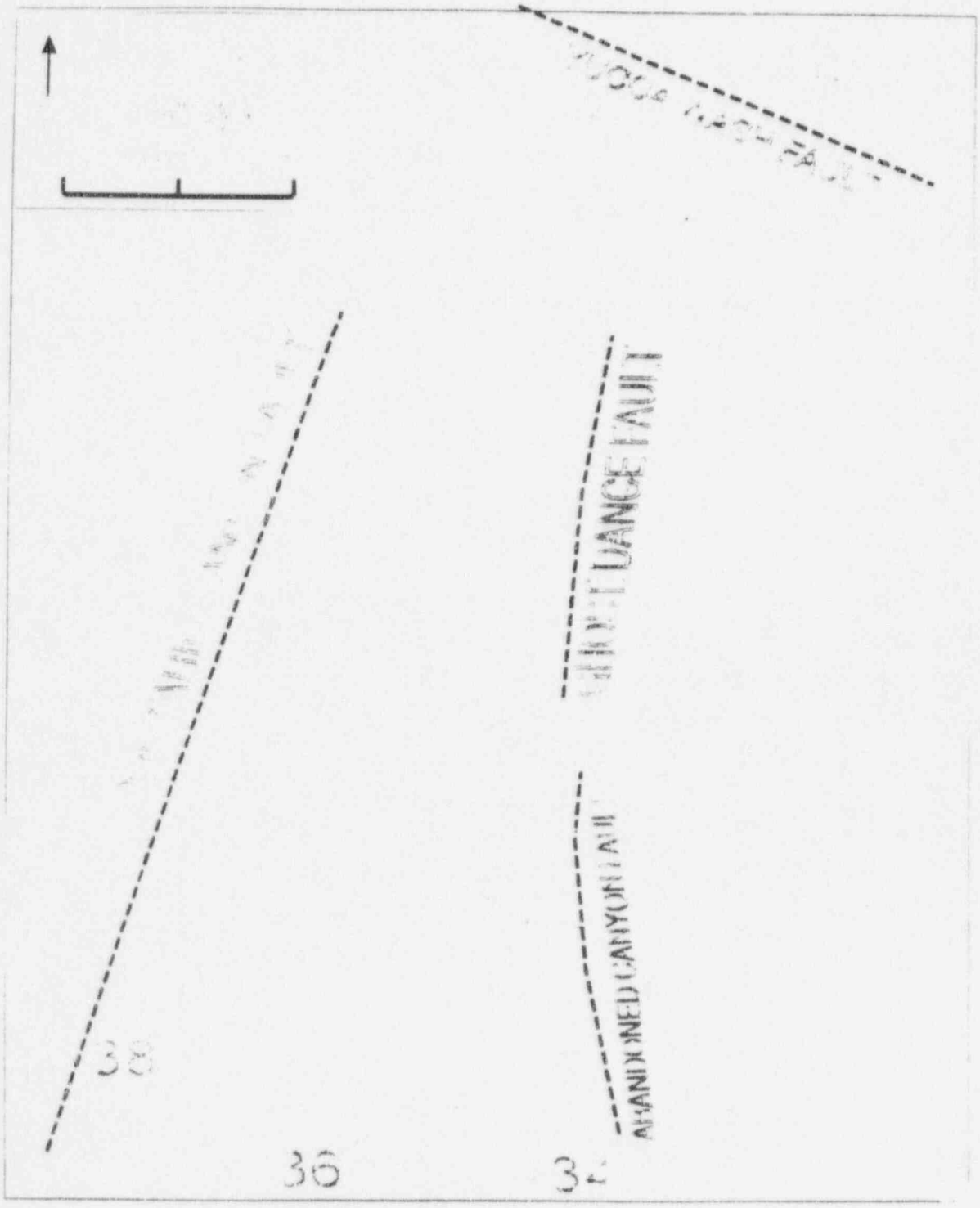


Figure 1. Water table temperature contours in degrees C (Sass et al 1988).

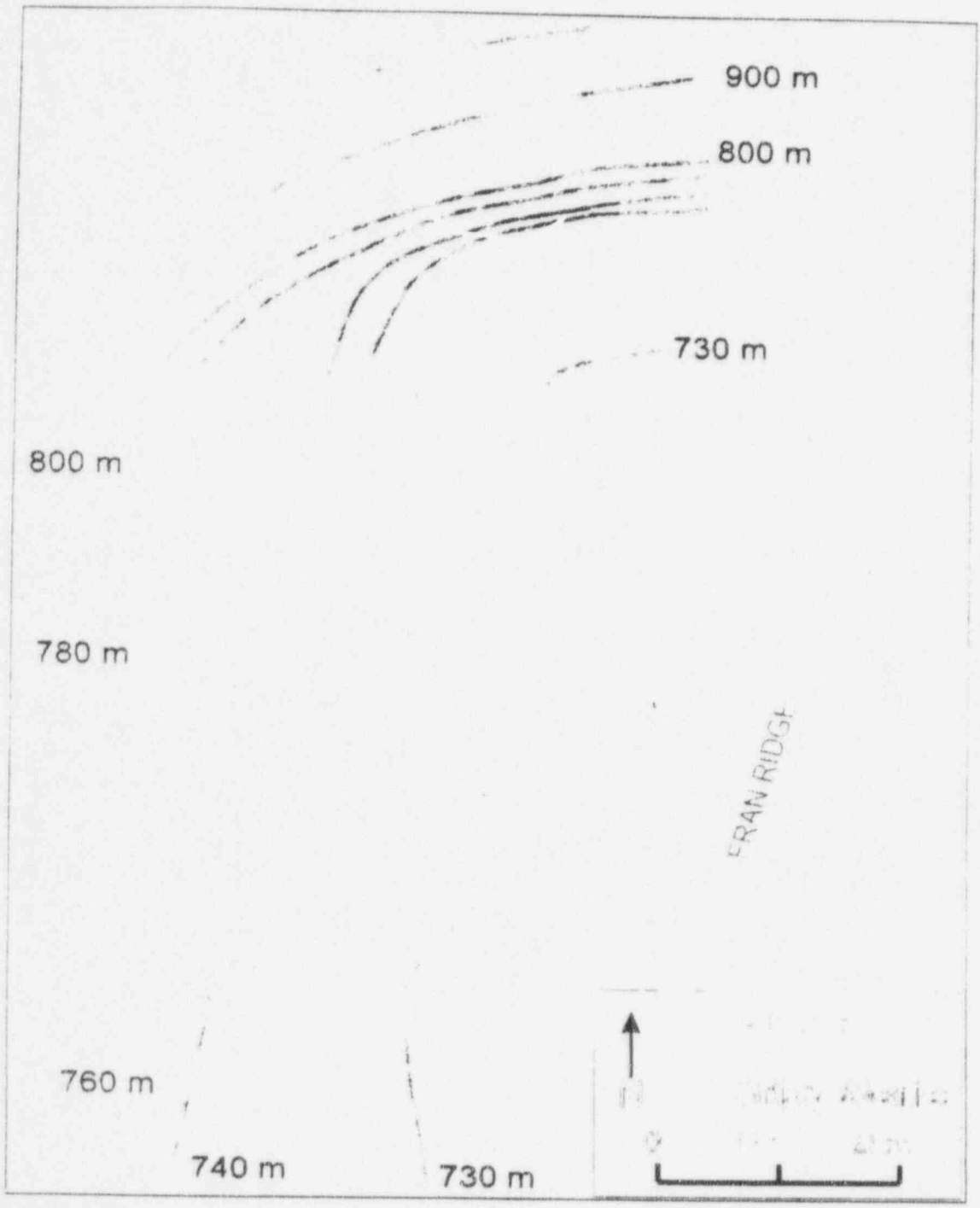


Figure 2. USGS preliminary saturated zone potentiometric surface (Robison, 1984).

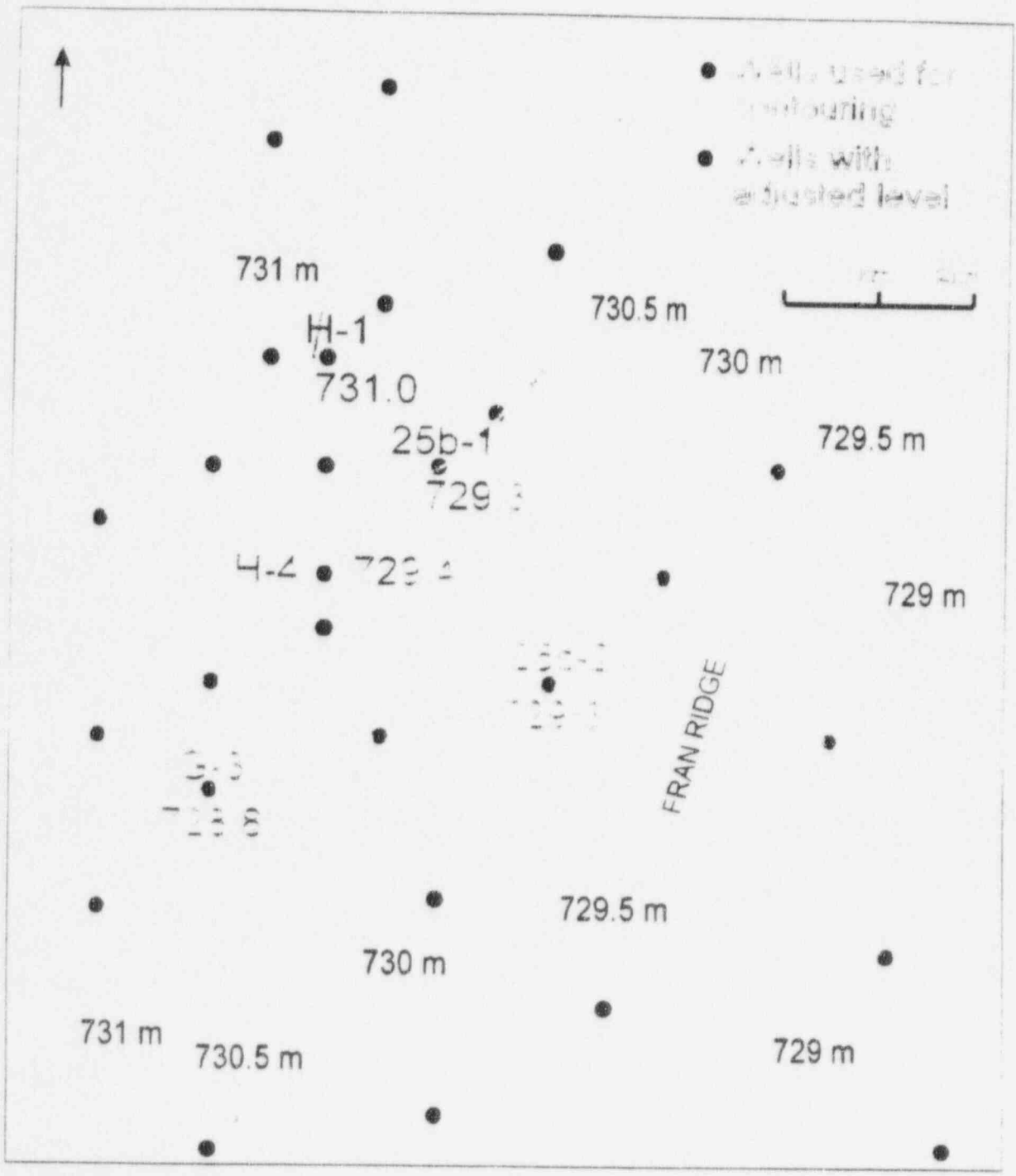


Figure 3. USGS Revised saturated zone potentiometric surface (Ervin, Luckey and Burkhardt, 1994). Red labels indicate adjusted data inconsistant with surface.

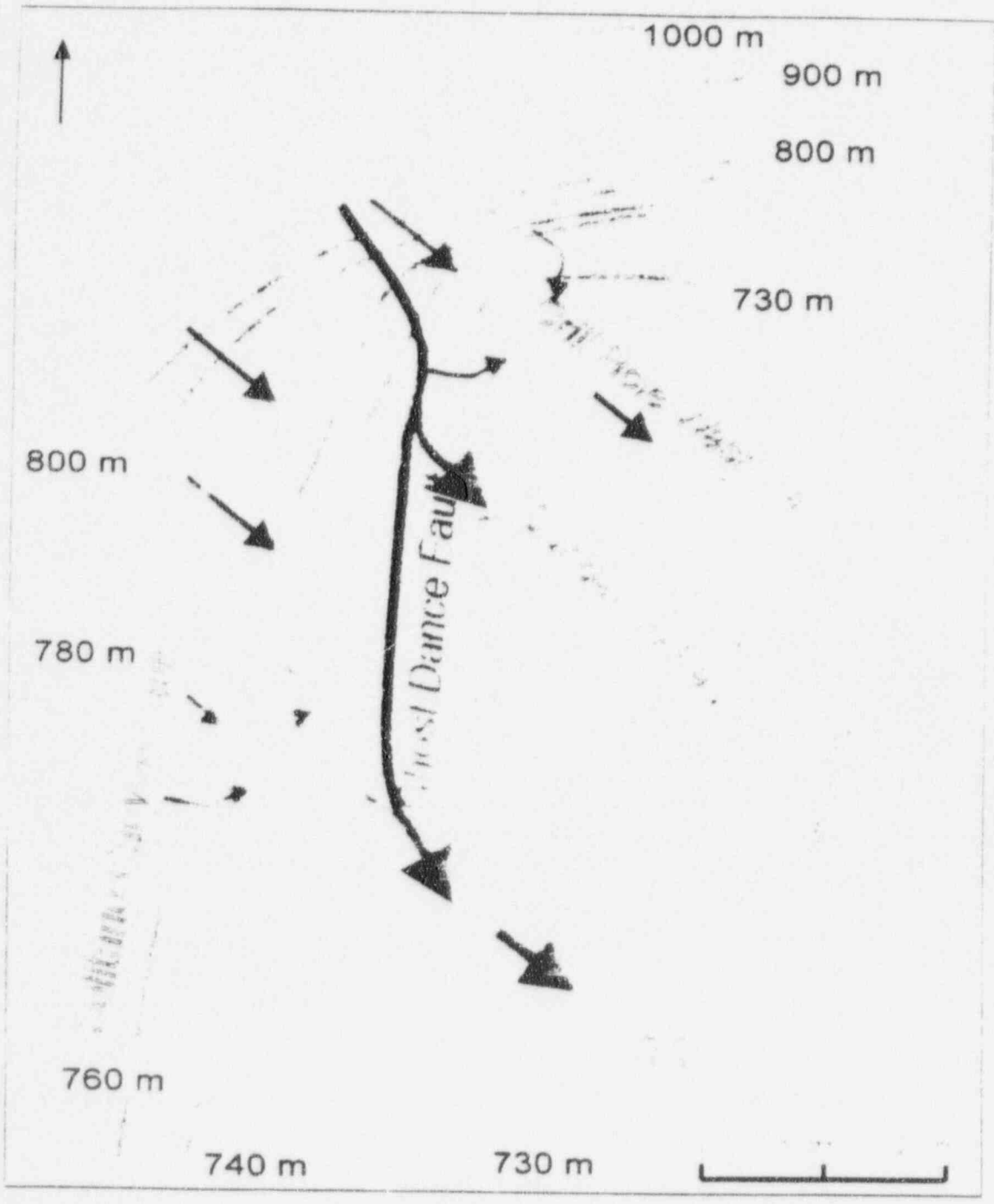


Figure 4. Alternative potentiometric surface with fault locartions and resulting flow pathways.

DOE NOW CLAIMS TO BE EVALUATING THE STATE OF

NEVADA SATURATED ZONE MODEL

IF TAKEN SERIOUSLY, THIS ALTERNATIVE MODEL WILL RESULT IN VERY DIFFERENT VALUES FOR DILUTION

DOE FAILURE TO TAKE STATE OF NEVADA WORK SERIOUSLY HAS RESULTED IN:

- MAJORITY OF DATA COLLECTED FOR INCORRECT UNDERLYING CONCEPTUAL MODEL
- DELAY IN PROGRAM WILL BE REQUIRED TO EVALUATE ACTUAL FLOW FIELD (STRIPA EXAMPLE TOOK OVER 10 YEARS TO EVALUATE)
- VIABILITY ASSESSMENT AND SAFETY ASSESSMENTS BASED ON MEAGER AND INADEQUATE DATA BASES

BRANCH TECHNICAL POSITION ON SCREENING METHODOLOGY FOR ASSESSING PRIOR LAND BURIALS OF RADIOACTIVE WASTE AUTHORIZED UNDER FORMER 10 CFR 20.304, and 20.302

Presented to:

THE ADVISORY COMMITTEE ON NUCLEAR WASTE

By:
Heather Astwood
Low-Level Waste and Regulatory Issues Section
Low-Level Waste and Decommissioning Projects Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

April 23, 1997

OVERVIEW

- Background
- Screening Methodology
- Public Comments
- Revisions to Methodology
- Next Actions

BACKGROUND

- The Final Rule on Timeliness in Decommissioning Nuclear Facilities (Timeliness Rule), published July 15, 1994 (effective August 15, 1994), outlines a schedule for licensees to follow in performing decommissioning activities.
- Information Notice 96-47, was published on August 19, 1996, to remind licensees of their obligation to notify NRC of "unused areas" and to commit to a schedule for decommissioning.
- Staff briefed ACNW on methodology October 22, 1996.
- On-site burial screening methodology was developed and published for public comment on October 25, 1996.

SCREENING METHODOLOGY

- There are potentially hundreds of on-site burials associated with hospitals, research facilities, and universities that will require some type of evaluation.

- The methodology is a simple but conservative screening method to evaluate the potential risk posed by the former burial and the need for additional site characterization and/or remediation of former burials.

- Step 1 Review of burial records
  Step 2 Calculation of screening dose from ingestion of contaminated groundwater
  Step 3 Calculation of screening dose to the residential farmer

- If an estimated screening dose produced from either scenario is less than 100 mrem/yr, the site would pass the screening. The staff would not require any additional site work and the former burial would be determined acceptable for unrestricted use.

- If a site does not pass the screening, the site would require evaluations by the NRC staff on a case-by-case basis.

STEP 1 RECORDS

- At the time the burials were made, licensees were required to keep burial records.
- The licensee should review burial records to determine the total activity in the burial area.
- If the licensee has no records, the site will have to be evaluated on a current case-by-case basis.

STEP 2 INGESTION

- The estimated total activity from Step 1 is assumed to leach into the groundwater in one year.

- The volume of groundwater is assumed to be 91 m^3, or enough to support a family of four.

- A screening dose is then estimated using 10 CFR 20 Appendix B and assuming an individual consumes 2 liters/day of this groundwater for one year.

ASSUMPTIONS

- The entire inventory is available at the time of the analysis
- The entire inventory leaches into the groundwater in one year
- An intruder places a well that captures all of the contaminated water in one year
- An individual drinks 2 liters/day of the contaminated water for one year

STEP 3 EXHUMATION CONCENTRATION

- The total trench volume for the burial is estimated
- A trench concentration is then estimated based on the trench volume and the total activity from Step 1.
- This trench concentration is reduced by a factor of 4 to account for mixture with clean cover material during excavation.
- This exhumed concentration is then compared to the concentrations in NUREG-1500 to produce a screening dose.

ASSUMPTIONS

- Total inventory is avaiiable
- The total inventory is excavated and brought to the surface
- Residential scenario in NUREG-5512

ACNW COMMENTS

- ACNW provided comments in a letter dated November 20, 1996.
- Staff responded in a letter dated December 23, 1996.
- Staff should complete independent audits and reviews
- Staff should pay particular attention to burials containing uranium and chlorine-36; and burials with limited or no records
- Staff should understand the risks and contributors to risk

PUBLIC COMMENTS

- Received 5 sets of comments to the BTP
  - -Washington Department of Health
  - -University of Washington
  - -Washington State University
  - -Illinois Department of Nuclear Safety
  - -University of Wyoming

- Most felt that the screening was good but too conservative
- 3 comments stated that the migration of C-14 and H-3 should be considered in calculation
- 3 comments stated that more site specific data should be used
- 2 stated that the case-by-case follow-ups would be inconsistent
- 4 stated that more information concerning the Timeliness Rule, location of documents, and mixed waste guidance should be included.

REVISIONS TO METHODOLOGY

- No revisions will be made based on the public comments.

- NUREG-1500 will be attached to the final BTP.

NEXT STEPS

- Publish BTP as final document in FRN
- Develop guidance for staff to review screening results
- Develop guidance for inspectors for burial sites and records
- Develop database for all on-site burial information

2A

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555

November 20, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: SCREENING METHODOLOGY FOR ASSESSING PRIOR LAND BURIALS OF RADIOACTIVE WASTE AUTHORIZED UNDER FORMER 10 CFR 20.304 AND 20.302

During its 87th meeting, October 22-23, 1996, the Advisory Committee on Nuclear Waste (ACNW) reviewed staff plans relevant to the decommissioning of sites in which radioactive waste had been buried as authorized under former 10 CFR 20.304 and 20.302. In addition to receiving information on the history and background leading to the development of the screening criteria to be promulgated in a branch technical position (BTP), the ACNW was briefed on related agency rules and information notices. The BTP, which was not available for ACNW review during its 87th meeting, will be finalized when more directly related field experience is obtained and public and licensee comments are evaluated.

These screening criteria are directed at potentially hundreds of onsite, non-reactor burial locations that will require an evaluation or screening process to determine if further remediation is required. The NRC staff has prepared a simple, conservative three-step method to evaluate the risk from these burial sites:

1. review burial records,

2. estimate the dose from ingestion of the total inventory in groundwater (a conservative approach), or

3. estimate the dose to a resident farmer from all pathways.

If the estimated dose from Step 2 or Step 3 is less than 100 mrem/yr, no further site work is required, and the site can be released for unrestricted use. The ACNW agrees with the NRC staff approach.

The ACNW offers the following comments and recommendations:

1. The NRC staff does have a responsibility to assure itself through independent audits and reviews that the risks are

reasonably assessed. These reviews are especially important where, for example, the burials may include greater than anticipated inventories of uranium; disposed wastes that contain isotopes, such as chlorine-36, which at the time of disposal were not perceived to be a significant problem; the location and distribution of wastes are imprecisely recorded (or, in some instances, unrecorded).

2. In those situations requiring review and approval of the NRC staff prior to final site decommissioning, the staff must be certain that the risks and contributors to the risks are understood, and should not rely only on an assessment of how the input parameters were either measured or calculated.

3. We concur with the staff's position that licensees not be allowed to use Step 3 of the BTP screening process for isotopes with atomic numbers of 88 or higher due to the lack of confidence in the dose equivalent factors in the current version of NUREG-1500, "Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment," August 1994.

The ACNW recognizes the benefit in providing a simple, relatively straightforward approach to resolving the problems extant from these past burials. We note that this issue might provide the Commission with an opportunity to advance its risk-informed, performance-based decision-making process. The ACNW anticipates further discussions on this specific issue with the NRC staff as the staff completes its evaluation of public comments and gains applicable field experience. Further, the ACNW intends to explore the compatibility of various screening criteria and methodology currently used by the NRC in the decommissioning process.

Sincerely

Paul W. Pomeroy
Chairman

Reference:

Draft Branch Technical Position, "Screening Methodology for Assessing Prior Land Burials of Radioactive Waste Authorized Under Former 10 CFR 20.304 and 20.302," October 1996.

2B

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 23, 1996

Dr. Paul W. Pomeroy, Chairman
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: SCREENING METHODOLOGY FOR ASSESSING PRIOR LAND BURIALS OF RADIOACTIVE WASTE AUTHORIZED UNDER FORMER 10 CFR 20.304 AND 20.302

Dear Dr. Pomeroy:

I am responding to the letter of November 20, 1996, from you to Chairman Jackson concerning staff plans relevant to decommissioning of sites in which radioactive waste had been buried as authorized under former 10 CFR 20.304 and 20.302. On October 25, 1996, the staff issued a draft Branch Technical Position (BTP) to provide a screening methodology that the staff finds acceptable for determining the need for further characterization and/or remediation of prior low-level radioactive waste disposals conducted under the provisions of former 10 CFR 20.304 and 20.302. Such disposals, at facilities licensed under 10 CFR Parts 30, 40, and 70, that have been unused for licensed operations for a period of 24 months, are subject to the requirements of the "Final Rule on Timeliness in Decommissioning Nuclear Facilities." Licensees who have unused outdoor areas containing elevated levels of licensed radioactive materials are required to notify the U.S. Nuclear Regulatory Commission that they are in possession of these areas and must begin following a schedule for decommissioning these areas. The staff briefed the ACNW on the BTP on October 22, 1996. A copy of the BTP is attached for reference.

In response to the ACNW's comments and recommendations, the staff agrees that independent audits and reviews are necessary to verify that risks are reasonably assessed. It will conduct an independent assessment of each licensee submittal. It expects that sites for which the ACNW expressed concern (e.g., sites containing uranium and sites with little or no records) will have to be addressed on a case-by-case basis outside of the screening methodology. In addition, it agrees that the risks and contributors to risk must be clearly understood in site decommissioning evaluations.

As the staff completes its evaluation of public comments and prepares the final technical position, it looks forward to further discussions with the ACNW.

Sincerely,

James L. Milhoan for
James M. Taylor
Executive Director
for Operations

Attachment:
Branch Technical Position

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
SECY

10 CFR Part 60 Technical Criteria

and

Total System Performance

Assessment

comments before
American Council on Nuclear Waste
by

Charles Fairhurst

University of Minnesota

April 23, 1997

EXTENSIVE CRITICISM OF PART 60 SUBSYSTEM CRITERIA

- Preference Expressed for "OVERALL SYSTEMS" Approach; Only Overall Performance Counts
- Lack of Technical Bases for Individual Criteria; May not be Meaningful Indicators of Barrier Performance
- Unduly Restrictive of DOE's Flexibility to Design Barriers to Meet Site-specific Conditions
- Specific Wording of Performance Objectives Unclear, Subject to Conflicting Interpretations
- Lack of Nexus between Subsystem Criteria and EPA Standard
- Commission Flexibility to Specify Alternatives Illusory; Politically Impossible to Implement at Time of Licensing
- May lead to Suboptimal Performance

THE COMMISSION CONCLUDED:

"...if the Commission were simply to adopt the EPA standard as the sole measure of performance, it would have failed to convey in any meaningful way the degree of confidence which it expects must be achieved in order for it to be able to make the required licensing decisions."

"...the Commission firmly believes that the performance of the engineered and natural barriers must each make a definite contribution in order for the Commission to be able to conclude that the EPA standard will be met."

Final Rule, June 21, 1983

POSSIBLE OPTIONS FOR STAFF CONSIDERATION

- STANDARD FOR OVERALL SYSTEM PERFORMANCE ONLY
- STANDARDS FOR BOTH OVERALL SYSTEM AND SUBSYSTEMS WITH RIGOROUS NEXUS
- STANDARD FOR OVERALL SYSTEM PERFORMANCE ONLY WITH QUALITATIVE REQUIREMENT FOR SUBSTANTIAL CONTRIBUTION FROM MULTIPLE BARRIERS
- MULTIPLE BARRIER OPTIONS

  Total Redundancy
  Engineered Barriers as Supplements
  Partial Redundancy

- STATUS QUO

HISTORICAL NOTES

Radioactive Wastes – Long Half-Lives

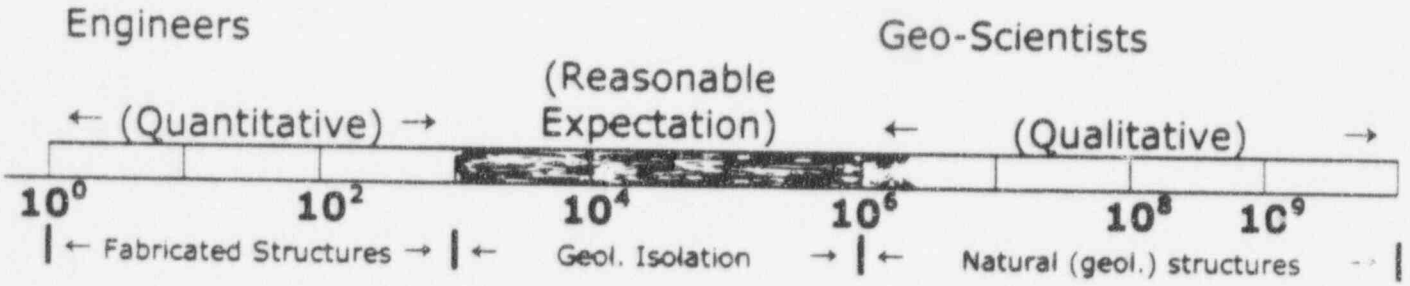
Isolate from Biosphere for $10^4 \sim 10^5$ years

Stable Structures with 10^6 years or more Potential

Some Geological Formations

1957 – NAS/NRC (Princeton)

(Salt mentioned)



<u>Reasonable Expectation</u> — Performance Assessment

Deterministic calculations with random selection of parameter values (within reasonable ranges)

solubility, permeability: driving potential; pathways: (releases) exposed populations; food chain; dose; "safety"

RETHINKING HIGH LEVEL RADIOACTIVE WASTE DISPOSAL

"No scientific or technical reason to think that a satisfactory geological repository cannot be built."

U. S. ... (prescriptive) ... "approach is poorly matched to the technical task at hand."

U. S. ... "only country to have taken the approach of writing detailed technical regulations before all of the data are in." [understanding]

... U. S. "program bound by requirements that may be impossible to meet."

"Alternative approach emphasizes flexibility, time to assess performance and a willingness to respond to problems as they are found, remediation if things do not turn out as planned, and revision of the design and regulations if they are found to impede progress toward the health goal already defined as safe disposal."

RETHINKING HIGH LEVEL RADIOACTIVE WASTE DISPOSAL (Cont')

→[If performance depends on contribution from components whose behavior cannot be adequately determined (defined), then design should be changed to eliminate dependence on that component. -- (Robust)] not in Rethinking C.F

One scientifically sound objective of geological modeling is to learn, over time, how to achieve reasonable assurance about the long-term isolation of radioactive waste.

That objective is profoundly different from *predicting* the long-term behavior of a repository...[models used for the latter purpose]

"Many of the uncertainties associated with a candidate repository site will be technically interesting but irrelevant to overall repository performance."

RETHINKING HIGH LEVEL RADIOACTIVE WASTE DISPOSAL (Cont')

The U.S. Nuclear Regulatory Commission, likewise, should reconsider the detailed licensing requirements for the repository. For example:

- What level of statistical or modeling evidence is really necessary, obtainable, or even feasible?
- To what extent is it necessary to prescribe engineering design, rather than allowing alternatives that accomplish the same goal?
- What can be done to accommodate design changes necessitated by surprises during construction?
- What new strategies (e.g., engineered features like copper containers) might be allowed or encouraged as events dictate?

PRESCRIPTIVE APPROACH

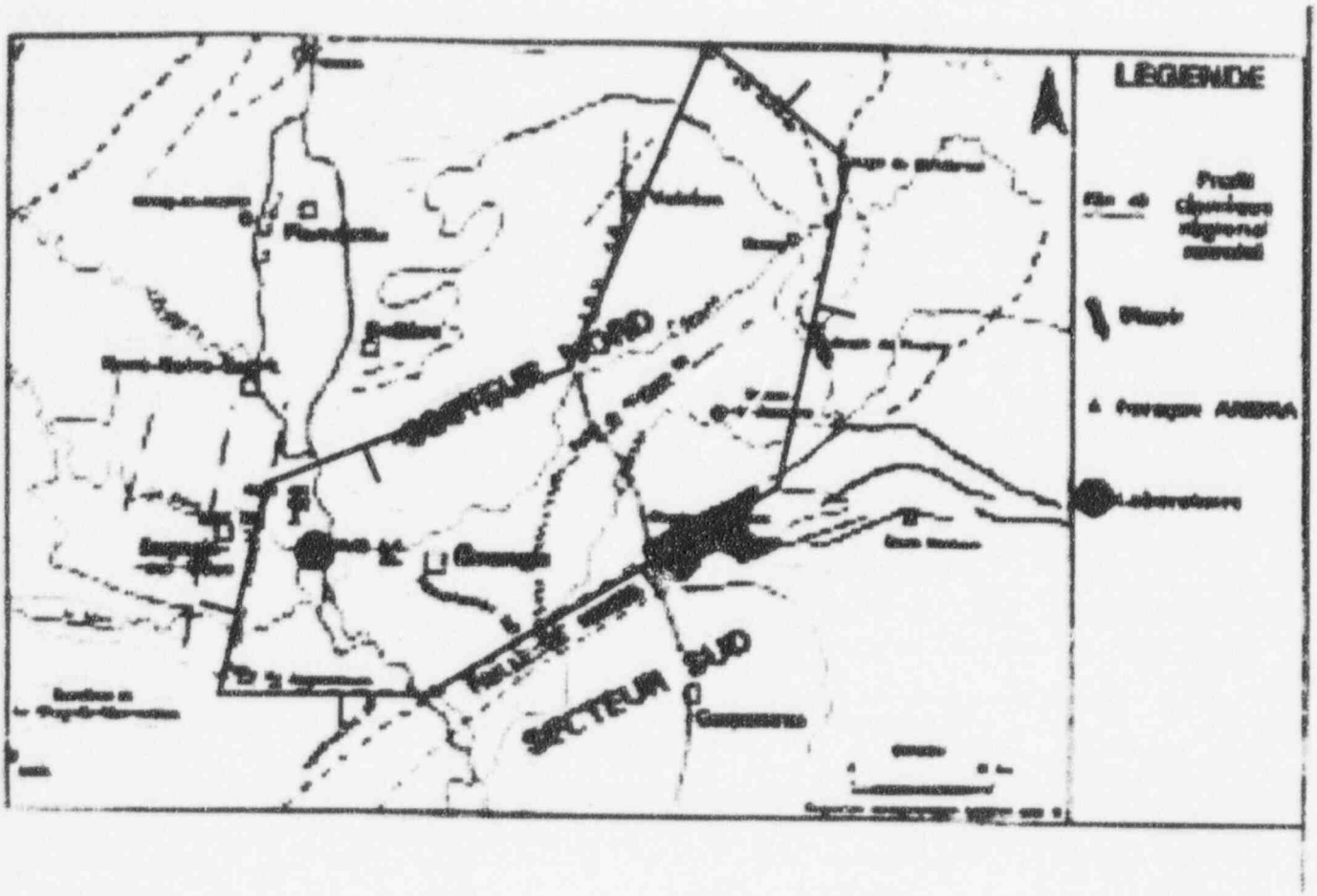
(Mainly US — EPA/NRC)

- France (Goguel.): "not in seismically active regions" (Rhode-Gardnien)

  Gard Repository: "Protected Lozenges"

- Sweden: WP Cave

$$Q = \kappa H$$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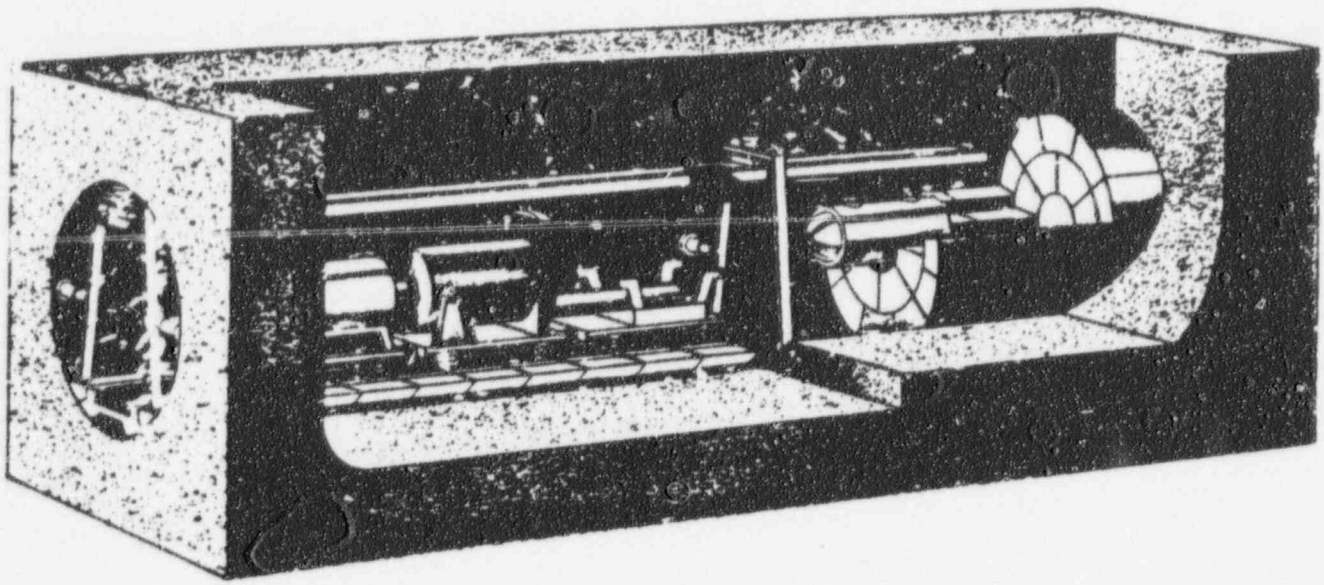

Figure 2-2. According to the NAGRA Gewähr project 1985, containers and highly compacted bentonite blocks are placed in full-face driven tunnels.

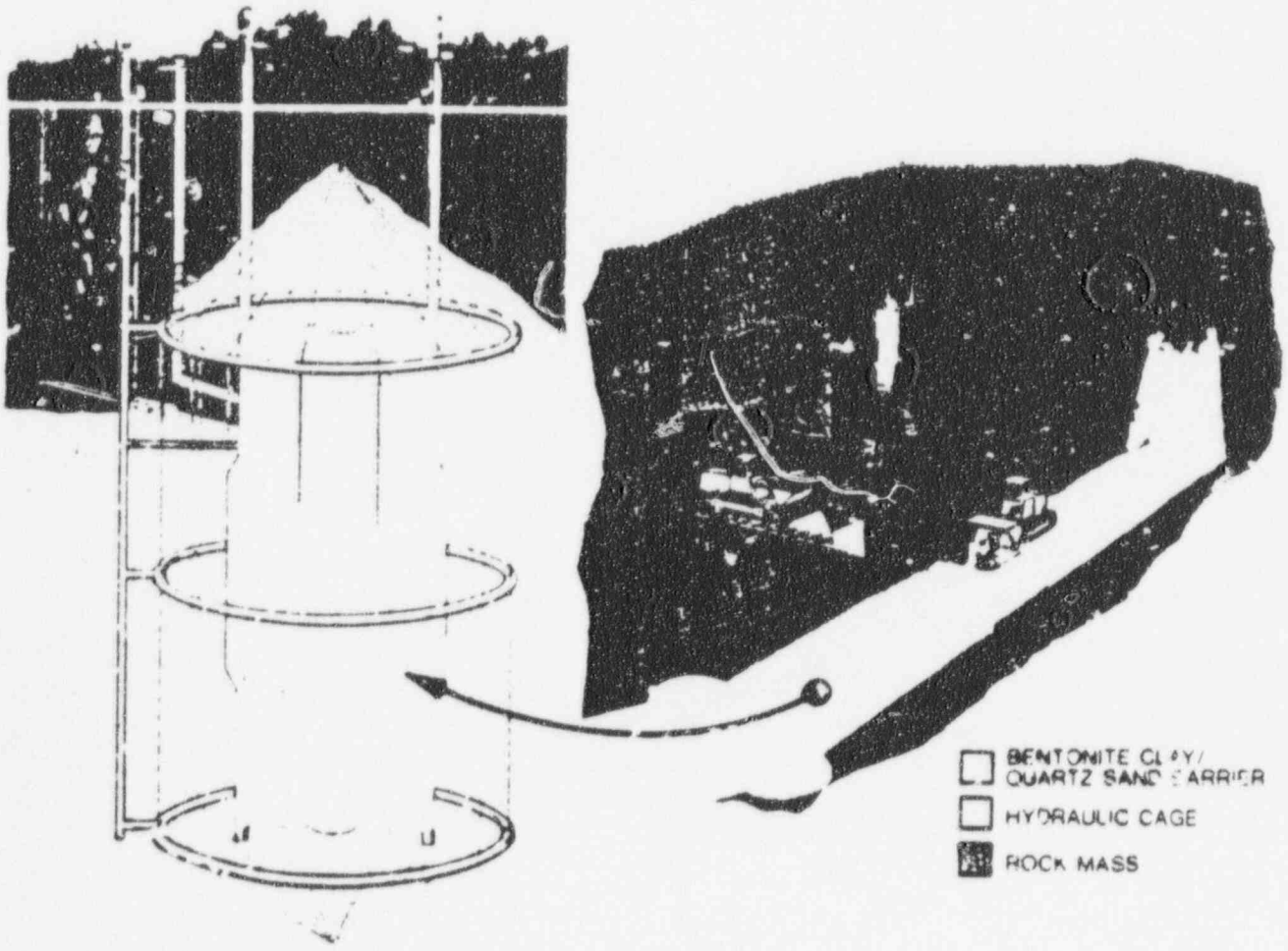

Figure 2-3. In WP-Cave, the final repository is surrounded by an impervious barrier. The figure shows how the barrier is built up.

T S P A

- Should include:
  - Comparative Risk (e.g. do nothing option)
  - Transportation Risk

    as well as
  - Geological Risk

P A

WIPP (TRU) not strictly comparable to H.L.W.

SALT:	Essentially impermeable; self-healing fractures; modest ion-exchange
CLAY:	Low permeability; self-healing fractures; high ion-exchange (Boom clay France – indurated)
GRANITE:	Fracture permeability (URL!) [retrievability]
TUFF:	Yucca Mountain!

- 1,000 years GWTT and Fracture Flow
  - Savannah River – M. K. Hubbert
  - Tuscaloosa Aquifer
  - Culebra (WIPP)