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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

144TH MEETING

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WEDNESDAY,

JULY 30, 2003

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ROCKVILLE, MARYLAND

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The ACNW met at the Nuclear Regulatory Commission, Two White Flint North, NRC Auditorium, 11545 Rockville Pike, at 9:30 a.m., B. John Garrick, Chairman, presiding.

COMMITTEE MEMBERS:

B. JOHN GARRICK, Chairman

GEORGE M. HORNBERGER, Member

MILTON N. LEVENSON, Member

MICHAEL T. RYAN, Member

DR. RUTH F. WEINER, Invited Expert

PANEL MEMBERS:
ROBERT BERNERO, NRC (Retired)
STEVE FRISHMAN, State of Nevada
JOHN KESSLER, EPRI
RICHARD PARIZEK, Pennsylvania State University, NWTRB
WENDELL WEART, DOE/Sandia National Laboratories
CHRIS WHIPPLE, ENVIRON

ACNW STAFF PRESENT:
JOHN T. LARKINS, Executive Director - ACRS/ACNW, Designated Federal Official
SHER BAHADUR, Associate Director - ACRS/ACNW
HOWARD J. LARSON, Special Assistant ACRS/ACNW
NEIL M. COLEMAN, ACNW Staff/Designated Government Official
RICHARD K. MAJOR, ACNW Staff
MICHAEL LEE, ACRS Staff
TINA GOSH, ACNW Staff Summer Intern/MIT

NRC STAFF PRESENT:
HANS ARLT, NMSS/DWM
JOHN BRADBURY, NMSS/DWM
RALPH CADY, DWM/NMSS
LARRY L. CAMPBELL, NMSS/HLWB
TED CARTER, NRC/DWM

NRC STAFF PRESENT: (CONT.)

KUIN CHANG, NMSS/HLWB

JIM DANNA, NMSS/HLWB

DAVE DIODERO, USNVTRB

JAMES FIRTH, NMSS/DWM

JASON FLEMMING, NRC

CHRIS GROSSMAN, NMSS/DWM

GREG HATCHETT, NMSS/DWM

LATIF HOWARD, NRC/NMSS

BAKR IBRAHIM, NMSS/HLWB

BANARD JARANNATI, NMSS/DWM

PHILIP JUSTUS, NMSS/DWM/HLWB

TIM KOBETZ, DWM/NMSI

BRET LESLIE, NMSS/RT6

TIM McCARTIN, NMSS/DWM

TOM NICHOLSON, NRC/RES/DSARE

JACOB PHILIP, NRC/RES

JEFFREY POHLE, Division of Waste Management

PHIL REED, RES/DSARE

KING STABLEIN, NMSS/DWM

CHERYL TROTTER, NRC/RES

ALSO PRESENT:
DEBORAH BARR, DOE
LES BRADSHAW, Nye County, Nevada Department of Natural Resources and Federal Facilities
DANIEL BULLEN, NWTRB
VERONICA CORNELL, Parallax
GUSTAVO A. CRAGNOLINO, CNWRA-SWRI
NICK DiNUNZIO, DOE
DOUG DUNCAN, USGS
ATEF ELZEFTAWY, Las Vegas Paiute Tribe
COLLEN GERWITZ, NYSERDA
CECIL HAULON
NORM HENDERSON, DOE/Bechtel-SAIC Company, LLC
KAREN JENNI, DOE (LLNL)/Bechtel-SAIC Company, LLC
ERNEST LINDNER, LAP/Bechtel-SAIC Company, LLC
ROD McCULLUN, NEI
AHMED M. MONIB, DOE (LLNL)/Bechtel-SAIC Company, LLC
ROBERTO NABALAN, Southwest Research Institute
TIM NIEMAN, DOE (LLNL)/Bechtel-SAIC Company, LLC
MICHAEL O'MEALIA, State of Nevada
ENGLISH PEARCY, CNWRA
JIM SHAFFIN, MTS-East
SURANNU STIVGLINSKI, Las Vegas Sun
E. J. TIESENMAUSEN, CCCP
JUDY TREICHEL, Nevada Nuclear Waste Task Force

ALSO PRESENT: (CONT.)

JOHN WALTON, University of Texas at El Paso/Nye County, Nevada Department of Natural Resources and Federal Facilities

JIM YORK, Bechtel-SAIC Company, LLP

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

8:34 A.M.

CHAIRMAN GARRICK: It's time for the invocation.

(Laughter.)

Good morning. The meeting will come to order. This is the second day of the 144th meeting of the Advisory Committee on Nuclear Waste. My name is John Garrick, Chairman of the ACNW. The other Members of the Committee are Michael Ryan, Vice Chairman; George Hornberger and Milt Levenson. Dr. Ruth Weiner is at this meeting as an invited expert.

Today, we're going to continue what we were doing yesterday and that is continue the working group on performance confirmation plans for the proposed Yucca Mountain high-level waste repository and Neil Coleman is the Designated Federal Official for today's initial session. The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions and should anyone wish to address the Committee, please make your wishes known to one of the members of the staff. And as usual, we request that the speakers use one of the microphones and identify themselves and speak clearly so that they can be readily heard.

As you recall, Dr. Ryan of the Committee is chairing this session and without further ado, I'm going to turn the meeting over to Mike.

MEMBER RYAN: Thank you, John, I'm going to start by saying thank you again to everybody who presented yesterday. I thought it was an extremely useful and informative session and hopefully today will be equally as useful and informative. We have several presentations by interested parties, the NRC and others and I think this will be an equally informative day.

Without further ado, I'd like to introduce our first speaker who will be Tim McCartin of the NRC staff. This title is "NRC's Risk Insights Initiative and Its Impact on Review of Performance Confirmation Plans."

Good morning, Tim, welcome.

MR. McCARTIN: Good morning, thank you. It's good to be here. Today's presentation actually fulfills two different roles. One is certainly providing information today to the people of this workshop with respect to approaches we have for risk-informed performance confirmation. In a broader sense for the Committee, I would like to point out for about the last year, year and a half or so, we've been updating you on the status of our risk-informing activities in general. And as you know, we continue to evolve and seek ways to improve and clarify how we intend to risk-inform our activities here at the Commission.

And this is installment number four or five. I don't keep track, but as you know, we have been presenting these and so you will see in this not only information for the workshop, but sort of a status of where we're at with these activities and where we're headed for in the future. And so it's really -- it serves two purposes. It's a timely presentation in that sense and Dave Esh and I worked together to prepare a couple of examples of our approach that we'll go through shortly.

May I have the next slide?

(Slide change.)

MR. McCARTIN: In terms of my presentation, I'll give some small perspective on the performance confirmation. Jeff went over the regulatory aspects yesterday. He's going to go over the review plan aspects after my presentation here and so most of that is going to be covered very well by Jeff, but I'll give some -- a brief perspective. Then I'll explain our approach for risk-informing, give a couple of examples, one engineered, one natural and then finally summarize at the end.

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(Slide change.)

MR. McCARTIN: In terms of performance confirmation, the first part -- there's really three aspects from a risk-informing standpoint. One, certainly as Jeff went through yesterday, to evaluate the adequacy of the information used to demonstrate compliance, and I know some question was raised, the word safety does not appear in subpart F and I will point to the second tick under that first bullet. The word "barriers" does appear in the subpart F and that really is the connection with safety. We're looking at barriers important to waste isolation. If you're important to waste isolation, it's in our mind, it's self-evident that it is important to safety.

Next, very importantly, that same subpart F, you provide data where it's practicable and I think Chris Whipple got into that very well yesterday. You want to have things that are doable. You don't want to promise things that can't be done.

And we also identify, there's a variety of different ways to get performance confirmation information, be it in situ monitoring, laboratory test field tests, etcetera, and that just as a backdrop.

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(Slide change.)

MR. McCARTIN: Risk-informed. When we're doing risk-informed here, I think we are really looking at the risk significance of each of the barriers and there's no question that you're looking at the relationship to the dose. However, it's very important that it isn't just the dose calculation. One might argue that what if DOE could very confidently demonstrate that no waste packages will fail within the first 10,000 years. Does that mean these other barriers don't have any risk significance? I would say no. It doesn't mean that. That the saturated zone still has a retention capability that we would expect to see demonstrated in the spirit of the multiple barriers and that's why we're really looking at the potential risk significance. When the packages eventually leak and I don't think anyone would say that eventually they will leak, what is the capability of the other barriers? And so that's why we try to focus on the risk significance of each barrier and it's a relative kind of thing. Not the absolutely.

Clearly, if no waste packages fail or if one waste package fails, the risk significance of the other barriers in that sense is if you just looked at dose, would be very small because the overall risk is very small.

So it's a broader concept that you'll see in my examples a little better what's meant there. Certainly, Dr. Garrick brought up the uncertainty and you have to consider the uncertainty in estimating the performance of the barriers.

Thirdly, we want to point out DOE is required to describe and identify the repository barriers. My presentation today, I'm making use of some of our performance assessment results, but ultimately it is the responsibility of the DOE and we will be looking at the DOE's compliance demonstration.

With that, I'll go right to the approach that we're looking at and clearly I want to emphasize the word iterative, primarily because you can see we start with risk significance. Well, the only way you can start with risk significance is you've already done some calculations. You've already done some analyses and as the status of where we are today, the risk significance I'm talking about here is really the risk baseline report that we provided to the Commission. That's our starting point today, if you will.

We have some risk significance that we've described to the Commission. We're going to be using that risk significance, look at the quantitative basis for that risk significance. Clearly, we've already done the analyses, but as I pointed out, this is a iterative process and I'm giving the status of where we're at. The Committee is aware that we, in October, we intend to provide an update to what we've given to the Commission that will include a more explicit discussion, explanation of the quantitative analyses including the uncertainties.

When you have that information, the quantitative basis, looking at the uncertainties, you should be able to identify important parameters, models, assumptions. It was correctly pointed out yesterday that you always when you're using the performance assessment code, you always want to be aware of assumptions, some of which excluded certain processes. You need to consider that, those assumptions also when you're looking at what are the important features of my assessment of demonstration of compliance.

And finally, and I borrow a word from Dr. Garrick that he used oh I'll say at least a couple of years ago, maybe earlier, but ultimately when you have -- you've identified from your analysis, the important models, parameters, assumptions, what's the evidence supporting these models? Once you look at the evidence, you then should be able to look at what are the things I would like to confirm? And that's sort of our thinking right now of the process we're going to go through internally in trying to risk-inform the performance confirmation. Like I said, this up here is that risk baseline report and we'll be walking through it to get to this point where at the end we're looking at the evidence and what makes sense from a confirmation standpoint.

Next slide.

(Slide change.)

MR. McCARTIN: To explain this process, if you will, with a couple of examples, I'll have an engineered example and a natural system example. People always get nervous when -- I don't know if it's just me, but when I think the staff here present examples to the Committee and we aren't -- we don't want to see -- we aren't implying DOE come back exactly with our example and that's approved by default. We are giving these examples in a way to demonstrate the process. We are still thinking about this. These examples do not represent some type of regulatory acceptance. Certainly, it's the DOE safety case. We're looking at our performance assessment here. And so it's just a caution that we think the example is good in terms of giving you an idea of how the process should work, the particulars of the example are not, should not be construed as regulatory acceptable in any way.

With that, let me go to the first example.

Next slide.

(Slide change.)

MR. McCARTIN: And we're looking at spent fuel dissolution. In our risk insights report, this was a high risk identified item. The dissolution of the waste affected a lot of the radionuclides, essentially all of the radionuclides and we saw that it could vary, the dissolution from hundreds of years to hundreds of thousands of years. There is a significant potential effect on performance, due to the dissolution rate of the spent fuel.

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(Slide change.)

MR. McCARTIN: In terms of the quantitative basis, we've used existing information in developing our TPA code. Right now, in terms of the code itself, we have four different dissolution models and going to one based on natural analog information, another one based on secondary mineral formation and a couple that are dependent on the water chemistry. So we're covering a range of potential different things and this is important, these alternative models a couple of which are based on different chemistries, we don't necessarily have the explicit chemistry in the TPA model, but we try to represent the effect some of these chemistry aspects of the environment inside the waste package could have on the release.

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(Slide change.)

MR. McCARTIN: In terms of the -- what does this mean in terms of performance and I apologize, the colors are not especially great on this slide. They were done as much to make a black and white xerox to look a little better, and boy, it's really hard to get colors to work well. But the net effect is you can see we have approximately a two order of magnitude variation in the dose due to the different release models. So once again, a fairly significant effect on the performance.

Going to the next slide --

(Slide change.)

MR. McCARTIN: In terms of the potential importance of the release model, you have to consider the limitations and once again I will point as much to water chemistry as a model uncertainty and that's why we have the different conceptual models.

There is certainly parameter uncertainty with the dissolution rate, but why did we have four different conceptual models? Part of it was due to water chemistry, the Schoepite model was a secondary mineral formation, but there's different processes to be considered in terms of the dissolution rate and these are the kinds of things, they tend to be fairly important. They're seeing a couple of order magnitude effect.

Next slide.

(Slide change.)

MR. McCARTIN: In terms of some of the evidence we now have, what supports these models and you'll remember Dave Esh showed the Committee a similar slide in a previous workshop that in terms of putting some parameters to the pre-exponential term of our two models, the first two models there which were

-- some of which is due to the water chemistry. You can see there's different solutions considered and there's different dissolution rates depending on the test method, etcetera.

This is -- the information that you have available supporting some of those models. I haven't shown everything, but the idea is to -- we've shown what's important, be it the chemistry, the rates, etcetera. Look at the evidence you have. Piece together all that evidence and try to get a sense of what kind of information there makes most sense to confirm.

And so this is a later step in our process and it's just the example, we want to tie the evidence we have up through the importance to the model, to the dose calculation and then look at the candidates for confirmation.

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(Slide change.)

MR. McCARTIN: I'm now going to move to the second example which is the retardation in the alluvium, the natural system versus the engineered system, the dissolution of the fuel.

Once again, this is the retardation of the alluvium and our risk baseline report was a high risk aspect of the performance calculation. The retardation, the alluvium had the potential to delay movement for a vast majority of the radionuclides for very long time periods, thousands, tens of thousands of years and longer. For the nuclides that tend to absorb, neptunium, americium, plutonium, clearly iodine and technetium are not in that mix. They're unretarded. They are a small fraction of the overall inventory of the repository.

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(Slide change.)

MR. McCARTIN: In terms of the quantitative basis, once again we're using existing information that's out there. Most of this is -- a lot of it is the DOE information. There's information on specific radionuclides with respect to looking at crushed tough analogs, literature values. There also is support for the conceptual model. There is some experimental evidence supporting some of the key assumptions in the KD approach, namely a linear isotherm and fast and reversible sorption.

Here's one of those items I'll point out that we don't have alternative models here. We have a range of KDs, as you'll see, but we don't have alternative models, but there are aspects of the model, of the conceptual model that could be supported in terms of the linear isotherm in fast and reversible sorption.

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(Slide change.)

MR. McCARTIN: Once again, the Committee in previous meetings has seen this slide. There's a lot of numbers here. There's -- but basically it's a sensitivity analysis of retardation in the alluvium and there are a couple of things we varied. One was the flow path in the alluvium, one kilometer versus five kilometers, a longer path versus a shorter path. And we also varied the retardation factor or the KD with a slight transformation from a low value to the high value of the sample range in our TPA analysis.

As I mentioned, technetium and iodine are assumed to be unretarded, so it's not too surprising that between low and high, it's the same number, they come out the same. There is some difference between five kilometers of alluvium versus one kilometer. If we go down to the bottom two, americium and plutonium, you can see the delay time and I guess I should have mentioned, this is a delay time and it's a time it takes once an initial release goes into the saturated zone, how long before that initial release gets out of the saturated zone. So let's say at the first time that radionuclides appear in the saturated zone, let's say one curie goes in, how long does it take before one curie comes out of the saturated zone? That's how we're defining delay time.

There are two aspects. These numbers, obviously, are very long. There's two parts to the rationale for this. For americium and plutonium, the sorption values, the KDs, are much higher than the other three, but there's also another big aspect. These do represent, between the two of them 75 percent of the curies in the repository, but they also have short half lives, relative to these three. And so as you delay something, it starts to decay and if one curie went in to get one curie out, the KD to delay it becomes even more effective with a shorter half life. It decays away as it's being transported. So that's a significant part, in addition to the fact that the KD values actually are quite a bit longer. But you can see for americium, plutonium are well over tens of thousands of year, all of them.

Neptunium, you can see for the low, between the low and the high KD, there's a fairly significant range there, at the low end, approximately a thousand years; at the high end, quite a bit larger, much larger than ten thousand years. A rather significant difference.

Likewise, even for -- it wasn't that significant, one aspect of this that was interesting, whether it was one kilometer or five kilometers. You can see the difference wasn't as dramatic as I thought it might be. Part of that is be aware that when we go from one kilometer to five kilometers, we aren't shortening the path by four kilometers, but four kilometers is now fractured rock, rather than alluvium, so it's still a total path of 18 kilometers.

One of the things that helps or delays the neptunium is matrix diffusion and neptunium has a KD in the rock matrix whereas iodine and technetium\ do not and so even though the alluvium path is decreasing, the fractured rock path is increasing with matrix diffusion which is partly responsible for not being that much difference.

Next slide.

(Slide change.)

MR. McCARTIN: In terms of the potential importance, certainly for the alluvium, the extent of the uncertainty, what you saw with those 3 to 5 radionuclides is three very different behaviors. First, you have a zero KD for iodine and technetium.

In terms of performance confirmation, you can't have a lower KD and so do you -- is there a need to confirm a KD that's at zero.

Next, the range of KD seems to be unimportant for americium. As you saw for that range, it was greater than 100,000 years, whether we were at the low end of the KD or the high end. And so depending -- you want to bring that in to your confirmation activities. It's extremely, you're mainly -- is that lower bound adequate, not the upper bound, isn't that important. That's another piece of information you bring in to risk-informing your confirmation activities.

However, the range for neptunium was significant. Neptunium has one of the highest dose conversion factors for the radionuclides in the repository. It has a large inventory and as you saw, the range of KD resulted in approximately a thousand year travel time versus on the order of tens of thousands. That is a potentially significant at risk significant aspect.

As I said, we had certain assumptions about this model, sorption is fast and reversible. There's always assumptions about the changes in the bulk chemistry along the transport path. We are assuming the chemistries don't change. We do sample pH in the saturated zone and so we have an effect of a range of different pHs, but we're not looking for halfway through the transport time, it reverses and changes to a different value. It's constant for the entire transport period.

So those are things that potentially are important. How is the chemistry going to -- in the saturated zone vary?

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(Slide change.)

MR. McCARTIN: In terms of the kinds of evidence, there's certainly information currently bout the mineralology about the alluvium that we've used in looking at appropriate KD values. There's been water chemistry measurements of the alluvium, pH and ionic strength and there's been for the neptunium, as well as other radionuclides, but there have been some bad sorption tests and some dynamic tests for neptunium to give you a sense of whether there's the reversibility fast and reversible sorption reactions, etcetera, to help with the confidence in the conceptual model.

That's the two examples, as you can see, and I'm not trying to suggest that we've covered all the bases here, but it's a desire to walk through the thinking process and that's what I've tried to show that ultimately I think as Dr. Garrick pointed out to us, I'll say a couple of years ago, what's the evidence? We want to be able to trace through our risk insights all the way to the evidence and give that clear linkage so people can see what information is supporting what important parts of the safety assessment. We think that is how you get to performance confirmation.

Clearly, this is an iterative process. We are not -- we hope to get to this point, I'll say in the next six months to where we have documented all the way through, but it's one of those things that you certainly continue to update your information and go back to the top and go through the system, but we want to be able to show this clear linkage all the way through the system from risk insights to the evidence and to me would provide a traceable path for reviewing performance confirmation.

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(Slide change.)

MR. McCARTIN: Summary. I've pretty much said most of this, but we certainly, we start at the top with risk insights to identify the important areas for consideration for performance confirmation. We certainly have to look at the uncertainties. It's an evidence based approach. You want to be able to get at the bottom to where whoever is looking at your idea of what needs to be in performance confirmation, they can see that linkage between the evidence you have and the assumptions and their -- how they impact the safety assessment.

There's always -- this last bullet is there. There's always this tension between realistic and conservative assessments. As was indicated for the retardation in the alluvium, iodine and technetium, both ourselves and DOE, both assume are unretarded. Some people would say iodine does have some retardation. Technetium may have some retardation. And that might be true. But if the Department, in that area, other areas, elects to take a conservative approach because they do not want to collect any further information, that is part of their approach and from a safety standpoint, if a conservative value is still acceptable from a safety perspective, that's reasonable for the NRC to make a decision with that kind of approach.

And so there is a recognition that depending on the DOE safety assessment, certain abstractions will determine and their approach will determine, have a role in identifying what needs to be confirmed and what doesn't.

Final slide.

(Slide change.)

MR. McCARTIN: This is more for the Committee than necessarily the workshop. Other people may be interested. In terms of where we are, as I indicated part of this approach is we have tried to keep the Committee informed of our progress as we go through our risk informing activities. This is one of those presentations for that purpose. As you know, the risk insights' baseline was provided to the Commission recently. We are on the hook, as you say, to in October to provide a final report with respect to the risk insights that will be based on the risk baseline, but it will provide the more quantitative bases and we probably will identify further calculations we need to do. I won't say that we have the best calculations in-house. I think most of the -- the risk insights we based on some analyses we've done, but will identify further ones, but in the October time frame, we'll have that quantitative basis, discussion of uncertainty and further quantitative work to improve our quantitative basis. That will be updated as appropriate. However, even with that October deliverable in our closely approaching, we are thinking of these next steps, these next steps, now that you have that quantitative basis.

What's the evidence that's supporting the important parameters and assumptions? And I think that, to me, is the more fascinating part of the work. All this other stuff is just to get you to where you can now examine the evidence and go back and say gee, what do I need to look at further, etcetera and I -- like I said, this is Tim McCartin speaking, the management, but I think we will have some information to present in the next six months in showing that trail to the evidence. And I would expect that at a future time we'll be coming back to the Committee on that and this part of the slide is talking more to our continual dialogue of keeping you informed of our process of risk-informing and with that I'll stop.

MEMBER RYAN: Thanks, Tim. Let me start by just comment. I think it's important to emphasize that your iterative comments, being an iterative process are important. To me, that means that you're learning as you go which is very good and that finding out new information at some point downstream from the starting gate isn't failure. It's actually a good thing when you identify important information as the process of all. So that's, I think, something we all ought to think about, and two, that that process I think your main point is can well inform the performance confirmation process itself.

Am I summarizing that well?

MR. McCARTIN: Yes, absolutely. And I really appreciate that. I add slightly in the sense that that's why we get nervous sometimes about coming up and presenting numbers to the Committee and clearly this is a work in progress. Have we thought through all the aspects of this? No, we haven't. We think the numbers we presented and the information we gave you give you a better sense of the process we'll work forward through and it's the iterative sense of that. We aren't suggesting that those numbers, is everything correct that we've presented? We're working through that. I mean obviously the calculational numbers are correct, but there could be other aspects of the modeling that we haven't identified. Some we've identified that, oh gee, it shouldn't, but we think it's helpful for the Committee to see that and that's why we have our caveats.

MEMBER RYAN: It begs the question then how do you bring closure to any particular item? When have you iterated enough on a particular item and maybe you could explore that thought just a bit for us.

MR. McCARTIN: That's where I think my idea of going to the evidence is really the closure point. When we get to that point, okay, what is the experimental evidence that we have? And how does that relate to the important assumptions? And that's where I think where the Committee and others, our management needs to see, what is the logic there? What do you see or don't see in that information that you need more, you want to confirm this or whatever. And that, I think, it really gets back to something I'll point to something of Dr. Garrick. We go back to the transcripts. Historians can go back to the transcripts, I'll say in the two to three years ago brought up the word evidence based.

I think that, in my opinion, that's what we have struggled to try to convey is what is the evidence and how does it relate to the important assumptions. And that what this approach is trying to get to. Once people see that, we may disagree as to whether well, I think we're done. They say no, you're not done. But as long as people can see the rationale and the logic behind what was done and how it relates to the performance, I think that at least is up for review and scrutiny. But I think getting to that where we could point to the more directly than I did today to the evidence. At least that's the desire.

MEMBER RYAN: Great, thanks. Any comments or questions from any of you?

MEMBER HORNBERGER: Tim, first, I guess I should repeat your caveat to save you from doing so. I recognize that these examples are just examples and we're following a thought process and by asking you questions related to the examples, I don't want to imply anything else.

MR. McCARTIN: Okay.

MEMBER HORNBERGER: There is no regulatory commitment here, shall we say. Nevertheless, what I wanted to do was explore, because the examples I think are useful. As you know, I find examples useful. And I'd like to explore the implications for performance confirmation. So if I take your example of fuel dissolution and for the sake of argument, let me hypothesize that the DOE uses a range of dissolution models that you have, I know they don't, but let's assume for the moment that they're using the same thing.

So they're using the same evidence and

they're using the range. And now they come forward with a performance confirmation plan. I can picture this being anywhere from we will keep tabs on experiments being done worldwide to see if there are any deviations, all the way up to some grand plan to do extensive laboratory experimentation including what secondary minerals might control solubility and developing a thermodynamic database, etcetera.

How do you see your risk insights as playing into where you would expect DOE to be on that spectrum with their performance confirmation plan?

MR. McCARTIN: Well, it really would depend on, in that curve I probably should have pointed out, but our base case model is one of the higher curves. And so it is not one -- some of those alternative models, the secondary mineral model only lowers the release. And so, you know, for things that they've shown gee, this is going to be lower, we wouldn't I think the rigor for showing that performance is better, is different than showing is there something that could increase the dose.

And so there would be along those lines in terms of the chemistry of the waters, have they properly -- we saw a dependence on chemistry. Do those models appropriately bound the range of different water chemistries they expect. And maybe there would be some experimental work to see if other more aggressive chemistries could occur that might make the release. Because it is sensitive, it might make it even worse than what we have today. It depends on some of the assumptions.

Certainly, if they used the secondary mineral models, that was their base case if you will. It is quite a bit lower than the other ones. I think in my mind there would need to be, we might want to see some confirmation of the basis for the secondary mineral model.

Is that helpful?

MEMBER HORNBERGER: Yes, it is. I still, yes, it is helpful. I think that the other part of the question that I think you answered toward the end, because if DOE, for example, does make an assumption of let's say a very high dissolution rate that, and then you might look at their argument that they really don't have to do any more as potentially acceptable.

MR. McCARTIN: Yes.

MEMBER HORNBERGER: The other question I have in looking at this, to go to your other example, it strikes me from yesterday and today at least in my own thinking, that an awful lot of the performance confirmation that we've been talking about seems to be in situ and in the field. And I have this gut level feeling that there might be an awful lot more of value to be done in the laboratory relative to expending tremendous sums in building robots that may or may not work to do monitoring and unshielded drifts with unshielded canisters.

Do you have any sense, if I look at your second example, KDs, as to how you might look at a performance confirmation plan that in terms of a balance between let's say laboratory testing of materials versus large scale tests in the field?

MR. McCARTIN: I will give you an answer based on my limited experience as a geochemist. I will ask that I know we have geochemists at the table that I will ask to correct me or counter that.

Generally, in terms of the -- there's a couple things you can do in the lab that are very useful in terms of some of the column tests, dynamic tests, to get a sense of is the conceptual model right. Do we have a linear isotherm. Do we have vast and reversible sorption. So those laboratory tests, some of which DOE has already done to support this model. Okay?

Would there need to be more done for that, I'll leave that to the geochemists to evaluate that if just because, I mean that's the other part in terms of the negotiation phase, if you will. If no further information can be gained by doing additional tests, I think it would not be worthwhile to ask DOE just to repeat a test to get the same result, if we have a high confidence in the information that is already there.

It just seems pointless in my mind that you have to look at performance confirmation as a program with a mission. And the mission is to confirm things, the adequacy that there is some uncertainly about. If there is some stuff that we have enough, why would we just repeat tests to get the same answer?

That is generically true, and I think it just depends on the nature of the uncertainties, the information, the tests, the state of the art that is in the plant.

Certainly in terms of the field, there are some things, with respect to the KD as I indicated, you can look at some limited measurements of water chemistry from mineralogy to give you a sense of the KD.

But I will happily turn it over to either English Pearcy or Andy Campbell from the NRC Center, if there's anything to add.

MR. CAMPBELL: One example of a field test the DOE did do was the seawells complex. And if, for example, in an application, there was extensive reliance on sorption in the fractured rock, based on the seawells complex, then we would have to look at the risk significance of that total compared to the other aspects of the system and also look at the uncertainties associated with the solutions they draw from that. So that's an example of a field test that might be appropriate for performance confirmation, if it has high risk significance and if there's high uncertainties involved in aspects of the test.

MEMBER LEVENSON: Yeah, Jim, I had two thoughts. One, you've introduced kind of a significantly different thought, I think, than we heard yesterday. Yesterday, the implication was the confirmation should confirm everything. And you've kind of introduced the thought that says if DOE is willing to more or less accept certain assumptions that the NRC has made, doesn't want to take more credit for or is willing to use your values, the confirmation may not be required. Is that the situation?

MR. McCARTIN: I did not mean to imply

that in that if they use our values. They have to defend their values, and the fact if they pointed to our PA, and every technical exchange we've had on performance assessment, pointing to numbers we use is not regulatory acceptance. That is not a technical basis for the Department. So I didn't mean to imply. And I don't think in my mind philosophically, it is not a new idea. I'll point to the one statement, I was at the same meeting as Jeff Pohle was with John Austin.

The NRC is not in the business of asking licensees to do things that are silly. And any time a licensee is doing something silly, they should come and talk to us because that is not the intent of our regulations. And that's my last thought. And I'll give an example, and I don't know if it, I'm not saying it is going to turn out to be true. But as an example, let's say the KD for neptunium is based on a column test. That is state of the art. That is the best way to get the KD for neptunium. And the DOE has done extensive testing in the license application for determining the KD of neptunium in these column tests.

If the NRC says gee, there's nothing more to be done here, would we say well, but it is an important parameter, so we want you to redo those tests once again. I in my opinion, I don't think the regulation requires that.

If it is just a matter of the testing technique, did you do this test right, I think we would have determined that in the review of the license application is a possibility. To just repeat a test, do they have to repeat every single test they've done. It is not my impression of performance confirmation that they have to repeat everything. At least, I see nothing in the regulation that requires that.

MEMBER LEVENSON: What you're basically saying is if there is substantial evidence for a point, it doesn't just because it wasn't done as part of what is called confirmation, doesn't mean it has to be redone.

MR. McCARTIN: Right.

MEMBER LEVENSON: The purpose of confirmation is to fill in voids and reduce uncertainties. Is that --

MR. McCARTIN: Not to fill in voids and uncertainties. It is a recognition that we will be dealing with uncertainty in the license application. Before you get to performance confirmation, you've made a determination that you have enough information to make a decision.

In my mind, what performance confirmation is now look at the information you use to make that decision and from a risk significant standpoint, which looks at the uncertainties in my mind. What information should I confirm? And if there's some information, just because it is important, if doing another test is not going to significantly change your basis, I don't know why we would have them just repeat the test for the sake of repeating, let's say a column test for KDs where --

MEMBER LEVENSON: Okay, I understand your disclaimer about the models. Let me compliment you on having selected one model where the motivation purview and DOE's view are probably 180 degrees out. That is in things like the KD for iodine and technetium, for NRC since it is zero it can't possibly be any worse than that. There's no need to think about changing. But since iodine and technetium are a significant of the eventual dose, since almost nothing is really zero, there might be a large motivation for DOE to do something about it.

So I think that's a good example as to why they shouldn't just follow your examples. Their motivation might be quite different.

MR. McCARTIN: Although, as we've shown though, it is important to recognize that iodine and technetium, while indeed they do cause the early dose, a more significant dose is potentially there from neptunium that dwarfs the iodine and technetium dose. And that's one reason in terms, in my mind of a safety standpoint, I'm not overly concerned about iodine and technetium. Do they get there first? Yes. But the larger potential dose is due to neptunium. That's partly why. Iodine and technetium are a very small fraction. You know, is it iodine, I believe it is iodine. Well, technetium, the dose conversion factor is three orders of magnitude lower than the neptunium dose conversion factor.

So there are aspects that, in all of this we want to bring out in the report. And that's where to me, you need to be, in fact somebody put this on my door in my office, you need to be very careful -- sure fire performance assessment advice in that recognizing the potential risks from iodine and technetium. But don't put blinders on to the neptunium, which it is delayed right now beyond 10,000 years. But as we showed in that example, there is a potential at the low end that it is a good come-in, and it is a larger potential risk item.

MEMBER RYAN: John.

CHAIRMAN GARRICK: Just a couple of quick comments. Tim, it seems you got the message on the evidence issue.

MR. McCARTIN: Yes, I think it is very useful.

CHAIRMAN GARRICK: The other thing I want to mention in that regard, because you touched on this as well is that this issue of assumptions have been described as the curse of analysis. And I think just as important as it is to try to connect the supporting information and evidence to your results, it is also important to be as transparent as possible with respect to the implications and significance of the assumptions. And you talked about connecting the supporting evidence to the assumptions. But we know that some of the assumptions do just as you said. They exclude some of the processes.

I think that this kind of becomes a risk communication issue of making darn sure that the assumptions are indeed understood, and the implications on the results are very clear. In the early performance assessments, we saw several cases of where assumptions were made about things like solubility, including the solubility of neptunium.

And you see early in the analysis, that that kind of an assumption and then later in the analysis, the uncertainty of solubility didn't contribute to the risk because it was assumed to be constant.

So those kinds of traps need to be exposed very clearly. And so I would say the diligence that you've applied to the evidence supporting information should also be applied to making the assumptions as transparent as possible.

The other comment is you indicated in your model, there's the explicit chemistry, for example, is not in the model, but the effect is. I think that is another category of sort of assumptions that need to be made very clear in terms of what the consequences are. There's been some criticism about some of the performance assessment models, that they lacked adequate mechanistic models with respect to some of the processes.

I'm not advocating they ought to necessarily be more mechanistic, but I am advocating that when you use a surrogate for a mechanism that you need to be very clear on how that affects the outcome and what -- how much uncertainly has been introduced as a result of those actions.

MR. McCARTIN: Yes, absolutely. The four

different models for dissolution point to that effect. One thing I'll say that when we do the quantitative basis for our risk baseline, we are going to try to bring into the extent possible, and everything is a matter of time and effort, of course. But both DOE performs assessment results as well as EPRI results in terms of that quantitative basis. Because our risk baseline is both on the spectrum of performance assessment results. And they're in the strength of having the different models which do have some different concepts.

You know, I point to one, matrix diffusion in the unsaturated zone is more prominent in the DOE model than in ours. And kind of oddly enough, matrix diffusion is more prominent and more significant in the saturated zone in our model than we think it is in the DOE model. So having that in there and being able to understand why, some of that is assumptions in the conceptual model, etcetera. I think our basis is strengthened by trying to account for these different approaches.

MEMBER RYAN: We probably have time for just one or two more questions.

DR. WEINER: This may be a simplistic concept that I'm trying to understand about performance confirmation. First of all, to your comment about taking your examples your comment about your not talking about solubility but a surrogate to solubility. I'd have to ask the EPRI I suppose, or your performance assessment, know why solubility and the reaction rate of solubility, rate of solubility and solubility equilibrium are very straight forward chemical concepts. So I see no reason why they shouldn't be in the model. But that's neither here nor there.

MR. McCARTIN: One thing on that. We do have solubility limits in our model.

CHAIRMAN GARRICK: I was talking about some earlier models just as an example.

DR. WEINER: Okay. The point I'm trying to make is find the point in both of these examples I'm trying to do where you are really looking at performance confirmation. And it seems to hit on in some of your closing statements the confirmation for your first example, your solubility example is the range of solubility appropriate, correct, or does that need to be defined further or confirmatory experiments yields something different and you have to do the whole thing again.

In the second case, by the same kind of

reasoning, is the range we're looking at appropriate, is that what your experiments have yielded? Something else as far as the range. And I just encourage you to identify very clearly what the confirmatory principle for each.

MR. McCARTIN: Sure, I would agree. Now it was merely the dissolution rate, not the solubility, but that's not important. It is more or less we were trying to walk through the process and we haven't got to that last step where let's lay out the evidence. When we do that, that's the logical step to take is what, given this evidence and understanding how it evolves out of the risk insights, what is the right things to look for confirmation and in what manner?

DR. WEINER: I think this might also help you in communicating the performance confirmation.

MEMBER RYAN: One last question for Tim from Bob Bernero.

MR. BERNERO: Tim, yesterday we heard some speculation about the possibility of DOE reporting performance confirmation results or information to NRC with some kind of a hierarchy of urgency. You just described an independent review process, an iterative overall approach to risk inform and trace down to the evidence.

Would you agree that what NRC expects is that DOE's process will be iterative tracing down to the evidence received from performance confirmation and any other sources, and iterate internally that the results of performance confirmation aren't to be presented to NRC unevaluated, but to be digested within the DOE license applicant process?

MR. McCARTIN: I just want to be careful with some of your words. In terms of the degree that DOE should. The process that we laid out I think is one of that's logical, that you would want be able to trace through down to the evidence and be able to go back, and we would expect DOE to think through that, whether they do it in this manner, I'm not going to, there could be other approaches equally invalid.

In my mind, in terms of if I'm thinking through the problem, this is what I would want to do. This logic makes sense to me, but I think in our review of what DOE gives us, we would certainly think through the evidence back through the risk this way.

MEMBER RYAN: I would ask that panel members perhaps hold their questions until a little later at our break time and maybe we can catch back up with Tim. I know you'll be here for the rest of the day and tomorrow is panel discussion and questions, so maybe we can hold the comments until then. Next up is again Jeff Pohle from the NRC who was with us yesterday and welcome back.

MEMBER POHLE: Thank you and good morning.

MEMBER RYAN: Good morning.

MEMBER POHLE: Bob raised the question again, I think it suits well that this topic. Maybe I'll address your question about having to raise it again. There's approximately 28 pages in the YMRP that deals with confirmation and to put all the criteria in there in a visually legible slide would probably take 75 pages and I'm scheduled for 15 minutes, so I wanted to keep this to a minimum of necessity.

An interest to the working group is expectations. How do we communicate our expectations to DOE, what we want from DOE in terms of performance confirmation? Looking back historically over 20 years on the record in developing regulations in Part 60 to Part 63, it is clear we knew there would be uncertainties involved in this project. We knew then there would be uncertainties existing even after a licensing decision was made. So I think it was hoped and intended that a performance confirmation program would really represent a continued or a continuous confidence building process, not only for the technical community but for the public in general.

At the highest level, I think our expectation on DOE would be for a performance confirmation program that challenges their performance assessment, challenges the assumptions underlying their performance assessment. And our expectations would be that DOE would take advantage of a permissive regulation to develop a program management process for performance confirmation that would express this as a mission goal.

Of course, the devil is in the detail. And so the first challenge really is to determine as aptly put yesterday what they want to do and why. Next slide.

(Slide change.)

MR. POHLE: Now the review plan is broken up basically into four sections dealing with the four primary sections of Subpart F. In the first area, just we'll deal with the general requirements. There's a number of criteria that harkens back to the engineered and natural barriers. And one aspect of this area, I'd like to stress the importance of the program management aspects. We've dealt with Tim dealing with risk, a lot of the technical details and the scenario that DOE realizes that they're going to have to address in revision three.

But there's a lot of opportunity in there to express what their provisions are for implementing the program. So I want to highlight that. We'll have to deal with potentially adverse impacts to the program, establishing the baseline information, monitoring and handling the changes from the baseline, terms for a periodic assessment and updated performance confirmation plan. And that gets back to Mr. Bernero's comment. There's opportunity in here for DOE to develop a strategy which allows for periodic reevaluations, reassessments, updating the plan in terms of their own control and self initiative.

So there's opportunity here for DOE to do that. Let's go to the next slide.

(Slide change.)

MR. POHLE: The next three areas are review. First deals with geotechnical and design perimeters. The following section deals with the design criteria in the context of engineered barriers and then the last section deals with the waste package.

The two middle sections are similar in their structure and review plan. There's a lot of criteria, but in terms of expressing our expectations to DOE, the criteria in there deals with the same criteria points Tim just dealt with, risk, uncertainty, evidence. But it also deals with a fourth point he didn't get into, and that is methodology.

If you allow me a moment, I'll read a couple of items to see the way the language is used to deal with these items. For example, geotechnical and design parameters in the U.S. Department of Energy will monitor and analyze our selected using a performance based method that focuses on those parameters that could affect health and safety. That establishes an expectation that their decision on what they want to measure you should consider risk.

Now questions arose there may be situations where and when do you stop the activities. When do you know enough, when do you need to end it, really deals with the question of uncertainty. Now you try to address this in the criteria in your review plan, and there may well have been better ways to write it. But one criteria we would consider is DOE has justified excluding any geotechnical and design parameter that is important to waste isolation. And part of the justification would be the evidence, that is, what is the current level of uncertainty with that. I can't think up an example, and perhaps gravity. It may be important in certain equations but I can't see a significant need to do confirmatory work on something that well known.

And we also have criteria in these areas dealing with the evidence. That is, there's a requirement in the rule DOE has to provide baseline information and we will review that and consider it. That baseline as used in regulation basically is the evidence. And the criteria, for example, the baseline of selected geotechnical and design parameters considered all data available at the time of the submittal. So we're going from risk, uncertainty, to the evidence, and the end point in the review would be a criterion like this, monitoring, testing, and experimental methods that are suitable for the nature of individual parameters in terms of time, space, resolution, and technique. And there's a statement instrumentation.

So we go to the next step, which Tim did not deal with in his presentation, that is getting into review of the detailed testing methods. And that basically is the process in this area, this area is primarily dealing with the natural system. Next slide.

(Slide change.)

MR. POHLE: The next area deals with engineered systems and components, which is really a euphemism for the engineered barriers. And a similar process will be used by the staff. Our expectations are that DOE will focus on those systems and components based on risk or importance to performance using the performance based analysis. They will justify in a sense based on evidence not doing work on items that may be risk significant.

And certainly the last item, review item, would be getting into the details of the testing methodologies. I just recalled Debbie saying something yesterday that the detail test plans are probably not appropriate to put in a performance confirmation plan. I just wanted to say that's something we can work with. I think the important point is clearly these will be made available to the staff and our only concern would be we have them certainly for planned test enough time in advance of the test to do a review and evaluation and provide comment. So that's not a big concern of mine whether they're in this particular document or not.

Let's go to the next slide.

(Slide change.)

MR. POHLE: Waste packages testing is a bit different in that the decision was made that there will be a requirement to test waste packages. So that's not based, let's say a detailed risk argument on a decision to test the waste packages would not be needed. In this case, the review of the more straightforward into the technical details of the types of tests to be done considering that type of criteria in the plan. Let's go to the next slide.

(Slide change.)

MR. POHLE: One thing that I really want to highlight is to do a review, we need an educated staff. It is just not feasible to review a performance confirmation plan without an overriding context. The staff needs to be knowledgeable about DOE's identification about what the barriers are, what the capabilities for the barriers are. The outstanding concerns or issues in these areas, information not uncertainties, the evidence related to these parameters of evaluated risk evaluations, information from NRC generated risk evaluations.

So you can see reviewers will need this as input, and we understand it is a iterative, evolving process. The difficulty we've had is it just hasn't been feasible to put the level of detail in Tim's examples explicitly into the review plan. Clearly, a product will have to be developed that we can communicate these insights to the staff and to the reviewers and use them as a source of a technical basis for any concerns or comments that we would address to DOE and their program.

And last, the center is a supporting group for us and they have been doing work to enhance their capability to review performance confirmation. Some of the work they're currently doing is generally in the area of instrumentation, in general, trying to look ahead as the types of testing activities the department may do and the instrumentation required, more longer term tasks for doing some work on software requirements for future changes in computer codes, particularly a couple THC codes. You can see that these performance confirmation activities can be very long term.

There will be data sets derived from DOE's program and we're trying to have a very long term vision on the type of tools we have used to evaluate a rather substantial amount of data. Those are the primary thoughts I wanted to highlight and I'd be glad to take any questions.

MEMBER RYAN: Sorry, any questions from Members? John? George?

MEMBER LEVENSON: I've got a couple, Jeff. On your slide three, the general requirements to the objective is to identify tests to determine whether the natural barriers are functioning as anticipated. How do you do that without putting failed waste containers down into the repository in large numbers? How can you demonstrate that the barriers are functioning?

MEMBER POHLE: I was thinking about that actually last night based on your observation yesterday. In DOE's comment, you know they have 0.4 failures per realization and appear to have a program that seemed to try and observe or capture that 0.5 failures somehow in an underground, active, ongoing monitoring scheme. And that I was having trouble with. Does that make any sense? I don't think that it is necessary to interpret that statement as we need to observe a failure. But then again you get into Dr. Hornberger's comment that when you do science, he probably could repeat it better than I could, that the negative versus the positive in your observations.

In any event, perhaps the way -- a way of thinking is a barrier functioning as anticipated would be to look at surrogates, for example, in a waste package. I think its life is really dependent on the environment it is in. And if one focused perhaps on the environment, that provides a confidence builder in terms of your projections of waste package failures rather than --

MEMBER LEVENSON: Jeff, my point was for the natural barriers. I could visualize tests for the engineered barriers, but the wording here is not to say do tests which might indicate whether natural barriers would function. This says tests to determine that the natural barriers are functioning. But that can't happen until after you've had failures.

MEMBER POHLE: I think the perspective would have to be on the --

MR. PEARCY: Jeff, it might be useful -- this is English Pearcy from the CNWRA. It might be useful, Dr. Levenson, to remember that the regulation requires such testing where practicable. And where it is not practicable, it would not be expected.

MEMBER RYAN: Jeff, just another comment. I think it sort of gets to the point that we discussed yesterday that you really have to think about what is the purpose for a particular test or measurement or suite of measurements, what is my goal? You know, and it has to be focused on some particular aspect of performance, whether it is natural barrier, engineered barrier, or whatever it might be. And is there, you know, a two-part use for it. Am I demonstrating compliance in some way? That is, how do I relate to the safety question in the safety case. And two, is it scientific information that enhances my understanding of the system? Maybe as a separate, at least parallel kind of line of thinking about how the system is functioning. So if you tie these tests or measurements, be they natural or engineered or whatever it might be to those goals, it might help you sort through that a bit.

Does that make sense to you, Jeff?

MEMBER POHLE: Yes, it does. And I see the review plans, it is the nature of who we are as regulators, I guess. We're very compliance oriented. DOE has put a process that is very clear, very compliance oriented. And that is good and that is necessary. But when I spoke earlier about building confidence, and really establishing a program to challenge the assessment and the assumptions, that probably is not what, it doesn't translate well into the review plan. I just wanted to make that point.

MEMBER RYAN: Thank you. Questions from Board Members?

MR. PARIZEK: Richard Parizek. Just on this comment, picking up on natural barriers. I was going to ask this question of Tim earlier really. It says well look, what about groundwater flow? And he was sort of suggesting that there would be difference performance if water stayed say in fracture or faulted ash on the one hand versus alluvium on the other. So the question is you could go further with confirmation testing to say that the groundwater flow path is going to be to the southeast, and finally south, or no, it is going to go straight south and stay in basically the ash.

And that's an example of a natural system that could be tested, right? Because performance depends upon knowing whether it is going to go south-east, get into the alluvium or not. If it doesn't get into the alluvium it is going to go somewhere else. The same would be are you going to get seepage into drifts? I mean, can you convince yourself that you're not going to have seepage or might you see evidence that there is seepage. And that's again, something can be tested. There are certain things seems to me confirmation testing can address on natural barrier performance that you depend on, but you really can't wait around to find out whether it is working, right?

MEMBER RYAN: Jeff, maybe you can react to that.

MEMBER POHLE: Yes, that sounds absolutely correct.

MEMBER LEVENSON: I have a couple of other questions. On slide four, where you talk about the surveillance program which might lead to changes in design or construction, is that intended to suggest that maybe you'd like to see a staged repository application?

MEMBER POHLE: There's nothing --

MEMBER LEVENSON: If you want to change construction, you can't do it after it is all done.

MEMBER POHLE: I plead an attempt merely to conform with the language in the regulation, and the underlying intent in that context, I would not read that into it.

MEMBER LEVENSON: But I guess that's a generic question. If the staff has trouble reading what the intent of the regulation is, it makes it even a little more difficult for the applicant.

MEMBER POHLE: I think it just recognizes that again that downstream, new information could become available, and you have to adapt to deal with it.

MEMBER RYAN: Follow-up comment?

MR. CAMPBELL: This is Larry Campbell. Like any part of the regulation, be it nuclear power plants, the MOX Facility, or Yucca Mountain, when new information becomes available, the licensee has the responsibility to do an impact analysis. Once that analysis is done, if it means some design aspect of the plan is inadequate, there may well need to be rework of construction activities. Or if the impact analysis shows there's no impact, there would be a non- or minimum impact. So there's always a potential when new information comes in, that it could impact design, construction, or some operation or need be a preclosure activity.

MEMBER LEVENSON: I think we understand that. It is just an underground repository is a little bit different than an above ground structure. I guess my question, which I had about evaluating effectiveness of ramp seals and stuff, the answer by the same thing, if practicable, you asked before. I have one other question and that is the monitoring and testing of waste packages including a plan for monitoring the condition of waste packages at the geological repository operations area, what does that mean? Is that above ground or does that mean underground? It doesn't say in the repository, which is what confused me.

MEMBER POHLE: If you have a moment, let Tim look up the definition. It has been awhile since I looked at the exact definition. Whether that includes surface facilities by definition or not.

MR. McCARTIN: It's everything.

MEMBER POHLE: I know it includes subsurface. The question is did it only refer to the underground facility or does it include the surface facility. Which implies --

MEMBER RYAN: John Kessler, question? Comment?

MR. KESSLER: I guess I just want to observe that there seems to be a fundamental disconnect between what NRC seems to be emphasizing in performance confirmation and gee, almost everything else for that matter. And what we heard yesterday from DOE, and that's the relative importance as Chris pointed out in his open talk between overall risk and what we heard about risk informing, which I think is really more potential risk or perceived risk that really gets down to individual barriers. Almost what I heard in Tim's talk, and now in Jeff's talk describing what is in the YMRP. His emphasis is on every single barrier, regardless of its individual contribution to overall performance.

If DOE is calling it out as a barrier, it seems as if NRC is going to ask them to defend it equally, whether it is the waste package or whether it is the saturated zone. That is very different than what we heard yesterday from Debbie Barr and the rest of the DOE PC team, in the sense that they were looking at more overall risk. What concerns me is there is now, there seems to be a lot of emphasis on every single barrier as long as it has some potential risk reduction. It is therefore important.

To me, I'm concerned what DOE is proposing is different than NRC is asking for in terms of relative importance of individual barriers in terms of level of detail that gets to George's question about gee, do you just have to follow the literature versus doing a full blown experimental system? As well as you know, how many tests do you do on waste package versus saturated zone?

I mean, we heard from DOE yesterday. Saturated zone was relatively unimportant from them.

We heard from Tim this morning that saturated zone is important, and it is the perspective that the two organizations are taking that is fundamentally different, that gets at not only performance confirmation, but I think the whole license application as well. And the sooner that you two talk is better.

MR. McCARTIN: Yes, I guess -- Tim McCartin, NRC Staff. I guess I'd like to respond a little bit to that. I don't believe we are disjointed from overall risk in what we're seeing. I understand what you're saying, and I may not have been as clear as I should have been. But certainly we are looking at, yes, the potential to contribute to overall risk. And let me just talk through this a little bit.

I mean, one of the issues if you just look at the performance assessment of DOE, there is one quarter of a waste package failing over ten thousand years. Guess what? Nothing else matters in that performance assessment for ten thousand years.

I can do that on the back of the envelope. I can tell you that the risk will always be acceptable if all I have failing is one quarter of one waste container. However, there are in terms of safety for a repository, there is a multiple barrier requirement.

That requirement is very important in our regulation. And the question is what are the other things that are going on in that system, now, with respect to what if more containers failed? What is going on in that system?

When you look at the overall risk, I'll say I look at neptunium and that is the largest dose contributor. And with that, what is the reliance? Now in our particular performance assessment model, and as I said we need to go through all the things. There could be releases that affect neptunium, solubility limits could affect neptunium. But also part of that is the natural system, the alluvium has the potential to significantly retard the most important radionuclide for overall risk. And that's why neptunium, we focus -- that is important.

Now with one quarter failing waste package, it doesn't matter. It is never going to show up. But it is thinking through that from a safety standpoint, what makes this repository safe, it is the one aspect as my good friend defense-in-depth. That's the multiple barrier requirement. We have an engineered system, the waste package. The natural system has a contribution, and that's why that part is there and of that natural system, the alluvium is very, very important.

So it isn't that we're trying to carve out for every barrier, because we would look at other parts with -- how significant is this to the overall dose? Alluvium KD in our model is very important. But it will be what the Department is taking credit for.

MR. KESSLER: Okay, fair enough. I recognize that the multiple barrier requirement is there and we agree that it is a good one. What I'm asking for is this degree of emphasis that you know, George and Chris and a bunch of us have talked about in the past couple of days. You know, Debbie has given a proposal which is there at least some performance confirmation activities for all the barriers that they are at least claiming right now they're going to proceed into licensing with. And however, the relative weighing of the amount of work is based on the relative overall risk importance. And so my question to NRC is, is that what you have in mind in terms of a balance between overall risk and barrier importance? Or is it something else? I mean, are they getting it fundamentally right philosophically, let alone the details or are you looking for something else?

MR. McCARTIN: Well, we continue to talk with the Department, but I believe they are giving us the information to understand how the capabilities of their barriers relate to the overall risk. It is, I wish it was a binary decision. Yes, no. It isn't. There is a opinion, there is a lot of subjectivity.

MEMBER RYAN: Okay, I would like to close this discussion up. We can certainly cover this in the panel discussion. We don't want to devote too much into an individual debate.

MEMBER POHLE: Can I make one closing?

MEMBER RYAN: Yes, please.

MEMBER POHLE: The debate is good, the regulation is permissive and silent on such a fine point.

MEMBER RYAN: And Jeff, I think you're hitting on things that hopefully we'll bring out in the panel discussion as key points. I mean, this is very fruitful, but to fair our next group of speakers, we have six folks who will be speaking in two hours. So we have a busy session ahead. I want to stay exactly on schedule. We will start promptly at 10:15. Thank you.

(Off the record.)

VICE CHAIRMAN RYAN: Again, we have six

speakers. I would ask each speaker to think about their 20 minutes, maybe perhaps using 10 or 12 minutes or so for comments and the remainder of that, 8 minutes or so, for questions and interchange. And we'll hopefully get through the next two hours as well as with good information and relatively close to schedule.

First up is Les Bradshaw presenting Nye County's views on performance confirmation and related topics. Welcome, Les.

MR. BRADSHAW: Thank you.

12) PRESENTATIONS BY REPRESENTATIVES OF THE STATE OF NEVADA, SEVERAL AFFECTED COUNTIES, THE LAS VEGAS PAIUTES, AND THE ELECTRIC POWER RESEARCH INSTITUTE

MR. BRADSHAW: I am very pleased to be here. I appreciate you all folks with your public service and serving on this Board in these capacities. We appreciate your efforts.

We are, of course, vitally interested in performance confirmation. We are as interested or probably more interested than anyone in the country on the long-term site performance and whether it behaves as advertised and whether it will do what it is supposed to do.

I would just point out that Nye County

views the Yucca Mountain project as a planned environmental degradation project. It doesn't promise containment. It promises release of harmful materials in a way that won't hurt anybody, with time and distance being our best allies in this regard. So we feel it's important for us to understand the mechanisms by which harmful materials may be disbursed away from the repository.

We have to put this in the context of many other activities happening within Nye County and on the test site. We believe that we have been good soldiers over the years. And we believe that we can work constructively with DOE and the nation on this project if we can be involved with it.

We do urge everyone involved in this project to reserve the right to get smarter as we go along. And I believe we have heard that theme today and yesterday as we have talked about this, that this is a cumulative, iterative process, that we are building a bank of data and knowledge that will help us change things in the future as new data, new technologies, new methods, and new thinking come along that will help the repository be better.

The next slide. We have talked enough about that. We are glad that the performance confirmation program is coming out. We applaud DOE on this. We hope that they will go forward. We understand from listening the last day or so that there are a lot of issues yet to be resolved and a lot of thinking to be clarified on how this will actually go forward and be implemented.

I don't think we need to review the next slide too much. I put this up for the state, the regulatory requirements. Baseline information is important. It's time to start collecting that in some cases. And in other cases, baseline information is being collected and can be added to this cumulative database, upon which performance can be judged.

We hope to be involved in that as the years go by. We believe that we are involved in collecting some baseline information. We hope to be involved in the future.

The next slide again reiterates our hope and belief and our aspiration that a performance confirmation program will be put into place that is sound, is well thought out, and that has independent stakeholder confidence and that we as people who are directly involved can have input into that performance confirmation plan.

We are not going to spend a lot of time

talking about perhaps DOE should have done in the past and how far along or behind they might be. We believe that they're working as quickly as they can with the funds on hand and that because of under-funding in the past, perhaps they're behind on some things now.

The next slide. Qualified outside oversight and participation by people that are outside of DOE and outside of NRC is essential to public confidence in the performance confirmation plan.

People won't believe what the government agents say, you know, just out of hand. We have a habit in Nye County of not believing, in fact. We have been bombed. We have been strifed. I am being a little facetious, but they crash their airplanes in our communities. Their little rockets go off course and crash.

If you talk to some folks in our vicinity about these huge dust clouds that rolled across the landscape back in the bomb-testing days. And then the federal agents showed up and said, "Don't worry. This won't hurt you." We have a natural tendency to want to be directly involved.

Congress has allowed outside entities to participate in this process. We think that that is important. It's vitally important that outside people review the plans, input their own independent assessment of the databases, the work that is being done and that the long-term institutional knowledge about Yucca Mountain be preserved in a way that will allow us to have this cumulative database readily at hand.

There is nothing in place now that assures us that over the long term -- and, remember, we are looking at this government project as it has a longer-lived time line than any other government project that has ever been undertaken except maybe Social Security. And there is some doubt about that.

We are going to be involved with this for the foreseeable future, for generations into the future; whereas, how is the institutional knowledge going to be preserved? We think that we can help with that. And we think that the nation ought to think about that.

This project, as you know with all government projects, is subject to annual appropriations, congressional elections, and presidential cycles. We're a little fearful of that mechanism for long-term stability of this project.

Next, please. We have been involved in our independent scientific investigations program for the last five or six years. We believe that we have contributed in a productive way. We have participated as a constructive entity in the Yucca Mountain program. We believe that we have demonstrated that other outside entities that have a vital interest in the outcome and performance of long-term success of the Yucca Mountain site can be effective participants and can work in a constructive way with all of the other statutorily based regulatory and implementing agencies.

We hope that as time goes by Nye County can continue to build its I'll say reputation, its programs in such a way that people have confidence in them that they are actually contributing in a significant way towards the database upon which performance confirmation can be based.

The next slide, please. We think that we're best qualified and we are most interested in the groundwater regime in and around Yucca Mountain as this will be the main mechanism by which radionuclides are slowly disbursed or out towards the accessible environment.

We all know, those of us who work with the project know, that this happening won't be for a number of 100 years in the future, that the first waste package will probably fail sometime well into the future and that there is no particularly immediate radioactive danger to the groundwater system in Nye County in the immediate future.

However, people just generally don't believe that. They just want the assurance that Nye County, their own governmental entity and the programs that Nye County has understands the project and that it gives its own independent assessment of DOE's work.

We also look at the NRC and its agencies, like yourself, as our last safety net. We think there are, in fact, three levels of barriers out there. There are the natural barriers, of course; the engineered barriers; and the NRC's oversight of the project. You are the ones with the big stick to make the Yucca Mountain project the best that it can be, make it work so that it has the confidence of the people that live in and around Yucca Mountain.

The next slide. We are working towards developing additional expertise in the future to be able to be an effective participant. We think that we can best participate by having some role in monitoring the natural environment, both surface and subsurface indicators.

Those are the things that we are most

interested in. They are the things that we have been working on in the past. We also think that we could help by being a part of the data storage and the long-term archiving of data about Yucca Mountain. And we're positioning ourselves to be able to do that.

Next, please. I think the next slide, which would be ten, is somewhat repetitive of the things that I've said. Let's go on to the next one in the interest of time.

The difference between performance confirmation work and R&D that would support the long-term operations of the repository, there have been discussions about that in these sessions. And I'm not here to make some bold pronouncement of where that boundary is.

We are saying simply that they both need to progress along this track of cumulative knowledge. We will leave it to you folks and others, DOE itself to decide what is an R&D project and what is a PC program, but we are suggesting that both of these items or both of these activities march along concurrently, perhaps not hand in hand. Each of them has a different track, but we need to be able to look at the repository as the years go by and incorporate new technology, new thinking, new information, and new ideas. And the repository in 100 years may be quite different than what we envision it to be today or at least have significant improvements.

Next, please. Well, I've said enough about that. Let's go on to the next page, number 13. The budgeting for this issue, as I said, we are a little nervous about the next 30 or 50 congressional cycles, maybe the next 150 appropriations cycles. We don't really have that warm fuzzy in our hearts that this project is going to be adequately funded as the years go by.

The last thing we want is to have some white elephant, haywire, bubble gum, and bailing wire type operation orphaned out in Nye County in 50, 80, or 100 years or whenever the nation loses interest in this issue. Somehow we are going to keep working for adequate funding, for keeping this issue on the front burner with the nation so that we don't end up with a goofy project.

Now, I am not saying that we think that that is happening today. People that are working on this, there are probably 1,500 or 2,000 of the brightest people in the land working on this project. We hope that that continues, but this level of thinking that we have seen here today and yesterday and at other meetings and at other times can continue to input into this project to make it the very best that it can be.

In summary, the last slide, I just want to say that. I mean, I want to summarize by saying that performance confirmation is important. We hope that DOE marches forward and gets the performance confirmation. Rev. I guess 2 is coming out. And if that comes out and we can all look at it, PC programs and R&D programs, you folks differentiate and distinguish between those but get these programs marching forward.

Get the R&D that is necessary in place. Get it funded. Get the PC programs defined and outlined and started. Some of them need to be started now. Some of them need to be continued from existing programs. And so if we lose too much more time, we're just going to be that much uninformed as time goes by.

Qualified independent entities should be able to oversee or by participants in this. EPRI is an example. Nye County thinks that it should have a place and can fill a place. We can be a niche entity here. We are not suggesting that we are going to be the big lead agency on this, but we think that we deserve a role and can fulfill a role in a constructive participatory way.

Let me just comment that in Nye County, people regard the Yucca Mountain project generally as a good thing in the sense that it appears like it's going to happen. Everyone is acting like it is going to happen. People are going forward as if it might happen. Plus, there are some milestones to be met. And there are people that are trying to make it not happen. We leave those battles to those folks. They have much larger sticks and more energy than we have.

But if it happens, our view is that it should be the very best that it can be. It should be a first-class, world-class operation. It should be funded in a way that allows the best minds in the land to continue working on it, and that to have the public acceptance and public confidence that it needs to have in order to be successful, the local government needs to be involved, the local communities. And I am talking local in the sense of not just the Town of Amargosa Valley, which is right there, but the people that are going to be impacted physically as well as financially and socioeconomically should be involved.

We appreciate all the efforts that go into the thinking that will make this repository one that will protect the health and safety of the residents of

Nye County. Thank you so much.

VICE CHAIRMAN RYAN: Thank you very much.

Les, do you have a few minutes for any questions? I will ask one. Les, you mentioned a role for Nye County on into the future. Of course, that has today, near term, and long term. Could you maybe give us a few extra thoughts on that point?

MR. BRADSHAW: Yes. We think that the model that we have now, the independent science program that we are conducting -- and we are funded by DOE for that. We don't have some other outside funding -- that is the role that we would like to continue or to see happen.

Now, the Nuclear Waste Policy Act in my understanding would tend to sunset that entitlement or that right at some point, but we hope that the nation sees fit to allow Nye County to have a group of scientists that can stand toe to toe with the DOE and the NRC folks and others that are working on this project, that we can be able to have the ability to understand the issues, to contribute to the resolution of issues and problems, and that we can transmit our own sort of warm, fuzzy feelings or our uncertainties based on our independence, that we can transmit those to our constituents, the residents, first of all, of

Amargosa Valley, the town that is there.

By the way, when they take you up on top of the mountain and they point you south and the tour guide says, "Isn't this a fine place to put Yucca Mountain? There's no one out here," we hope that you will get your binoculars out and look closely because where you're standing is within about six miles of the boundary of a town. The town has a town board form of government. They have libraries and schools and fire stations and police functions and so on. So it's not all that remote.

And the Town of Beatty is over this way about 13 miles. And the Town of Pahrump is close by, within the 50-mile radius. There are probably close to 40,000 people who live within that 50-mile circle.

So we are working to be a credible -- I don't want to say "partner" but a participant. In the model that we see, there are a couple of models out there, but the institute that was formed at Carlsbad that was a part of the Civil Engineering Department of the University of New Mexico, there's a scientific institute there that is funded, set up. They have buildings and equipment and people that can do the independent type of work. That would be one model.

We haven't gotten to the point where we

have set up something as specific as that, but that is what we have in mind.

VICE CHAIRMAN RYAN: Thank you very much.

Our next speaker is John Walton. John is at the University of Texas at El Paso and will address us with some observations on performance confirmation and performance assessment on behalf of Nye County.

MR. WALTON: Go ahead and change the next slide. I am going to tell you about some observations we have on monitoring, some of the impacts that will occur in Nye County, and also some issues with performance assessment. We are just going to touch a few highlights and hopefully generate some interest that leads to better performance confirmation.

One of the first impacts, one of the things we do in this game is we tend to focus on low-probability events, which may never occur. But there are also some higher-probability events that probably will occur. And this is an example of one.

We are interested in our groundwater, but there is also the ecology of Nye County. One thing that happened is we put the waste in here, and it's going to heat up the mountain. And that is likely to lead to some increased advection. And that advection may lead to air coming in here, going out there. And it doesn't really make any difference if I have it exactly right or not.

That air is likely to cool and dry the soil near surface. And this air, at least in the winter, is likely to warm and humidify the soil, add moisture to the soil up on top of the mountain.

Well, desert vegetation responds very rapidly to small changes in temperature and moisture. Next slide. So the sequence is the mountain heats up. That warms the soil temperatures by a degree or two above the mountain just by heat conduction eventually. The breathing of the mountain increases. And you would expect to see change to flora and fauna over time periods of tens to hundreds of years.

Well, if you live in Nye County, that itself can be important. And it could have secondary importance; that is, if there is more vegetation grown on Yucca Mountain in 1,000 years and we're relying on the nitrate that percolates through to lower corrosion, well, perhaps the vegetation is going to absorb the nitrate we're relying on for performance. So there could be feedback in there as well as just the changes to the county.

So perhaps we could do a preconstruction vegetation analysis looking at slope and aspect and elevation so we could try to predict what will occur in the future.

Next slide. There are a number of unresolved issues in performance assessment. We will just highlight a few of them. One of them is the drift roofs. If you talk to some geologists or mock mechanics types of folks, a lot of them will tell you that they expect to see the roofs collapse over time periods of tens to hundreds of years.

If you talk to most of the modelers, the modelers will say, "Well, our model assumes that the drift stays open from now until eternity." Well, it makes a pretty big difference. Rubble is relatively good insulation, at least compared to an open drift. And things can get complicated.

If it collapses over here and not over here, then not only do we get unpredicted temperatures and relative humidities, but we can get strange conduction cells. So we get a situation that is difficult to predict.

And so we need to either decide if we're going to collapse or not going to collapse and if we can't really figure out if it's all going to collapse or not, perhaps we need design change, such as backfill or something else, that makes it immaterial whether the drift is open or not. So that seems to be an unresolved issue.

Next slide. Natural ventilation. I talked about natural ventilation a little bit. What happens it he mountain will breath by advection. This process is really not fully in a lot of the performance assessment models. They tend to be conduction only or make simplified boundary conditions. And it's important for heat and moisture transfer, particularly as your predictions go out in the future. The longer time period you go, the more the breathing is important. And so this may be an error term in some of the performance assessment models.

Another issue out there is uncertainty relative to variability. That is, the real world has natural variability, but we also have uncertainty or ignorance about those processes. And in our models, we tend for the most part to lump the two together. There is some separation, but for the most part, we lump the two together. There is a concern that this could lead to dilution or lowering of the risk projections.

My feeling as an engineer is that sometimes when I get fuzzy concepts, I like to do some calculations because it I think sometimes provides clarity.

So I, next slide, did a simple little calculation. I made up a simple little pseudo PA code. It just has four processes. It has corrosion in that sample variable. It has a release rate that is sampled, release rate. It has a transport lag time. And then we define an event. An event is unspecified except that it fails the rest of the remaining waste containers when it occurs.

The units are not really arbitrary. They are dimension-less, but they are not really important because we are just going to compare two simulations, do 1,000 realizations, Monte Carlo. All the parameters are normally distributed.

And the way we do this is we assume we are God for a minute or since I work in a university, I can assume I am like one of my colleagues who know everything. So if you are all-knowing, then you can define exactly what occurs.

Each realization represents spatial variability. That is, the containers over here have a different environment that the containers over there. That's reflected in the results.

So we do that simulation. And then

because our metric is the peak of the mean, we take the mean of those 1,000 realizations. Then I do a second simulation, where all we do is take one parameter, increase the standard derivation of that parameter, which, as John, to pick on him, the other day said, "That's conservative. You increase the uncertainty range. That's conservative."

So next slide. Okay. Here are the two results. This is the mean of 1,000 realizations. The red one is the God simulation. That is, it's what actually is defined to occur. And the blue one is where we take one parameter and we increase the standard deviation.

Well, contrary to popular expectation, in this case, the risk is actually reduced because we measure it as the peak of this mean of the realizations. And so the peak of the blue curve is lower than the peak of the red curve.

Why does that occur? Well, what happens is sometimes when you modify a parameter, each of the individuals of the 1,000 realizations will have its peak occur at different points in times. That is, the peaks of the individual realizations will be spread in time.

And so when we do a mean of that, what

happens is the curve, the mean curve, the blue curve, tends to broaden and flatten relative to the red curve. That is, the projected risk is lower. We have actually improved our performance by our ignorance. That is what my students try to do sometimes, improve their performance that way.

Next slide. In this case, the inclusion of uncertainty reduced -- when we put uncertainty in, we improved our performance. And it has something to do with this metric we'll use, which is the peak of the mean of the realizations.

Now, what I showed you is not a general conclusion. Sometimes if I change different parameters, rerun the same simulation, the risk would increase when I broadened the parameter rates. So it depends on which parameter you broaden and what part of it it is. It's complicated. It's not obvious what is going to happen.

Again, -- and it's a result of the metric we use, and it's really difficult to say a priori what parameters when you expand or contract the range, how they're going to change performance.

What does it do in TSPA? Well, we don't know. One of the questions would be, why don't we know? We see a lot of one-off analyses. We see one-on analyses. Why don't we see if somebody from DOE can come up and address the question of when is a broad uncertainty ban conservative? When is it non-conservative?

Another way to say it is if I am a DOE manager and somebody wants to do some study on the KD off neptunium, do I really want to fund it because, after all, maybe I am taking credit for the fact that I don't know it.

Next slide. So that's the conclusion. We are just trying to put some concepts out here, maybe get some discussion. We think that local involvement is crucial to performance confirmation because otherwise you tend to get in group think and you don't get as many ideas. And we think Nye County should be involved in that.

So that's it. I've tried to be brief.

VICE CHAIRMAN RYAN: Thanks very much.

Questions? Milt?

MEMBER LEVENSON: I had a quick question. I am glad to see people looking at the breathing of the mountain. That is a thing that has been of interest to me for some time.

Just a quick question. Have you -- one of the things I don't know -- I hope maybe you have looked at it is -- what is the relative amount of air that moves through the mountain by breathing which would be affected by this compared to the amount of air moved in and out of the mountain by barometric pumping? Is the thermal effect an important one or is barometric pumping a major effect?

MR. WALTON: Good question, haven't really looked at it. Unfortunately, most of the issues I raised were pointed out as we think that is important and needs to be looked at, but I don't have an answer for you. Sorry.

VICE CHAIRMAN RYAN: Yes, Ruth?

DR. WEINER: I'm sort of a number and detail person. I was looking at your slide titled "Sequence of Events." You haven't got the slide numbered. It's like the third or fourth, where you say the mountain heats up and increased natural breathing and so on.

Could you supply me with the calculations that went into that? I know you can't do it now, but I would greatly appreciate having that.

And, in addition, on the unresolved questions, you say many analysts anticipate roof collapse in tens to hundreds of years. And I wondered if you could supply one or two references for that.

That's just these are details. And I don't intend that you answer them now, but I would appreciate having that information.

MR. WALTON: Right. The first question I can tell you is that we don't have regular information on. I am raising a process that I think is probably important.

In the DIS, I think DOE had some projection of two or three degrees C increase in near-surface soil temperatures. I haven't seen any analysis of the advection component added to that. So on that one, I don't know of any study that does it. It's just something I believe will probably be important.

DR. WEINER: So your statement here, "The mountain heats up. There is increased natural breathing, changes to flora and fauna on a scale of tens to hundreds of years," there is nothing quantitative that you know that you based that on? Is that correct?

MR. WALTON: That's right. I'm saying that I believe the changes were big enough that they may change the flora and fauna. I don't have any proof.

DR. WEINER: You haven't done a

calculation?

MR. WALTON: I haven't done a calculation that would have proved that. I'm just putting out a process that I think has been ignored and shouldn't have been. That's all that is, no calculation at all.

VICE CHAIRMAN RYAN: John Garrick?

CHAIRMAN GARRICK: Just a quick one. You mention in one of your slides about heating up the mountain will result in changes to flora and fauna. Do you have any sense of what some of those changes are and how many of them are positive and how many of them are negative?

MR. WALTON: No because really what I am doing is putting out a research question I think needs to be looked at. Which are positive and negative, I think if more vegetation grows on top, that is probably positive because they pull out the nitrate because a lot of plants are nitrogen-limited. So performance-wise I think that's positive.

I suspect you could figure that out by calculating the predicted changes and then looking at solar radiation and elevation levels on the mountain and what grows where. And by doing that, I think I could predict the changes.

CHAIRMAN GARRICK: I guess my point was

that these kinds of changes are not all necessarily negative.

MR. WALTON: No, no, they're not necessarily --

CHAIRMAN GARRICK: It's like the warm effluent that comes off of a nuclear power plant, that some of the best fishing around is around that warm effluent.

MR. WALTON: And it can be alligators. No. It's not clear whether it's positive or negative, but it is a change to Nye County in a potential impact on repository performance. And so I am just saying maybe we ought to look at some of these things that we expect to really occur.

CHAIRMAN GARRICK: I was just thinking of the public perception of the comment.

MR. WALTON: Yes, I agree.

VICE CHAIRMAN RYAN: Any other questions, comments? Yes?

DR. WEINER: I'm sorry. This really interests me. I live in the desert also. I live in Albuquerque, New Mexico, as does Dr. Weart. We are right now experiencing the major drought of what is a natural cycle, a natural drought and rainfall cycle.

I was wondering, these changes that you

predict or think are going to happen, how those compare with the natural weather cycling that occurs in the Yucca Mountain area anyway.

MR. WALTON: Again, I don't really know, but I suspect that they might be somewhat similar to natural changes. What happens is that I have done some studies where we look at the sides of a mountain, calculate the solar radiation. And you can show that the plants grow in response to only total radiation, what time of year the radiation occurs.

Now, I would suspect that as you get some subtle change at the top, you get some shifts like that and likely get with climate changes. So I think they would be analogous, yes.

VICE CHAIRMAN RYAN: Yes, John?

MR. LARKINS: I'll try to keep it shorter this time. Good points about risk dilution versus potential risk magnification. I think from a performance assessment standpoint, we have some understanding of which causes which type of behavior.

For example, if you spread your uncertainty bounds too wide on things that cause a wide distribution in release times, you know, the time at which things release or release rates, you tend to lower your peak doses. And I think you must have picked one of those in your example.

MR. WALTON: Yes, I did.

MR. LARKINS: On the other hand, if you pick an uncertainty that is very wide, it may tend to raise everything, say, maybe neptunium solubility as an example. Then if you set that wide, you might get an overestimation of your dose risk. So we have some understanding of which is which.

I like your recommendation about perhaps providing some clarification as to which kinds of uncertainties are causing which behavior as DOE puts together its safety case, puts together --

MR. WALTON: Yes. That is what I would like to see, where somebody from DOE comes and does a hard look at that issue with their PA code and comes and tells some of the reviewers, you know, where it is conservative, where it is not conservative. That's really kind of what that push is for.

VICE CHAIRMAN RYAN: One last question, if I may, on your graphic slide, on mean of 1,000 realizations and this point about that the metric or the value of the metric, which is -- I forget the exact words -- the peak of the mean of the realizations, could we show that curve, please? It's not numbered. Thank you.

Dose rate, I don't know what the units are. So I don't know how to interpret that.

MR. WALTON: What it is is that is fraction of the inventory per unit dimension-less time. And if you look carefully, because there is no decay in this calculation, both of these have an area of one. That is, all of the inventory was released.

VICE CHAIRMAN RYAN: So it's very stylized in its meaning. So the relative --

MR. WALTON: Absolutely.

VICE CHAIRMAN RYAN: -- height may not have really any ascribed meaning? I guess two things strike me about it. One is the integral under the curve is, as you pointed out, one or whatever fraction of one it would be and another set of assumptions. So the collective dose would be the same.

MR. WALTON: Right.

VICE CHAIRMAN RYAN: And it's really only a matter of the temporal arrival of a slightly different peak based on assumptions?

MR. WALTON: Right, which my understanding is what the standard is right now. That's what our metric is.

VICE CHAIRMAN RYAN: Yes. And I guess I view this to be the same kind of analysis, at least in concept, that Tim McCartin and his folks are doing to think about exercising a model to look at variability and contributors and times of interests and all of those sorts of things.

So I guess I would turn your point around and say I don't view this to be a negative. I view it to be a positive because if it's robust and not sensitive to changes or other evaluations or input sets, that potentially can give one confidence that, even under variable circumstances, you are within some reasonable range of the mean of 1,000 realizations or other kinds of risk-related parameters you could calculate.

MR. WALTON: Well, in this case, the metric wasn't very robust. I change one parameter, and I reduce my projected risk.

VICE CHAIRMAN RYAN: You know, a highly stylized calculation, it's robust or not robust doesn't have much meaning because it's very stylized.

MR. WALTON: Right. I don't argue there.

VICE CHAIRMAN RYAN: And you have no error bars on either curve. So it's hard to know if they're even different.

MR. WALTON: Oh, yes. Well, I didn't draw error bars in the curve, but after 1,000 realizations, they're really very stable. You can calculate it a few times and show they don't change very much.

VICE CHAIRMAN RYAN: That's the intrinsic calculational uncertainty, not the error.

MR. WALTON: Well, of course, on the one curve, I defined it to be God. And so there is no error at all except 1,000 realizations. So that is the assumption I put in the calculation.

VICE CHAIRMAN RYAN: I wouldn't take such a bold step in my calculation.

(Laughter.)

VICE CHAIRMAN RYAN: But I appreciate the context.

MR. WALTON: Well, that allows you to do the context.

VICE CHAIRMAN RYAN: Right.

MR. WALTON: You have to make that assumption.

VICE CHAIRMAN RYAN: But, again, I mean, the criticism of the mean of 1,000 realizations as a metric really needs -- I mean, the context in which you are criticizing it is a very narrow one, I think.

Any last question, comment?

(No response.)

VICE CHAIRMAN RYAN: All right. Next up

-- we're doing wonderfully well on time -- Steve Frishman from the State of Nevada. Steve?

MR. FRISHMAN: As you notice, I did what I have often done with working groups with committee before, and that is that I don't commit anything to paper because I think the purpose of the working group is to try to work through issues and topics and not just have paper to walk away with and say, "Okay. We have our stack of paper for today."

In the last day and a half, we've tripped over I think most of the obvious questions that are out there about performance confirmation that we have all, in one way or another, talked about over a number of years.

One point to remember is that this is nothing new to Part 63. Performance confirmation requirement is essentially identical to that that was in Part 60. Its meaning hasn't changed either from what I can tell.

Also it I think now, at least for current purposes, probably without my very detailed review looks like it's been sort of adequately analyzed out of the regulation by the review plan.

So I am not sure that there is a lot to do about a further understanding of performance confirmation in the sense of looking to the commission to maybe reinterpret or further interpret.

I think it's sort of there, but we still have this big question, what is it in terms of the various interests from both the applicant side and from the regulatory side and, of course, from the review side ultimately?

We have to remember, first of all, what performance confirmation is said to be in the rule. I noticed that nobody in the last day and a half has actually gone back to the definition of performance confirmation.

It's probably instructive to remember that it says that it is -- this is without verbatim, but this has sort of stuck in my mind for a long time -- a program to confirm the validity of the information that is used to demonstrate the reasonable expectation, the information used to support the reasonable expectation determination. It's to begin, as was mentioned yesterday and again today, during site characterization and continue through closure.

So let's think about what the real purpose of performance confirmation must be. I think if you -- I didn't do that. Somebody else did.

VICE CHAIRMAN RYAN: It's good, though.

MR. FRISHMAN: Okay. If you put it in the context of the regulatory process, it seems like its purpose is a relatively simple one. And that is just to provide some additional continence in the technical basis for a decision to amend the license for closure.

I think it is probably important to sort of keep it in that context. And the reason for that is a discussion that you and others with the commission and other places have heard from me before. And that is that under the regulation, the disposal decision is made with the construction authorization decision. And all after that are amendments in one way or another, but they need to be supportive of that original disposal decision.

What I see performance confirmation sort of inching towards, even though there are statements to the contrary, is that performance confirmation is the sort of currently available, as Chris put it yesterday, bucket. And I see a danger of unfinished business in site characterization being casually flipped into performance confirmation.

And, in fact, I had a thought. When Tim was doing his presentation today, where if you look at his presentation and just do a few sort of minor word changes here and there, the title really should be

"Risk-Informing Performance Assessment." And then, see, he picked a couple of narrow examples of how to do that.

So we are in a situation where it is pretty clear that there are a number of areas where site characterization is not complete. But, at the same time, there is the recognition that the license application has to be one that is adequate for a decision regarding reasonable expectation that the performance requirement will be met.

So because of the circumstances of this program, we are in this sort of push/pull. And I would be greatly concerned if there were any approach literally on the part of anyone to try to use performance confirmation to overcome this incomplete site characterization and actually get to a point where it gains significance in licensing.

Now, I think probably the key message out of all of that is that the license application review and the hearing should proceed to a reasonable expectation decision without any deference whatsoever to the substantive content of the performance confirmation program.

Performance confirmation is essentially an add-on. And it should have literally no basis in the disposal decision that comes at the time of a decision on construction authorization.

Yes, it's a good thing to do. And it is a good thing to do for a couple of reasons that I want to get into. But it should be, as I said, given no deference, meaning that yesterday's comment from Jim Blink towards the end was certainly a friendly offer from the standpoint of making things operationally a little bit simpler, but it also was sort of a violation of this because what he invited in one of the tough spots was, "Well, make it a license condition." Well, what I see coming is making a lot of things a license condition and a license condition hooked into this vehicle or bucket of performance confirmation so that we get in that situation where site characterization is never ending.

We know that performance assessment is going to go on forever, as it probably should. But that first one had better be demonstrably good enough in every possible way.

So the performance confirmation program itself may be looked at in a light a little bit different from the direction that both I think the staff is going with its risk-informing, a little bit maybe different from the way Chris was describing in terms of pick out what is most important and go after that.

I think there are two things going on. One of them is yes, it is very important to look at the things that are most important, but it's also very important to have a place for the necessary ongoing baseline data collection that is going to come with the fact that if this goes forward at all, you are going to have people doing construction and disturbing type things for many, many years.

And the rainfall discussion yesterday was a good one. You know, what do you do if the rain falls out of compliance? It should not be a difficult question because there shouldn't be a question of whether the rainfall is in compliance.

But what it does is it drops things into sort of two boxes. One is what are the things that are most important, and how do we get at them, remembering all of the time that further major discoveries are most likely to be adverse, rather than in your favor. Things just seem to happen this way.

So we can't get in a situation where you can say that we're looking for good things in the future to sort of make up for what we don't know now. You can't do that. And I have told the NAS committee on staging the same thing.

You can't set up a situation where you expect good things to help you out of what may be just marginal right now. The future isn't going to bring you that unless you are really lucky. It is more likely it will bring you things you don't want to know, rather than things you do want to know.

So looking at the things most important to risk, yes, that is necessary to do because you are in a situation where information is going to be made available throughout this long period of time and information that, of course, is important to what you think now about performance.

There is also a whole bunch of other information that I think the performance confirmation requirement sort of gave an incentive to collecting. And that's just the ongoing information that is available, such as weather, such as you've only got five miles of tunnel right now or six miles, where only a small portion of it is in what the current design shows will be the vast majority of the emplacement rock.

If this all goes forward, it's going to be another up to about 100 miles of tunnel in that rock over a horizontal space that is known to vary from north to south anyway.

And there is data that needs to be collected that we could call confirmatory, I think, if that is a regulatory word we are going to use. But what it tells you or is intended to tell you is if you collect it properly, that that rock has properties and characteristics that either are or are not within the range that were anticipated in the models. This is just a matter of course type of thing that should be done.

There was a question earlier today about as anticipated. Well, what is anticipated right now for the lower length comes from the data that has been collected in a pretty small place compared to the larger area that could be excavated.

"As anticipated" in this case means you look at all of it to make sure its hydrologic properties are within the range that your models were based on. Chances are you will find things that are not within that range. And then what do you do about it?

That needs to be, as someone said yesterday, in the pre-thinking "What do you do about it?" as opposed to the post-thinking "What do you do about it?" because we have a myriad of examples in this program where the answer to "What do you do about it?" is go out to prove that it doesn't matter. And if you think about it ahead of time, that is not your first natural reaction over what you would do about something new in the way of new information.

So I guess what I am urging is that performance confirmation be sort of taken on its face is something that is a way of dealing in an organized way first with data that should, in fact, be collected because it is available to be collected because you're opening new space that can provide you sample that provides data.

Also, it should be taking a very hard look at the performance approach that has been taken and thinking maybe not so much in terms of looking at what is most important, not sort of doing endless reiterations and rethinking about the components of the waste package model. But remember that the most important thing is to go back and look at and challenge the conceptual models on which the performance assessment is built.

If you will remember, it is only less than ten years ago that a monstrous change in the conceptual model of a Yucca Mountain repository had to be made. And it was not expected 12 years ago, but starting about 10 years ago, it was essentially mandatory that it be made.

It's not unlikely that additional data are going to lead to the necessity to make other analyses of whether the conceptual models behind performance assessment are sufficiently representative to be carried forward.

So what I am trying to do is saying that performance confirmation allows a framework to do something that I think would be totally inappropriate, which is be a bucket for everything that is undone, but it also invites something much more rational to be, which is a way of dealing in an organized way with a common sense data flow that comes from the ongoing activity as well as providing information to challenge the real basis of safety, which is a short string of conceptual models that have led to a decision that would allow you to dig these extra tunnels in the first place, if there is even enough information for that.

So my caution is that you don't use this workshop and all the presentation that has been made as a means to try to revisit what performance confirmation could be if it were to be most friendly to a license application, most friendly to the applicant, or maybe even most utilitarian to the regulator. Performance confirmation is a pretty simple thing to be used in a common sense way, not in a way that results in an uncertain job only becoming more uncertain because someone found it to be a convenient way because it is the only bucket left out there to throw stuff into.

Thanks. I am sure we have plenty to think about now.

VICE CHAIRMAN RYAN: Thank you, Steve.

Questions from members? Yes?

CHAIRMAN GARRICK: Steve, I think you have made the case for one of the points that we have made many times and how important it is to have the performance assessment results to be realistic because you are going to make discoveries down the road, some of which are adverse.

And if you have taken the bounding approach all the way and, therefore, you don't know what the margins really are, as you make these discoveries, you have imposed on yourself a much greater burden of analysis than you would if at the outset you had made your models a little more representative of reality. So I think we are in agreement on that point.

VICE CHAIRMAN RYAN: Ruth?

MR. FRISHMAN: Thank you. That doesn't often happen.

DR. WEINER: Steve, since I don't take notes that fast, could you recap in a few words what you think DOE should do and what you think NRC should do?

MR. FRISHMAN: DOE should at this point be spending most of their effort on trying to have a convincing performance assessment that they think they can take to licensing.

They should not be worrying about performance confirmation in terms of what is left on the table. They should be thinking about performance confirmation as an organizational element that goes into their license application that says what the objective of future data collection is going to be and how that data is going to be managed and rolled into an ongoing analysis, rather than looking at it as some benefit to come in the future if they organize it properly.

The performance confirmation program in the license application I don't think is going to be a big deal in the decision because the decision itself if it is carried through as the regulation is written, the disposal decision doesn't rely on the performance confirmation program and, as I said, should not.

So DOE's real effort should not be on a performance confirmation program. They should outline the terms of what they are going to do with new data and the objective of collecting new data. And within the confines of the way the staff has interpreted the rule, I don't think it requires a great deal of creativity.

And what the staff, what the NRC staff, should do, get prepared for how to deal with a performance assessment that may not demonstrate, as the word has been used again this morning, may not demonstrate, the requisite level of evidence and make sure that bucket isn't out there handy.

VICE CHAIRMAN RYAN: Thank you, Steve.

Our next speaker, right up on time, is Atef Elzeftawy, speaking on behalf of the Las Vegas Paiutes.

DR. ELZEFTAWY: Good morning. I am glad that all of you are looking at me. That is good. My name is Atef Elzeftawy. I'm glad for the chair or the vice chair can pronounce my name. If you have a problem with that, call me Bob, like I have been doing for the last 35 years.

Anyway, I am doing this work for the Las Vegas Paiute tribe and for its government pro bono in a sense. The chair, Gloria Hernandez, changed my schedule. And I am going to take the opposite end of Les. I don't know whether he is here or he isn't.

I am not pleased to be here -- he was; he said that "I'm pleased to be here" -- because I think I have another place I would have loved to be according to my schedule, to be in northern California fishing for salmon and some of the tribes. But the chair called me at the last minute, and she said, "Well, you're going to go and represent us." So I had about five minutes with her to give me some idea about what she wants me to say.

And then she gave me that Vegas golfer to pass it to the chairman. And she said, "Point out to him that the Las Vegas Paiute have a nice article here. It talks about the natural desert." And I'll pass it to him in a minute.

Las Vegas Paiute tribe ten years ago, they were more or less poor, have nothing. And ten years ago they thought to save for money and get some golf course, economic development on the land.

So today they have three golf courses. There's about 150,000 people visit that golf course.

Some of them pay $100. Some of them pay $300 to go through the golf course. It's very good income for the tribe.

The tribe has about 45 members who are adults, Native American Las Vegas Paiute. And the total population is about 150. They have a seven-member council. That's the government and the elected chair from them. They have an election every two years democratically administered and so on.

Now, that brings me to my second point. I want to make my presentation to you in terms of probably five minutes and let you go early. I like to tell stories, but I think I am going to leave you with making the decision about what the story is.

One of those stories says, "Well, you know the tree by its fruit." And I'll let you think about that. Some of the stories or some of the lines say, "You shall know the truth, and the truth shall set you free." This is inscribed here on the CIA building, sad as it may be.

Anyway, there is a story that I remember back when I got involved with Jeff about being tenacious in terms of you guys, committee members. The USGS got involved into the program of Yucca Mountain for the money. They got their best geologist. I know that there is a USGS fellow around here. They got their best geologist. And they are going to characterize the unsaturated zone.

Here I was sitting as a consultant back then, my first to the NRC working on 10 CFR 60 as a sort of a soil physicist or somebody who knows a little bit about the unsaturated zone. And the guy described for about two hours a long, beautiful program.

I had only one question for him to characterize the unsaturated zone. I said, "Well, how are you going to drill?" I have one question.

He didn't answer it. He said, "We are going to do this and this and this and this." But I was driving at one single point. And he said, "We are going to do the drilling. And we are going to hire the contractors and so on." To make the story short, finally after about a limited discussion, after about maybe 30 minutes, he said, "Well, we will drill with drilling mud."

I said, "Well, I'm glad you said that because that is what the plan is." Now, DOE, take heed from that. The plan is to drill with the drill mud, drilling mud, to characterize the unsaturated zone.

My second question was, what is the drilling mud? And I said, you characterized the unsaturated zone by drilling with air or maybe compressed air. Find out how you are going to get it. But you characterized the unsaturated zone by not adding water and mud in the bore hole as you drill 1,000 feet or 2,000 feet. Now, Neil Coleman in NRC and the rest of you know the rest of the story.

It's very important to get to the nitty-gritty for the committee members to be tenacious. That's really what I want to say. Be tenacious to find out how they are going to do it.

I like to put all of my presentation in mathematics because I am a mathematician in a sense. Then I will talk about what it means. For the last six, seven years, I have been reviewing all of these papers, unnamed person to be mentioned. And you know what? The statistics are very staggering.

We get about 60 percent of the people who marry today get a divorce. Do you know what? We get about 60 percent of the hydrogeologists or the hydrologists who write one simple equation about Darcey's Law. And Darcey's Law to write the equation, you have got to tell me where is the water moving from where. And 60 percent of those professors or hydrogeologists put the wrong time.

Now, it's so sad that I have all of these copies in my garage to mention that. And I send all my comments back to them unofficially. My name is off to mention that to them.

Now, be careful of what the Department of Energy presents to you. It might look so nice up here. They might have the best speaker. They might have Ronald Reagan back from whatever he is going to be now to communicate to you, the best communicator. But look at the details.

Now, I was just asking your person a minute ago performance assessment. And he said, "I am the chief of the performance assessment."

I said, "Well, I'm glad." Now he needs to look at my comments that I did for the State of Nevada in 1987 or '89 about the total system performance. I said in it, "Watch out for the unsaturated zone parameters. They're going to be the driving factor."

And until today, from some of the things that I do once in a while, I have not seen. For your information, I haven't done anything on the program since 1990 money-wise. And until today, I have not seen the mathematical derivation of the so-called coupling process.

I have heard about the reflux. What is reflux? For the water to move down to change to turn upward, I have to look at the physics. How is it getting done?

I haven't seen a mathematical derivation yet. I would like to see the details. I would like to see the initial condition, the boundary conditions, how they put it in a source term in the computer, and what the computer does.

Talk about a performance program. I just came from the EPA special conference for invited people dealing with the big, huge air modeling program model. Mobil 6 it's called. You put a lot of information. It tells you about the aerodynamics and pollution and the clientele or whatever it was, Vegas and so on.

I want to finish up in two seconds. And the most important person of that program decided, well, how many depends on, some of the inter-value is, how many times you start your car. So she had, "Well, three starting the car. Every person of you start the cars three times a day." Do you know what? If you come to Las Vegas, the people will start their car almost ten times a day.

So when I said to her, "What happens if I change the three to six or seven? Let's put it in the program," in one parameter, it changed the whole area from attainable, a word that means confirmed to the boundary conditions, to non-attainable. This is one single factor.

Other comments, I was very surprised to see in the confirmation graph yesterday about the waste package. How many numbers are you going to have in performance confirmation in the waste package? I was surprised to see also that I didn't see a lot of the unsaturated zone.

Now, to end up my talk, I am going to tell you what the chair did. She gave me this money. And she said, "Go to the chair. And let them see what it is."

So this is one dollar. Everybody knows that this is one dollar. It has George Washington on it. Now, here is another one. It says, "$5." It has Abraham Lincoln on it. Everybody knows that. This one says, "$20," Andrew Jackson. This one says, "$100," Franklin. Then this says again one dollar.

What happened in that process? Think about it. Started with a dollar. This is for her, that is a performance confirmation. Simple, just like the gentleman penciled in space.

I'll leave you with that. Thank you very much for inviting us. Thanks to the chairman. Thanks to Commissioner Merrifield and to you and thanks to Janet and thanks to John Griggs. Thank you for having me and listening to the nonsense I just said. Thanks.

VICE CHAIRMAN RYAN: Thank you very much. Questions?

DR. ELZEFTAWY: Any questions?

VICE CHAIRMAN RYAN: Yes, Ruth?

DR. WEINER: Where does the tribe get the water for their three golf courses?

DR. ELZEFTAWY: That's a good question. It's a very long story. The state made an enemy out of me because 10 years ago they came to me and said, "Well, we have this 4,000-acre feet, and we want to develop a golf course and all of that. Do you think you can find us water in the desert?"

I said, "Well, I'll look at the geology." And about five weeks later, I said, "Well, I think I know that it should be some water there. I don't know how much and how far or how deep." Well, we drilled the six wells.

We came here to the Department of Justice. They told us, "Go and do it." We didn't see them. As we knew that the state was going to come with us, state engineer is going to kill us, drilling without so-called license approval of the state. Water belongs to the state.

And so we did it. We closed the 4,000-acre feet with police force. Nobody came in except the ones with IDs, like us here. We drilled 24 hours a day for 6 months. And we found the best water ever. Don't ask me where. Around all of us, the water is "salty." This bull's-eye delivers the best water that has no contamination whatsoever, some salt, calcium, magnesium, and all of that, 5,000 gallons a minute, field hydrologists who might drill down about 10 feet.

And we drilled the six wells. And that's where they are getting the water. The state fought us in court. We finally got about 3,000-acre feet for life to keep them going.

That's the rest of the story. Sorry for taking so long. Any questions?

VICE CHAIRMAN RYAN: No problem. Any other questions?

(No response.)

DR. ELZEFTAWY: Thanks for your attentiveness.

VICE CHAIRMAN RYAN: Thank you.

Our next speaker is Engelbrecht von Tiesenhausen.

MR. von TIESENHAUSEN: I would like to say I am glad to be here, but standing and speaking here is not always one of the things I am most fond of.

VICE CHAIRMAN RYAN: Could you pull the mike a little bit closer? I know they don't build them for the --

MR. von TIESENHAUSEN: Can you raise it up a little?

Steve already discussed some of the issues that I wanted to bring up, but I will reiterate what my points are. PC, "What does it really mean?" seems like a silly question, but I would like to go through how stakeholders look at it, how the NRC and other participants look at PC, and how DOE looks at it, and then how it appears to be implemented at the present time.

Next slide. The Department of Energy in 1997, long before Part 63 was issued, made this comment. And I think it's a good comment because they realized at that time that PC may not always confirm their data, that they may need to revise some of their data or their models. And that could be positive or negative.

Next slide, please. These are just basically some comments from the NRC Part 63. The only thing I want to highlight is that it is a confirmation program. It is not a program for original data as far as the license application said. Natural engineered systems are functioning as intended. In other words, the decision has been made or the calculations have been done as to how these systems are expected to function.

Next slide. And, again, performance confirmation will evaluate the adequacy of assumptions. In other words, you have already made assumptions. You have already collected data. That's really all I want to highlight. It's been said before so many times today and the last couple of days.

EPRI in the report on performance confirmation I think also confirmed this point. It says that any decision by the NRC to license each stage of repository development would be made on the basis of information that exists at the time the NRC considers such an application. To me, that means when the NRC gets an LA, they will have the data there to make that decision.

So what are the challenges -- this is kind of digressing -- in getting what I would consider a performance confirmation program? You're looking at temperature effects. Temperature effects are almost impossible to scale. That is one of the things that you might want to do if you are looking at corrosion processes.

You're looking at long time periods. In chemical processes, where the reactions are extremely well understood, you can sometimes make allowances for time by changing temperatures or vice versa and still come out with the same result.

DOE has mentioned the possibility of putting in dedicated drifts for a performance confirmation program. And it is unlikely that those will, in fact, duplicate the conditions that you would find in the repository.

In one case, there would be ventilation problems, which will destroy all possibility of collecting good geochemical data. And in the other case, with the weighted waste packages, it will be close, but whether the time period is sufficient to go through that critical window of susceptibility for corrosion is an issue that has yet to be answered.

This is not to say that all of this data is going to be useless. I think some of this data is going to be very useful. Whether it will answer the critical questions that need to be answered is another problem.

All of this is basically driven by the fact that waste package performance is still the primary barrier. And the effectiveness of that barrier is based on current models, models that are based on corrosion data, which is basically not representative of a repository environment. I think this is a critical issue.

My last point is something that Steve also mentioned. Data collected during the PC period should not be used to close agreements or to be a source for the license application.

Next slide. This is DOE's latest current schedule for the closure of agreements that they have made with the NRC. If you look at a license application date of 12/04, you will see that there are a lot of agreements that they fully realize that they will not be able to close prior to that time. I guess this would be the start of Chris Whipple's bucket if you want to call it that.

In fact, some of this schedule is already somewhat out-of-date because one of the agreements on igneous activity will not be closed until March of '06. But we now hear that DOE has put that into the performance confirmation program. It is no longer part of the license application.

Next slide, please. So this is what PC should not be used for. It should not be used as a means to defer the resolution of issues that are part of the license application. It should confirm but not be the primary source of data.

I think it is up to the NRC to realize that if DOE proceeds on the current path, it will get a license application that is based on issues that will be solved in the performance confirmation program and that will be loaded with RAIs up front. In other words, there will be areas where DOE knows up front there will be requests for additional information.

A couple of thoughts on what could be done to really, at least in my opinion, improve TSPA. Calico Hills is something that hasn't been looked at very critically that could be a very good barrier for radionuclide transport.

And the critical question that still hasn't really been answered is, where does it go and how fast does it get there? The knowledge of the saturated zone is still fairly small, I would say.

And then geochemistry is critical. Geochemistry, especially in the post-closure period, is what will drive repository performance.

Thank you.

VICE CHAIRMAN RYAN: Thank you.

Any questions? Going once, going twice.

(No response.)

VICE CHAIRMAN RYAN: Thank you, Engelbrecht.

The last speaker of this group of six is John Kessler from EPRI.

MR. KESSLER: Thanks very much for the opportunity to speak. I guess I will start by trying to slice and dice performance confirmation yet one more way. I am going to wind up repeating a lot of what is said. So that will help. It will shorten things a bit.

The next viewgraph, please. I thought I would start by just talking a bit about where is performance confirmation in the whole row, really what is it that -- it's all about uncertainty in a sense, that uncertainty is unavoidable to some extent. How is it that it can be managed?

Well, there are two groups working on managing uncertainty. First, there is NRC, EPA in terms of regulatory approaches. And then what is DOE doing about it?

So in the broad brush, the way that the uncertainty is being managed to maintain safety is, first of all, we are talking about dose to a reasonably maximally exposed individual, not to some average individual.

The RMEI dose limit is a fraction of natural background, the requirement of multiple barriers, which I think is a good requirement. The waste must be retrievable. And they're also requiring longer-term R&D to look at safety questions provision, and the NRC review plan and the performance confirmation program are always that NRC is managing uncertainty.

DOE has got some additional approaches. They are reducing uncertainties with design modifications as they can as it makes sense. Some of their analyses are conservative. I would say, on the whole, their performance assessment in general is conservative, not in all areas but in some.

Furthermore, another way to manage uncertainty is to have margin; that is, not to be at 14.999-millirem per year as your peak dose but something below that.

And then, finally, you have got a long-term R&D and performance confirmation program that is yet another way to manage uncertainties.

I think this was alluded to by one or two speakers earlier. Again, something that we talked about in the EPRI performance confirmation panel is we consider performance confirmation just one subset of all the longer-term R&D that could be done out there.

So that performance confirmation with the activities that are specifically designed to evaluate the technical bases for the licensing decision and the longer-term R&D or other activities not specifically directed evaluating the licensing bases, I think that DOE has kind of proceeded that way. And this more or less follows the philosophy of NRC in terms of performance confirmation.

Next, please. There has been some discussion about the EPRI performance confirmation workshop as well as some other work that was done. The work was done in 2000 and 2001. The performance confirmation workshop that included various parties was done in November of 2001. We also convened a performance confirmation panel to make recommendations and observations.

Other things that are in the report are we provided some examples of some appropriate performance confirmation activities using DOE's eight-step methodology that I will discuss in a moment here.

They are all summarized in a December not 20,001 but 2001 report. I've got a couple of extra copies there if somebody would like them. And if those run out, give me your name and address. And I will get one to you.

Next, please. A quick rundown of the performance confirmation panelists. Some of the names you recognize. We have people on there that also represent stakeholder mediation, people who have worked with stakeholders before. That's Alice Shorett, a couple of people on there that have had some licensing experience to understand how performance confirmation might work in the licensing arena.

Next, please. The performance confirmation panel December -- now I've got the right year -- 2001 comments, sort of the top-line comments are the performance confirmation and other long-term R&D was considered useful and appropriate, recognizing that there were many interested parties in performance confirmation, not just DOE and NRC, and that those people should be given a voice.

NRC and DOE need to start now developing a shared understanding of how long-term R&D and PC will be carried out. I think that is still obvious after discussions we have had today that those discussions need to continue. The concern, of course, is that commitments are going to be identified in the license application in any near-term amendments. And it is best if everybody is on the same page about that and how to work that through.

Again, to repeat, -- I think Chris mentioned this in his talk -- our main recommendation was a flexible adaptive plan is needed. So the concern I have got here is, what are the implications for using a rather rigid license amendment process if that is what is selected? It is not clear from the discussions, at least, exactly how that will work. If the point is to keep things flexible, a licensing approach needs to be able to accommodate that.

We also recommended prioritizing now using risk-informed judgment and clear criteria for prioritization. I'm still not sure if those criteria are real clear in terms of prioritization, although this discussion we have had the past day and a half has been pretty good.

Avoid traps. Chris went through some of those traps. I will probably reiterate a few of them in a minute.

Next, please. NRC and DOE need that shared understanding of both performance confirmation and long-term R&D. I am convinced they're not on the same page quite yet.

The commitments are likely to be defined in the licensing process, even those that wouldn't start until much later. So the concern is DOE seems to have to get it right the first time, which is counter to the flexible adaptive PC approach.

NRC and DOE have both made a commendable start. We have got the final regulation in now, the finalized review plan from NRC. DOE has a draft performance confirmation and long-term plans. And, as Debbie Barr talked about yesterday, it seems as if Rev. 2 is coming soon, which will be good.

These differences between the two PC approaches need to be resolved. Again, it looks like DOE is focusing on the overall performance objectives that need to be achieved. And it looks like NRC is looking at these natural and engineered barriers or functioning as intended and anticipated. And that seems to me, as I was just going back and forth with Jim and Jeff, it implies some very fundamental differences in approach in terms of prioritization and weighting.

Use risk-informed judgment and clear criteria prioritization now. Some potential criteria that the EPRI performance confirmation panel came up with is the relative value of the information, risk-informed. I think what Karen Jenni talked about is just right down that alley of the kind of things that we were thinking of.

The timing and the need for specific information has not really been talked about so much yet. The cost of conducting them has been alluded to. Interference with other activities I believe was also mentioned. And certainly we'll see in PC plan Rev. 2 or 3, I guess.

Agreements with stakeholders, I am not sure what the plans are there, but certainly those need to be in there. And Chris mentioned them as well yesterday morning.

Concerns of stakeholders, potential health effects to workers and the local population, and the ability to define sufficiently that activity such that the confidence is truly enhanced in a reasonable amount of time, I think that what DOE is proposing is there, although it probably needs to be clearer, that last point.

Next. Same basic traps as what Chris went through: agreeing to measure parameters that do not affect performance. One of the things we had on the list was that, well, sometimes you tend to satisfy parochial interests. I believe Chris gave a few examples in his talk of the kind of thing you can get into. That needs to be avoided.

Agreeing to do things that can't be done. Chris talked about that again yesterday, such as requiring unnecessary accuracy or precision in measurements, monitoring of too limited duration or extent. I look forward to Rev. 3 to see how that is going to be managed. I understand that is where that will show up.

Assigning excessive levels of conservatism on bounds because it's easy. They tend to eat into margin that don't really give it up unless you really feel you have to is what I think we are after there; and neglecting institutional aspects. You must maintain technical capabilities over a long term is something that some folks are very interested in.

Periodic report cards was something that has been done for other stakeholders in other cases. And I think that this will likely be something that is important to the public as well.

Next. Okay. Here is what DOE had for

their eight steps in defining a performance confirmation activity in one of their earlier revisions, their 2000 draft performance confirmation report. We like these eight steps. We think they are really good ones. We look forward to DOE getting through all of them.

The first step is identify which processes are to be measured, the key performance contribution factors. I think that is what we heard yesterday. We understand that is what is going to be in Rev. 2. What I have in brackets here are my guesses and based on my understanding from public meetings as to what will show up when. These aren't DOE inputs necessarily but my guesses.

Define the database and predict the performance. It sounds like that will be in Rev 3. The three things in red I want to talk about in a little bit more detail in a minute.

Then establish the tolerances or predicted limits or deviations from predicted values. Indeed, that's critical. We look forward to seeing that in Rev 3.

Identify the completion criteria and guidelines for corrective action. It wasn't clear from the talks yesterday whether that will be in Rev.

3. It seems pretty important that it must be. I'm guessing it will be just to remind folks that we are looking for that.

Conduct the detailed test planning, monitor the performance and do the tests, analyze the data. And then our eighth step is very important. I think several speakers have already mentioned it: recommend and implement appropriate actions if there are deviations. I hope that will show up in Rev 3. Certainly that needs to be thought through.

Next. Step 3; that is, establish the tolerances, limits, or deviations from prediction, certainly that is a key step in a successful performance confirmation activity. Without it, you may as well not do it.

Combine baseline data with predictions for performance confirmation period. How do you mix those together? What we're concerned about is that they may become licensing conditions. If this happens, then you do this. If not, then something else. So it's important to get it right.

An example of that is in the next viewgraph. This is taken also from that same DOE's draft performance confirmation plan, this whole idea of how you acquire the data, run it through your data reduction, convert it into what you think you have for baseline data, then going into the confirmatory period with some sort of predicted bounds in terms of expected behavior.

And I have a note that I have added here, which is the compliance bounds may be much wider; that is, you can be outside those bounds and still meet the regulatory criteria. I think that is what Debbie Barr was talking about yesterday. I am not quite sure. But certainly that kind of philosophy needs to be incorporated when one talks about these tolerance bands and how to define them.

Next, please. Another step, identifying completion criteria. You need to know when you have done enough. So a clear end has got to be identified. These time periods are examples. You might want to develop tolerance bands at these time periods if that is where you think you are going to stop your test or whenever you propose to stop your test, you need to say, "How is a 50-year tolerance band going to be defined to show me a longer-term behavior that helps confirm things are going to behave as anticipated?"

The test has to be sensitive enough to detect that required tolerance. The test has got to be long enough. So you need to know in advance adequate time is going to be likely. And it's going to be difficult to exactly define how much time is required there, hence that need for flexibility.

Sample size and frequency issues must also be considered, like do you have to really test every container or just some subset?

Next. Finally, step eight; that is, recommend and implement appropriate actions depending on what you see from your performance confirmation tests. Potential actions? No. No action required. Maybe you need to do some more testing. Maybe you need to modify the original license bases. Maybe you will have to make some engineering design modifications. Maybe you have to completely halt emplacement for a while and stop and rethink and see what happens or it may even require retrieval or abandonment of the site just depending on what is seen in performance confirmation. And DOE needs to have some sort of plans depending on what they think they might see that would develop some of those options.

Next. Some suggested options for important effects, not amenable. That is this whole idea of if there is something that is important to performance confirmation, part of Chris' criteria he was mentioning, but you can't test it, either you can't measure it or you don't have enough time, what is it that should be done?

I think probably the first thing I should add that has been talked about by Tim McCartin and others is maybe you don't have to do anything. Maybe there is no performance confirmation activity that is required at all. That I'm sure would depend on the kind of case that was made originally for the original license application or you could use reasonably bounding values based on expert elicitation.

Debbie Barr gave us some examples of how that is going to be done, it seems, in the vulcanism area, where you can't really get at all of the aspects of collecting data for vulcanism.

You might want to leave some margin, leave natural analogs such that some analog research could be part of the performance confirmation program or it could be an aside. How you define it probably is less important than that it's there.

Add or modify an engineering feature to reduce the importance of that particular FEP, say, dip shields were added to mitigate groundwater flow uncertainty and heterogeneity is an example of an engineering approach that was taken based on some of these data I believe that Steve Frishman was alluding to earlier that came out five-ish years ago. This was a deliberate engineering change partially to accommodate some of those data that --

VICE CHAIRMAN RYAN: Since there are other speakers, you might want to hold --

MR. KESSLER: Okay. Next. Here is an example of a licensing process, this idea that your confidence builds over time. We were trying to compare this to a reactor equivalent with all of those steps. The idea is you may have some FEP activity here where your confidence may decrease and you have to have a way forward for that.

Next viewgraph, please. We think that the performance confirmation is similar to a tech spec surveillance program; that is, your verifying reactor equipment is operable. You have limiting conditions of operation; that is, what has to be operable, and if not, what actions are taken. Certainly the time periods over which you look at inoperability and recovery are much different for repositories than reactors, but we think the analogy holds.

Next. Just to kind of reiterate the big three conclusions from the performance confirmation panel, describe how the long-term R&D program provides enhanced confidence is the first thing that we would recommend.

Consideration of activities. How do they fit in each stage of repository development? And options for treatment important FEPs with which you can get little additional information.

Next. Is appropriate baseline information being collected? You've got to establish meaningful tolerance bands, identify a clear enough end to the activity, and you need to prioritize.

Thanks. Sorry for running so long.

VICE CHAIRMAN RYAN: That's all right. Any short questions? George?

MEMBER HORNBERGER: John, you obviously have given this a lot of thought, perhaps as much as anyone. Do you have any notion of what NRC and DOE need to do to make sure that they get onto the same page?

MR. KESSLER: Talk to each other. Talk philosophy, to begin with. Like I was getting into there, I think it really concerns me the relative weighting in terms of approaches of the overall risk criterion versus the barrier. They're both in the regulations. We understand NRC wants both of them.

DOE has provided a shot at how to balance between those two. What I heard this morning makes me unsure whether that balances at all what NRC is looking for philosophically.

And the next step is just the level of detail. How detailed a program does it need to be? Back to your fundamental question you asked earlier this morning I think is a real good one.

Those are the two places to start. And then the last one is just the formality of how performance confirmation is dealt with in the licensing environment. How does one do that to get what one wants?

Like Jeff Pohle was talking about yesterday about there is a lot of flexibility here, good. How do you do that in a licensing environment?

VICE CHAIRMAN RYAN: Ruth?

DR. WEINER: On your slide "Traps to Avoid," you talk about excessive levels of conservatism and about maintaining technical capabilities. Can you enlighten me as to how you would do those things, how you avoid excessive conservatism and, even more important, how in the current way these things are funded you have an agency that maintains its technical capabilities?

MR. KESSLER: My memory's fuzzy in the first one. Chris, if you can help me out a bit? On the excessive levels of conservatism, I believe what we talked about was the idea that don't just set your bounds really wide because you don't really know. You have got to do something to try to maintain to do some work to rein those in up front was part of what I think we talked about in terms of maintaining excessive levels of conservatism.

Chris, do you want to add anything before I go on to the next point?

DR. WHIPPLE: Well, perhaps this is disagreeing to an extent. I think that one of the things that hasn't been done sufficiently here, Tim mentioned in his examples -- and I can't believe he got away with it with John sitting here -- that, in fact, for relatively trivial properties and processes, taking an issue off the table by use of a bounding analysis is fair game. If you try to do that with the big stuff, you can't do it.

And I think that's the key, that you have to do what you can to be realistic on the important processes, but polishing the fourth decimal place does nobody any good.

MR. KESSLER: Right. On your second point, this sort of gets at Todd LaPorte's reason for being, so to speak. There are certain institutional, long-term institutional, requirements. This is really what that point was about, the idea that perhaps over the long run, you may want to fund local organizations, maybe something like what Les Bradshaw was talking about, but the idea is that perhaps you should develop technical capability within the State of Nevada, wherever that is, for them over the long run to maintain the know-how and the knowledge and the understanding to make the decision 50-plus years out into the future as to what you should be doing.

VICE CHAIRMAN RYAN: Thank you, John.

That brings us to the end of our morning session. I would like to take a few minutes and talk about the rest of the day. We will hear from Tom Nicholson, the NRC Office of Research, after lunch on their activities regarding long-term testing and performance confirmation.

And then we will begin a working group roundtable panel discussion. I would like to take a minute and ask members to be thinking over the lunch break how we will do that. We have six members in a time slot of about two hours. So the 20 minutes apiece rule seems to make a lot of sense.

What I thought we would do is invite you to make comments on what you heard and what it means to you in the first ten minutes or so and then for the second part of each individual's talk to try and get an exchange going among members reacting to that individual's comments. And hopefully the audience will also participate.

We have time in there we can take questions during that last ten minutes from staff or from the audience or other participants here today. So if that is acceptable with everybody, we can begin that process and see how we do. Sound reasonable?

Well, great. Given our hour, it's right at noon. Our schedule is to break until 1:15. We will convene promptly at 1:15. Thank you all for an interesting morning.

(Whereupon, at 11:58 a.m., the foregoing matter was recessed for lunch, to reconvene at 1:15 p.m. the same day.)

MR. GARRICK: If I could ask everybody to take their seats, please.

MR. RYAN: Good afternoon. We're back from lunch with our first presentation to be made by Tom Nicholson of the NRC's Office of Research. Welcome, Tom. Tom's going to talk about research perspective on long-term testing of performance confirmation and development of an integrated ground water monitoring strategy.

MR. NICHOLSON: Thank you very much, Mike. I want to thank Mike Ryan, the Chair and Neil Coleman for inviting us to make this presentation. First of all, I want to clarify that this is generic research. Next slide, please.

Jake Philip and myself from the Office of Research are involved in looking at development of an integrated ground water monitoring strategy. Many of the ideas that we're going to be presenting have evolved from our low-level waste performance assessment. The whole concept of performance confirmation originated back in the mid-80s with performance assessment for low-level waste. So our research is generic in that it is focusing on low-level waste, assured isolation facilities and decommissioning.

We'd like to briefly give you the outline of our talk. We're going to talk about needs that we've identified through a variety of sources: National Academy of Science report, licensing experience, research that we've conducted and other people have conducted -- USGS, Agriculture Research Service and the U.S. Geological Survey. We'd like to talk about what our research objectives are, our research tasks. We have recently selected a contractor through a competitive procurement procedure, Advanced Environmental Solutions, and we'll go through the tasks that they're performing today. We'll briefly mention some generic applications that we think might be appropriate, and then we'll do a summary.

Well, first of all, as many people have already commented, the issue for us is what, when, where and how to monitor for both water flow and contaminant transport. There's been quite a bit of work done on this field already, and we'll get into that in a few minutes, but the issue of what, when, where and how to monitor goes to the issue of not only the devices and the technologies but also what you're trying to achieve. So we want to design a monitoring system.

There's a need to detect both the current conditions and changes in the system behavior, and we put an emphasis on system behavior. The system may be the site itself or it may be the site in combination with engineered systems that may affect contaminant transport. We also want to look at development of databases for identifying and quantifying causative mechanisms, features -- excuse me, events and processes. These causative mechanisms are extremely important as we look at the coupling to performance assessment. Next.

We also want to look at the features, the potential pathways. The preferential pathways may be due to a variety of hydrogeologic features, fractures, faults, thinks of that nature, or they may be human related, such as bore hole ceiling failures. We also want to assess the effectiveness of contaminant isolation system. This is engineered systems, both their performance overtime and their degradation overtime.

And then as some of the speakers have already pointed out, what do you do with all the data you've collected? Data management is a big issue. We've looked at what Hanford is doing. They have a tremendous amount of data they've collected over the last 45 years, and how do you manage all that data? What kind of analyses do you do with that data, and how does this information through your analysis feed back to your performance assessment?

Visualization is an extremely important part of this. The monitoring is within a very complex system, a three-dimensional system. How do you visualize that to people? How do you tell them where you're monitoring, why you're monitoring and what information is coming across? And that goes right to the heart of how to communicate monitoring data. Next, please.

Now, our research objectives take into account all of those needs. What are our research objectives? Well, first of all, of paramount importance is to provide technical basis to our licensing colleagues for their evaluation of ground water monitoring programs. And as I said before, it could be low-level waste, assured isolation facilities, decommissioning or other important licensing reviews.

The second point is probably somewhat new to this research. It's how do we couple monitoring to site characterization and performance assessment? There obviously is a very strong relationship. We want to explore that relationship and tailor monitoring to site characterization and performance assessment.

Another important aspect is looking at relevant alternative conceptual models. A lot of times monitoring is oriented towards some type of compliance where you put in sentinel wells at the boundary, you look at those wells with regard to concentrations, and you think you're done when in fact you may be monitoring in the wrong location because you haven't considered alternative conceptual models that may be fast pathways. We can give you many examples of situations where monitoring wells were put in the wrong place giving people a false sense of confidence when in fact the plume had been evolving and moving off-site.

Now, with regard to the alternative conceptual models, some people have looked at different scales. One scale -- next, please -- is to look at the actual flow properties of the medium itself. For structured medium, this could be fractured rock, this could be fractured clays, it could be a variety of geologic media. Over the years, there have been a lot of conceptualization of how water and contaminants may move through structured media, and there has been quite a bit written about this. American Geophysical Union Monograph 42 began the discussion way back in 1989 on this, and some of these illustrations are from Peters and Klavetter where you're basically saying there's a relationship between the fracture and the matrix and you've put in the so-called double hump curve relating relative permeability to tension. One of the things that isn't up there is a discreet fracture network conceptualization. That's at the small scale with regard to the medium. Next, please.

You have to understand that that's just the medium. There are a lot of features, events and processes. We put this up as an illustration of the Hanford tanks in which you have a disturbed zone around the tanks themselves, you have monitoring wells that may be sealed or their seals may be faulty, you have a regional water table at some depth, you have some type of engineered failure modes that may cause contaminants to move out, you have to look at detail at the hydrological system, plastic dike seals. How in the world do you take all that complexity abstracted, put it into a performance assessment model and talk about monitoring? So we're dealing with a very complex system, not just for a system like this but other near surface systems, and that's what we're focusing on. Next, please.

One of the first things we thought about is that if we're going to talk about monitoring, what are you going to monitor, and we related back to performance assessment models by calling them performance indicators. Now, these performance indicators, there is no magic list. Each one of these, obviously, is a function of the site you're investigating. For some sites, it may be water content if you're dealing with the unsaturated zone; it may be the hydraulic pressure; may be both tension if it's negative or positive; flux, could be water flux, heat flux, contaminant flux, maybe air flux, contaminant concentrations in a variety of means, both in the water and in the air phase and in the soil. All of these are candidates for monitoring, but you have to relate them back to your performance assessment.

We want to look very strongly at this relationship between performance indicators and site performance. The performance indicators are a monitoring information or database and how we relate that back to site performance, as predicted by performance assessment models. And then we want to design a strategy to collect the monitoring data for parameter estimation, model calibration and uncertainty analysis. Next, please.

So a logical approach then would be to say, well, the monitoring data has to be used to update these performance assessment models and using the analysis of that data to generate new realizations and to update or modify your performance assessment models. And the last point I can't emphasize enough: The technology to the NMSS staff. Next, please.

Now, as I said earlier at the beginning, we have through a competitive procurement action selected Advanced Environmental Solution to conduct a series of tasks for us, and I'll run through these tasks very briefly and tell you where we are in that research effort. At the present time, they're reviewing the present technologies with regard to ground water monitoring. We've sat down with EPA's Technology Innovation Office, we've attended the Federal Remediation Technology's round table, we've been talking with the USGS and other people finding out what people are doing today with regard to their monitoring strategies for nuclear and hazardous waste facilities. This isn't just radionuclides. We're looking at other contaminants also, not because we're going to regulate those but because we want to understand the thought process, the philosophy, the techniques, the technologies, the sensors that are available, what is practically being done today.

Following that work, and they're finishing up that task, we are asking them to develop an integrated monitoring strategy, integrating, as I said earlier, decouple site characterization and performance assessment to modeling. And then we're asking them to develop a test plan to critically test this monitoring strategy, the process, the thought process you go through and how you come up with this information for a range of hydrologic features, events and processes.

And then the most important part, of course, is testing this against a specially selected data set. We have been in some discussions with some of the national labs to find out what data they have available. At all the labs there has been quite a bit done in the way of monitoring. We're looking specifically at those data sets, and we're going to select some of those in cooperation with DOE to understand how to test that strategy. We're going to provide technology transfer, as we have in the past, to NMSS. When we had an unsaturated zone monitoring strategy developed by Professors Wierenga, Warrick and Mike Young at the University of Arizona, the staff went out to the Maricopa Environmental Monitoring Site. We looked at geophysical techniques, we looked at suction samplers, we looked a whole variety of techniques that are being used today to monitor in the unsaturated zone and to have them go through that data with us and explain to us this is an evolution of that work.

And then, finally, we want to document and publish this report. In research, we've been putting a lot of our NUREG reports as pdf files on our web site and we plan to do that also.

What about generic applications? Well, first of all, every site is unique. There's no way of saying that there's a magic recipe for every site. So we want to take this information, obviously, and provide it to our Licensing staff and make it available to the public, licensees and how to look at the issue of how to understand monitoring needs at specific sites to update and verify performance assessment models.

We also want to look at alternative conceptual models that are related to causative mechanisms. For instance, episodic recharge event seems to be an important issue at many sites. We're doing research with the Agricultural Research Service at Beltsville and Riverside to look at recharge events and ways in which people do model abstraction and look at the effect on transport.

We want to look at estimating parameter and boundary conditions using monitoring data and assess uncertainty in performance assessment. We think that monitoring data could be extremely valuable evidence in looking at the sources of uncertainty. And coordinate this information with -- there are eight federal agencies involved in a Memorandum of Understanding, and if you go to that web site, you can download a copy of the Memorandum of Understanding. We have four working groups. One of those working groups deals with parameter estimation and uncertainty, and this work is going to be coordinated -- is being coordinated with them.

Well, in summary, what are the important points I'd like to leave with you? First of all, we think this is fairly new that we want to couple monitoring to site characterization and facility performance assessments. They are not distinct but they're related, and we want to look at that coupling. We also want to look at how monitoring strategies provide evidence for comparing and supporting alternative site conceptual modes. We think this is the heart of many hydrogeologic problems is that there are plausible alternatives. Does your monitoring provide you the evidence to explore those? The ongoing research with the Advanced Environmental Solutions Company, we want to provide that information to our NMSS staff as it evolves.

And with that, I'll take questions. Thank you.

MR. RYAN: Thank you, Tom. Questions from members?

MR. GARRICK: You, of course, emphasize that this is generic. Is there any intentions of specializing the research program in any particular direction or any particular application?

MR. NICHOLSON: I think the points I was making to reach our research objectives I think from the very beginning this work is tailored to help our Licensing staff. They're struggling every day with a variety of issues, one of which, of course, is monitor natural attenuation. A lot of people think that to allow nature to move the contaminants and that they will abate with time. So to answer you question, no, we do not have a specific application. We think that we want to do this generically to help a variety of applications.

MR. RYAN: George?

MR. HORNBERGER: Tom, I don't know how much of the past day and a half of this workshop you've sat in on but I'm going to ask you the question anyway. Given your generic approach and what you've accomplished to date and what you've thought about, what do you think the lessons are relative to performance confirmation at Yucca Mountain?

MR. NICHOLSON: That's a fairly difficult question since I'm not actively involved in the High-Level Waste Program. I think some of the objectives that we identified, the need to look at alternative conceptual models and to have a monitoring program that can evaluate and test those, I think are extremely important.

MR. HORNBERGER: In your works to date, you mentioned some of the things that you were looking at as candidates for monitoring. Do you have any insights on an effective monitoring strategy for vadose zone transport in fractured rock?

MR. NICHOLSON: One of the difficulties with that is that depending upon how wet the unsaturated zone is, you have pathways that some people haven't in the past considered. For the eastern part of the United States, the emphasis is generally speaking on the unsaturated zone on soils and soil complexity and trying to understand are the so-called fast pathways perch water systems. So that is a different animal than if you look at in the western part of the United States where you have vapor phase. The USGS is doing work at the Amergosa Desert site. They have identified a variety of potential processes that previously had not been considered or capable of being modeled. With regard to water moving in a variety of ways is a volatile in such a way that it could actually move with an organic compound.

So to answer your question, no, I don't have any magic answers today. What we're trying to do is we're trying to look at the complexity. The National Academy of Science had a meeting out in Santa Fe last October in which they talked about the so-called vadose zone road map that was put out by Dan Stevenson Associates in consultation with a lot of very knowledgeable people. The thing that surprised us was that although the plan was developed, it never, to our knowledge, has been implemented, and it was a shame because there was so much information that was brought together.

Now, DOE, through their EM Program, is actively trying to say how can we apply this to our decommissioned sites, we'll call them? They're sites other than Yucca Mountain. And we're actively discussing with them how they're going to be looking at decommissioning technologies with regard to demonstration of unsaturated zone sites. Work in Idaho, work at the Hanford Reservation, all those sites have a whole different needs with regard to technologies than a site on the east coast, such as Savannah River or the Mound or Fernald or places like that.

DR. WEINER: How do you manage knowledge transfer and information transfer from one contractor to another?

MR. NICHOLSON: That's a very good question. What we tried to do is we do it in a variety of ways. First of all, we have a lot of teleconferencing. We expect -- for instance, I'll give you a very good example. Pacific Northwest National Laboratory is trying to develop for us right now what we call a unified uncertainty methodology in which they're combining what had previously been developed at University of Arizona on conceptual model uncertainty with what they've done on hydrologic parameter uncertainty.

Now, how do you merge those together and how do you get people talking? Well, one way, of course, is to put it into the contract to have teleconferencings, to have workshops, to have field sites and to get people to work together. For instance, in September, the National Ground Water Association is going to be putting on a conference dealing with environmental modeling and monitoring. And we've strongly encouraged our contractors to attend that meeting; they have submitted abstracts. So it's this constant need of having people to get together via telephone or in person to focus on problems together and to actively question the person's results. Whether it be models or field data or whatever, you need a very strong interaction between them and allowing them to be different.

One of the problems we had in INTRAVAL, INTRAVAL was an international project we had on validation of conceptual models. A lot of people were frustrated because we weren't getting the same answers. And I said I think that's good because the worst thing that can happen is if everybody comes in with the same conceptual model and the same results and all they're doing is testing their ability to echo back computer results. What we want to see is a very technically diverse set of people looking at problems in different ways and then bringing it together.

MR. RYAN: Tom, I had a question, and this slide's a good one to talk about. Couple monitoring of site characterization. First of all, I think it's a great idea, and, second, there's probably ten different dimensions of it I can think about. You know, yesterday I made the comment that any monitoring well, for example, ought to be placed for two purposes. One is for whatever compliance demonstration needs you have -- the safety case or concentration limit or whatever it is -- and the second is to enhance your knowledge of behavior of the system. I guess I'd appreciate any expansion you could have on how you're thinking in those regards.

And the second point is many of these programs where you're coupling monitoring to characterization create a lifespan for such a program that instead of being perhaps a few years as a pre-operational aspect to a license facility becomes a lifetime activity for that facility, because you can always enhance, improve or build confidence in how you think things are working through additional monitoring, both from a compliance standpoint and a how's it working standpoint.

And I guess my question is have you thought about that data management aspect in detail of how things migrate over time? My specific example is 20 years ago I took an awful lot of data on a PDP-8. I would have to try and figure how to read those tapes today.

MR. NICHOLSON: Well, one of the things

we've been thinking about is that contrary to people's belief monitoring is not something to be afraid of; it's something that tells you -- it's diagnostic information about a living system. In this case, we're dealing with a natural system in which an engineered system has been placed within that system. And so you want to understand the dynamics of that system. We use the word, "causative mechanisms," meaning what affects transport? We don't want to monitor everything because the worst thing you can do is be so confused with so much detail that you're missing the most relevant, the performance indicators.

So part of it is, I think, going back to characterization is to understand the system as best you can from an initial standpoint, and then you build a monitoring program that builds on that site characterization but never has the arrogance of saying, "I know it all." I don't want to just monitor those things which today I think are critical. For instance, is it the perched water table, is it the water table fluctuations, is it a certain preferential fracture that you think is going to be controlling? You want the system to be viewed in a way that the monitoring can look at a variety of possible outcomes, and that's where these alternative conception models come in.

But they have to be important, meaning you can't have a 1,000 variations on the same thing. You could have literally millions of alternative conception models. They're not significantly different, they're just changing one parameter. And as a speaker said earlier today, if you change a parameter, everything changes. That isn't the issue. The issue is are the hydrologic features and events that may be so different today -- excuse me, down the road that you looked at today?

For instance, the perched water systems, I keep bringing this up again and again because the later Professor Evans from the University of Arizona was kind enough to come and work with us here at the NRC, and we were looking at issues with regard to high-level waste, he brought up perched water systems. We put it into Part 60. Many years later some of the Management went out there along with the Chairman and they were incredibly impressed at how could you be so clairvoyant to think about perched water systems, because even then DOE and USGS did not think that they occurred at that particular site.

Well, if you understand the basin range and if you look at the work of George Maxie and other people, they exist. They exist and Professor Evans knew that. So you have to have that ability to think differently with regard to evolution of a dynamic system. That's my input.

MR. RYAN: I'm reminded and aware that Tim McCartin said it's very much iterative.

MR. NICHOLSON: Yes. Yes.

MR. RYAN: That was point one, how about point two? What do we about all this data over instead of a few years maybe a few decades?

MR. NICHOLSON: Well, I think the monitoring database, again, has to be actively worked on. It has to be -- there has to be part of analysis procedure. You just don't collect the data and store it. There has to be some way of saying every -- and you pick the a period of time, whether it's every year there's a water year that most hydrologists know about, you could go maybe even further out. But you want to pick a period of time in which you go back and look at that data and analyze it and ask the question, does this provide evidence that my performance assessment model is correct? It also gives you some understanding of how the system may evolve.

A lot of people dismiss things such as focus recharge and the relationship to hydrology. In some of the work that we've been funding, we've discovered that infiltration, in order to really understand it, you really need a real-time monitoring program to understand it. The question is how do you do it? There is work being done by people like Glendon Gee who's come up with a flux meter to put in the subsurface to directly measure ground water recharge. Some people, of course, in the past like the Thornthwaite analysis. You did a monthly balance of evapotransporation, precipitation, moisture content distribution, ground water fluctuation. You have to do some type of analysis that gives you a sense that, "Yes, in fact that system is performing as I thought or it is changing and why is it changing?"

MR. RYAN: Questions? Chris, you're next.

MR. WHIPPLE: Go ahead, Steve.

MR. FRISHMAN: Are you going to offer in this integrated monitoring strategy any suggestions or hints to sort of a common mode of quality assurance to go with it, rather than having each person who implements or tries to implement a plan try to figure out how to do something acceptable and it's always a real problem?

MR. NICHOLSON: One of the things we've been thinking about, Jake Philip and I just came back from a meeting up in Philadelphia. The American Society of Civil Engineers had a world water environmental congress, and one of the groups there that was very strong was ASTM. ASTM has done an awful lot of trying to talk about procedures and ways of understanding how to properly use instruments and how to calibrate them and how to verify them. We ourselves will not get into the issue of QA by creating guidance, but we will look at what guidance is being developed by other people in the area of quality assurance.

So the answer to your question is, no, we're not going to come up with a single mode, but we're going to rely upon those people who are experts in quality assurance to tell us what approaches people have used or may use.

MR. FRISHMAN: Just to follow on that, is there any opportunity to think about adding that to the program to make it more useful, especially for people dealing with Commission regulations?

MR. NICHOLSON: I will pass that on to Management and let them consider it.

MR. RYAN: Chris?

MR. WHIPPLE: I would welcome your thoughts on the role of monitoring much later in the process than you've been discussing. You've been discussing the site investigation, conceptual model of water flow at a given site that would be important in a licensing decision for any given site. And as I look at sites that have been through that and are now considered more or less closed, whether they be DOE EM containment cells or EPA CERCLA/RECRA sites, I guess my sense on both of those organizations is that there's no money and perhaps not interest in reexamining conceptual models. The best you can hope for is that they'll do a good job of looking for leaks and that somebody will notice them when they occur and get on the phone.

Those two organizations have different approaches to the question of the duration of the monitoring. EPA uses a succession of 30-year regulatory periods extending till the end of time, as I understand it, and DOE keeps trying to hand the Office of Legacy Sites off to other government agencies and to wash their hands of the whole deal. Do you have a thought about monitoring once you get a site that's done, closed and in just a monitoring mode?

MR. NICHOLSON: Well, the National Academy of Science looked at this with regard to long-term stewardship, and it would be kind of presumptuous of me to make any observations other than to say that I think that they looked at the problem fairly thoroughly and refer you to that.

MR. WHIPPLE: I was on that Committee.

(Laughter.)

MR. WHIPPLE: I was on the second Committee, yes. We didn't figure it out, I can tell you that.

MR. RYAN: Other questions from panel members? Yes.

MR. PARIZEK: Parizek, Board. I have a question with regard to confirmation testing. Does anything need to be done to make sure that the monitoring techniques that we all consider routine, we all do this, really as it applies to long-term monitoring in a place like Yucca Mountain it really needs to be included in basically a confirmation testing program. To show that it will be that metals or that cement is one thing, but on the other hand, how will these things behave in the long haul. Do we have remote sensing or indirect monitoring devices that can send signals back when you place them in some location where you really can't go in there and you don't want holes left behind, so this whole idea of what are the technologies that might be available that are sort of futuristic in some respects? But do you see confirmation testing as a worthwhile through process? Otherwise we're going to just go do it the old way.

MR. NICHOLSON: Well, the thing that amazes me, I have been able to go to the Federal Remediations Technology Round Table and I'm always impressed when I come away from those meetings because people like the United States Air Force and other people are not afraid of new technologies. And they're talking about advanced methods, sensors that I was not familiar with. And I think that, generally speaking, if there's a need and there's a resource to follow that need, then a lot of people are very creative. And I think a lot of it is telling people what are the performance indicators and what issues are you trying to look at?

So to answer the question, yes, I think that development of sensor technology's important but too often, though, people just want to come up with a better fiber optic method for looking at a specific chemical when in fact it's the overall system performance you want to look at. And so people may get diverted running down that path of just developing better and nicer or miniaturized techniques and they still don't understand the big picture. But I think there is certainly a role. I agree with you.

MR. RYAN: Other comments? Questions? Tom, thanks very much. We are at the Working Group Round Table Panel Discussion on Performance Confirmation. I had suggested that each of the six members take ten minutes or so to offer comments and observations on the last day and a half of activities and information and then a second ten minutes we'll have for interaction and exchange on that speaker's points. Steve Frishman has volunteered his ten minutes to the group for more discussion rather than an individual comment. Steve, thank you. It will be good to have that time for extra discussion.

MR. FRISHMAN: Well, you know, I always have plenty to say so it's fun to give it up occasionally.

MR. RYAN: Yes, absolutely. It will be good to have the time for some more exchange. So without further ado, Chris, let me start with you, please.

MR. WHIPPLE: All right. Since I had a longer session yesterday morning, I can do this in about two or three minutes, I hope. As I listened to the last day and a half, what came across for me is the important points with respect to performance confirmation is I heard it said several times, although I'm not sure I can cite where in the Part 63 it appears, that performance confirmation is to be done for things that are important to safety. We've clearly heard that Part 63.131 through 134 requires PC for all barriers that are classified as important to safety as opposed to being safety significant in a PA sense. And then, finally, it has to be practicable.

I guess I see the potential conflict between the first two requirements, and it may well be that DOE has simply extended the definition of barriers important to safety beyond the logical stopping point and that the consequence being now that you need to do performance confirmation on things like gravel in the bottom of the drift, which to most of us might not be seen as terribly important to safety, is a consequence of semantics and a poor choice by DOE not recognizing a down side to classifying so many things as important to safety.

But I would like to hear, particularly from the staff, if they think there is a substantive requirement for importance to safety somewhere else in Part 63 than in the 131 to 134 link that might be a basis for not doing some things that appear to be pretty low valued. So I guess that to me is kind of the central question that's emerged after a day of listening to this.

MR. RYAN: Okay. Great. Thanks. Any other panel members wish to comment or add to those thoughts? Well, I hear that. I was just going to start with our game plan and move out there very soon. Hearing none -- yes, Tim?

MR. McCARTIN: Well, I understand what people are saying there's a conflict there, but part of the flexibility is identifying the barriers that DOE is relying on, and I have a problem with DOE identifying a barrier but it's not really a barrier, it really doesn't do much. Well, then it isn't a barrier, you're not relying on that. And the Commission purposely did not try to assign any prescriptive numbers to individual barriers. The Department is free to identify those barriers that are significant to performance. And there is no numerical value given to significance, but we certainly would expect that the Department would look at the barriers most significant and apply most of the technical basis in their safety case and when they're looking at performance confirmation, they would also be looking at the barriers that they are relying on most.

And so by gravel in the -- okay, maybe it does give some minimal delay, ah, it's a barrier. I don't think so, not the way I read Part 63. Sixty-three says, "A barrier is defined as something that substantially reduces the amount of water that gets in, the movement of water, the transport of radionuclides, the release of radionuclides." So it has to have some substantial effect, and we leave it to the Department to identify which barriers they're relying on. So I don't think there's a problem there. I don't believe there's a conflict there. I don't know if that helps or further confuses.

MR. WHIPPLE: Well, it answers I think the question I had which is if DOE in conflict with its own self interest insists on identifying a larger number of barriers than a reasonable person might technically believe are important, one cannot look to NRC to rescue them from their own folly. That's what I heard you say, Tim. Even though in the back of your mind as you review this stuff, you'll say, "This isn't a barrier." You won't say, "Therefore, you don't need to do performance confirmation because I don't think it's a barrier since you told me it is." Is that roughly correct?

MR. McCARTIN: Well, I don't know if I'd go quite that far. We are not there to rescue DOE, that's for sure. I mean I agree with that completely. But if you look at our review plan for post-closure performance, the first thing we have up front is the identification of the barriers important to performance. That's the very first thing we look at. In terms of the analysis, clearly, you do that at the end, but in what we're looking at in the documentation we would like from the Department, tell us up-front what you believe you are relying on the most. We would then tailor our review to what they have shown to be important. And if indeed they say, "Oh, we're relying on the gravel. It gives a ten-year delay of transport, that's one of our barriers," I think we would say, "Okay. Well" -- I would be surprised if we would call that a barrier, to be quite honest. Ten-year delay when you're looking at 10,000 years doesn't seem to be very significant.

MR. WHIPPLE: Well, let me ask just to be clear, if in fact you would not call that a barrier, would you then say that no performance confirmation action is needed since in NRC's view the gravel is not a barrier?

MR. McCARTIN: Right. The performance

confirmation is looking for the barriers.

MR. WHIPPLE: All right. So I mean you would second guess DOE's classification of barriers important to safety.

MR. McCARTIN: No, no, no, no. We're not -- if they have performance confirmation, we would be -- as Jeff indicated, our review of performance confirmation would be do you have the things there that you need, okay? Now, if they have additional things that we might think, "Gee, you really don't need that," that's the Department's -- it's the Department's plan, but we would be looking at, say, conversely, gee, the Calico Hills unsaturated unit gives them thousands of years of delay time. They have no confirmation program for that barrier. We would say, "Well, that's a fairly substantial barrier and here are some uncertainties." We would add things, but, as Jeff indicated, when we review things, generally we're looking for things that haven't been considered or have been left out.

MR. WHIPPLE: Okay. Now that helps.

MR. RYAN: Bob Bernero had a comment?

MR. BERNERO: Yes. I just want to add to this dialogue that what I'm hearing is a classic problem in nuclear licensing involving the NRC. The applicants for a license are chronically looking for a prescriptive formula, "Tell me what I need to do so I can do it and you'll therefore give me a license." And the staff is chronically trying to give a description, an approach, but the responsibility for the logic and the supporting programs is the applicant's. And that's an extremely -- it's a common problem, and it's especially a problem with DOE because it's not used to being licensed.

MR. RYAN: You know, if I could add, Bob, a couple of times I heard items like, "be on the same page," and it strikes me too that there's a need for a dictionary in this iterative process. We talk about barriers and different context and with different subtlety of meaning but maybe even general meaning, and the process that Jeff spoke about about an iterative process or a negotiation or we've got three revisions to this plan in front of us, one in hand, two coming. How does that factor into how we get down the road?

MR. BERNERO: Can I answer that before Tim?

MR. RYAN: Sure. Please.

MR. BERNERO: I bridle at the use of the word, "iterative," to describe something like a negotiation. The iterative process is something that the applicant for the license does. It's a safety analysis, everything. That's iterative and it's review is iterative, but they're independent; it's not negotiated.

MR. RYAN: I'll accept your friendly amendment.

MR. McCARTIN: Just one addition to that. Certainly, my view of the rationale for the pre-licensing interactions we have with the Department that many of the meetings, obviously, are all open to the public, it allows this dialogue so that the applicant understands what we're expecting to see in a license application so we have the information that we believe we need to review the license application. And I think that dialogue occurs through that. It's useful for the stakeholders that can see this dialogue and get a better understanding of the process. But I mean it's -- for this first-of-a-kind facility, I think it is useful.

MR. GARRICK: This whole issue of classification of something that's safety or non-safety related reminds me of the analog we used to use in PRA of the rocks in the pond example. You have a pond that has a lot of rocks sticking out and when you remove the biggest rock the pond level goes down a level and some more rocks surface, and finally you remove enough rocks that they're small enough now that the surface doesn't change and therefore I'm not interested in the gravel pebbles and what have you. And that's what the performance assessment is supposed to give you. The answer to the question of whether or not it's safety important is whether or not it makes any difference to the bottom line.

And if you have a competently prepared performance assessment, you should have a road map for that. You should have the information you need to say that, "I'm not going to measure or worry about this particular rock because no matter what I do with it it doesn't change the performance, it doesn't change the lake level." And I just don't quite understand what all of this fuss is about because if we have any confidence in our analysis at all, we have an inherent mechanism for classifying whether it's safety important or not, whether we need the barrier or not, whether it contributes to performance or not.

MR. FRISHMAN: John, it's not only whether or not, it has a time factor as well, and I'm thinking about one parameter in particular because I think it sort or raises this question that I think Tim's response was at least interesting, that, to paraphrase it, if you, DOE, don't think it's important, don't put it in, and if you do think it's important, be prepared to defend it and prepared to go through the analysis of alternatives and so on. Well, one that's sort of in that hang area right now, and has been sort of all along, is matrix diffusion where it's been in and out performance assessment a lot on DOE's side, it's of relative unimportance in the NRC model, and it's been relatively stably unimportant in the NRC model. But that's one that doesn't necessarily go directly to the bottom line, it goes indirectly to the bottom line. It doesn't really either show up there or not, it's when it shows up, so that becomes sort of a separate regulatory issue. I remember years ago when the Department decided to take no credit for it because they estimated that it was only worth between five and ten percent of performance. Now, in the last couple years, there's been sort of an upswing, and the question with matrix diffusion is can you really prove it up.

So the Department's decision, at least in my view, is do they throw it out and not claim anything or do they try to prove it up and have to go through what they consider to be an overly onerous process? And Chris might say why is the NRC making it so onerous when it's such a small thing? And so I think ultimately it comes back to maybe Tim's good advice here, and that's if it's not worth a lot to you as an applicant and you don't want to have to go through what you may have to claim as onerous later, don't claim it in the first place.

MR. RYAN: Richard?

MR. PARIZEK: Yes. Parizek, Board. There's another value to it, however, even if it's hard to prove to the satisfaction of NRC, and that would be the safety case. Seems to me you have to put together all of the logic that leads you to believe that the TSPA analysis is credible, knowing there are a lot of problems with TSPA results, right? So why isn't that maybe one of the add-ons you get by going through the safety case and the logic behind it, which you can see value or see credit but you can't quite put a number on it. Still get credit for it. Don't throw it out, in other words.

MR. KESSLER: I'd like to get back to John's point about, well, if it's risk important, it's in, if it's not risk important, it should be out. What I was trying to say earlier was that there seems to be two measures of risk importance that we've heard the past two days. One is overall risk importance, and DOE has been making the argument that there's only so many things that if you basically -- I think they're doing -- when they look at risk importance, they're doing one-off analyses, saying you take a barrier out and if we don't see much change, then maybe that's not so important as taking other barriers out.

Then we see what I think is a completely different yet insightful approach, EPRIS' done both, which is putting a barrier in. I think that's what we heard from Tim this morning, which is this idea that if you have alluvium KDs that range from here to here, well, suddenly you can get delay times for certain radionuclides that become important relative to either 10,000 years or relative to the half-life at the particular radionuclide. They're two very different measures of importance, and in my mind they result in two potentially very different weightings of your whole program and not just performance confirmation. My concern is that they're both claiming risk importance but from doing different kinds of analyses and looking at things differently. One is using a lot of weight on overall performance and the other is looking at barriers. It has a lot to do with how many barriers you even want to carry along.

MR. RYAN: Comment? Richard, maybe I could ask you to give us your thoughts on that.

MR. PARIZEK: Okay. First of all, I want to thank this group for being included in the discussion. It's a very important topic, in my opinion. I also want to indicate that I'm speaking as a private member, citizen, a Penn Stater in this case rather than as a Board member, although Dan Bullen is here as a Board member and also Dave Diodaro is the staff member, so we could have room to chat about this in more detail, any points in more detail. Dan's not known to be quiet. He can't sit very long without having something useful to say.

MR. BULLEN: I thought I was just here to watch you.

MR. PARIZEK: I know, I know. I introduced you so that you would not hide in the background there.

I had a couple of bullets and whether that slide comes up or not is not too critical, but I want to, first of all, compliment DOE for its efforts it's made really to date in developing this confirmation testing thought process. We've been kind of waiting to see it, or I've been waiting to see it for quite a while, and now we start to see the detail at a level to which it's been carried, and I think that's extremely important. And to have the discussions that we've been having should be helpful to DOE and also to bring some understanding between what expectations there are for NRC versus DOE and bring closure on some of these items.

There's I think some very valuable lessons we learned at WIPP and fortunately with Wendell here and others some of that has been captured. But there is a real program there, and some things will be included in confirmation testing, some things were not. There's an opportunity to kind of understand how that program worked and why those decisions were made to include or not include certain testing efforts.

There's a lot to be said about what we need to know about a site and about the characteristics of the site. We heard, for instance, why mess around with weather, I mean why do you make yourself responsible to measure weather issues? And it was raised a point that maybe you'd understand infiltration and maybe you'd understand something that was happening underground because you were measuring the weather. And, surely, to make that as part of a compliant responsibility raises an interesting point.

Save the money and not get caught with it as -- or WIPP got caught, I guess, in some of the gas testing that they have to do in waste packages.

So then you go back and say what other things are in the program risk that we saw, those items that seem to be included as maybe confirmation testing requirements, such as the joint fracture measurements that were to be taken. An awful lot of measurements to be taken but what are you going to do with the data, unless you're going to say, "If I find nine joints per meter, maybe I shouldn't put a waste package there." I mean what are we going to do with it unless you say we now correlate that as a fast pathway possibility that has consequence. We have to know why would you make those measurements, because that could be a tedious thing unless there's some indirect ways of doing it.

As far as the weather monitoring, there is some reason maybe to do that purely on a scientific basis and understanding, basically, processes at work in the desert. So that's a fourth reason to do monitoring. A fifth one is just to make the public go away, although the public's not dumb in this regard, so it's compliance monitoring, it's done because of law, but you're not going to fool the public any more to say we monitor. The public wants to know what are you going to monitor, why, what does it tell us about it? But for science understanding, what do you know about weather and weather changes? What's the whole racine? What's the whole racine climate, for instance, in the TSPA model that you assume? And then we look at the whole racine, we go out in the Death Valley area, we go out and look at the Mohabi River drainage basin and we see in 10,000 years four major lake level stands in lakes that were more than just trivial, not just rains in the San Bernadino Mountains that gave you still stands of water for months or perhaps a year but substantial lake level stands that probably a lot of water got there in the desert. And then we have three or four or five periods of alluvial fan development which really requires big triggering mechanisms to flush sediment down to generate fans. So there's something about this weather story and about monitoring that might then say, "I'd better start looking underground because maybe this is a time when fast paths will kick in and this may have something to do with repository behavior. But, again, not necessarily because you're prescribing it but rather to understand the science of the processes that are involved.

And then there's been funding in three different areas. The site characterization effort, there's an awful lot of work being done, and then there's a short listing of what really seems to be the critical path, things that really matter in studies, right? Go back ten years ago and see what the program was doing. And as funding got tighter and as we became more focused, we see very direct efforts to try to deal with those parts of the system that mattered or contributed somehow to performance.

On the other hand, after SR, it seems like that money was sort of disappearing and getting hard to sustain the effort on the unfinished business. Take for instance the testing -- you know, the hydrological testing. You can't do it because the state engineers says, "Well, if you know the site's suitable, why run these tests?" So it's holding up certain aspects of the testing program, right, that's really harmful to the progress being made.

Now with the science and technology initiative -- and, boy, for those of us who didn't get the results that we wanted to get in terms of improving confidence under site characterization think, oh, good, there will be a science and engineering initiative. Maybe some further answers will be raised as part of that process, and that's not considered fair because maybe the money won't be there and maybe the people who pick and choose what's important may not include some of the things that some of us might be important. So it's kind of a crap shoot whether it will get done.

Then they had the confirmation testing thing. Oh, good, all the things we didn't do so far could be done there, and we've already been told that's dumping it in the basket, but, hey, from a science understanding point of view and confidence building point of view, some of us wouldn't care where the money came from as long as it got done. And so I'm worried that as you bounce this ball back and forth, maybe some of these things won't get done. Some of the unresolved issues may fall between the cracks. This should be in that program, they might be in that program, may never be in any program, in which case it just sort of weakens the importance of the study.

This is again why an oversight -- independent oversight's useful. The pig farm analogy yesterday says you get so used to the odors that you don't even notice them anymore, right? And the idea is to be able to look at the program and decide whether something is an aspersion from the average, right? We're watching paint dry and that's not too much fun, and after 5,000 waivers you probably won't know after all what's going on unless you have some independent check on yourself.

Then there's a TSPA impact on decision making, what goes in confirmation testing, the one-on, one-off and the various analyses that have been run, and some things dropped out. And the things that dropped out may have dropped out for reasons that maybe the processes that were being understood weren't adequately understood or the data to support them wasn't too well understood. So if they dropped out, they better not disappear if they're really important. Somebody has to think about it for a minute, which ones did we leave out? Like colloids. Did you study colloids as a source term? Yes, that seems to be on the list. There will be tons of colloids. In the shield shafts there's going to be tons of colloids in the waste package and in the waste drum, and it isn't whether you're going to have colloids, the question is will they move through the unsaturated zone and ever get to the water table? Even once they get down, something gets down, then you'll have new colloids.

But when you look at the secondary

minerals in millions of years of history of that Mountain, the only thing that might have been called colloids is some of the silicious materials that are part of the secondary minerals. So I don't know if these particles and things that you say -- that's a particle that got trapped in the lithophysal cavities or in the secondary joints and prove that there was colloidal transport through the unsaturated zone, other than up near the land surface somewhere. So there's an example there of way in which you might spend time looking at aspects of the programs that are quite important and not necessarily leave them out.

Then there's the confirmation testing synergies. There was a young intern yesterday that I don't see here today who brought up some question about interactive terms, but take, for instance, the test plan to look at the aeromag anomalies. There some aeromag anomalies, and according to the scale at which you scan the area with overflights that were done in 1999, reports by the USGS, certain anomalies didn't show up. And then the Center people went out and did ground-based work and said, "God, here some anomalies jumping right out of the area," according to the resolution that you get from that method of testing. So we knew there flights of plan for 2004, as we understand, looking for possible aeromag anomalies, and EM surveys would be part of that process.

And there's at least a commitment to grow maybe eight drill holes minimum at sites which have a high probability of volcanic and age, date and so on. And I would argue that just to drill the hole and backfill the hole and walk away from it and say, yes, it was an aeromag thing, no, it wasn't, this is what it's age, there's more to be gained from it, which the program as a whole has a lot at stake. How thick was the overburden, was there buried ashes in there that could give you a rate of sentiment accumulation, is there paleosols present because that might sandwich flow, and transport within the saturated alluvium could be very important items to add on as value added.

And there ought to be a monitoring well. I would go to Chris and others' program and say, "Hey, from a science and engineering point of view, for very inexpensive play at this point, stick a damn casing down the hole and use that as one level measuring point, as a data point for chemistry, isotopic studies. Because like, for instance, in some of the drilling areas, like in the Crate of Flat there's only three holes out there in that huge area, and it might make a big difference of what the pathways of water flow are. And the pathways of water flow are something that you can test even though you might not wait around for the radionuclides to break through to the accessible environment, but nevertheless you could say the flow field hasn't been changed. It will go south-southeastward, it will get in alluvium, and these new holes support that argument. So I think there's some value to that kind of a thought process.

And then there's a natural-engineered analog example. You know, the Teton Dam, I guess it's up there, is an example of thing that failed. You know, the engineering part was an Earth-filled dam, and the Earth-filled dam was made of wind-blown dust. It had a filter core, it had ripped up, and much of the dam was still there. It was designed to withstand the intentional use of that dam. And so the engineered barriers were great, the geology was for salts and it had fractures and it was somewhat permeable, but remediation could include grouting near where the soil met the Dam and so on. And between the geology, which was good, and the engineered part, which was good, put it together the Dam failed. So this is a question of what are the actions that might occur when you take them out, which is pretty good, and the engineered barriers, which have some uncertainties with them but are pretty good, put them together and now you create a near field environment which is hard to really quantify, and it seems like a lot of the metals behavior, so it comes back to this near field environment. So we'd say this analog has a value to us of making sure that when we combine the geology of the Mountain and the engineering of the Mountain that we don't have some surprises in between that slip through the crack.

So under confirmation testing, I don't see too many connections between interactive processes. I see individual items listed, but I don't see that interaction thing brought out to deal with this sort of a through process. So I think Yucca Mountain has to be cautious about it. And you know that there's going to be thermal, mechanical, hydrological kind of interaction things which are damn complicated.

And then we heard Debbie Barr say, well, take corrective actions should significant variances arise. Well, okay, for seismic stability, maybe you better backfill, maybe for volcanism that's the only best choice in order to protect some waste packages, maybe to prevent rock fall damage that's what you can do. But you can't just list that, that that's what you can do, you have to say what was the consequence of using backfill, because that changes the end drift environment, and all the behavior of the waste packages change, I guess, if you backfill it, right? And it's sort of like Chernobyl. I think the Chernobyl disaster teaches us something. They tried to put the fire out, but trying to put it out they dumped all sorts of debris on it which made the particles that were released worse than they would have been if they hadn't tried to put it out. But there was no contingency plan in the event you had a fire what you should do, what you shouldn't do. So it was a sort of Band-aid that blew up on the program in terms of particles generated and where they drifted and the size and all the rest of it.

And, finally, there's one other point on the engineering testing concepts. When you look at the European programs, a lot of effort's been put into testing the waste package, the seals. I'm going to weld it and demonstrate you can weld it. It didn't work as good that way as maybe some other way, so there's a very advanced program of putting waste packages in place, trying to pull them out to show you could retrieve them, all the things that we show on paper but the program is not yet done. And so there's a lot of work to be done, and maybe that's not critical to do all this before license application but somewhere along the line you have to spend a lot of time developing the remote handling device to put the waste package. They don't crawl over rocks if rocks should fall and so on. You know, all the bits and pieces of the hardware that it's going to really take to do this job.

So the program shouldn't be misled by the effort that that's going to take even though there's a lot of design work that's going on right now. But until you build the prototypes and try them out, you really don't know how all of this is going to turn out in the long run. I think we're in for some surprises, some delays, but the program is innovative and it's going to be fun to watch. So that's sort of some highlights.

MR. RYAN: Okay. Thank you. Reactions? Comments?

MR. BERNERO: Yes, especially on the interactive processes and other things. It sounds like the Performance Confirmation Program model really has to be somewhat broader for the basis to be the total system performance assessment. It can't just be barriers or important barriers. And it seems like it would have to also reflect on important models, you know, measuring the weather or local climate effects to test important models and interactive processes. And what we heard in the last day and a half is much more, I think, based on -- both from the staff and DOE, much more based on barriers, on barrier analysis, and the dispute or discussion more on is it an important barrier or not an important barrier, is it a require barrier or not a required barrier? And I think that's a source of concern in my mind too.

MR. PARIZEK: Or how to define a barrier and what the cutoff should be. When it's only two percent benefit do we ignore it? My gut reaction is you retain them all in one way or another, because you don't really know how the metal is really going to pan out. Somewhere along the line you may find out there's something drastically wrong or maybe now have second thoughts about it, and you're going to use all these other barriers if you can. But that's not necessarily up to DOE to prove their value, but I think you ought to think through the ones you're going to drop off the table that may actually provide more benefit than they're getting credit for right now.

MR. BERNERO: I would say that the

decision is more a positive decision: What shall the program pursue in performance confirmation testing? Obviously, I think the important barriers should be tested. The unimportant barriers may not be. They may be set aside but important models, performance assessment models may call for resurrecting. You know, matrix diffusion, I don't know if it's right or wrong, but it could call for a revision of the Performance Confirmation Program to pick up on those barriers. But I think the key thing is to test models and the performance assessment, the Performance Confirmation Program, the entire safety analysis has to be a living system, has to be a living document, learning and incorporating that learning and changing accordingly.

MR. RYAN: Other comments on Richard's observations? Staff, comments? Wendell, perhaps we could go to you and hear your summary.

MR. WEART: All right. I don't know whether to say I'm pleased at the opportunity to be here or not.

(Laughter.)

MR. WEART: I'm sort of like some of the speakers. I have had relatively little connection with Yucca Mountain over the past, and I suspect the reason I'm here is because of my WIPP experience, of which I've had also more than perhaps I could enjoy.

(Laughter.)

MR. WEART: But I will give you the benefit of some of my thoughts that I jotted down as I heard the presentations and some thoughts based upon my association with WIPP over the years.

I sort of start with, as some other people have done, about what is your basic definition of performance confirmation, and what do those words really imply to the people who listen to those words? Well, I think it is important in any program to look at those things that have formed an important basis of your performance assessments, of your TSPA, but I don't think that's quite all you want to do. I think you need to look beyond trying to measure those things which can confirm that performance to make sure that you look broadly enough to find any holes or voids or differences in models or assumptions that may surround those models and techniques that you believe to be correct. Because usually our surprises come in findings things that we didn't expect, and performance confirmation as a tool ought to be broad enough to look for those kinds of things.

I know from my experience in working for

DOE for over 40 years that there's a tendency in things like this where milestones are important, where the project is important to try and be comprehensive and all-inclusive because not being so in a regulatory environment can result in substantial delays, additional cost if you have to go back and remedy omissions. On the other hand, I think there is a problem that sometimes more is done than is really necessary. And I would hope that meetings like this might get DOE and NRC to seeing things a little closer to each other's viewpoints, and maybe instead of being super conservative by putting in almost everything you can think of to do performance confirmation on, you can work out, as we've heard quite a bit of discussion about here, selecting those barriers which are really important, selecting those things which really are the major impactors on safety, on total safety, and look at those. And perhaps on NRC's side, if you find that there are things that aren't there, finding perhaps a smoother way to get DOE to implement those omissions back into the program so it doesn't result in a big delay. I don't know if that's possible in the regulatory environment in which you work, but I'd like to think that there are ways that that could be done.

Along the lines of doing too much, it's

not just too many barriers analyzed, it's also, as we've heard, promising to do things or implying that you can do things that you in fact may not be able to do. I've seen my share of that on WIPP, and we've learned to regret it. I think that there may be a place to initiate those kinds of programs but maybe it's not in performance confirmation. Maybe it's in long-term science and technology programs or some other place, unless you're really certain that you have the technology you need to do the things you promise you're going to do.

We've heard about avoiding using PC -- maybe I shouldn't use PC, that has another connotation, political correctness -- maybe I should, maybe they're the same thing. But I would hope we don't use it as a shopping basket, that we be discriminating and we select carefully those things which we think are really important to confirm.

I would hope and I'm sure that DOE has thought about prioritizing their PC Program within the plan that will come out, because, frankly, I'd be surprised if they find they get the funding to do everything that's in that plan. And if they don't get the funding, there must be some things that are more important to them than others, and I hope that they're thinking about that in advance, because I predict that will be one of the things that happens. Because this is a program that's going to be long enough that early on there may be intense interest and there may be funding for it, but as times goes on you'll find that interest flags, funding flags, and it will be a continuous struggle to do the program, to implement the program that you now think is important and perhaps even necessary.

Just a word about using conservative bounding arguments. It's often appealing and appears attractive to do this if you think there's relatively little harm or adverse consequence in doing it. But I've found from my experience in WIPP that sometimes even though that's what you think at the moment, in programs that go on for a long time, you may find that in the end that turns out not being the case and that you can be hurt by the fact that you've now locked in these conservatisms which it's very hard to get rid of after the fact. So don't adopt them, don't adopt these conservative bounds and limits unless it really is necessary to do. So if you can't get the data or if you can get it by taking a little more time, I would urge you to think carefully about doing that.

One of the things that we have on WIPP

that you don't have in quite the same way on Yucca Mountain is this five-year recertification, although NRC can, of course, and will look at the programs continuously to see if there's anything of significance that must be reexamined. This five-year recertification and perhaps the way the Yucca Mountain program develops can be a two-edged sword because there have been some people who suggested that if you don't learn anything new, you have very little to do in recertification. Therefore, don't look for any further understanding, any new information, because you might not like the information you find out. Well, of course, none of us would do that here, but I just point out that that is a possible 180 degree effect that could occur. I think that's enough for now.

MR. RYAN: Thank you, Wendell. Reactions to Wendell's comments?

MR. HORNBERGER: Mike, can I say something?

MR. RYAN: Yes, please. Have at it, George.

MR. HORNBERGER: In listening to both Richard's comments and Wendell's, I think that for me I would like to make a distinction that I don't think that performance confirmation should be completed with a scientific research program. I think that scientific research forward looking, what the NRC terms anticipatory research, is certainly necessary. We want to have programs that are forward looking, but to me performance confirmation should be directed at the support, if it turns out that way, for a judgment on reasonable expectation.

I know I think I disagreed with Chris at the beginning where he said that he didn't like the word, "confirmation." I think that it's a perfectly appropriate word. Confirmation to me is just the flipside of Popper's falsification anyway, because if you read Popper, the first chapter is that if you go out and your hypothesis is that there are only black swans, then in fact every black swan that you observe is, as Popper puts it, an increase in various millitude, which is sort of confirmation. And it is true that it's the other way around with white swans. You go to Australia and your first observation of a black swan, this is Popper's point, is falsification. So that in a Performance Confirmation Program, one would hope that you would design your measurements to be the most -- how to say it -- to stress the system as much as possible; that is, you would like to make the measurements that would show variances as soon as one would see them.

So I don't see that performance confirmation is at odds with the scientific method at all, but I do see it as separate from an absolute passion that people have for complete scientific understanding. I don't think that it's fair to put that burden on a Performance Confirmation Program.

MR. GARRICK: I think that it's important too to realize that a good treatment of uncertainty gives us a mechanism for accounting for the fact that we don't know as much as perhaps we'd like to know, and I think that we haven't seen as much uncertainty analysis done as we'd like, but we've seen lots of progress being made in that regard. And it just strikes me that if in fact a contribution is considered against the performance measures in view of its complete -- your complete state of knowledge about it, that has to be a very good measure.

And, also, I'm not sure I understand this distinction between the safety case and the TSPA. My view on the TSPA is that anything you can think of that's going to affect the performance of the repository, by definition, has to be a part of the TSPA. If you can think of something and do it offline and consider it important, then, clearly, it should be graded into the performance assessment. And I would hope that's in fact that is the way that it's done. And if there's a better way, then of course we should do that, but I haven't seen that yet, what's a good alternative to performance assessment. I've certainly seen great opportunity for improving the performance assessment, but I think the focus ought to be on that, on how to make the performance assessment such that, as the regulations say, that it's kind of the primary basis for establishing the technical conclusions about the repository.

MR. RYAN: Reaction? Another comment?

DR. WEINER: I love being able to ask Wendell questions. Was there anything in the WIPP recertification program that I guess you're now going through that spoke to this question of important things to look at -- important barriers versus less important barriers, things important to safety or less important to safety or not important to safety, or are the two programs, the WIPP recertification and the performance confirmation, are they so different that you can't draw a parallel?

MR. WEART: I'm not terribly well-acquainted with the recertification efforts, but it's my understanding that the things that are being looked at now through a performance assessment, and it is a total redo of the performance assessment, really incorporates things that came about because of changes, design changes, operational changes to WIPP and not because of any new scientific data on barriers that was discovered or proposed.

MR. WHIPPLE: Yes. I want to comment briefly on Wendell and John's point about avoiding bounding analyses and trying to be as fully realistic as one can be. Of course, in principle, I support that idea, but I also -- I guess I have more experience with regulation on the small scale with a county water district or an air board on the EPA side of the house where I must admit the regulators find enormous comfort in having been handed a bounding analysis chose compliance with margin. There's little chance of that coming around and biting them, and I think it's similarly true with a nine million page license application to the NRC.

One of the aspects of a fully realistic analysis is it represents best understanding, best estimates with a kind of a 50-50 chance of being wrong in the non-conservative direction, and I think that tends to be unacceptable in a politically charged, politically visible licensing process. And I think that as desirable as it would be to have a fully risk-informed approach through the licensing process, I think that would be a very risky strategy for an applicant to take. I mean I think there is intellectual merit in a risk-informed approach, but I think the political reality of a licensing approach is the burden is on the applicant to prove that everything they say is either true or wrong in the safe direction, and I don't see that being fully compatible with being realistic and risk-informed.

MR. RYAN: Yes, Bob?

MR. BERNERO: Yes. I'd like to react to that a bit in light of the history at the NRC. As John Garrick certainly knows, in the NRC, in its approach to a probablistic risk analysis for reactor plants, there was a concerted effort to be realistic, but as I used to say then, to approach realism from the conservative side of the field. You know, there was -- you know, simplification. If you lose the conditions for adequate core cooling, you assume the core melted right away. You didn't try to mechanistically go through things.

There was a very important reason why that could be done in a regulatory environment. The NRC consciously avoided regulating with a safety goal. It described a safety goal, one-tenth of one percent increment of background risk, et cetera, but did not regulate to the safety goal. It was intended for retrospective use of performance assessments, or PRAs, that were as realistic as they could be made.

The big difference here in the high-level waste is the fundamental basis of the regulation is to regulate with the performance assessment. It's not a safety goal, it's a condition of acceptability. And of course the results that have been seen in so many performance assessments now are their compliance with margin. And the real question is trying to understand that margin, trying to understand what confidence you can have in those results and trying to understand barriers that right now may not be very important, but if the principal barrier of the package, et cetera, fails, they become very important. So I think there's a fundamental difference in NRC history in that regard.

MR. RYAN: Steve and then Wendell.

MR. FRISHMAN: Just to follow that, I've kind of anticipated, Bob, that you were going to explain it that way, and I think that's a fair explanation. And if any of us just care to remember from even a few years back the number of people who suggested that performance assessment should not be used as a compliance tool, and I think we're now beginning to see some of the wisdom in that. And I think from things that people all around the table have said or implied over the last couple days, the thing that we're really facing is using performance assessment really in two different ways.

There are those of us, and I think strongly suggested by Richard a few minutes ago, where the performance assessment should be an exposure of what you know, and I think that's probably where John has been coming from for years and why he says everything you know ought to go into it and what you don't know you ought to be able to accurately characterize as you don't know and to quantify what you don't know.

So then on the other hand, we have a performance assessment that has to be used for compliance because that's what the rule says. And my point earlier about if you don't want to take credit for it, don't use it, and that's sort of anti-intellectual in a performance assessment, but it's not in the compliance assessment. So I don't know the regulatory, mechanistic, administrative way out of it, but there may be the need to sort of develop an expectation that there's going to be two kinds of performance assessments done, and one of them is going to be meeting the need that is also required by the rule to demonstrate what you know, and the other one to be a bare bones show us that it complies based on our assessment of your demonstration of what you know.

And I think this is something that Abe VanLuke at DOE has pushed for a long time and I finally saw the results of his goal or having worked up the performance assessment for dummies. And I went through most of the disk on that and it's pretty interesting, and it's certainly not sufficient for regulatory purposes but the framework might be in terms of show us how it complies and then on another nine million pages show us how you know what you just told us.

MR. RYAN: Wendell?

MR. WEART: I just wanted to elaborate a little bit so that people don't misunderstand what I said about not using bounds when you don't need to. I think there are occasions when appropriate use of bounding assumptions is justified, but there are also examples in my experience where you assume something that you thought was conservative, for instance, the permeability of salt. We thought we would be conservative based on some very early measurements made in the surface and adopted the permeability of salt that was relatively high. Later on when we started to get underground, we found that the permeability was in fact much less. Well, you'd think permeability being much less would be in a conservative direction. Except due to gas generation, we found out that low permeability was bad for us.

So you can't always judge in which direction conservatism exists. And unless you're smart enough to have thought of everything in advance and say, "I'm never going to have any surprises," then perhaps you're okay. But that's all I'm saying is if you don't have to rely on bounding, don't, but there are times when perhaps it's all right. But it can come back to haunt you.

DR. WEINER: Most of what I wanted to say Wendell just said. I'd just like to add that when you use a conservative consequence and couple it with probabilities, which is what performance assessment does, you can get yourself in a lot of trouble, because the people who read this decouple those two. And we have just seen wonderful examples of that in the transportation area.

And they will say, well, look, you say that such-and-such a result, because the probability of such-and-such an event is small. But when you decouple that, look at what happens. And you -- so there has to be some kind of tradeoff between a bounding -- you know, the obvious advantages of a bounding value, and what's going to happen to that when you put it into a probabilistic framework.

MEMBER RYAN: Bob, maybe we could turn to your summary.

MR. BERNERO: Okay. As is evident from my remarks already, I remind the audience that my remarks will reflect a certain bias based on my years of experience in NRC licensing of all kinds, and also on personal experience in the development of the high-level waste program here at NRC.

I tend to view this subject and this discussion in the last two days as a license applicant, DOE, presenting and talking about what they would offer to meet the regulations to a regulator -- the NRC. That's the fundamental character of it. That's the way I perceive it.

And so my first remarks are, what did I hear from the applicant? And one of the most important things I heard, and I think it is particularly important for Yucca Mountain, is who spoke? Debbie Barr is DOE. Her affiliation is the Office of License Application and Strategy, and basically to me that's the applicant's safety analysis seat.

It's that arm of the applicant that files the application and maintains it. And that's extremely important, that she did not -- she represents the applicant, and she is not a contractor.

This is not to demean the competence of Karen Jenni or Jim Blink. They are contractors to the applicant, and they gave excellent presentations. But I think it's very important that the initiative, the responsibility, remain in DOE hands.

Now, what did they say? One of the most important concerns I perceived, it's actually Debbie Barr's overview presentation, page 3. You may remember all of the gold circles, and the root circle is the NRC-specified tests. And it's a plant of many flowers.

And you come up and there's this swooping dotted line to performance confirmation right up at the top middle. And my concern is that of the many specified activities and required activities, this is a niche. And it's a niche that's characterized -- I made in my notes -- that Jim Blink answered my question said, "Performance confirmation begins with the assumption that the system is installed as designed." That's just one example of assumptions that could be difficult or wrong or would change, because the design may well change.

My own opinion is when you start to go through even the mock installation of waste by remote means, of setting up waste package, inverts, the railroad tracks, and the waste package, and the canopy, a lot of mechanical designs are going to change. Those drifts are hot cells with no back door and no front door.

And I think a lot of simple operational problems may lead to the change of the design, the implementability of the design, and my concern is fundamentally is this niche of performance confirmation, is it coordinated with these other things on a valid basis? It is based on the TSPA, and I agree with that, because that's its fundamental purpose.

But we've already had some discussion of, well, what about these loose ends? There are barriers, and a multiple barrier approach is required for this, and certainly one has to have a performance assessment technique to evaluate the effectiveness of barriers.

But we get into questions about, how about important models? How about research? Is that research and development that would explore alternate models, different models, ways to challenge the existing model? Would their interactive processes that Dick Parizek mentioned, coupled processes, are they adequately tested or evaluated? And, if so, where?

And so my fundamental concern is that the DOE License Application and Strategy Office must have a really good system of coordinating all of these niches on that chart, along with the performance confirmation.

Now, the decision analysis for selecting the portfolio, I found that decision analysis process difficult to track but clear. I thought that was very well done. I think it's a logical process, clearly tracked, and I think the result is reasonable. However, I stumble somewhat on the characterization of the portfolios A through K, skipping some of the letters for whatever reason.

That characterization of portfolio A as the minimum needed to satisfy the regulator, at least that's the way I interpreted it, that wouldn't be right, because that would be the minimum necessary. It would an applicant for a license saying, "I know all I have to do is tell them this, and that's enough to satisfy them." And that's not what I think is right.

Rather, I interpreted the end product, which I made notes as portfolio C plus, with some additions, that to me came across as the best judgment of the applicant. That it is our responsibility, DOE, to come up with the right performance confirmation. This is how we selected it, this is what we selected, and that's how we're going to satisfy the regulatory requirement. And NRC would review that.

And that sounds right to me. I think that's the right way to choose it.

If I understand Karen Jenni and Jim Blink clearly, that is what they did. They actually -- you know, getting aside the cost-benefit issues, they actually developed for DOE the best applicant's opinion, the best applicant's judgment, for what is needed. And so, to me, I'm satisfied with that selection.

Obviously, as time goes on, some things will fall off, some things will go on. There will be changes.

For the path forward that Debbie Barr presented, what is needed, the one problem I had at the time of the presentation, further thought makes it somewhat less -- that in Rev. 3, not yet in hand, there was discussion of developing bounds. You know, what constitutes exceedance of the expected behavior of the parameter.

There was a little too much flavor of compliance reporting, as if the performance confirmation program, someone with a hat that says "Performance Confirmation Program," is reporting only on those tests and calls up NRC and says, "We just exceeded the rainfall standard," or whatever it is.

I don't think they intend that. I hope they don't intend that. What is important is that performance confirmation standards of exceedance, bases for reporting, are part of the safety analysis maintenance. Performance confirmation testing, any other kind of testing, feeds into the maintenance of the safety case, and the maintenance of the safety case hinges on the total -- a living total system performance assessment.

Now, the last documented version of it may not be fully up to date with this data, but the key evaluation is: does this significantly affect the performance assessment and such?

So I think if care is taken, the path forward is a promising one. And I suspect, or hope even, that in the spring of '04 we will see a rational integrated approach to that kind of setting of compliance reporting, documentation. And, of course, NRC already in the regulations, as I understand it, has routine reporting something like every two years of all, you know, the important documentations, kind of refreshing milestones.

And there will be licensing systems if you have a showstopper, you know, to have urgent reporting. But the important thing is the urgent reporting comes through the license safety analysis, maintenance, and responsibility. It's DOE's responsibility and that should work out in the license.

Then, I have only a few remarks on what I heard from the NRC staff. Having lived through that kind of activity for years, the NRC, especially here in performance assessment, is trying to be, a) an independent -- a competent independent reviewer, and, secondly, to illustrate for DOE what ought to be exposed or expounded by the applicant for a license.

And the NRC avoids, and should avoid, overly prescriptive regulation -- in other words, telling you, "Here is exactly what the performance confirmation program should consist of." That's wrong. They shouldn't do it.

They shouldn't give DOE an exactly prescriptive description of what the performance assessment should be. But NRC should be developing alternative models of their own. They should be giving descriptive analyses to say what the performance confirmation ought to be.

So I found them encouraging to the applicant and not -- I think they were trying to avoid being prescriptive. I think there might be some further use of the generic material that Tom Nicholson presented. That is basically, you could see from the slides in the nature of the work, it's basically for almost retrospective evaluation of DOE sites with waste tanks and licensee sites with piles of waste that, by hook or by crook, got in that configuration.

But the general principles that were in his summary I thought were very good, you know, to apply a risk significance, to have conscious awareness of being sure of your models, and reaching some kind of useful conclusion.

That's all I --

MEMBER RYAN: Any reaction? Comment? Yes, Ruth.

DR. WEINER: I've been consistently puzzled by the notion that the minimum amount that you need to meet licensing criteria are not enough. If they're not enough, what is enough? And do you then define what's enough? And whose responsibility is it? And if what you see is the minimum isn't enough, maybe that shouldn't be the minimum.

It's a concept that -- it has come up over and over again, and it came up on the whip. And it's a concept I find very confusing, so I wish you'd expand on it.

MR. BERNERO: Well, I would just comment that a favorite example I use of that is if you go to the NRC regulations on the power reactors -- you know, just reactor regulations -- you will find extensive technical requirements. You will find extensive requirements for quality assurance programs and training and all sorts of things.

You won't find a word about being a member of the Institute of Nuclear Power Operations. Not a word. But if a new reactor owner came up tomorrow and presented a bullet-proof application for a reactor license, and said, "There's only one difference. We don't intend to pay the money to join INPO."

I don't think they would docket the application, because the real requirement for INPO isn't an explicit INPO membership. It is an approach to management responsibility to say, "This is what I need to do. I understand your grounds and bounds for compliance. But it is my responsibility, and this -- I will take that responsibility. And I will add to those minimum requirements as I see fit."

CHAIRMAN GARRICK: Ruth, I want to comment on this one, because it's one of my favorite topics.

(Laughter.)

I think that there's a couple of points here that need to be made. One is that the regulator is never the expert on the system being licensed that the operator-owner is. Never. No matter how many regulations, no matter how many lawyers they have, they do not know the system as well as the owner-operator-designer-builder, or whomever.

And I want the perspective to be that the most expert group in the world on that system is completely satisfied that that is a safe system. I don't even want them to think compliance. I want them to think totally from the standpoint that it's safe, and then let the licensing people worry about whether they've complied with the regulations.

That should be a secondary issue. The first issue should not be that we're in compliance. The first issue should be that we are safe.

The other thing is that the regulations are full of words that are misleading, words like safety-related equipment. This concept was manifested in wholesale fashion in the reactor business. And what we found out when we started doing risk assessments was that a lot of the safety-related systems were not particularly safety-related.

A lot of the systems that were not classified safety-related were extremely critical to safety, like support systems. Support systems were relatively weakly addressed in the regulations, and yet they, in many respects, dominated the risk of nuclear powerplants. So that's kind of a gross comment to why the regulations -- why the state of mind should not be just to meet the regulations.

MEMBER RYAN: Milt?

MEMBER LEVENSON: Well, I guess my comment is similar but quite different than John's in a way. I once resigned from the Safety Advisory Committee to a utility that I will not identify when the new management decided to convert it to a compliance committee.

And compliance never assures safety. The owner or the licensee is absolutely responsible for safety. But that's a completely different issue than what you submit for the license application, because I think John and I agree that what -- your interaction with NRC never assures safety. It's not enough to.

So why you have to provide everything -- I mean, there's all kinds of things that reactor operators do to assure safety, above and beyond the minimum. So I think I agree with you that there's a serious question as to why the license application, which is a compliance, not a safety, thing, needs to go beyond.

Bob, let me ask you a question about your statement of INPO. Suppose Congress, in its infinite wisdom, decided that our nuclear submarines need to be licensed. The Navy decided to not join INPO.

(Laughter.)

Would you not docket their application?

(Laughter.)

MR. BERNERO: No. Clearly -- and I'm sure you're aware that the nuclear submarines for many, many years have been reviewed by the NRC, you know, by advisor or something like that, an advisory role.

No, the important thing is is the regulations cannot be so prescriptive as to have specific solutions to problems. As John says, they're not expert, but they can require a competent, quality assurance program.

I remember vividly I signed a letter July 31, 1989, to the Yucca Mountain Program that said, "This won't wash. Your site characterization plan is -- we have two objections to it. You don't have an adequate QA program, and you don't have an adequate design control process."

We did not tell them what those processes had to be. We just said what you have doesn't cut the mustard. And so the regulator can't pose as the expert, but the regulator can say, "You don't meet the standards or evidence. You don't show evidence of sufficient safety or competence in an area."

MEMBER LEVENSON: But that's in -- that's a little bit in conflict to your previous statement that even though there is no regulation requiring INPO membership, that you wouldn't even docket a case if they weren't a member. But I think you are saying what a lot of people have accused the staff of doing, of indirectly specifying exactly how to do it. I could come in with a management system equal to INPO's, and you wouldn't accept it.

MR. BERNERO: Milt, I remember -- there are diplomatic ways to handle issues like this without flogging them through a formal review and licensing process. I remember many years ago a plant that you now know as Hope Creek was going to be on New Bold Island in the middle of the Delaware River.

And we were doing the environmental impact statement on that, and the population and many issues were so bad that it just looked like that we wouldn't be able to go through to a successful conclusion. And the applicant was informed that, if you change your site, we'll put you first in line to suffer minimum licensing delay. And that's exactly what happened.

And today, if you go to Salem, New Jersey, you will see a boiling water reactor with a concrete containment.

MEMBER LEVENSON: Well, from Hope Creek we'll go to Ruth Weiner, and then I want to ask John Kessler to make his summary remarks.

DR. WEINER: I just wanted to very briefly say thank you. This really clears it up for me. And if I was confused about -- well, it really does. If I was confused about the difference between meaning --

between compliance and safety, I imagine that this confusion -- a lot of the members of the public are also confused.

And I would encourage whoever does this to make that distinction very clear, because from the naive public perception we perceive the regulator as guaranteeing safety. And that's not just NRC. I mean, we do it with EPA also, and with the state regulations.

And if there is a difference, and the difference has been very well explained by the three of you, I think it's important to make that difference clear in public communications.

MEMBER RYAN: Chris, Sher. We've got two hands in the air. I'll take another --

MR. WHIPPLE: I do want to weigh in on this, because I think we may have a common mode failure here in that --

(Laughter.)

-- Bob's and John's and Milt's background are all as experienced reactor guys, and there are other schools of thought. And particularly, there are very different cultures. And to my way of thinking, a high-level waste repository is physically and operationally a lot more like a RCRA landfill or a low-level waste site or some other EPA-oriented contaminated site.

And EPA culture and approach is that if you comply, you comply. If the dose limit is 10, and you go to EPA and convince them that the performance is eight, you pass. If the dose limit of NRC is 10, and you convince them that you're at one, they'll give you 63 more things to do. And those are cultural differences in the history of the organizations.

Okay. But it's not necessarily that one works better than the other. I think EPA does their job pretty well, too.

MR. PARIZEK: Debbie Barr, are you a member, or have you ever been a member, or do you intend to become a member of INPO?

(Laughter.)

MEMBER RYAN: Sher.

MR. BAHADUR: Ruth, this conversation which we've heard just now may have cleared your misunderstanding quite a bit, but it has totally confused me.

(Laughter.)

The NRC staff -- my thinking has been that the NRC's mission is to protect public health and safety. And NRC does it by promulgating regulations, making sure those regulations are in compliance by a licensee. And if a licensee does that, then that provides adequate protection for the public health and safety.

My understanding was, having met the compliance, having done the compliance, the licensee would continue to do things to further the safety of their license facilities, because there is a concept called ALARA. It is reasonably achievable, and it is the ALARA principle for which a licensee continues to do a lot more than what is just needed for compliance.

MEMBER RYAN: Bob, and then Milt, and then we'll move on.

MR. BERNERO: Okay. I just want to add that I agree with Chris Whipple on the fact that this is a different culture. And if you go through the history of waste management regulation, what you find -- that the performance assessments are indeed of a nature that compliance is sufficient.

And ALARA doesn't really play a role, in fact, in the license termination rule. NRC even virtually concluded that if you get down to this level you are inherently ALARA. It's very difficult to apply the ALARA in waste management.

But nevertheless, in the analysis of the high-level waste repository, you have both the compliance aspect and the question of realism, because if you simply act as compliance you lose any sense of margin and you risk having unfounded confidence in a conservatism that may not be right.

So there needs to be a marriage of realism and compliance. But you're right that in waste disposal, you know, it's compliance.

MEMBER RYAN: Milt?

MEMBER LEVENSON: Yes. Chris, in response to your note, the ACNW is on record with a letter to the Commission of its concern of the fact that an awful lot of reactor culture has been carried over into the original draft of the Yucca Mountain Review Plan before it was revised. So I think we're fairly sensitive to that issue.

But, Ruth, in response to your question, there is safety and there is safety. I guess the way I divide it is that compliance, as far as I -- my own personal viewpoint, compliance with the regulations and reactors assures public safety. It does nothing to assure safety of the plant and necessarily the employees, and my concern was that that was the major difference where I was involved -- is that compliance for public safety is not enough to assure your investment.

MEMBER RYAN: Let me just make one comment, John, before you finish. And I'm offering a perspective as a former licensee. And I'm aligned more with Sher's summary. You know, I think the ALARA principle is something that is in place. There is a basic requirement to sort of get you into the game, whatever that licensed game is that you're involved in. And then, there's an evolutionary process to, in a general way, continue to improve.

And I think that's part of the culture we're thinking about, and I think to me in performance confirmation and in Yucca Mountain how you get to that "continue to improve" is -- you're improving knowledge base perhaps rather than practice, or maybe a little bit of both. But there's a shift from a facility where you can do stuff differently to a facility where you've already made that commitment up front.

So that's -- it's a great discussion, and there's lots of views there on that. And I think if we digest that and think about it, something positive will come out of it.

What I'd like to do is finish with John's summary and comments before we break, so that we have continuity with all six panelists giving their comments. We'll take a short break. Then I would ask the NRC staff who are here to react to the panel discussion, with the idea of, how does what they've heard -- you know, how would you reflect on your review of the DOE performance confirmation plan? And how has this working group influenced you, affected you, or changed what you thought coming in, or enhanced what you thought coming in?

So maybe you can give that some thought between now and 20 minutes, and offer us your reactions as well.

So without further ado, John, please give us your 10 minute or so summary.

MR. KESSLER: Well, I'll keep it less than 10 minutes --

MEMBER RYAN: Thank you.

MR. KESSLER: -- since I've already had chances to say a lot of the things I wanted to say.

I guess just to respond to two things I've heard in the last little bit is there is discussion about analogies back to reactors, which I think is appropriate in some regard, and back to, you know, experience with EPA and RCRA sites and CERCLA, and things like that.

We have no history with NRC and any kind of high-level waste disposal regulation here. There is no INPO. There is no prior EPA experience. There is no prior reactor experience per se. I think it's probably okay for there to be a bit more guidance from NRC, given that this is the first one out of the starting block.

I'm not saying a lot more specification. One of the things I've been harping on is some sort of clarification of the relative importance of doing -- supporting the barriers versus just supporting the overall performance criteria. I think that would be a reasonable thing to do.

Just the fact that there has to be more discussion, and don't leave it entirely up to the applicant without some discussion. I think that from the presentations we had yesterday, I think that Debbie -- well, all three of their presentations were quite good in the sense that they're trying to pick their way through a bunch of very general statements in Part 63 about overall performance criteria and very general words about what constitutes a barrier and some general words about what is performance confirmation.

They're trying to pick the right balance between what barriers do we support, which -- you know, which are the major barriers, and how much do we emphasize those, what level of detail we go into. The C plus -- I don't know, maybe it's the right balance. Maybe it's too much. Who knows? But I think that some feedback from NRC is warranted, given our lack of history, no INPO, no nothing.

I've always supported the idea that we should try to, even with the combination of expert judgment and our best shot at evidence-based information, come up with what we think is a -- the most realistic performance assessment that we can do.

My understanding is that, you know, for reactor PRAs that was what was done. They'd start with the best estimate to figure out which was the most important aspects of performance they wanted to go after. Then, they'd jump back into Part 50, more prescriptive approaches, to go from there.

So perhaps what DOE needs to back up and do is add a little bit more on the realistic side to at least provide some insight on how much margin there is that they're providing in their compliance-based assessment.

One thing that George brought up last, although it's been brought up by several of us in the past two days, is George made a comment -- I'm not sure I'm quoting you right here, George. You said that the performance confirmation program should be used in part to determine reasonable expectation.

And I think this goes to something that Steve made in his comments, and that I made yesterday, too, which is, you know, what is that role of performance confirmation? Steve had a very different view from what I understood, which is that -- set performance confirmation aside. It's extra fluff.

You need to have a core set of data that you use, and that's what you determine reasonable expectation. And the performance confirmation is something more than that. It's just we're not quite sure what.

I'd actually like for there to be some discussion about how much you need to know now and what is the role of performance confirmation in terms of its role in setting reasonable expectation for DOE to obtain a license to proceed into construction.

MEMBER RYAN: Maybe that's something the NRC will offer thought on after you come back.

MR. KESSLER: Yes, okay.

MEMBER RYAN: And then, Steve, I wanted to just add to John's comment, if I may. I thought your comment along those lines was in the context of recognizing the construction authorization, sort of a jumping off point, or, you know, that was the approval to dispose, and that you saw performance confirmation after that decision was made as being kind of something in addition to rather than condition of.

MR. FRISHMAN: Yes, that's exactly what I was saying.

MEMBER RYAN: Okay. I just want to make sure I understood his summary of your comment.

MR. FRISHMAN: Yes.

MEMBER RYAN: Thank you.

MR. KESSLER: That's it.

MEMBER RYAN: Okay. Any initial reactions to John? Yes, please.

MR. PARIZEK: Dick Parizek, the Board again. On the basis of what John was saying in terms of trying to get to the end point in a more efficient way, I would turn back to Wendell and ask, Wendell, would it have been -- what would you have -- would you have been better served if you had some guidance from EPA earlier? He's the only other guy in town that went through this process, not quite the same process, but it -- so can you offer us any insight as to whether you had guidance that would have helped you out?

MR. WEART: I think we were fortunate. See, EPA was learning how to do this. They had never been through it. They weren't handicapped -- wrong word. They weren't laboring under having licensed a lot of nuclear reactors and trying to license a repository the same way.

So they were trying to learn how to do this. And, consequently, we had lots and lots of interactive meetings, workshops where we could trade back and forth. They heard our ideas. They gave us their ideas. And we did get a lot of input from them as to when we finally got into the official permitting stage, we then provided what we called a draft permit, which allowed them to look at what we had done and tell us whether we hit the mark or not, and they were very helpful in interacting with us in that way.

MR. PARIZEK: So why isn't this a similar process saying, well, since NRC has never given license for high-level repository, this is sort of what you're saying, John, maybe to get this dialogue going and to make -- to streamline it some more. All right? It's not collusion. It's trying to be efficient with the use of everybody's time and getting to the end point.

MR. FRISHMAN: Well, I think it's going to be a very difficult situation if you have the applicant and the regulator essentially negotiating the meaning of the regulation. And it's a case that I don't think has real precedent, and also is one that certainly invites a lot more of the kind of trouble that you know I raise all the time. And I wouldn't be alone in it either.

But I think the discussion that goes on now that -- in terms of the technical exchanges is -- it's a matter of record. People understand the ground rules of those discussions. People understand that nothing there carries forward to a -- the necessity for anything defensible once you get into a time when a license application has become docketed.

To do the informal negotiation prior -- and sort of everybody, or the regulator and the applicant, developing their positions with a little wink at each other, so that once you get to licensing then at least we understand what we're talking about is, you know, antithetical to any type of an accountable regulatory system. I just can't see it.

There is one advantage in the use of these technical exchanges that I don't think has been fully exercised that could be fully exercised. And that's that most of the people responsible for Part 63, and many who at least are well aware of the conceptual thinking and the actual development of Part 60, are still around, or at least there are people in the agency who knew what they were thinking.

And I think that can be used maybe to some benefit within the process of technical exchanges, but at the same time the idea of the regulator and the applicant sitting down and deciding what the regulation means is, you know, beyond anything that I could see would remain under anything other than ultimately judicial control.

MR. KESSLER: There seems to be plenty of precedent for the regulator and the applicant to be sitting down on a generic basis. There's all kinds of reg guides I know, and I'm more familiar with Parts 71 and 72 on storage and transportation.

And there is all kinds of very quantitative, specific interim staff guidance that grew out of technical discussions in publicly-noticed meetings where the applicants and the regulator sits down and talks about a technical detail, and it winds up with things like specific guidance on you should not exceed 400 degrees Celsius when you're trying to draw your assemblies before you put them in storage.

Lots of details, and it's all about

quantitative descriptions of what the overall safety requirements are that are in Parts 71 and 72. Happens all the time, and it's done in public meetings with that kind of level of discussion.

MEMBER RYAN: It's time for a break. Before we do break, though, what I'd like to do is come back and offer to NRC a chance to react and reflect on what they heard and how this is affecting their thinking.

And I'd also like to ask Debbie and your team, if you have any summary reaction or comments you'd like to make, we'd welcome that as part of our summary, and then members will certainly offer their final comments along with panel members, and we'll move on to the public comment phase, hopefully pretty close to schedule.

It's now 3:30. I'd like to ask everybody to be seated and ready to go at 20 minutes of 4:00. Thank you.

(Whereupon, the proceedings in the foregoing matter went off the record at 3:28 p.m. and went back on the record at 3:42 p.m.)

MEMBER RYAN: If we could take our seats and reconvene, please. We'll proceed by having some reactions and thoughts from, first, the NRC and then from Debbie Barr and her team. And then I'll ask each panel member to give a couple minutes of maybe summary key thoughts and comments, ACNW key thoughts and comments in summary, and then we'll proceed into the public comment period. I've had one request for comment from the public -- actually, two now that I've been made aware of. So we'll have those comments and any additional ones and proceed from there.

So without further ado, Tim, let me turn it to your --

MR. McCARTIN: Thank you, Dr. Ryan. I just want to make a couple of quick points, and then a few other staff members will have some brief comments also.

First, getting back to Steve's comment about the regulation and negotiating it, number one, we don't negotiate the regulations with licensees.

Now, we try to write the regulations as clear as we can. We also have statements of consideration that precede the regulation to try to explain the staff's intent. However, there are areas where people sometimes find the regulations confusing or not quite clear of the intent. And certainly in the discussions we have with the Department, as well as any licensees, other stakeholders, we discuss openly the intent of those regulations. We would continue those discussions with the Department.

I'll say one of the examples -- does our regulation require them to confirm every barrier? No. There's nothing in there that says -- there's the word "practicable." There are other things that have to be considered as appropriate, so you don't have to confirm every barrier.

However, there can come times where people have a conflict with a regulation, and generally the staff -- the technical staff do not interpret the regulation. That's up to OGC, our Office of General Counsel. And if people have a disagreement of our -- what we believe is an interpretation of the rule, that ultimately one can go to OGC to get the interpretation. So that's open.

Getting more to what we've presented, I think we've benefitted from making the presentation, hearing the different comments and views. I think in terms of our approach to risk informing, we think that sort of gets you to the end point of looking at the evidence and possibly getting to what kind of things you might confirm.

As that evolves, once again, I think at

every meeting we try to present risk information. We learn the importance of communicating what's meant and being as clear as we can. The objective is to have some transparent picture of how you have the risk insights going down to the evidence. We think that will be helpful. It continues to evolve, and we take away from the meeting the importance of doing that.

We will continue the discussions. I know John Kessler is hoping for the continued discussions between NRC and DOE. We will continue those. We have been discussing with DOE many items, and certainly when we get Rev. 2 of the performance confirmation plan, having reviewed that, we would continue discussion with the Department of Energy in a public technical exchange, giving our views of what we think needs to be in a performance confirmation program for our review.

And we will look forward to having those meetings. And, clearly, the discussions we've heard today point to the -- I would agree that we need to have continued discussion for all stakeholders.

And Jeff Pohle had a comment or two.

MR. POHLE: Originally, I had one, and now I have two. I personally am still not convinced that this topic of weighting barriers and confirming every barrier, that there's really anything there. We may be just creating something out of nothing.

I still have an uneasy feeling about that. I think when Tim did his risk insights analysis, I don't think he walked into that analysis with defined barriers and sought to find what's important for each one. I think the analyses yield conclusions as to what parameters, etcetera, rose to the top as being important. And after the fact, one can choose to assign them barriers or not.

I have a very uncomfortable feeling that we may be creating something out of nothing.

My second comment, which is -- really hits home, since I'm one of the few people who has been trying to think through the management aspects of performance confirmation. I really appreciate Bob Bernero's insight. Safety analysis maintenance is a new term to me. I've learned something that I can take away with me and research out.

I think it should be helpful to us, and it's something for DOE to keep in mind when they start getting into those aspects of program management and Rev. 3 of their performance confirmation plan. I think there's something here.

A concern of mine is that we not end up

with something that would tie the program in knots. And if it rained a tenth of an inch yesterday, we have to crank up the operations center and go into some incredible response cycle on this. And I think Bob's insight is helpful, so I wanted to thank him for that.

With that, I'll pass on to Larry Campbell for our -- I guess our closing remarks.

MR. McCARTIN: I did start with barriers.

MR. PEARCY: I want to thank everyone for their comments on the research presentation -- in particular, Steve Frishman's comment on QA/QC. We'll entertain that question with management.

Chris Whipple's question on long-term monitoring, we'll certainly go back and look at that further.

Dick Parizek's comments on the evolving technologies and reliability -- that's extremely important. We'll think about that and talk to our contractors.

With regard to John Garrick's question, we will inform the ACNW staff, Neil in particular, and Mike Lee, as we select those test cases for the testing of our integrated strategy.

And finally, Mike Ryan's question on data management analysis -- is there appropriate time periods to do that analysis, and how you let that evolve. We'll entertain that question also.

So thank you for your comments.

MR. CAMPBELL: I'm Larry Campbell. First, I want to say I really appreciate all of the efforts that went into this workshop. A lot of people traveled long distance. A lot of preparation -- I can tell very good preparation -- went into some of the presentations.

And being somewhat new in this project, compared to the others at this table, I've been involved with four years, I would say some of them have been involved 18 years. I learned a lot today, and I hope everyone else is leaving with something very useful. I gained insights from DOE, from the stakeholders, and from the staff. So I know I'm learning a lot here.

I thought this was very productive, a lot of good information, a lot of good thoughts, and a lot of good discussions.

I would encourage everyone -- the term "dictionary" came up. There was use of safety, safety-related, important to safety, important to waste isolation. I would encourage everybody to look at the rule. There is a dictionary. For the purposes of preclosure, it is important to waste isolation. That's defined in the rule. Important to safety more or less applies to preclosure.

That's the only closing thought I would have is just to encourage everybody to look at the rule. There was some discussion on minimum requirements. Staff's expectations are in the review plan, which is now issued. The review plan, of course, is about an inch and a half thick. The rule is a few pages long, so that might help some people with determining what's minimum.

But with that, I just want to say I've been here for two days and have -- I know I learned a lot, and it shows a lot of good planning and a lot of good effort went into this. And, again, I appreciate -- I do appreciate having the opportunity to be here.

MEMBER RYAN: Thank you very much.

Let me turn to Debbie Barr and her team.

MS. BARR: I don't have any specific comments on the discussion that occurred during the panel here, although if anybody has got an INPO application form that would be very helpful.

(Laughter.)

But I did want to say that we very much appreciated the opportunity to come out here and meet with you about this. This has been incredibly valuable to us, and we've gained a lot of insights into the thought processes. We've heard a lot of very good discussion that we will then take home with us and work to improve the program.

We've gained some better insights into some of the thought process that occurred in the development of the text and the rule, and we've also learned a lot from some of the things that you've said as far as the panel members and the ACNW as far as your thoughts on the meaning of those.

So I think we have definitely gained from this, and we welcome the opportunity to come out. And we thank you for inviting us out to talk about this.

MEMBER RYAN: Thank you very much.

Let me start in reverse order with panel members. John, do you have any closing key thoughts?

MR. KESSLER: Nothing more.

MEMBER RYAN: Okay. Bob Bernero?

MR. BERNERO: No. I think it was a useful workshop, but I don't have anything to add.

MEMBER RYAN: Okay. Wendell?

MR. WEART: I'd like to echo Bob's comments. I found it very interesting on my part, particularly as someone who is a little more remote from both NRC and Yucca Mountain. Valuable meeting I thought.

MEMBER RYAN: Thank you. Richard?

MR. PARIZEK: I found it extremely helpful to me. And I'm looking forward to seeing the confirmation testing plan, and then following its evolution, because I think based on today's meeting there's bound to be adjustments made. And what those adjustments are we won't know; we'll just see what comes out. But that won't be the end of it either. Probably it will evolve.

It was very helpful to sort of see the licensing mentality of you folks -- again, how you think about it differently perhaps than science-oriented people who are on another end of the puzzle. And so I appreciate that insight.

MEMBER RYAN: Thank you. Steve?

MR. FRISHMAN: I, too, am interesting in seeing this Rev. 2 come out. And my guess is that some of what has been discussed here will be reflected in Rev 3, and I think it's probably important that it is.

Overall, I get the sense that -- or maybe at least I'm filtering it into my thinking -- that Rev. 3 should reflect some pretty hard thinking on what is needed to be done rather than just trying to fill as many boxes as possible. And so I think there's some value in that.

And getting a very tight look on a -- maybe a better interpretation of what the purpose of performance confirmation might be rather than just putting a shotgun pattern on the wall and see, you know -- seeing how much of it actually ultimately has to be carried out, because I think a few people have mentioned here -- and I didn't earlier, because it had been said, but I think it needs to be said again -- and that's that if there is a construction authorization, there isn't going to be any money for anything other than build and load.

MEMBER RYAN: Chris?

MR. WHIPPLE: Mike, let me congratulate you and Neil on a well-organized and well-run meeting. I learned a lot in a day and a half, not the least of which was that there actually could be a downside to having too many important to safety barriers.

That hadn't occurred to me before the meeting, and I think the clarity with which the staff and the DOE and the contractors explained their thinking and positions will help both of them with their next iteration. So I think this is very constructive.

I also think Steve's comments helped me think through what sorts of activities belong in performance conformation and which belong elsewhere -- S&T or the base program towards the license application. And I think those distinctions are clearer than they were before the meeting.

MEMBER RYAN: Ruth?

DR. WEINER: I want to thank the panel for taking the trouble to get these presentations together -- I thought they were really wonderful -- and DOE and NRC staff as well. And they have provided me with what I hope is the beginning of a great education.

Thank you.

MEMBER RYAN: Member comments. George?

MEMBER HORNBERGER: I don't think I've ever been part of this much of a lovefest before.

(Laughter.)

It scares me when I agree so much with Steve Frishman.

(Laughter.)

I do have a couple of comments that I wanted to make. And, basically, they are just some observations on what I've heard, to give my take on several things. First of all, I don't think that performance confirmation should be taken to be part of the -- any judgment that might be made about reasonable expectation. I don't think that that's the role of performance confirmation, and I -- that's certainly not my take. I hope it's not anyone else's take either.

I do see performance confirmation as an ongoing program in the sense that you want to expand your evidence base. I don't think that it would be sensible for us to, if, in fact, there is a construction authorization, to say, "Fine. We won't collect any more data." That would be stupidity, I think. It's sensible to collect information throughout the active period.

I think that our expectation, by the name of the program, is that if there is a judgment of reasonable expectation that the performance confirmation results will support that, will confirm it.

But there will be surprises, as everyone said, and we also have to maintain enough flexibility in the system to accommodate changes that need to be made. And I think that we have heard that the NRC staff, and DOE I hope, are committed to such a program.

It's clear that DOE -- their responsibility is to define the program, and I think -- I certainly hope -- I think that the committee would urge the NRC staff to stick with their risk insights as a basis for judging what parts of performance confirmation make sense.

I happen to agree that it's not their job to say, "Oh, don't bother doing that," if DOE comes in with a plan. So DOE certainly has to define the plan.

Finally, I do want to say that in my estimation I don't think that performance confirmation is in any way, shape, or form a safety issue. So I think that to a certain extent that might have been a red herring when we dragged that out, to say, "Well, we have to define the program to ensure safety."

Anticipation is that by complying with the regulation, I think as Sher said, that it would be -- assure a safe repository.

Like everyone else, I found it to be a very interesting workshop, and I look forward to -- I'm really, really grateful that the DOE shared their information with us. It's very important for us to know how this is shaping up. It's a lot to think about.

MEMBER LEVENSON: Most all the nice things have already been said, and I've not been known to focus on nice things.

No, I think it was an unusually good workshop in that I don't think it's a love-in. I think it's an indication that this is not a contentious issue. Almost everybody agrees this needs to be done and needs to be done properly.

I think I'd like to second what George said and add one thing, and that is that I don't think performance confirmation should be part of confirming expectations. On the other hand, it should not be a basic R&D program. I think it's a narrowly-defined thing that we need to identify what really needs to be done, how well does it need to be done, and that includes precision, accuracy, frequency, length of time, can it be done, can it be done as well as it needs to be done.

And that maybe in the end it consists of two sets of things. One is the minimum set to comply with regulations, and, secondly, just based on reactor experience, information useful for operation, maintenance, and operational safety. That can be somewhat different.

I gather that there's really no disagreement that that would be the basis for this.

CHAIRMAN GARRICK: I have about 10 bullets here, but I'm only going to talk about two of them. I'm saving eight of them for when we discuss the letter a little later. But I would like to say a couple of things.

One is that this is another reminder that what we're engaged in here is a learning process. We've never built a facility like this before. We've never done performance analysis quite like this before. We have developed guidance documents without having the direct experience of what we're dealing with before. And it's obvious every time we go through one of these kind of activities, working group sessions, we are once again reminded how much of a learning process it is.

There's one aspect of the performance confirmation that intrigues me a great deal, and we had some discussion about it. And the decision analysis activity sort of touched on it -- that's of great interest to me -- and that's the way in which we're going to monitor, if you wish, our growth of knowledge as a result of the performance confirmation exercise.

Ideally, what you'd like to think is that we are in agreement on a few important performance indicators, and that we set up some sort of a tracking system of those indicators such that we can see, as we analyze the data from our performance confirmation program, just exactly what the growth in our knowledge is.

My vision of it, of course, would be some sort of a Bayesian-based system against a set of performance indicators about which we would express our uncertainties, and we would see how those indicators move from left to right or right to left as well as see how the spreads on the probability distributions that indicate our uncertainty about the indicator changes with time.

I think that would be an impressive way to monitor just exactly what we're getting out of this system, and then, at the same time, we'd have it in a form such that we would be able to ask the performance assessment how this is affecting our most current thinking about the actual performance.

The one thing that did come out of the workshop -- and my final comment -- is I think that -- and I was delighted to see this, because we've made a few speeches about this. I think that this discussion about what we've come to call a compliance performance assessment, and a state of knowledge -- if you wish --

performance assessment, was very healthy and very good and is important, because I think many of us believe that what we really have so far is more of a compliance performance assessment than a state of knowledge performance assessment. And I think it's important for us to recognize that.

This is wrapped up in a lot of issues, because part of the Part 63 is prescriptive, particularly with respect to the dose model and the biological uptake and the dilution factors, and what have you. And just how much these kind of prescriptive components of Part 63 are masking a truly performance assessment output is something I'm quite interested in.

And I don't think we've got very good resolution of that yet, but it is something I think that the performance confirmation program could make an important contribution to.

Thank you.

MEMBER RYAN: Just a couple of additional comments. I appreciate, Larry Campbell, your comments, and your entire team's effort today to participate, as well as Debbie Barr and your entire team. It was a very good exchange.

I won't repeat what others have said, but

I think it's very important that we're not at the end of a process; we're kind of in the beginning stages -- Rev. 1, on to Rev. 2, and on to Rev. 3 -- and this kind of exchange I think -- I agree with John -- is very healthy to make it better over those two revisions in a formal way.

A couple of key questions that came out to me about, what is in the performance confirmation plan? Let me focus on that. I come back to my two questions. What does the performance confirmation data that's going to be collected add to questions of safety? And what information is obtained that enhances understanding of system performance?

And while it's not a safety determination for safety's sake, it does add to that question and enhance it. So I would be thinking about all this list of items that will be evaluated in that way and how they add.

I think another aspect that has become a little clear to me is that this is a program that will live for quite some time. It won't be this year or next year. It's going to be ongoing for the life of the facility, up to closure I guess. And how you get information and migrate it over time is as important as how you're going to analyze it when you collect it that year or the next year.

So we have to figure out ways to make sure that all of that stays visible and is part of the living history of how things move along.

I'll save some other thoughts for the closing comments. But at this point, I'd like to turn to our two requests for comments from the audience, and invite any other comments.

Judy?

MS. TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force. If you're worried about a continuing love-in, you can put away the Prozac, George, because --

(Laughter.)

-- it's over now.

(Laughter.)

There is really a lot of water over the dam at this point. And I think it was clear to see, in the way I think you went completely around the circle at least twice, about what is performance confirmation. And it became everything and nothing and back to a lot of other things.

But it should have been there, and it should have been sort of defined and kind of understood at the time that there was a site characterization plan. And it should have been out there and on the table, so that people like you, the rest of NRC, other oversight agencies, the public, the state, could have said, "No, I think this little item should go over into this box." "No, I think that should probably be over there."

And it should have all been clearly defined, rather than at this stage of the game kind of having all of these balls up in the air and trying to figure out which plate they should land on and how they should stay there, because now everything is screaming toward the license application, and I think it shows more than anything else that the site recommendation was incredibly premature. And as I said, that's water over the dam.

And part of the flood that went with that water was your sufficiency letter, which I think was also premature, and these kinds of things should have all been settled out well before that happened, but you can't pull it back.

So there is no clear picture of exactly what the performance confirmation plan is, and I think that the discussion at the end was good about the fact that it should be separated out. It shouldn't be part of the essential work that didn't get done.

When somebody ran in and drew a line and said site characterization is over, and there were things left to do, that that won't be considered performance confirmation, because my real fear -- and I'm entitled to have it, since I -- I was a part of it for probably two years, is that you wind up getting the license application, and you get a new form of closing/pending.

And it means there are issues that needed to be solved that were essential for licensing, and they wind up being part of this future performance confirmation program. So, therefore, I know that the same term won't be used, because that wound up being very troublesome. But there would be something like that, and you can't have these things that just trail on.

And so that's been my real big fear, is that there would be something that wasn't in the license application, there didn't seem to be an appetite to not docket or to turn it down, or to really be tough on this thing. So a new kind of category was created, and that's just -- it just can't happen that way.

In the discussion about safety and who plays what role, and John Garrick talked about the owner-operator-designer being the real safety expert, well, you can't sell that in Nevada. It's different when you're building a big project.

Even if that project is real dangerous and the community wants it, and they've made this decision, that, yes, something can go wrong, yes, we could have a kid killed, but, you know, all in all it's probably something we want to do. That is not the case.

This is a forced project on an unwilling host. These are people who do not like the idea of being the host for the repository, and they really don't like DOE. And they -- whenever you've been out there -- I know that you've been out to Nevada, you've had public comment, and you've had people rail about what went on during testing. It has nothing to do with Yucca Mountain. It has nothing to do with now. But that's the headset. These people killed us once; we're silly if we let them do it again.

And we have been told for years and years and years and years, you don't have to like DOE, you don't have to trust DOE, because you've got NRC. And NRC is going to come in here -- I know you don't know them. NRC is going to show up. They will only license this thing if it's absolutely safe, and NRC will take charge of your safety, your health, and your well being.

So be clear about that. That's what has been told, and that's what their expectations are. And you've got people, you know, who are very nervous and really in a bad position right now. So we don't want to see compromises. You already know the lay of the land in Nevada. But don't let this thing become some sort of an excuse.

I'm eager to see what performance confirmation winds up being myself. But I don't want it to be something that just hangs over everybody's head.

Thank you.

MEMBER RYAN: Yes.

MR. ELZEFTAWY: Can you hear me?

MEMBER RYAN: Yes.

MR. ELZEFTAWY: I guess you can. Again, Atef Elzeftawy. I have one point. I think I'd like to clarify something I did as a representative of Paiute, and then I'll switch hat as a public. I have two other points I think I'd like to make.

The first one, for the Paiute one, when I raised the $100 bill or the $1 bill, I intended to clarify to you that performance confirmation should not be defined as who is Jew or who is not a Jew. Maybe you don't have that background. The fundamental Jewish people, since the Roman times and until today, they are still arguing about who is a Jew and who is not a Jew.

All you have to do is just to go to the Middle East, and then you'll find out how lively the discussion is. That's 2,000 years. That should not be the performance confirmation or this program. It's somewhere less than 2,000 years to get it done.

The $1 bill or the $100 bill, they have something in common. Number one, almost everybody knows what the $1 bill is and what the $100 bill is. So the performance confirmation program needs to be simple but so beautiful to the public for the people to have confidence that this program is on track and it's applicable. We, as a scientist, can talk up here, but the people down here who have just a little bit common sense, and which is not very common these days, need to understand the simplicity of it.

Albert Einstein said his theory was simple and beautiful, and it was, and it still is. So I think your goal should be striving for specific points. You can discuss it to the nth degree. The Department of Energy has the responsibility of developing, designing the program.

The NRC has the responsibility of looking at it here and there. But I think you need to come to a focal point, and the focal point is as you focus the light that comes to a point, you need to come and that point of my chairman was make it simple, understandable, to most people. And if you don't make it simple and understandable to most people, it's going to be like, "Draft me some report."

A long time ago came with risk assessment, but you know what? The chairman of NRC, after 9/11, said, "We couldn't imagine that some people can get on an airplane and hit the Towers." And if they had hit a nuclear powerplant, I think we would have been a little bit having more problem.

That's her comment. So I'll switch it to my public comment.

I think my public comment is as a person who has left the program on a daily basis in 1990, and then now I just saw a couple of things during the last year or year and a half. It reminds me of the goal saying, "The more the things change, or they seem, it's" -- how does it go? I forgot it. The more things change, the more they stay the same.

And it seems to me that we are back again into the discussion of 1982, '83, '84, when I joined the NRC. We are still more or less standing still. How much progress have we made? The Department of Energy may spend about $2- or $3 billion, which we spend now in less than three weeks. What do we have to show for it?

I think you need to look at that point. You need to make it public, because this is a public program.

One of the things you need to do -- hold more meetings in Las Vegas. I don't think anybody in Las Vegas or in the State of Nevada will come up with $3,000 in his pocket to come here to attend your meeting and stand here and give you the public opinion.

I think you need to address that point, and you need to address it really seriously. Hold many, many, many meetings, as many as you can, not in the NRC building, and not over there. Come to the public over there, and you don't have to worry about even security. Just go over there and hold your public meeting, and in the process you will lose $10 or so gambling. So that's good for Las Vegas, to make it humorous.

One thing I think I'd like to see most of you, as a technical person -- I like the lady here -- we're all Type A people I think. I might be triple A. But I think it's so nice to have that simplicity of the heart and the humbleness of the attitude of saying, "Well, I really don't know this. I'm here. I'd like to learn."

It took the Department of Energy more than 11 or 10 years to say, "Oh, yes, there is a fracture flow in Yucca Mountain." It took the Nuclear Waste Technical Review Board, with my dear friend the late Pat Domenico, more than eight or nine years until they got it down in the report.

Well, sometimes seeing is believing. You need to go over there and see what Mother Nature is giving you and telling you, and then you will be able to comprehend and understand the reality of the place. This is a very big, important program to the nation, and I think it's -- a lot of responsibility is placed on you guys, Department of Energy, the NRC. I always think about you guys, ACRS -- but the ACNW, I think I need to get that.

And also, it's going to have a whole lot of political heat on the Commission. Some day they're going to have to vote. And just like the President of the United States said, "Well, in 10 minutes, okay, Yucca Mountain can go." It's when the DOE give him the information.

So there's going to be a very tough political situation -- decision to make, hard decision to make. But I think you are laying down the ground rules and the ground information that is going to be used by the people and the Congress and others.

Thank you for the privilege of being here. And I want to say good-bye again, so best wishes for you, and I will see you sometime soon.

Thanks.

MR. BULLEN: I'm Dan Bullen, and I'm from Iowa State University. I'm not wearing the Nuclear Waste Technical Review Board hat. I'm also not used to getting the last word here, so it should be kind of interesting.

First, I'd like to offer my compliments to the ACNW and to your staff for organizing a great meeting. I think this was a very worthwhile endeavor, and it also had multiple lines of input. You had the input from the state, the input from the utilities, and John Kessler, and you had the input from the interested parties, and I think that's very important.

When we have meetings at the Nuclear Waste Technical Review Board, we find that that's a very valuable experience also, and I wanted to give you a compliment on that. I also wanted to point out the timeliness of the performance confirmation meeting. I think it's a very important part to look at.

Right now, maybe the state thinks it should have been done prior to site recommendation, but it is a very important part of the license application process. And so to know what's going to be in the performance confirmation is extremely important.

I want to talk a little bit about the importance of the dialogue and the communication that happened here, and maybe the semantics are very important. I know that there's a dictionary associated with the rulemaking, that you can go take a look at the meaning of the words. But even people who work with this daily don't necessarily know the difference between compliance and a safety case.

And compliance means you've met the letter of the law or the rule. But the safety case, as I've learned as being a member of the Nuclear Waste Technical Review Board, is much more than just a TSPA. And I want to reiterate some things that the Board has said, specifically with respect to things like multiple lines of evidence and the actual analogs, and how they tie into the safety case.

Now, John mentioned that if we knew all of this, we should be able to get it into the TSPA or the performance analysis. And maybe that's true, but it's something with respect to confidence-building that you have when you understand the sort of physics of what's going on.

And I really like the idea of the basic understanding versus the detailed analysis. If you've got something that's maybe the simplified TSPA, that's the little disk that Steve Frishman has a copy of, and my students have a copy of, that you can see the response of sliding the slider bars around.

That's one thing that gives a little bit of confidence, as opposed to a 27,000-line or 27,000-note code of gold sim that no one can understand, because if you make a simple change you're not sure that that change is indeed conservative. So the basic understanding is important.

Now, along those lines, I also want to state one last thing, and that is I'm very interested in seeing Rev. 2 of the performance confirmation plan, and Rev. 3, and understanding the weighting factors, because I think those are all very important aspects to how the decision-making process was done.

And I think it's going to be an ongoing process, and I actually look forward to being a public participant in future workshops, if you so choose to have them, because I think these are very valuable.

Thank you very much.

MEMBER RYAN: Thank you very much. Any other comments anybody wishes to make?

I'd like to close by saying, first of all, thanks to each and every participant over the last two days, members of the panel, members from the staff of the NRC, members of DOE and your contractor staff, summer interns at the NRC, and everybody else who had valuable and important comments to make during the meeting, members of the public, and members of the ACNW. I think it has been a really excellent workshop and that we've explored an ongoing topic.

As was just pointed out, Rev. 2 and Rev. 3 are in front of us rather than behind us, and hopefully this collective discussion will have positive impacts on Rev. 2 and on Rev. 3 of the performance confirmation plan and how it ultimately moves forward into the license application.

So with that, I would close the working group session, and turn the gavel back over to the ACNW chair.

MEMBER HORNBERGER: Thank you. I think the first action that I would like to take as chair is we haven't done any applauding during this working group session. I think Mike Ryan and Neil Coleman and the staff that put this working group session together deserve a little bit of an applause.

(Applause.)

All right. Well, I think what we're going to do is this ends the period of the day where we need a recorder, and we're going to take a five-minute break and move into the more laborious part of our assignment as a committee. The committee will be talking a little bit about our report on the working group session, but this is officially the closure of the working group session. Five-minute recess.

(Whereupon, at 4:25 p.m., the proceedings in the foregoing matter went off the record.)

CERTIFICATE

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

Name of Proceeding: ACNW 144th MEETING

Docket Number: N/A

Location: ROCKVILLE,MD

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

Debra Wilenski

DEBRA WILENSKI
Official Reporter
Neal R. Gross & Co., Inc.

Risk-Informing Performance Confirmation

144th Meeting of
Advisory Committee on Nuclear Waste
(Working Group on Performance Confirmation Plans)
July 30, 2003

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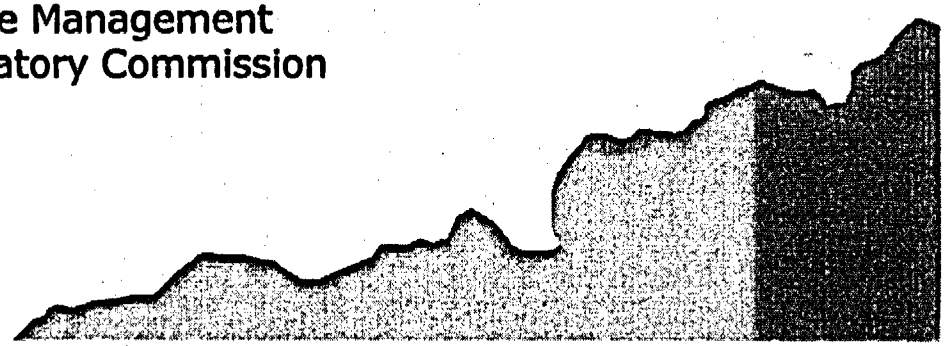


Outline

- Performance Confirmation Perspective
- Approach
- Engineered Barrier Example
- Natural System Example
- Summary

Performance Confirmation

- Evaluate adequacy of information used to demonstrate compliance
  - subsurface conditions are within the limits assumed during licensing review
  - barriers functioning as intended and anticipated
- Provide data where practicable
- In situ monitoring, laboratory and field testing, and in situ experiments

Risk Informed

- Risk significance of each barrier
- Uncertainty in estimating performance of barriers

Note:

DOE required to identify and describe repository barriers

Overall Approach (Iterative)

Describe Risk Significance

⇓

Consider Quantitative Basis (including uncertainties)

⇓

Identify Important Parameters, Models, and Assumptions

⇓

Consider Evidence/Confirmation

Examples

- Illustrative of Concept
  - engineered system
  - natural system

- Examples are not regulatory requirements nor do they imply regulatory acceptance

Spent Nuclear Fuel Dissolution
- Identify Risk Significance -

- Risk Insights baseline indicates that spent nuclear fuel dissolution is risk significant:

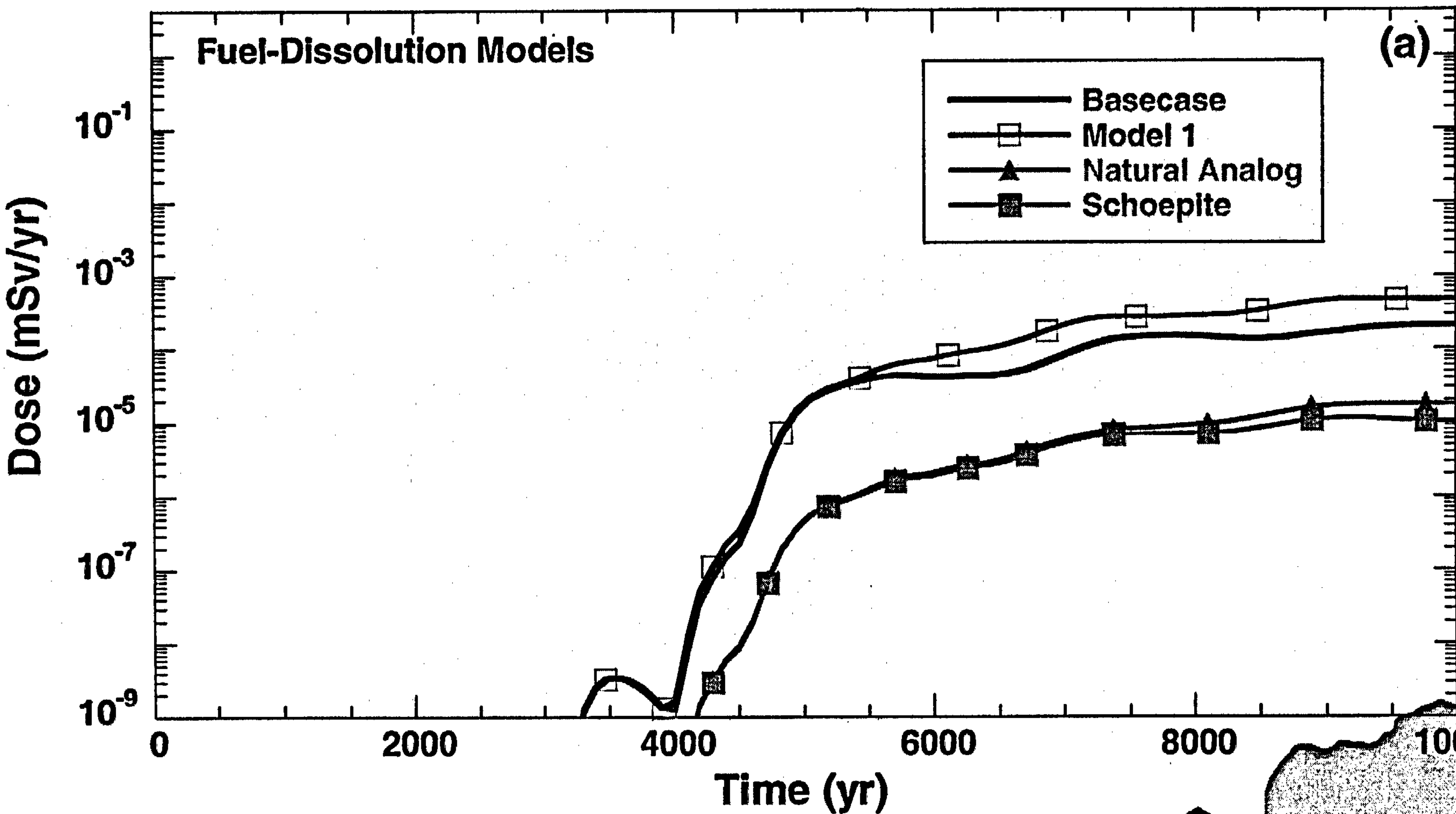
"The dissolution of the waste form in an aqueous environment is important for all radionuclides. Uncertainty in the dissolution is large such that the time required to release radionuclides from the spent fuel matrix can vary from hundreds of years to hundreds of thousands of years."

Spent Nuclear Fuel Dissolution - Consider Quantitative Basis -

- Existing information has been used to develop models in the TPA code

- Four different models in TPA for dissolution of spent nuclear fuel
  - carbonate solutions (model 1)
  - presence of Si and Ca ions (basecase)
  - natural analog
  - secondary mineral formation (Schoepite)

Spent Fuel Dissolution Model Sensitivity Analysis



07/30/2003

Spent Nuclear Fuel Dissolution
- Potential Importance -

- Limitations of the models were considered in developing risk insights baseline
- Parameter uncertainty
  - dissolution rate
- Model uncertainty
  - water chemistry
  - secondary mineral formation

Spent Nuclear Fuel Dissolution
- Consider Evidence/Confirmation -

Dissolution Rate (mg/m2-day)	Sample	Solution (pH)	Test Method	Reference
0.2 - 1.0 ~ 1/140 for partially clad fuel	Spent fuel	J-13 (8.4)	Immersion	Wilson, 1990
3×10^{-2} – 3.0	UO_2	$NaHCO_3 + CaCl_2$ +Silicic Acid (8.4)	Flow Through	Gray and Wilson, 1995
$(0.8 - 2.5) \times 10^{-2}$	UO_2	Silicate Solution (Near Neutral)	Flow Through	Tait, 1997
0.07 36 (initial, will decrease)	Spent fuel	Allard Synthetic Groundwater (8.1) (2.0)	Immersion	Forsyth, 1997
2.7	Spent fuel	J-13 (8.4, down to 3.2)	Drip	ANL, Finch et al., 1999
10 ~1/30 at pH 8 compared to pH 3	UO_2	HCO_3 (3) Reducing	Flow Through	Bruno et al., 1991

Retardation in Alluvium
- Identify Risk Significance -

- Risk insights baseline indicates that retardation in the alluvium is risk significant:

"Retardation in the alluvium has the potential to delay the movement of most radionuclides for very long time periods (e.g., thousands to tens of thousands of years and longer) for nuclides that tend to sorb onto porous materials (e.g., Np-237, Am-241, Pu-240)."

Retardation in Alluvium
- Consider Quantitative Basis -

- Existing information has been used to develop retardation factors for the TPA code
- Information for specific radionuclides
  - crushed tuff analog
  - literature values
- Support for conceptual model
  - linear isotherm
  - fast and reversible sorption reaction

Retardation in Alluvium
Sensitivity Analysis

[years for initial release into Sat zone to exit Sat zone]

Nuclide	Alluv(1km) Rf (low)	Alluv(1km) Rf (high)	Alluv (5km) Rf (low)	Alluv(5km) Rf (high)
Tc 99	350	350	550	550
I 129	350	350	550	550
Np 237	950	76,000	1,050	>100K
Am 241	>100K	>100K	>100K	>100K
Pu 240	54,000	>100K	>100K	>100K

Retardation in Alluvium
- Potential Importance -

- Extent of uncertainty
  - zero Kd (e.g., I and Tc)
  - range of Kd unimportant (e.g., Am)
  - range of Kd significant (e.g., Np)
- Sorption reaction is fast and reversible
- Changes in the bulk chemistry along the transport path

Retardation in Alluvium
- Consider Evidence/Confirmation -

- Mineralogy of alluvium

- Water chemistry in alluvium (e.g., pH, ionic strength)

- Sorption Coefficient for Np
  - site-specific batch sorption tests
  - dynamic tests (flow-through column tests)

Summary

- Risk insights identify areas of consideration for performance confirmation
- Uncertainties in parameters and models help determine extent of performance confirmation
- "Evidence" based approach
- NRC staff recognizes that DOE may make modeling selections (abstractions) that limit the significance of particular models and parameters

Status

- Risk insights report to be completed in the October time-frame
  - based on risk baseline
  - provides quantitative basis
  - identifies further calculations

- Risk insights report will be updated as appropriate

PERFORMANCE CONFIRMATION PROGRAM
Section 2.4 of Yucca Mountain Review Plan

144th Meeting of
Advisory Committee on Nuclear Waste
July 29-31, 2003

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Discussion Topics

- Overview of Section 2.4 of Yucca Mountain Review Plan in terms of the four primary areas of review

- NRC reviewer's information needs

YMRP Section 2.4 Overview

Areas of Review

- General requirements including:
  - Objectives to acquire data by identified tests to indicate whether subsurface conditions are within limits assumed in licensing review and whether natural and engineered barriers are functioning as anticipated
  - Overall schedule
  - Implementation with regards to adverse effects of program, provision of baseline information, and monitoring and analyzing changes from baseline

YMRP Section 2.4 Overview

Areas of Review (continued)

- Confirmation of geotechnical and design parameters including:
  - Measuring, testing, and mapping during construction and operation to confirm geotechnical and design parameters related to natural barriers
  - Monitoring, in situ, the thermomechanical response of the underground facility until permanent closure
  - Surveillance program to evaluate subsurface conditions against design assumptions including provisions for comparing observations with design bases and assumptions, determining need for changes to design or construction methods, and reporting comparative differences, their significance to health and safety, and recommended changes, to the Commission

YMRP Section 2.4 Overview

Areas of Review (continued)

- Design testing including:
  - Testing of engineered systems and components, other than waste packages, used in the design (for example, borehole or shaft seals, drip shields)
  - Program to evaluate thermal interaction effects of waste packages, backfill, drip shields, rock, and unsaturated zone and saturated zone water
  - Plan to test, before permanent placement begins, effectiveness of backfill placement and compaction procedures against design requirements (if backfill is used)
  - Plan for tests to evaluate effectiveness of borehole, shaft, and ramp seals before full-scale sealing begins

YMRP Section 2.4 Overview

Areas of Review (continued)

- Monitoring and testing waste packages including:
  - Plan for monitoring the condition of waste packages at the geologic repository operations area, including an evaluation of the representativeness of those waste packages chosen for monitoring and representativeness of the waste package environment of waste packages chosen for monitoring
  - Plan for laboratory experiments that focus on the internal conditon of waste packages, including evaluation of degree environment within underground facility duplicated in laboratory
  - Duration of the waste package monitoring and testing program

Performance Confirmation Plan Review

To achieve an adequate review context and focus, NRC reviewer's need to be familiar with:

- Barriers important to waste isolation identified by DOE (and any outstanding NRC concerns)
- DOE's description of the capability of each barrier to isolate waste (and any outstanding NRC concerns)
- DOE's information on uncertainties related to parameters, processes, models, etc. relevant to individual barrier's waste isolation capability
- Available DOE risk evaluations
- NRC's risk insights baseline
- CNWRA support to enhance independent review capability

DOE Performance Confirmation Observations

Richard R. Parizek

U.S. Nuclear Waste Technical Review Board

- Good Progress on Confirmation Program
- TSPA Impact on Decision Making
- Confirmation Testing Synergies
- Natural-Engineering Analog Example - Teton Dam
- Importance of Testing Engineering Concepts

Nye County Department of Natural Resources and Federal Facilities

Nye County's Views on Performance Confirmation and Related Topics

Presented by:
Les Bradshaw

ACNW Working Group Session on Performance Confirmation Plans
July 30, 2003

Introduction

- Nye County has always considered Performance Confirmation (PC) as a critical program element because it will demonstrate whether the repository will perform in a manner that protects the human health, safety, and the environment in Nye County.

Regulatory Requirements

- Under 10 CFR 63.131(b) the Performance Confirmation program must have been started during site characterization.
  - Has it?
  - No approved program is in place to our knowledge.

Regulatory Requirements (Continued)

- 63.131(d) (2) provides that PC program must be implemented so that it provides baseline information and analysis of that information on those parameters and natural processes pertaining to the geologic setting "that may be changed by site characterization, construction and operational activities".
  - Has this requirement been met?
  - What about the DOE decision to suspend monitoring of UZ boreholes in 2001? This should be a component of any PC program.
  - Nye offered to pick up that effort, but DOE turned down.

Regulatory Requirements (Continued)

- Under 63.131-134 all facets of the repository must be subject to a PC program.

- In summary, a comprehensive PC program should have been in place, or at least designed and subjected to independent stakeholder review and input, long ago.

Participation in PC by Independents

- Nye and many others believe that PC should include significant participation by qualified organizations that are independent of DOE.
- PC performed by DOE will not be as acceptable to the public as PC performed by qualified independent entities.
- PC tasks that could be conducted by these independent organizations include, but are not limited to:
  - Technical review of plans, data, analyses, and interpretations beyond the NRC licensing process.
  - Establishment of baseline data for environmental media including surface and subsurface water, air, rock/soil, and biota.
  - Long-term monitoring of environmental media beginning when waste is first received (i.e. post-emplacement monitoring).
  - Storage and dissemination of PC data.

Nye's Present PC Capabilities

- Nye, via its successful Independent Scientific Investigations Program, is presently participating in, or positioned to participate in, a number of PC tasks. For example:
- Nye's Early Warning Drilling Program has and continues to demonstrate technical expertise in establishing and operating a groundwater monitoring network downgradient from Yucca Mountain.
  - Nye currently collects and analyzes groundwater samples and water levels from this network for independent baseline monitoring and shares samples and data with DOE and NV.
  - This network, with Nye as the qualified operator, should serve as the basis for post-emplacement groundwater monitoring downgradient from Yucca Mountain.
  - DOE has in principle approved funding for the continued expansion of this downgradient network through 2007.

Nye's Present PC Capabilities (Continued)

- Nye is well qualified to extend and operate this downgradient groundwater network to adjacent regions on the Nevada Test Site that may be impacted from nuclear testing.

- Nye presently employs/contracts a group of technical experts in subsurface hydrogeologic characterization and monitoring who are well qualified to:
  - Independently review PC plans, data, and analyses.
  - Plan and conduct vadose zone PC monitoring of air, water, and rock in the repository and in surrounding boreholes.

Nye's Plans for Developing Additional PC Capabilities

- Nye is working towards developing in the near future the expertise, organization, and facilities to participate in other PC tasks suitable for independents including:
  - PC monitoring of surficial environmental media (soil, air, and biota) downgradient from Yucca Mountain as well as within adjacent regions of the Nevada Test Site that may be impacted from nuclear testing.
  - Storage and dissemination of data.

Nye's Plans for Developing R&D and Operational Related Capabilities

- Nye is also working towards developing the capability of managing and hosting other Yucca Mountain related development, manufacturing, and construction activities including:
  - Development of instrument systems for remote monitoring of subsurface conditions in the repository and in monitor wells or boreholes.
  - Manufacturing waste cask prototypes and production units.
  - Construction of facilities necessary to support training, monitoring, sample archival, and data storage and dissemination.

PC vs. Research and Development

- There seems to be some confusion today about the difference between long-term R&D and PC
- PC should be considered to be those scientific activities, including long-term monitoring, that assures the repository is, or likely will, operate as expected, and that thus assures license compliance.
- R&D should be other scientific investigations designed to enhance understanding of the system, both natural and engineered, and that might be used to improve repository performance in the future.
- PC is linked to, but separate from R&D
  - e.g. As proven cost-effective R&D advances in monitoring become available they should be incorporated into PC.

Planning and Budgeting for PC and R&D

- PC and R&D are both complex and long-term undertakings. Neither in the past have been included in the routine budgetary process, or in the Total System Life Cycle Cost (TSLCC) report, except in very general terms.

- How one prioritizes and funds PC and long-term R&D is not yet clear. It is essential that we start focusing on this now, rather than cob together some program at the last minute for the LA that no one else has had a chance to provide input.

- When you look at some examples of the activities involved in PC that will probably be most difficult (remote monitoring of waste packages, e.g.) it becomes clear that budgetary considerations and decisions other than purely scientific ones will be important, if not the drivers.

Planning and Budgeting for PC and R&D (Continued)

- The institutional arrangements for conducting PC and R&D over the very long-term have not been examined.
  - i.e. Nye would like to be involved in the development of instrument systems for remote monitoring.
- Confidence in the long-term stability of the independent organizations involved, not just DOE, will also be critical.
- Nye studies indicate that current fee structure may be inadequate to fund the DOE TSLCC, even without adding in long-term R&D and PC costs.
- No consideration has yet been given to the resolve of Congress to continue appropriating large sums of money once spent fuel and high-level waste is "out-of-sight and out-of-mind".

Summary

- DOE has much PC ground to make up.
- PC and R&D are different and detailed planning and budgeting should be completed ASAP.
- Qualified independent entities should be involved in PC.
  - e.g. Similar to the role the Electric Power Research Institute (EPRI) has undertaken in addressing PC strategies and developing a prototype PC plan.
- Nye has unique qualifications and should play an active role in PC and R&D.

Nye County Department
of Natural Resources and Federal Facilities

Some Observations on Performance Confirmation and Performance Assessment

John Walton
University of Texas at El Paso

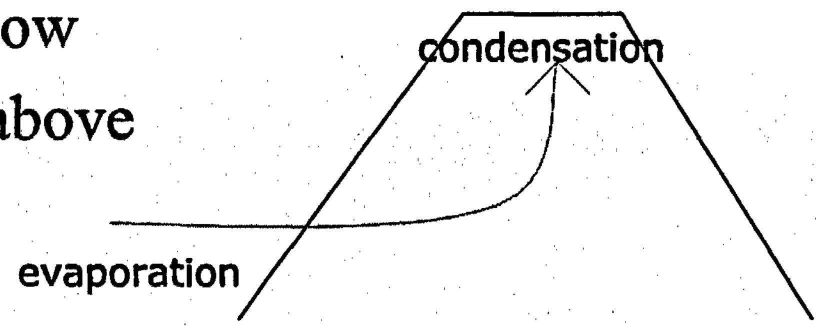
ACNW
July 2003

Areas of Concern

- Monitoring of anticipated impacts on Nye County resources
- Unresolved performance assessment issues

Anticipated Impacts

- Heating of mountain and induced airflow at YM
  - dryer and cooler below
  - warmer and wetter above



  - will induce flora and fauna changes

Sequence of Events

- Mountain heats up
- Increased natural breathing of mountain
- Changes to flora and fauna on scale of 10's to 100's of years
- Monitor soil conditions and vegetation changes
- Adequate pre construction vegetation analysis necessary for baseline

Unresolved Questions

- Roof collapse
  - many analysts anticipate roof collapse in 10s to 100s of years
  - DOE modelers assume drifts are eternally open
  - rubble makes good insulation
  - THC modeling is of limited utility if we don't know the "R-value" in the attic
  - if the situation is uncertain, backfill may be required to provide a predictable environment

Unresolved Questions

- Extent of natural ventilation
  - Repository will increase natural breathing of mountain
  - Not fully in DOE models
  - Important for heat, moisture, chemistry modeling

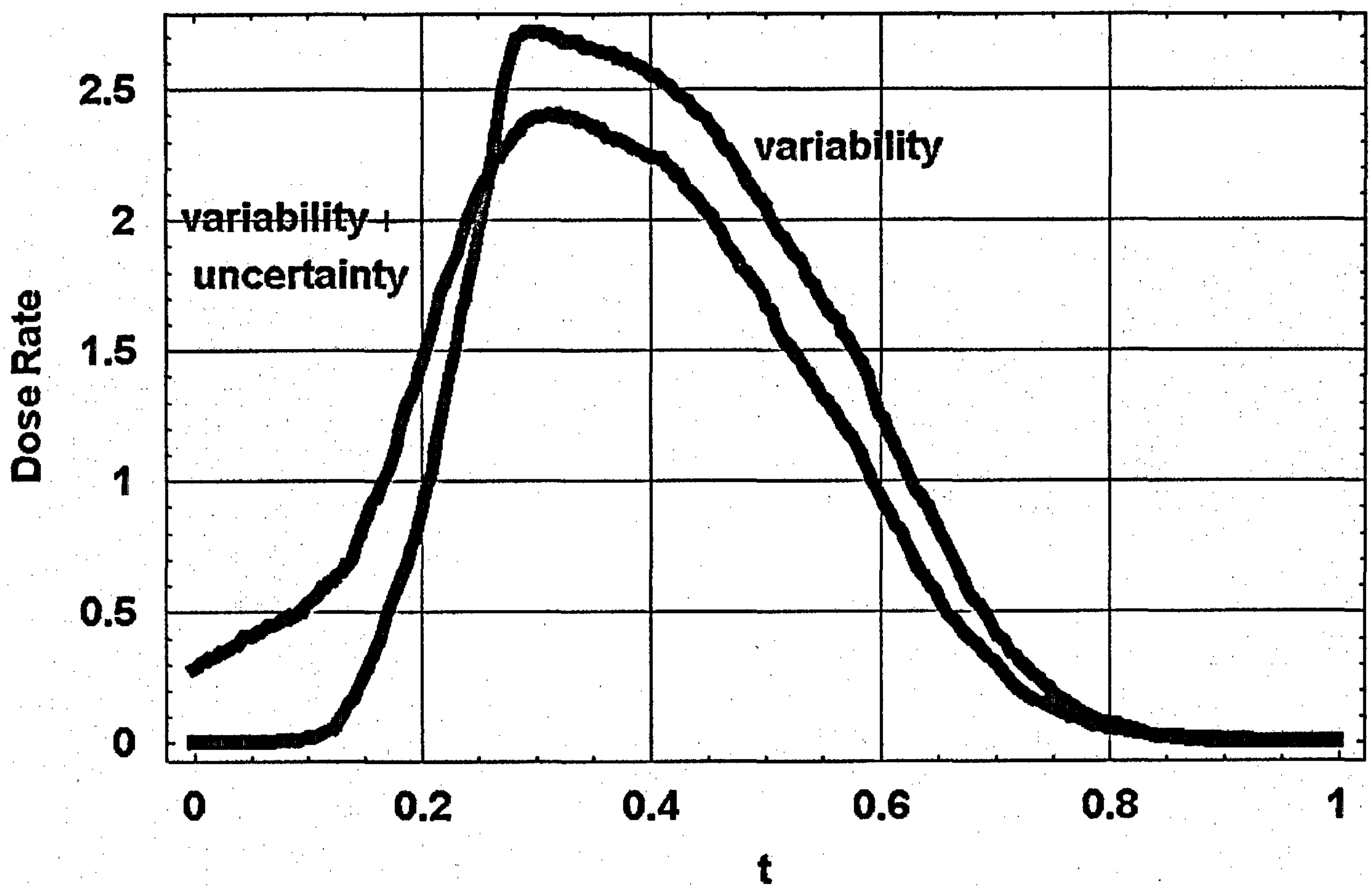
Unresolved Questions

- Uncertainty vs. variability
  - By necessity performance assessment models mix spatial and temporal variability with uncertainty
  - This can lead to unrealistic spreading (dilution) of projected risk, thereby reducing peaks in the mean projected dose curve
  - Mixing of variability and uncertainty is not realistic, but . . .
  - In YM context is it conservative or non conservative?

Example Calculations – a simplified PA

- Processes:
  - Corrosion
  - Release
  - Transport
  - Event
- Arbitrary units, 1000 realizations
- Normally distributed parameters
- If we assume we are God for a moment, we can run the calculation both ways

Mean of 1,000 Realizations



Result

- Inclusion of uncertainty reduced projected risk as measured by the "peak of the mean of the realizations"
- Sometimes inclusion of uncertainty increases projected risk
- The difficulty is caused by the metric, "peak of the mean of the realizations"
- With this metric, inclusion of uncertainty may either increase or decrease projected risk in a difficult to discern pattern
- What does it do in TSPA?
- What incentive does DOE have to reduce uncertainty when it can increase projected performance?

Conclusion

- Many important issues remain
- Local involvement in performance confirmation is essential
- Nye County can work cooperatively to help resolve some of the issues

PC, what does it really mean?

Comments by
Clark County to the ACNW

Department of Energy Statement

- The Strategy of the Performance Confirmation program is to utilize multiple data acquisition methods to produce an overall data set which is adequate to **confirm (or revise)** licensing assumptions about repository performance.

Nuclear Regulatory Commission 63.131

- (a) The PC program must provide data that indicate, where practible, that (not direct quotes)

  (1) Actual subsurface conditions are within the limits assumed

  (2) Natural and engineered systems are functioning **as intended**

  (b) The program must have been started during site characterization and it will continue until permanent closure.

Definitions Cont.

- 63.103(M) Performance Confirmation

  A performance confirmation program will be conducted to **evaluate the adequacy** of assumptions, data, and analyses that led to the findings that permitted construction of the repository and subsequent emplacement of the wastes.

EPRI Report on Performance Confirmation

- any decision by the NRC to license each stage of repository development, if a license application should be tendered, would be made on the basis of the information that **exists at the time** that the NRC considers such an application.

Challenges

- Temperature effects are difficult, if not impossible to scale.
- In processes that are well understood the effects of long time periods can be compensated for by changing other independent variables
- Even in a dedicated drift for PC, conditions are unlikely to duplicate those in the repository.
- Some of this data will still be useful.

Concerns

- Waste package performance is still the most critical issue from a performance standpoint
- Data on long term corrosion in a representative repository environment is most likely impossible to collect prior to closure
- Data collected during the PC period should not be used to close agreements, or to be the primary data for TSPA for LA.

Current Schedule

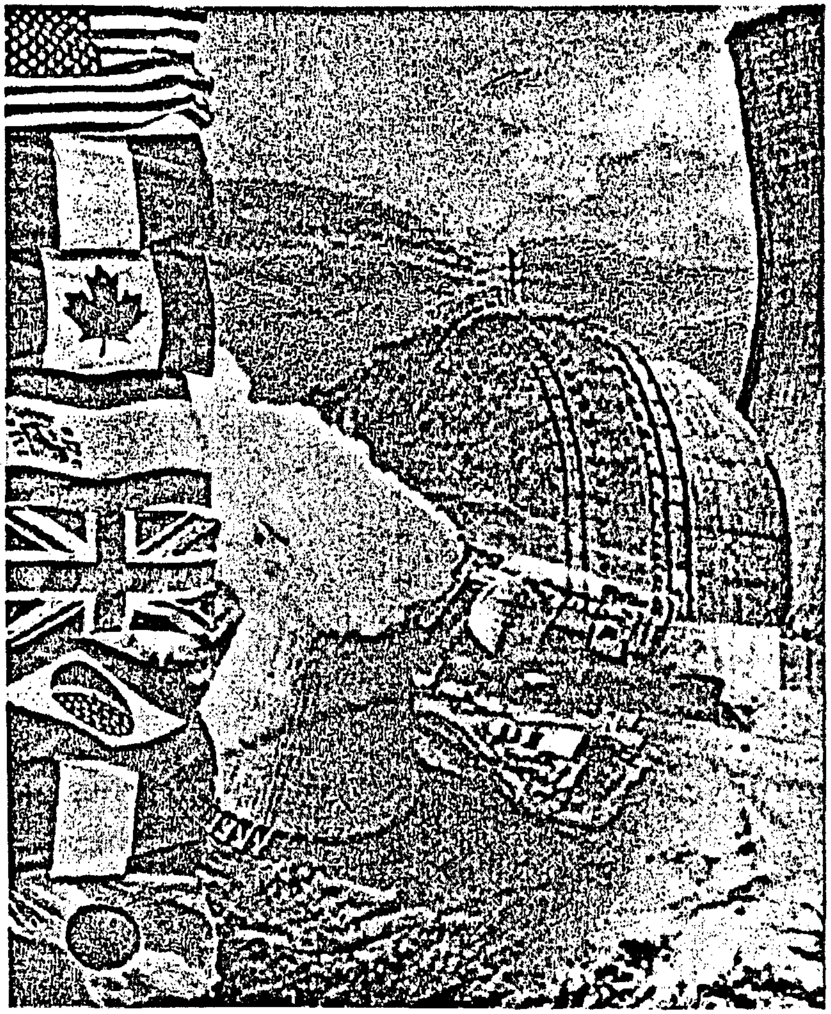
	CLST	ENFE	IA	PRE	RDTME	RT	SDS	TEF	TSPAI	USFIC	Total
7-12/03	9	20	9	3	7	14	0	2	15	11	90
1-6/04	14	4	1	0	2	9	6	5	23	3	67
7-12/04	12	4	0	2	14	2	0	1	13	1	49
1-6/05	2	0	0	0	0	0	0	0	0	2	4
7-12/05	1	0	0	0	0	0	0	0	0	0	1

PC

- Should not be used as to means to defer the resolution of issues that are part of LA
- Should **confirm**, but not be the primary source of data
- An LA that relies on PC and RAI's should be looked at **very critically**.

PC or ST
Understanding the Natural System

- Improve the understanding of the role of the Calico Hills on waste isolation
- Water, where does it go and how fast does it get there?
- Geochemistry, current and future?



The Role of Performance Confirmation in Yucca Mountain Development

John Kessler

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Presented to the NRC Advisory Committee on Nuclear Waste, 30 July 2003

EPRI

Background: Uncertainty is Unavoidable. How can it be "Managed"?

- Regulatory approaches:
  - Dose to a "reasonably maximally exposed individual"
  - RMEI dose limit a fraction of natural background
  - Multiple barriers
  - Waste must be retrievable
  - Long(er)-term R&D:
    - "Safety Questions" provision in NRC review plan
    - **Performance Confirmation program**
- Additional DOE approaches:
  - Reduce uncertainties with design modifications
  - Analyses conservative (on the whole)
  - "Margin": below, not at the limit
  - Long-term R&D / Performance Confirmation program

Distinction Between Long-Term R&D and 'Performance Confirmation'

- **Performance confirmation:**
  Activities that are specifically designed to evaluate the technical bases for the licensing decision

- **Long-term R&D:**
  Any other activity not specifically directed toward evaluating licensing bases

EPRI Work on Performance Confirmation (PC)

Work done in 2000-2001

- Evaluation of early (2000) DOE draft PC report
- Convene PC panel and make recommendations and observations
- PC workshop (DOE, NRC, NWTRB, Nevada counties, PC panelists, others), November 2001
- Provide examples of some appropriate PC activities using DOE "8-step" methodology

All of the above summarized in a December 20001 EPRI report (EPRI report number 1003032)

EPRI Performance Confirmation Panel Members

- Chris Whipple, Environ, Inc. (chair)
- Robert Budnitz, Future Resources Associates, Inc.
- Matthew Eyre, Exelon Corp.
- Barry Gordon, Structural Integrity Associates
- John Kessler, EPRI Inc.
- Rodney McCullum, Nuclear Energy Institute
- William Miller, QuantiSci Enviros, Ltd.
- Warner North, NorthWorks Inc.
- Alan Ross, Alan M. Ross and Associates
- Alice Shorett, Triangle Associates
- John Taylor, EPRI (retired)

EPRI Performance Confirmation Panel December 2001 Comments

- PC (and other long-term R&D) is useful and appropriate
- There are many interested parties in PC
- NRC and DOE need to start now developing a shared understanding of how long-term R&D and PC will be carried out
  - Commitments will be identified in the license application and any near term amendments
- A flexible, adaptive plan is needed
  - Implications for using a rather rigid license amendment process?
- Prioritize now using risk-informed judgment and clear criteria for prioritization
- Avoid "traps"

NRC and DOE Need Shared Understanding of PC/L-T R&D

- Commitments would likely be defined in the licensing process – even those not starting until much later
  - Concern is that DOE must get it right the first time, which is counter to a flexible, adaptive PC approach
- NRC and DOE have both made a commendable start
  - NRC: Final regulation
  - DOE: Draft PC and long-term R&D plans (Rev. 2 soon?)
- Differences between the two PC approaches need to be resolved
  - DOE: overall performance objectives are achieved
  - NRC: natural and engineered barriers are functioning as intended and anticipated

EPRI

Use Risk-Informed Judgment and Clear Criteria for Prioritization - Now

Potential criteria:

- The relative "value" of information (i.e., risk-informed)
- Timing of the need for specific information
- Cost of conducting a specific activity
- Interference with other activities
- Agreements with stakeholders
- Concerns of stakeholders
- Potential health effects to workers and the local population
- Ability to define sufficiently the activity such that "confidence" is truly enhanced in a reasonable amount of time

EPRI

Traps to Avoid in Defining a Long-Term R&D Program

- Agreeing to measure parameters that do not affect performance
  - Satisfying parochial interests
- Agreeing to do things that can't be done
  - Requiring unnecessary accuracy or precision in measurements
  - Monitoring of too limited duration or extent
- Assigning excessive levels of conservatism on bounds because it is easy ("eats" margin)
- Neglecting institutional aspects (must maintain technical capabilities; periodic "report cards")

EPRI

DOE's Eight Steps* in Defining a Performance Confirmation Activity
(from DOE's 2000 draft PC report)

1. Identify which processes are to be measured, the 'key' performance confirmation factors [*DOE PC Rev. 2*]
2. Define data base and predict performance [*DOE PC Rev. 3*]
3. Establish tolerances or predicted limits or deviations from predicted values [*Rev. 3*]
4. Identify completion criteria and guidelines for corrective action [*Rev. 3?*]
5. Conduct detailed test planning [*Rev. 3*]
6. Monitor performance, perform tests, and collect data
7. Analyze and evaluate data
8. Recommend and implement appropriate actions if there are deviations [*discussed in Rev. 3?*]

*The "steps" can be iterative

EPRI

Step 3. Establish Tolerances, Limits, Deviations from Predictions

- This is a key step in a successful performance confirmation activity
- Combine baseline data with predictions for performance confirmation period
- May become license conditions
  - i.e., "If…then" and "If not…then" specifications

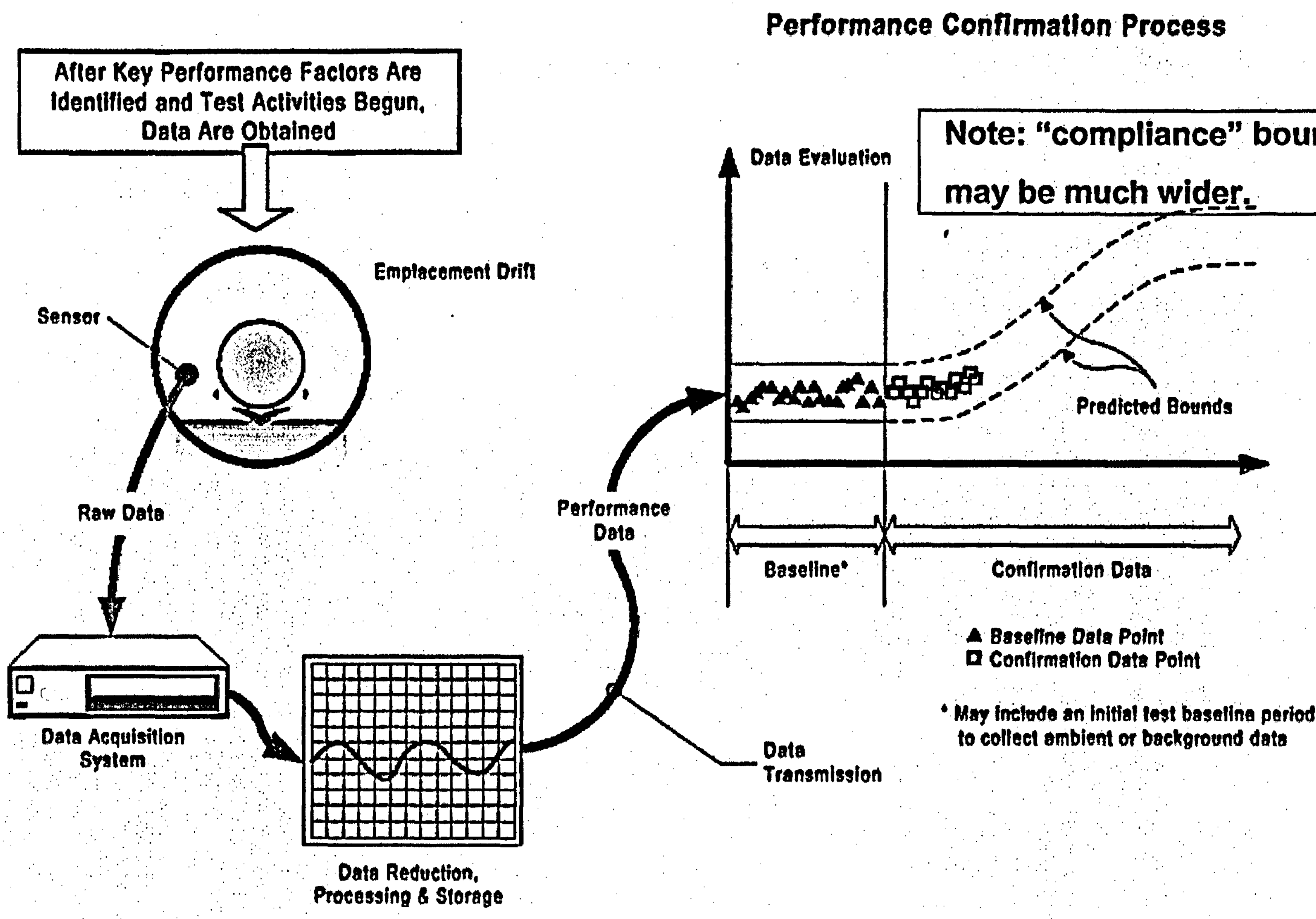


Figure 2-1. Schematic Diagram of Performance Confirmation Process From Testing to Data Evaluation

[Taken from DOE's May 2000 Draft PC Plan]

Step 4. Identify Completion Criteria

- A clear end point must be identified
  - Tolerance bands at 50, 100, 200 years need to be developed
  - Test must be sensitive enough to detect the required tolerance
  - Test must be long enough
    - Need to know in advance adequate time is likely
    - Will be difficult to exactly define up-front how much time is required
- Sample size and frequency issues must be considered
  - E.g., must *every* container be examined?

EPRI

Step 8. Recommend and Implement Appropriate Actions

Potential options:

- No action
- Limited, additional testing (if endpoint adequately defined)
- Modification of original licensing bases
- Engineered design modification(s)
- Temporary halt of emplacement
- Retrieval / abandonment of site

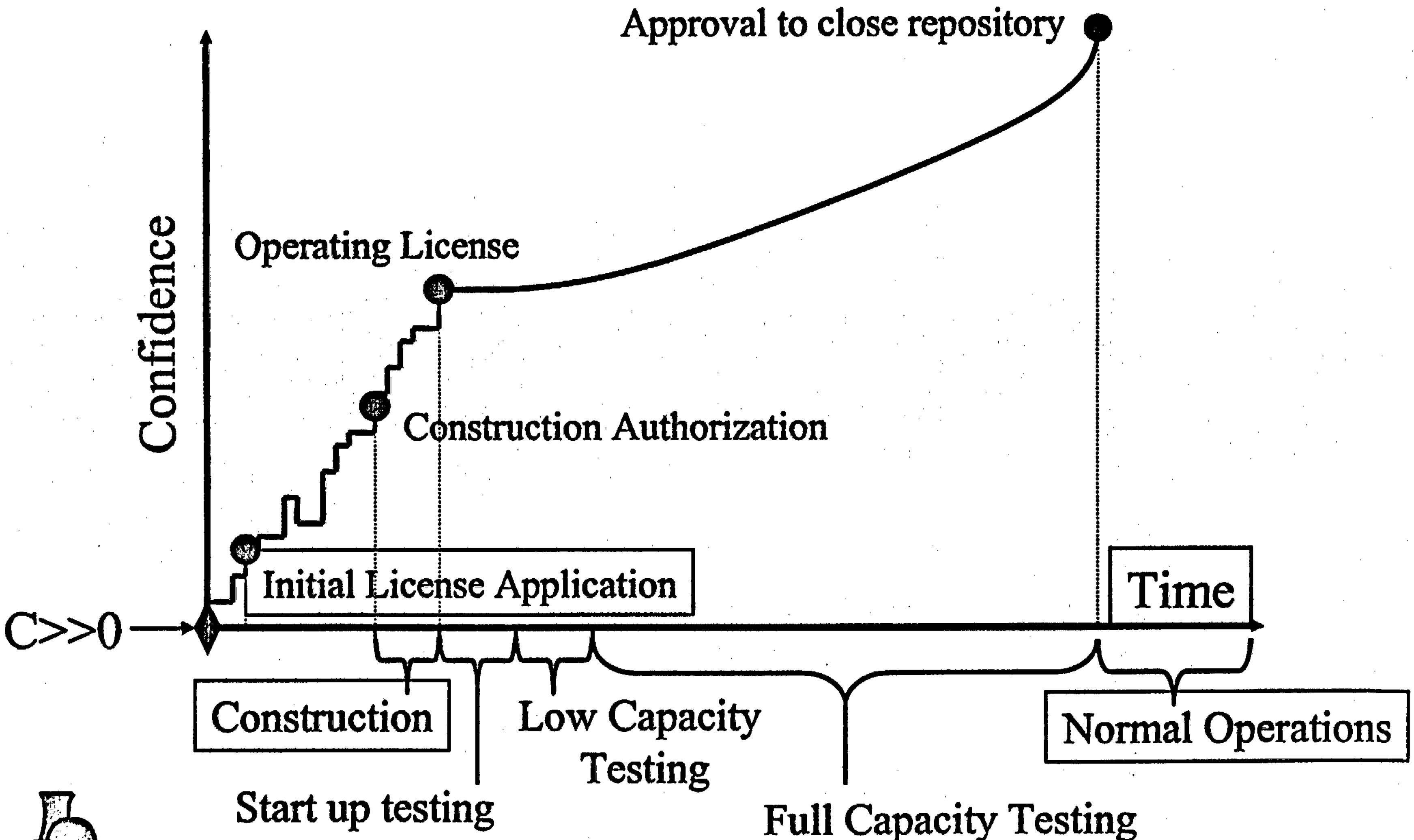
Suggested Options for Important FEPs not Amenable to PC Testing

- Use reasonably bounding values based on expert elicitation
- Leave margin
- Use natural analogues
  - Analogue research can be part of performance confirmation program
- Add/modify engineered feature to reduce importance of the FEP
  - E.g., drip shields added to mitigate groundwater flow uncertainty/heterogeneity issue

Important to identify these FEPs early.

Step-wise licensing

Post-closure reactor equivalents



EPRI

Analogy to Reactor Licensing

PC similar to "Tech Spec" surveillance program for reactors

- Verify reactor equipment is operable
- "Limiting Conditions of Operation": what equipment must be operable and, if not, actions to be taken
  - In repositories, there are likely to be differing degrees of "inoperability"
  - Could be decades before "operability" needs to be restored or alternative action taken

Conclusion (1 of 2) : 'Big 3' EPRI PC Panel Long-Term R&D Issues

- Describe how a long-term R&D program (of which "performance confirmation" is only a part) provides enhanced 'confidence' in the future
- Considerations for activities to fit between each stage of repository development
  - SR, Construction LA, Construction authorization, Loading authorization, Closure LA
    - Widely different amounts of time between each
    - Commitments increase for specific FEPs
- Options for treating 'important' FEPs for which little additional information can be obtained over 25-300 years

Conclusion (2 of 2): Other Important Details

- Is appropriate 'baseline' information being collected at the right times?
- Establishing meaningful tolerance bands
- Identifying a clear (enough) end to the activity
- Prioritization in case of limited funding (or time)
  - Need to establish broadly based input on the criteria here?

Generic Research on an Integrated Ground-Water Monitoring Strategy

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144th Meeting of the
Advisory Committee on Nuclear Waste
Rockville, Maryland
July 30, 2003

Outline

- Generic[1] Ground-Water Monitoring Needs
- Research Objectives
- Research Tasks
- Generic Applications
- Summary

[1] LLW, Assured Isolation Facilities and Decommissioning

Generic Ground-Water Monitoring Needs

- What, when, where and how to monitor for water flow and transport of contaminants
- Design monitoring systems to detect both current conditions and changes in system behavior that affect contaminant transport
- Develop database for identifying and quantifying causative mechanisms (e.g., events and processes)

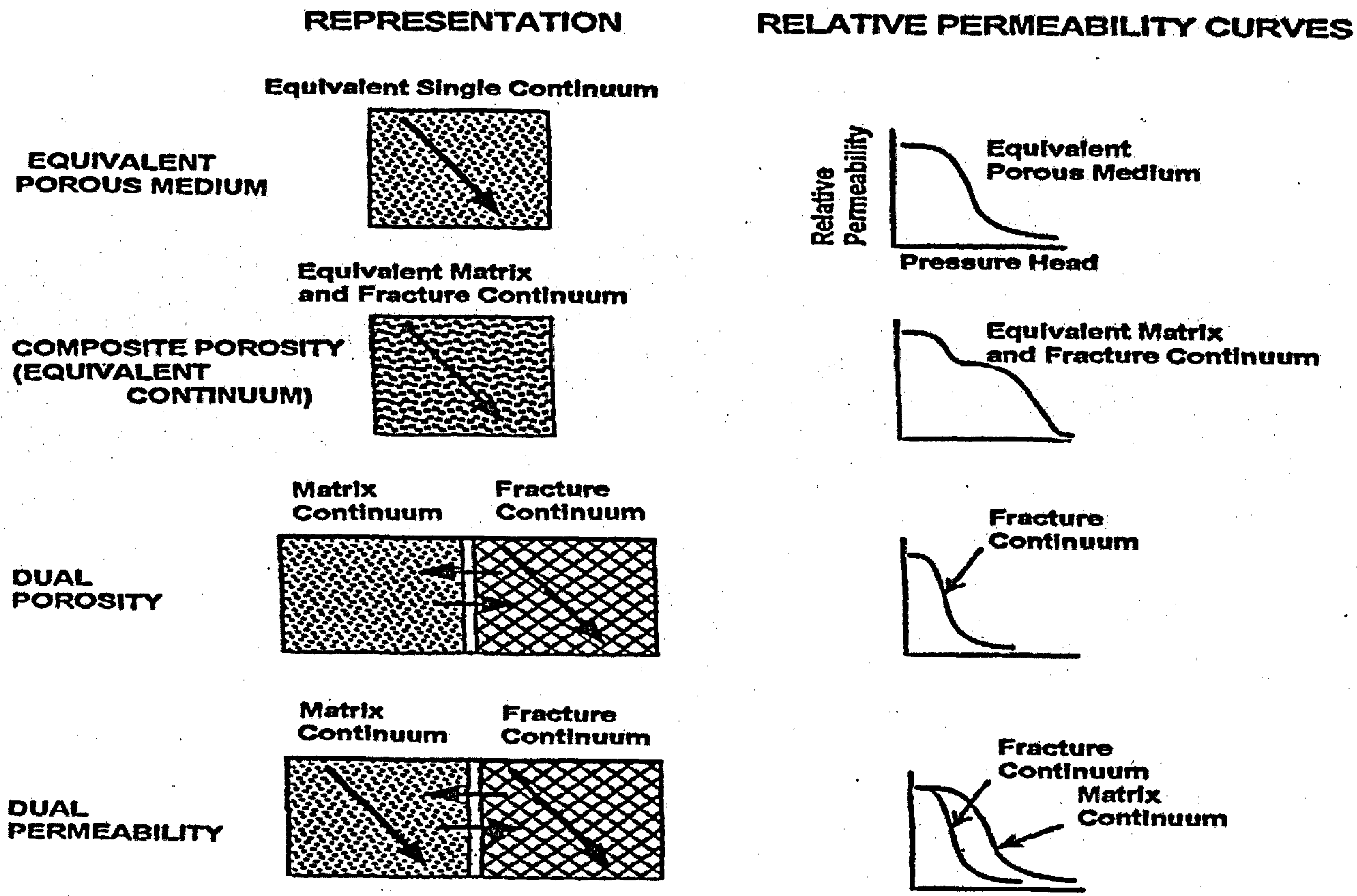
Generic Ground-Water Monitoring Needs (continued)

- Identify potential for preferential transport pathways (e.g., features)
- Assess effectiveness of contaminant isolation systems (e.g., performance/degradation of engineered barriers)
- Data management, analysis, visualization and communication of monitoring data

Research Objectives

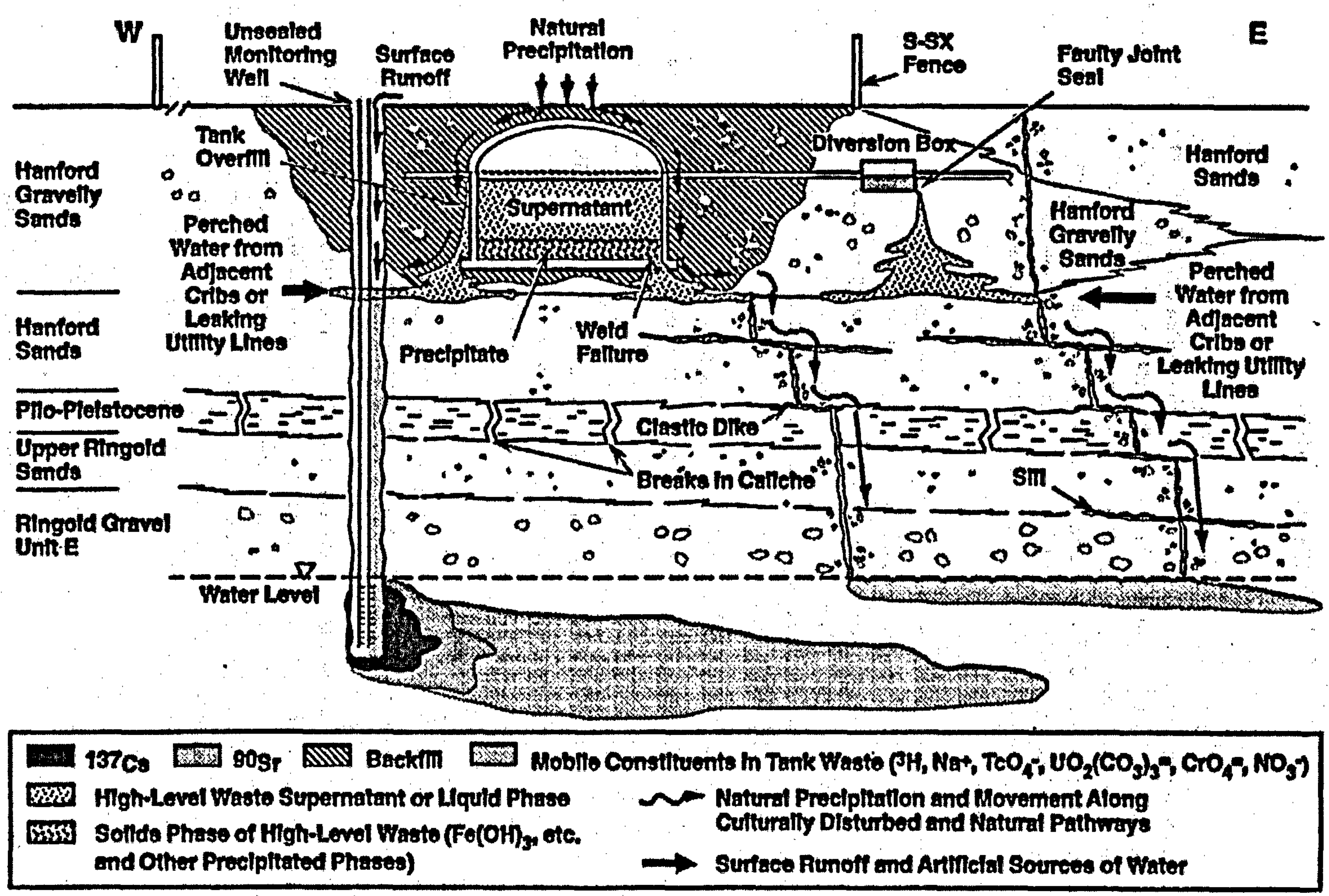
- Develop technical bases for NRC staff evaluation of ground-water monitoring programs
- Couple monitoring to site characterization and facility performance assessment (PA)
- Assess monitoring strategies for identifying and supporting relevant alternative conceptual flow and transport models

Conceptual Flow Models for Structured Media (after Altman et al., 1996)



Alternative Conceptual Models for Transport from Hanford Tanks

from Ward et al. (1997) after Caggiano et al. (1996)



Research Objectives (continued)

- Identify relevant performance indicators (e.g., water content, pressure, flux, contaminant concentrations) to be monitored

- Demonstrate connection between performance indicators and site performance as predicted by PA models

- Design strategy to collect monitoring data for parameter estimation, model calibration and uncertainty analyses

Research Objectives (continued)

- Update PA models using system monitoring data and analyses to generate new realizations of system performance

- Technology transfer to NMSS staff

Research Tasks

- Review and harmonize ground-water monitoring strategies presently used to evaluate nuclear & hazardous waste facilities

- Develop ***Integrated Monitoring Strategy***

- Develop test plan for evaluating the ***Integrated Monitoring Strategy*** for a range of hydrogeologic features, events and processes

Research Tasks (continued)

- Test ***Integrated Monitoring Strategy*** by application to specially-selected monitoring datasets

- Technology transfer to NMSS staff

- Document and publish ***Integrated Monitoring Strategy*** and tested applications

Generic Applications

Provide practical information for:

- Understanding monitoring needs at sites to update and verify PA

- Identifying and evaluating alternative conceptual models related to causative mechanism (e.g., episodic recharge events) and its effects on transport

Generic Applications (continued)

- Estimating parameter and boundary conditions, and assessing uncertainty in PA models

- Coordination with participants in the MOU on multimedia environmental modeling research (***http: www.ISCMEM.Org***)

Summary

- Couple monitoring to site characterization and facility performance assessment
- Monitoring strategy to provide evidence for comparing and supporting alternative site conceptual models
- Ongoing NRC-funded research study is evaluating existing monitoring technologies
- Technology transfer to NMSS staff