UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

SPRING 2002 BOARD MEETING

May 7, 2002

Washington Marriott Hotel
1221 22nd Street N.W.
Washington, D.C.

NWTRB BOARD MEMBERS PRESENT

Dr. Daniel B. Bullen, Afternoon Session Chair
Dr. Norman Christensen
Dr. Jared L. Cohon, Chair, NWTRB
Dr. Paul P. Craig
Dr. Debra S. Knopman
Dr. Priscilla P. Nelson
Dr. Richard R. Parizek, Afternoon Session Chair
Dr. Donald Runnells
Dr. Alberto A. Sagüés
Dr. Jeffrey J. Wong

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P R O C E E D I N G S

8:00 a.m.

COHON: Good morning. My name is Jared Cohon. I'm the Chairman of the Nuclear Waste Technical Review Board. It's my pleasure to welcome you here to this second meeting of the calendar year of our Board. Our Board generally meets three to four times a year, usually in Nevada, but we try to meet at least once a year here in Washington, and here we are. And we're very glad to be here.

We know many of you travelled a long distance to be at the meeting, and we appreciate your efforts to be here, and we hope we will reward you with an interesting and important meeting. I think we will.

We find ourselves at an important and very interesting time in the life of the Yucca Mountain Project. As you no doubt all know, Secretary Spencer Abraham and then the President both recommended the Yucca Mountain site as the site for a permanent high level waste repository. And on April 8th, Governor Kenny Guinn of Nevada notified Congress of the State's disapproval of the President's recommendation. It's now up to Congress to decide within 90 "legislative

days" of the Governor's notice of disapproval whether or not to override it or let stand the State's veto of the site.

This Board's role in the site-recommendation process is to assess the scientific and technical basis for the recommendation, and to communicate its evaluation to decision-makers in a way that is both understandable and useful. To accomplish that, we wrote a letter that was sent to the Secretary and to Congress in January of this year. And in that letter, the Board presented its conclusions that, taken as a whole, the technical basis supporting DOE's repository performance estimates is weak to moderate at this time. The Board made no judgment on whether the Yucca Mountain site should be approved for possible repository development. We view that as a decision for policy-makers.

I outlined the major points from the Board's letter in testimony before a House subcommittee on April 18th. A resolution of approval, which would, in effect, override Nevada's veto, has since passed the full House committee, and a vote on the House floor is expected soon. We understand that the Senate will begin holding hearings within the next several days. If you're interested and if you haven't seen it, both the Board's January letter and our House testimony are available at the documents on the table, which I think is outside. Yes? Please, someone nod their head, or either tell me I'm wrong.

Back of the room. You all know. Okay. Just so you know. That's the important thing. I've seen it.

Let me now give you some brief background on the Board itself. Our Board was created in the 1987 amendments to the Nuclear Waste Policy Act. Congress established the Board as an independent federal agency to evaluate the technical and scientific validity of activities of the Secretary of DOE related to nuclear waste disposal. The Board is required to report its findings and recommendations twice a year to Congress and to the Secretary.

The president appoints Board members from a list of nominees submitted by the National Academy of Sciences. The Board is, by law and design, a multi-disciplinary group composed of eleven members with expertise covering a wide-range of issues related to nuclear waste management.

Let me now introduce the members of our Board to you. In the past, in fact at all meetings I've chaired up until this one, I would have started by introducing John Arendt. Sadly, John passed away just two and a half weeks ago on April 21st. John joined the Board in 1995, and was known for his firm and consistent views. When John spoke, we listened.

John was a graduate of Marquette University. During World War II, he was employed by the University of Chicago on the Manhattan project. In 1947, John moved to Oak

Ridge, where he worked in the Oak Ridge Gaseous Diffusion Plant. He held numerous management positions there until his retirement in 1984. He continued working as a private consultant with his son Steve at JBF Associates in West Knoxville, Tennessee for several years after that.

John was a champion of the highest standards of public service, both for himself and for our Board. He cared deeply about the Board and its work, keeping us on task and focused on the Board's Congressional mandate. He was a wonderful person and near and dear to the hearts of all of the Board members and our staff. We will miss John and cherish our memories of him.

Please join me in a moment of silence in John Arendt's memory.

(Moment of silence.)

COHON: Thank you. As I introduce the rest of the Board members, let me remind you that we all serve in a part-time capacity. In my case, I'm President of--well, it is part-time. It just seems like full-time. In my case, I'm President of Carnegie-Mellon University in Pittsburgh. My technical expertise is in environmental and water resources systems analysis.

Daniel Bullen is Associate Professor of Mechanical Engineering at Iowa State University. His areas of expertise include performance assessment modeling and materials

science. Dan chairs both our Panel on Performance Assessment and the Panel on the Repository.

Norman Christensen is Professor of Ecology and former Dean of the Nicholas School of the Environment at Duke University. His areas of expertise include biology, ecology, and ecosystem management.

Paul Craig is Professor Emeritus of Engineering at the University of California at Davis, and he's a member of that university's Graduate Group in Ecology. His areas of expertise include energy policy issues associated with global environmental change.

Debra Knopman is Associate Director of RAND Science and Technology located in Arlington, Virginia. Her areas of expertise include hydrology, environmental and natural resources policy, systems analysis, and public administration. She chairs the Board's Panel on Site Characterization.

Priscilla Nelson is Director of the Division of Civil and Mechanical Systems and Directorate for Engineering at the National Science Foundation. Her areas of expertise include rock engineering and underground construction.

Richard Parizek is Professor of Geology and Geoenvironmental Engineering at the Pennsylvania State University, and he's President also of Richard Parizek and Associates, consulting hydrogeologists and environmental

geologists. His areas of expertise include hydrogeology and environmental geology.

Donald Runnells is Professor Emeritus in the Department of Geological Sciences at the University of Colorado at Boulder. He also is a technical consultant to Shepherd Miller, environmental and engineering consultants. His areas of expertise include geochemistry, hydrochemistry, and mineral deposits.

Alberto Sagüés is Distinguished University Professor in the Department of Civil and Environmental Engineering at the University of South Florida. His areas of expertise include corrosion and materials engineering, physical metallurgy, and scientific instrumentation.

Jeffrey Wong is Deputy Director for Science, Pollution Prevention and Technology in the Department of Toxic Substances Control of the California Environmental Protection Agency. His areas of expertise include risk assessment, toxicology, and hazardous materials management. Jeff chairs our Panel on Environment, Regulations and Quality Assurance.

We are supported by a wonderful staff, led by Executive Director Bill Barnard, who just walked--oh, is standing in the back. There he is. And the rest of the staff are displayed impressively there along the wall.

Let me turn now to our meeting agenda. I'll be as

brief as possible, but I have to warn you we have a very ambitious agenda and a lot of ground to cover, both in the meeting itself and in this overview.

Today, right after I'm done, we'll start with Bob Loux, Executive Director of the State of Nevada Agency for Nuclear Projects, who will present the views of the State related to the potential siting of a repository at Yucca Mountain. Mr. Loux is responsible for the staffing, organization, and direction of the State Nuclear Projects Office.

We will then have an overview of the current activities of the Office of Civilian Radioactive Waste Management, or OCRWM, by Dr. Margaret Chu, who is the new Director of OCRWM. Dr. Chu, who will be participating in her first Board meeting, has had over 20 years of experience primarily at Sandia National Laboratory, ranging from research and development to program management. And I understand she was actively involved in the WIPP project.

She's an expert in many aspects of nuclear waste, both technical and policy issues, and on behalf of the Board, Dr. Chu, congratulations on your appointment, not condolences, congratulations, and welcome to our meeting, your first meeting. We look forward to your participation today, and in many meetings in the future.

I want to now take a moment to recognize the

efforts of Lake Barrett who has on many occasions addressed the Board at our meetings. It was Lake who five years ago, among many other things, suggested that the DOE, OCRWM and the Board should work to improve communications on technical issues between the program and the Board. And in our view, the resulting open technical exchanges have been very beneficial, both to the program and to the Board. This will be Lake's last attendance at a Board meeting in his current capacity, and we appreciate, Lake, all that you've done in improving Board and DOE technical interactions, and for your active participation in our meetings over the years, and we wish you well in your retirement.

Lake, thank you very much.

Back to our agenda, after Dr. Chu's presentation, Russ Dyer, the Yucca Mountain Project Manager, will present an overview of project activities, including long-range plans and project priorities for science and engineering activities. Dr. Dyer has overall responsibility for the study of Yucca Mountain as a potential repository site.

The morning session will conclude with a presentation by Under Secretary Robert Card. This will be the first time that the Under Secretary has addressed the Board, and we look forward to his comments on the current status of the site recommendation process.

Mr. Card has responsibility for DOE operations

related to energy, science, and environment. We've timed his presentation to give him the opportunity to respond to questions during the public comment period, if that becomes appropriate.

After our lunch break, we'll begin the afternoon session with a status report on corrosion studies. Due to scheduling constraints, both presentations that we had originally scheduled for tomorrow were moved to this afternoon.

First, Dr. Joe Payer, Chair of the DOE's Waste Package Materials Performance Peer Review Panel, will summarize the Peer Review Panel's Report and its key recommendations. Dr. Payer is Professor of Materials Science and Engineering and Director of the Yeager Center for Electrochemical Sciences at Case Western Reserve University.

Following Dr. Payer's presentation, Maury Morgenstein of Geoscience Management Institute will present an evaluation on near-field corrosion processes on behalf of the State of Nevada. Dr. Morgenstein is President of Geoscience Management Institute, Inc. He spent 18 years as a consultant with the Yucca Mountain Project supporting the State of Nevada. He directs the State of Nevada's engineering barrier and near-field assessment program.

In mid-afternoon, we will turn our attention to the Yucca Mountain safety case, confidence building, and the

reduction of uncertainty.

Claudio Pescatore of the Nuclear Energy Agency will lead off by giving us an international perspective on these issues. Dr. Pescatore is currently a principal administrator for radioactive waste management with the NEA. In this capacity, he's the technical secretariat to several international committees for the NEA.

Tim McCartin will follow with the Nuclear Regulatory Commission's current views on the same topic. Mr. McCartin is senior advisor for performance assessment in the Division of Waste Management, Office of Nuclear Material Safety and Safeguards at NRC.

Joe Ziegler will present the Yucca Mountain Project's view. Mr. Ziegler is currently acting manager of the Office of Licensing and Regulatory Compliance.

The session will conclude with a presentation by Steve Frishman on the State of Nevada's views on the safety case. Mr. Frishman is a nuclear waste program consultant who has since 1987 served as a technical policy coordinator for the Nevada Agency for Nuclear Projects.

Let me now turn to tomorrow's agenda. The first session tomorrow morning will focus on staged repository development, concepts and plans. Charles McCombie will provide his views on staged repository development, and is especially well suited to do so. Dr. McCombie is an

independent and international consultant in radioactive waste management. He's also Vice-Chair of the National Academy's Board on Radioactive Waste Management, and Chair of the National Research Council's Committee on Principles and Operational Strategies for Staged Repository Systems. He recently became executive director of the Association for Regional and International Underground Storage.

Following Dr. McCombie's presentation, Jeff Williams of the DOE will outline the Department's current views on staged repository development. Mr. Williams is currently OCRWM's Director of the Systems Engineering and International Division.

That session will conclude with comments by Steve Frishman on the State of Nevada's views on staged repository development.

In the late morning, the discussion will turn to repository design.

Elwood Stroupe will discuss the Project's concepts of flexible repository design and thermal operating conditions. Mr. Stroupe is currently the manager of special projects for Bechtel SAIC.

After him, Parviz Montazer representing Nye County, Nevada will present a ventilated repository concept. It's always a pleasure to have Nye County participate in our meetings, and we'll be happy to welcome Dr. Montazer back to

the meeting tomorrow.

Mark Board of BSC will provide an update on repository design; current geotechnical considerations, and specifically thermal mechanical properties, and ground support. Dr. Board is a senior engineer with BSC, and prior to joining the Project, he worked for 18 years as a consulting rock mechanic and mining engineer.

The afternoon will begin with two presentations on performance confirmation and research and development.

Steve Brocoum will outline Project testing and R&D activities. Dr. Brocoum, who has made numerous presentations to the Board in the past, is senior policy advisor for the Yucca Mountain Project Office.

John Kessler will conclude this session with a presentation on the role of long-term R&D and performance confirmation. Dr. Kessler is currently EPRI project manager and was responsible for organizing and hosting the EPRI workshop on performance confirmation and R&D last November.

We'll conclude the meeting with presentations on Project plans for performance assessment and design, as well as Project priorities for Fiscal Year 02-03.

Nancy Williams from BSC will lead off with an overview of project plans. Ms. Williams is manager of projects and has responsibility for repository design, performance assessment, including scientific investigations,

site-characterization, and licensing for BSC. Though I haven't mentioned the affiliations of other people, I'm proud to point out that Nancy Williams is a graduate of Carnegie-Mellon University and has 24 years experience in management of commercial nuclear facilities and large complex engineering, procurement, and construction projects.

After her overview, Peter Swift, Manager of Performance Assessment Strategy and Scope, will outline the prioritization process and priority activities for performance assessment and science.

And we'll wrap up with Larry Trautner, Repository Design Manager. He'll discuss design priorities planned for the coming fiscal year.

And that brings us finally to the close of our two-day agenda. I told you it's ambitious.

Let me just say a few words and wrap up about public comment and the ground rules of our meetings.

We provided three public comment periods during the course of the next two days, one following Under Secretary Card's presentation, as I mentioned before, another at the end of today's session, and a final one tomorrow at the end of the meeting in late afternoon. Those wanting to comment should sign the Public Comment Register at the check-in table in the back where Linda Hiatt and Linda Coultry are seated, and they will be happy to assist you.

To keep the meeting as close to schedule as possible, we'll encourage those of you who can hold your comments until the later comment period, to do so, saving as much time as we can during the day. If someone wants to comment tomorrow and absolutely cannot stay until the comment period at the end of the meeting tomorrow, let us know and we'll try to accommodate you during the meeting tomorrow.

Let me point out, and I'll remind you again later when we get to this, that depending on the number of people who sign up to comment, we may have to limit the length of time you have to make your comments during the comment period.

As always, we welcome written comments to the Board for the record. Those of you who prefer not to make oral comments or ask questions during the meeting, may choose the written route at any time. And we especially encourage written comments when they're more extensive than our meeting time allows.

Finally, I have to offer our usual disclaimer for the record so that everybody is clear on the conduct of our meeting and what you're hearing and the significance of what you're hearing.

Our meetings are spontaneous by design. Though I'm scripted, everything else about the meeting is not. Those of you who have attended our meetings before know that the

members do not hesitate to speak their minds. But I have to emphasize that that's precisely what they're doing when they're speaking. They're speaking on behalf of themselves, not on behalf of the Board. When we are articulating a Board position, we'll be sure to let you know.

Well, with that, let me now then start the meeting itself by introducing Bob Loux, Executive Director of the State of Nevada Agency for Nuclear Projects. He will present the views of the State related to the potential siting of a nuclear waste repository at Yucca Mountain.

Bob?

LOUX: Good morning, and thank you for your invitation to be here today. I apologize to the Board for the last meeting you had in Las Vegas, or I guess Amargosa Valley, where I was scheduled to appear, and I think, as Steve Frishman may have told you, the logistics of getting out of Carson City that day became very difficult, and made it virtually impossible to get there. But I appreciate your indulgence and wanting to have me back again. I appreciate again the opportunity to be here.

I think we're all highly complimentary of the Board's work and the tireless work of the staff over the years. You really should be complimented for this work. It's really well done, and I know in reading the last report on the way on the plane out here, I'm really impressed by the

body of work that's occurred over the number of years in looking at the history of meetings and notes and correspondence, and it's quite an impressive record that you all have put together. And I know many of us, especially in Nevada, are highly appreciative of the work that's gone on.

Well, as the Chairman indicated, it's certainly an important time in this particular stage of the process. As he indicated, and you all know, that we're now in sort of a preliminary stage relative to site suitability, and ultimately if the site will turn out to be a repository. You know there's a heck of a long way to go, and in talking with Dr. Chu a moment ago, I welcomed her and met her for the first time, look forward to working with her, and of course had a very enjoyable time working with Lake Barrett over the years. I understand that he is going to be taking up golf and a number of other activities very shortly. So, I wish him well, and if you get to be quite good at this, maybe you can offer some lessons, Lake, and we can get together and go hit them.

I think most of us in Nevada, and I think throughout the country, are probably not surprised by the decision by the Secretary and the President to recommend the site, although I think we're probably surprised a little bit about the speed and timing of the decision, which I think is a concern not only to us, but the majority of the scientific

community as we hear from them over time.

I don't think that anyone really expected a different decision from the Secretary or the President relative to Yucca Mountain. Again, I just think that we were surprised by the speed and timing of it, and concerned about the database that's out there, and the record that's been established to try and make these decisions.

Given sort of the nature of where we are now, it really I think can be characterized mostly as a political decision, given the fact that the Secretary and the President, and certainly the Governor, are all creatures of the political world, and certainly the activities of Congress here that's going on are taking place in a political environment and not necessarily a scientific one.

The tough road ahead for the project for DOE is going to come in the next two stages, which is going to be the legal arena and the scientific arena, assuming it proceeds that far. And those issues are going to be exceedingly more difficult as we go along. I think we were talking earlier that these last 15 or 20 years have sort of been the easy part, and now it only gets more difficult from here on out.

For us in Nevada, it's sort of the first time that DOE has actually made a decision that we can hold them accountable for, the scientific community and others can hold

them accountable for. As you all know, all of the decisions of the program to date, whether it has been the promulgation of site suitability guidelines or recommendation decision, have all been done in the last year or so. And as a result, no surprise to you that the State has filed a number of legal actions against all three of the agencies that have a role to play in this process, the DOE and of course the EPA standards, and more recently, against the NRC for their licensing role, and we understand that those schedules are going forward, and some of those cases are going to begin being heard shortly after the 1st of the year. And we anticipate at least some decisions in those cases perhaps as early as next summer, as the case may be.

The one that we have not filed as of yet is the one challenging the actual environmental impact statement. I have to caution our legal team to begin trying to draw this to a close because of the number of defects, both procedurally and substantively, that they have found in the document, are just very long and very numerous, so having to actually try to bring those to a close so we can actually get the case filed.

I think one of the more disturbing or a largest concern the State has with the project at this point in time is this continual decision to postpone and push to the future all sorts of future decisions. When various objections are

raised in the program here and on the Hill over here, all these things will be decided in the future. You can go ahead and punt this off to the NRC in the future. You can go punt all of these issues off to the future. Just let us make this decision and move on in the process.

Given the track record of the agency and their virtual inability to really successfully complete projects, that becomes a very disturbing point in our view relative to the project. It almost is as if the database of course is not there, and the decision to postpone the decision to the future simply is an excuse for lack of data and a lack of information about the project.

I've even remarked about the Secretary's recent Op-Ed in the Washington Post and the New York Times that the scientific inquiry will be finished as we go over the next 100 to 300 years. And we believe that that sort of accountability needs to be brought to a head now, and not postponed to the future, regardless of what the state of the decision making is at this point and the database. DOE is simply going to have to live with the record they've established to date, and be accountable for it, and not to some decision in the future.

We kind of view the same process, and I know you'll hear from Steve later on about it, but that kind of summarizes most of our view also about the staged repository

licensing approach. It simply is an excuse for lack of information and data at this point in time, and not one that we think is attributing to building public confidence in the project as been advertised.

In 1982, Nevada believes that Congress made a compact with the nation and with the citizens of the State that any decisions about Yucca Mountain, recommendation decisions, would be based on a very complete scientific database, and that data would be complete and in hand prior to any decision, and that any recommendation for a site would be made primarily upon the geologic characteristics of the site, and not necessarily this total system performance and substitution of engineered barriers to mask or hide deficiencies in the geologic system.

As I think we've all seen, and our data is suggesting, and I know that John Bartlett presented this to you at your last meeting, that our view now is that the engineered barrier system comprises nearly 99 per cent of the overall performance at the site, with the natural system providing relatively little.

Therefore, the constant phrase we hear that there's no show stoppers at the site can actually have some validity in this case, in the sense that the site really contributes nothing to waste isolation, in our view, and, therefore, there are no show stoppers, obviously.

Our view is that DOE has not fulfilled the compact that Congress made with the nation and to Nevada and the others. That commitment I don't think anyone really believes has been filled.

As I think many of you know, we petitioned the Secretary in 1989 to have the site disqualified under the siting guidelines, and were told that that was premature. The site characterization was ongoing. We petitioned them again in 1999, same reasons, and were told that site characterization isn't over, and will be shortly. And now that we've had recommendation and site characterization complete, we're told that science is somehow going to have to catch up to this decision.

The Governor recently remarked in I believe a hearing, which event it was is kind of hard to remember, it's like giving someone a license to practice medicine, and then requiring them to go to medical school sometime in the future. It's not the kind of person you probably would like to be operating on your kids.

In any event, the State of Nevada intends through the legal process and through every other process we can find to ensure that the process is followed meticulously, and in fact that the national policy is upheld. And as I mentioned, those are many of the issues that we've filed cases over and will continue to argue them.

As we all know, the Secretary, in recommending the site, primarily said there are two reasons for the decision. One was that there was sound science in hand, and also that the national security concerns relative to terrorists and other sorts of activities going on in that community. In our view, neither of those reasons are valid, have much validity to them.

Certainly, the national security issue is one that is difficult to talk about, given the current construct of where we are with the current state of the affairs in the world. But, clearly, as long as nuclear power plants continue to operate, there is going to be high-level waste stored at those sites. I think the Governor indicated that the end of the Yucca Mountain period, if it should go forward, the shipping period, if it should go forward and reaches its legal capacity, would then be somewhere in the neighborhood of 40,000 to 50,000 metric tons of waste still at these reactor sites needing disposal. So, removing them to Yucca Mountain does not solve that problem.

In fact, creating the site at Yucca Mountain probably creates one more additional site in the entire inventory of potential targets, to say nothing of the thousands of shipment of waste over a number of years it would take to get to the site.

In the science arena, we have not found a single

scientific entity or believe there's one outside of DOE that supports the decision at this time. I just don't know that anyone really believes that that information is in hand to support a recommendation decision. And clearly no one in the scientific community believes that you can apply the engineered barriers in the way that DOE has to mask or hide the geologic deficiencies at the site.

All of the entities who have been reviewing the project, and you know the entity, the Board itself, the ACNW, the NRC, the GAO, virtually all these groups are of the belief that there's gaping holes in the science still at Yucca Mountain.

And I guess the more astounding part is looking at the entities that DOE has actually contracted with. It's maybe one thing to look at these external entities and describe their comments, but the comments that I reviewed, and as I understand, the Waste Package Peer Review Board, and I know you're going to hear more about it later, has recommended that Titanium 7 as a drip shield ought to be discarded, something that both the State and the NRC, the Center has cautioned DOE about over the last couple years. We think probably that Alloy 22 is going to have to follow the same path eventually. We see the problems there as well.

I think the most important thing that we saw was the comments from the IEAE and the NEA, their peer review of

the DOE program, and made some rather extraordinary comments about the state of the project in their comments to DOE, comments such as that DOE does not even know enough about the hydrogeologic system to create a model, let alone run one with some validity. And I don't want to belabor the point by reading all those comments, although I have them prepared here, but it seems to me at this point in time, that if every other entity who's out here looking at the project is making the same comments, including those contracted by DOE for their comments, it seems very difficult to believe that there can be any public confidence in the decision that we have in hand.

I know that in Nevada, of course, the public is very, very concerned. But it seems to me that if we're about building public confidence, that postponing a recommendation decision until we have this information in hand and be confident of it would have been the smart way to go. But apparently we're alone in that view, at least outside of DOE.

So, in sum, it seems to us that the national policy is in conflict with the science. It isn't complete. It seems to us that this is a political decision, primarily made for political reasons. And as I mentioned at the outset, the difficult steps are still ahead and, again, we intend to enforce them legally and in the licensing arena, assuming it gets that far.

In conclusion, let me just reiterate that as far as the Board is concerned, I guess the State and everyone else has been highly supportive and complimentary to the work. We agree with the major recommendations of the Board, and urge their continuation to urge DOE to complete work on the waste package and the EBS system, although parts of that seem to be maybe back at square one.

We certainly think that reducing uncertainties, both in the model and the data, are critical. The four to six orders of magnitude uncertainty in numbers are simply unacceptable, not to us, but probably are to the NRC and licensing, I would imagine. And yet we're being told by DOE that maybe these uncertainties cannot be reduced any further, that we may have to live with this level of uncertainty down the road, something that we find unacceptable, and I'm sure many others do as well.

And we certainly support the view from the Board that there needs to be a separate independent line of evidence for site suitability. I think this is going to be a very difficult task for DOE to do, simply because of the way they've approached the project and the way they've looked at total system performance.

And we think that the one-on analysis for understanding contribution of barriers continues to be a very important piece to be looking at, because it's clear that the

role of the engineered barrier is very important in the overall performance of the site, and I think that we need to understand that and learn how they should interact with each other.

And, lastly, I guess for the future, it seems to us that there might be a role for the Board to play, and we recommend that the Board look at the question of the scientific validity of this postponement, or leaving the repository open for the next 300 years, to understand whether there's truly any scientific validity in that proposal, or whether it's really sort of a time just to bide time to collect and look at more data.

Since most of the science questions are still unanswered at Yucca Mountain, I think the Board needs to continue its strong independent role of overseeing the project, and resist falling victim to the DOE proposal being made to state and local governments that somehow we kind of join in now in some sort of cooperative process, and begin working together to make this thing work. I think that it's only a matter of time probably before the Board receives this kind of proposal, and we would urge you to resist that as well. I know that state and local governments certainly intend to do that.

Well, with that, I'd like to conclude. I hope that Steve Frishman and the others on my technical staff have been

helpful to you in your deliberations, and look forward to working with you all, as well as the Department of Energy, as we proceed down the road.

Thank you for your time.

COHON: Thank you, Bob. Questions from the Board? Dan Bullen.

BULLEN: Bullen, Board.

Bob, I had a quick question about the litigation. You mentioned that you had filed suits against the parties, NRC, DOE, and EPA, and that you expected those cases to actually--do you expect them to be resolved, or just basically to start, prior to the license application timeline, which looks like it's going to be sort of late '04? Can you give a little bit more information on what the timeline might be?

LOUX: In the initial case that we filed, at least in time, was the challenge to the EPA standards, and that case, as I understand it, has been scheduled for oral argument here before the courts of appeal in D.C. in February of next year. And our experience, at least with the courts of appeal in the past, has been that a decision from the Court usually follows in the next three to five months generally thereafter.

So, it seems likely we could see some decision on the standards as early as sometime in the summer. I suspect

we're going to see a briefing and hearing schedule in the other cases as well fairly soon.

We, and I know the Justice Department, both asked for sort of an expedited process. It's remarkable how long it really takes to move things along in these venues. And then, of course, it really remains to be seen whether those decisions would end up being appealed at the Supreme Court or not. But I think next summer, we'll begin seeing decisions out of the court.

BULLEN: Bullen. Just a quick followup question.

Then the FEIS case that has yet to be filed, do you think will also be resolved in that time frame, or do you think it's going to drag on longer?

LOUX: My guess would be perhaps a bit longer. There may be a move to consolidate some of these cases and try to get them all moved forward. I know that we, and I think the Justice Department as well, would like to see these things moved along. And if we can collectively persuade the court, I think it would be to everyone's benefit.

BULLEN: Thank you.

COHON: Bob, is the funding for your office sufficient for what you need to do?

LOUX: Well, it's never sufficient, as you well know. We could spend any amount of money that was given to us. Right now, we are spending the bulk of our resources on the

corrosion work, as you know, since it appears that the package and the EBS is the primary component of the system at this point.

But, yeah, we could actually obviously use additional funds. Right now, the annual appropriation, as you know, is about $2 1/2 million. DOE has, at least at this point in time, only agreed to provide us with about 1.8 of that, withholding parts of it for some reasons that we don't understand yet, that we're yet to work out with them. But, we could use some additional funding, without question, although we'll do quite well with the funding that we do have.

COHON: Other questions?

(No response.)

COHON: Thank you very much, Bob.

LOUX: Thank you.

COHON: To introduce Dr. Chu, I call on Lake Barrett, who we're always happy to welcome to the podium, even if it's maybe, likely, for the last time.

BARRETT: This will be the last time.

COHON: You've said that before.

BARRETT: No, I didn't say it. I said it might have been. But, thank you very much, and thank you very much for the kind words that you said earlier and the last meeting.

It is my privilege and honor to introduce to you

today Dr. Margaret Chu, who is the Director, and is taking on the program. And I'd like to make a comment regarding the Board's views over the many years.

I compliment the Board, this Board and previous Board's, for making this a much better program than if you had not existed. You really have enlightened us. You have challenged us and pushed us to greater levels. I've learned a lot. The program has learned a lot. I think the pushes that you have done, and the fundamental understanding to improve the understandings and the scientific work, has taken seed much more than it was before.

I think our good program will be a much, much better program. You'll hear from Bob later this morning, but with Bob and with Margaret and their views, is going to take this a quantum leap up. I believe we have an adequate scientific knowledge for the state we're at to go to the next step in this. We'll have to wait to go to Congress to see if we go back, or if we go forward. But if it is to go forward, what Margaret is going to explain to you now, and also what Bob will reinforce later today, I think you should be pleased of the fruits of your labor and the service that you've done for this country and the international community as well.

So, I thank you for your service, and thank you for your help that you will provide Margaret, much more than you have for myself. So, thank you very much.

And, Margaret Chu?

COHON: Thank you, Lake. Dr. Chu?

CHU: Thank you. I would also like to take this opportunity to thank Lake. Where's Lake? Okay. He's been extremely helpful to me in the past several weeks, and gave me a tremendous data dump every day, and made my life from impossible to very difficult. Thank you.

After having said that, all the hard questions go to Lake later.

I really want to thank the Board for giving me this opportunity to talk to you today. I'm very honored to be nominated by the President to take on this job. And, frankly, I'm quite humbled to take on the job of this work.

You know, like I said, this is my seventh week on the job. Before I came on board, I thought that my 20 year involvement in nuclear waste disposal will well prepare me for this job. But I find myself facing the challenge of my life, my career.

I remember on the day of my Senate confirmation, one of the Senators came over and shook my hand and said, "Margaret, you're one brave lady." I think he knows more than I did at the time.

First, I want to introduce myself a little bit, I know Dr. Cohon already, introduce me a little bit. My academic background is in chemistry. I have a Bachelor's

Degree in Chemistry from Purdue University, and a Ph.D. in physical chemistry from the University of Minnesota.

Actually, my Ph.D. was more physics than chemistry. Lake, I like your word "quantum jump" actually. My Ph.D. thesis was quantum mechanics.

You know, except for three years of post-doc work early on, I've spent my entire career at Sandia National Laboratories in Albuquerque, New Mexico, and then I would say almost entirely in nuclear related projects. I have done quite a bit of work in the risk assessment area when I was a technical person way back.

What I want to share with you is early in my career, it was the early 1980s, I was part of a technical team at Sandia which was I would say the first technical group in the country that was supporting the Environmental Protection Agency in formulating the early stage of the waste disposal regulations, 40 CFR 191. Also, we worked with NRC in developing their early regulations.

And I still remember we used to debate late into the night on the balance between what the current generation's needs are in terms of waste disposal, against the legacy we may leave behind for our future generations. And these early days set a foundation for myself in my understanding that waste disposal is a multi-faceted problem, and that ever since it has given me a perspective that

nuclear waste disposal, it's not just a technical issue, not just regulatory issues, or engineering issues, and it gave me an appreciation that it also serves society's needs.

Before I go on, actually I did forget something very important. In my almost 22 year career, I would say the highlight of my career was during the Nineties when I was the Deputy Manager for the Waste Isolation Pilot Plan program, that's the WIPP program, in New Mexico, and then its been called the other, less-known repository program. It's also a deep geological repository program. And my main role in the program was to integrate 20 years of scientific work and present it to the Environmental Protection Agency for its certification of the repository. And, of course, the WIPP program did not have the NRC as its regulator. We had the EPA as the regulator. And in my opinion, the scientific rigor is comparable to this program.

And then it was a very rewarding experience for me, and then also I want to point out that at the time, we had the National Academy of Sciences WIPP Panel as our oversight group, which is quite similar to this Board here.

Let me repeat some of the things Dr. Cohon already mentioned is the current status of the Yucca Mountain program. You all know that the State of Nevada has disapproved the President's recommendation on April the 8th of this year, and then there are 90 days of continuous

legislative session days for the Congress to veto that disapproval.

And I never could figure out what that 90 days was until about a month ago, I was reading the New York Times that says it's July the 26th. So, I believe that's probably a petty accurate date for 90 days.

And the important thing I want to point out is according to the Nuclear Waste Policy Act, both the House and the Senate will have to vote with a simple majority vote, and I believe the House might vote this week. That's what we hear. And then we're not sure when the Senate will do it. But the important thing is if the Congress votes and does not veto Nevada's disapproval, or it does not take action, that means there's no vote, then the Yucca Mountain project will no longer exist. So, we are waiting for the outcome from the Congress.

Now, if the site is designated and gets approved by the Congress, these are the big future milestones in the program. License application, we're planning to submit the application around the end of 2004. And then we're hoping to get a construction authorization sometime around 2007, and then we're hoping to open the repository and start waste receipt in 2010. And then it takes, here I say about 100 years, but really it could be as short as 50 years, because of the retrievability requirements of NRC, it could as long

as 300 years to close the repository.

What I want to point out with these milestones is it's a long, long time before the repository program is totally complete.

Now, I want to show you some of the next steps, and then also share with you how they map into the big milestones that I have just shared with you. Of course, the first thing we are focusing on right now is preparation for license application. There are a few key things in there, the quality assurance program, which is a very important part of the license application, and then there are still a lot of technical issues that need to be addressed, and there are license application related design decisions that have to be made. And actually, the day and a half, you're going to hear mostly on the license application portion.

But I also want to tell you that in the past, the focus of the program has been preparation for site recommendation, and so we have not done a lot of work on the transportation program recently. Given the 2010 repository opening date, we are ramping up very quickly on the transportation program. I'll talk a little bit about that.

Also, the next thing we have to address is the waste receipt issues. My understanding is there are like 70 individual contracts with utilities, with over probably 50 utility companies, but there are like over 70 individual

contracts. So there are very convoluted and complicated waste receipt schemes in these contracts. And in reality, we also have to consider the relation of waste receipt with design, with waste emplacement requirements, and transportation requirements.

So, we're hoping to address all these issues so we have--I hate to use the word optimize, but really that's what I'm thinking, you know, have an optimized scheme that still satisfies all the contractual agreements so we'll be ready to receive waste in 2010.

And then the last thing is I would like to implement and enhance the science and technology program. I'm going to spend most of the time talking about that in a little bit.

Before I do that, I just want to say a few words about the transportation program. The transportation program, there's a lot of logistics involved with it, in addition to demonstrating the safety of transportation. We are in the process of planning on the equipment and operation needs that includes cast and fleet acquisition, and route and mode designations.

DOE has made a position on its preference for rail shipment, and so in the State of Nevada, rail development becomes a very important part of the transportation program. And then associated with that will be a lot of preparation

type work, for example, possible environmental impact statement, records of decisions, and all of these things. And then the Department's position is to work closely with the State and the local government, and also the tribes, in identifying what are the preferred routes.

And I'm going to weave in the knowledge from the experience that WIPP has used in their transportation program. It was a very successful transportation program for WIPP, because they worked very closely with the local government, and we're going to continue doing that.

Now, I'm going to go on to the science and technology program. What is my vision in this area? I'd like to ensure the best science and technology are utilized in the planning, the development, and the implementation of the repository program, so a safe and cost-effective repository can be developed, and then also we can, at the same time, enhance public confidence.

I want to point out that safety and public confidence both derive from a robust scientific program. And in my opinion, a robust scientific program, its key element is not just merely technical content. Most importantly, it comes from the integrity that's coming from scientific inquiry. That's what's going to give you the public confidence, and then that's going to be my personal guidance in this program.

And what do I mean by the science and technology program? I have to confess these are my personal initial thoughts, and what I'm thinking of, it could include a whole spectrum of activities. One of the first is, of course, activities that can reduce uncertainties through continuous improvement in scientific understanding of the Yucca Mountain program system. We all know what that means.

But I'm also thinking of a couple other things. Another thing is I'd like to see some new ideas coming on board in this program. I'm talking about new ideas, potential breakthroughs for waste disposal.

You know, when we were at Sandia Labs, advanced materials development is a huge thing there. And then once in a while, we'll go over and talk to these people. We were just amazed by the kind of things they can do. So, sometimes I wonder can we use the advanced materials concept, and then start making backfill materials that can retard negatively charged ions. That's a problem that's been prevalent for decades and decades in this area.

And another example, I'm going to use the WIPP example, when we were working--actually, it was the final stage of the science program at WIPP, we realized that we could not discount the possibility of microbial degradations in the repository in the postclosure stage. As a result of that, the pH environment around the waste, the uncertainty

was like huge, as a result the solubility was like six or seven orders of magnitude of uncertainty, and that kind of uncertainty we just could not take.

And what we ended up doing was we decided to put in magnesium oxide material as a backfill, which is a chemical buffer material, actually it buffered the chemical environment, so the pH of the environment was reduced, the uncertainty was reduced to just from pH 7 to 9 instead of from 4 to 12. As a result, the solubility became much, much less. It was well controlled in our opinion. And then also we actually got some natural analog data to support the long-term behavior of the magnesium oxide, so we know that it will work the way we intended it to work.

And I would like to see more of that kind of concept. It's really outside of the box concept for the program, in addition to continuous understanding of the basic science phenomena. And for those of us who have worked for a long time in the program and have interfaced with other countries, would know that there are generic common technical issues that are facing the global waste disposal programs.

For example, fracture flow problems. Another example is long-term prediction of climate change. You can go on and on. And another thing is the migration of anions, how do we control that. These are generic problems. And then I think if we can tackle some of these basic technical

issues, it would not only benefit Yucca Mountain, it would also benefit other countries who are facing the same issues.

Another thing is I would like to see the scope of this program not only address the long-term postclosure phases, also I'd like it to address some of the preclosure phases. I'm a scientist, but I also have a business in mind in my heart. I would like to see how to reduce the life cycle costs of the repository program, because it kept going up, and then I'm not sure what the end number would be. It would be nice if we come up with a robust, very cost effective repository by the time we're closer.

I'm going to say a few words about the implementation of the science and technology program. I'd like to develop a sustained program with continuous funding, and then I truly believe we can do that. What I would like to do is--Lake, tell me one last thing correctly--I would like to put together a program that has a minimum amount always, and then it's always proportional to the size of the overall program. Can I do that, Lake? Okay.

A lot of the things I don't know whether I'm allowed or not, but this is really what I would like to do.

So, basically, there will be a chunk always there, and then if the program gets more funding, I would like to increase that in some kind of proportion.

And another thing in implementing this program, I

do not like a laundry list of activities. What I would like to see, we can identify some important main themes for the program that are important to Yucca Mountain. And another thing is, like I mentioned on the international program, I believe lots of the science and research globally, and then I would like to tap into that whole pool of talents, and then I would like to tap into the university system, the academics, and the national labs, the USGS.

And along with this program, I have a vision of putting together a good international program, international deep geologic repository international program under OCRWM. And, again, I hope it's a sustained long-term program. I think we can leverage a lot out of a system like this.

And then I do want to emphasize this work, there will be a lot of scientific investigation as part of the LA application, so this work would go concurrent and congruent with the LA scientific investigation. And more importantly, how I envision this goes, if there is good science and information and data coming out of this program, they will be incorporated into license application, license review, later on, the development, maybe supplemental license application. So it will be part of the main stream, and it will really get used.

And then I want to say a few concluding remarks. I'm really looking forward to the continuous valuable input

from the Board members, not only the license application, but in the repository development, and I'm hoping I'll get valuable input from you on the transportation program as well.

And, personally, I'm really seeking help and input from the Board in helping me to implement my vision of this long-term sustained science and technology program.

And then also, the last point is from my experience at WIPP, you know, I mentioned that we had the National Academy of Science WIPP Panel. It was such a rewarding, satisfying experience for all of us. And I noticed that the difference, the small differences between this and that board was we had, in addition to formal interactions, we also had a lot of infrequent, informal, very technical interactions between the technical folks and the panel at the time. And then these were very informal, but real time interactions, small group, and then if I'm allowed, I really would like to see more of those technical interactions that are more topical oriented, and smaller groups.

And this is all I have to say, and I want to thank you again, and I'll be more than happy to take easy questions. The hard questions, like I say, go to Lake.

COHON: Thank you very much, Dr. Chu. Questions? Debra?

KNOPMAN: Knopman, Board.

Thank you, Margaret, for a very good presentation, and it's good to see your vision laid out as you have. It's very helpful to us.

Let me just try to get a little bit more detail in this vision, particularly as it pertains to science and technology goals within the license application time frame. You talk about what you want to accomplish over a very long term, including operations, and you talked also about the importance of building public confidence. How does that translate into specific targets of improved understanding that you would like to see in this program within an LA time frame?

CHU: You know, I think tomorrow, you're going to hear a presentation from Peter Swift, who is the performance assessment manager. I believe, Peter, that's your title now? He's going to share with you there's a new approach on how to prioritize the scientific work, and that should go into the core program of license application. They have Level 1, Level 2, Level 3, and there's different criteria of what's required, what's desired. And there's some of them, for a variety of reasons, some of them are just timing, and some are just more qualitative, less quantifiable reasons, that will not be able to incorporate as part of LA, and may or may not be important. We hope it's not a vital part of the LA.

But what we were thinking was picking up some of

those things as part of the science program. And then I don't know how to answer you right now, but from my prior experience, what I would like to see is what we used to do is get together a small group, we would handpick the best in the world, and have them look at the issue very quickly and get a scoping sense, like what that means, and then we usually sort of proceed, depending on what those people's recommendations, like, you know, in the saturated zone, I can probably handpick people right now. And sometimes, you know, these are the people who are working on it for years and years and years, and have a very good understanding of certain features, and then we use that as sort of the jumping point for the decision.

So, it's hard for me to verbalize it to you right now, but my vague idea is if it turns out that it's something we believe is vital to license application, we might be able to put it in as part of the license application right away. If it's something, it's a more continuous understanding and enhancing the confidence, we may just go in parallel. So, I don't know if I'm answering your question.

KNOPMAN: In part. If I could just quickly--

COHON: Very briefly.

KNOPMAN: Okay. You cited an example for WIPP where you thought there was a very large uncertainty, in particular, in your near-field environment there and the buffering capacity,

and you talked about narrowing that from five or six orders of magnitude to about two, or something along those lines.

Is there something comparable in this program right now that just comes to mind where you see such large uncertainty that you'd really like to have it as an LA priority to bring that uncertainty down?

CHU: I have a personal bias. I believe the natural system, there are a lot more credits we can take in the natural system, especially in the saturated zone. That's my opinion. So, one of the things that I would like to do is have people quickly take a look at it and say are we way conservative in the saturated zone. My gut feeling is we are. I used to work on similar things, and when I look at some of the technical things, I know the behavior is much more than what we are taking credit for.

So, in this case, it's not reducing the uncertainty, but it's basically saying do we do enough to say, you know, it's going to retard things a lot more than we're claiming. And this is one type of example.

Another example is the near-field chemistry, and being a chemist, I'm very interested in this, have we thought through all the things we'll be able to do, the chemical things we can do? You know, all these things I think can be looked at in a very creative way. Like, you know, the magnesium oxide example for WIPP, at the time, we had no idea

how it's going to come out. But as soon as we saw that, we geared up that program, and then actually it got used in the license, the certification application.

So, I'm hoping for some kind of a flexibility we can use in the program, so where we see important things, we will put it in if the time allows. And then I believe there are a lot of things we can do if we open up all these concepts, and then we tap into the best people, and then I get help from you guys. You can help us very much in how to march on in this area.

COHON: Before I call on Dan Bullen, let me just, without wanting to put too much of a fine point on Debra's points, but nevertheless to elaborate a little bit, and I think it's especially timely, given where you are in your tenure in the program, when you're thinking about big issues and philosophical issues related to science and technology as it relates to the program. There are many reasons why one might pursue a particular scientific or technical project at this point.

Certainly LA, because of time pressure, and because of the importance of that step, will drive much of what you do. But when you think about why you're doing it, what you do to reduce uncertainty, but that means just that, trying to reduce the uncertainty from six orders of magnitude in pH to two. But that may not contribute directly to performance in

the sense of increase mean performance. It's just reducing the uncertainty.

There's also research you could do to increase confidence that may or may not do anything to quantitative estimates of uncertainty. So, for example, doing research to challenge assumptions about basic process models, which might result, one would hope, in confirming your first assumptions about process models, but it may not. That may or may not reduce uncertainty, but it would certainly contribute to confidence, confidence building.

CHU: Right.

COHON: So, there are a lot of reasons why one might undertaken research at this stage. But I think that keeping in mind the reason for it is very important, because one of the--I think one of the challenges for the program is the distinction between showing compliance and developing basic understanding in the underlying processes. And that's an issue that the program has been hearing a lot about from this Board, from peer review groups, and I think is a very key one, and it's very easy to get caught up in demonstrating performance, because that's what LA is all about. But we hope you'll go beyond that.

CHU: Thank you. Thank you for your comment.

COHON: Dan Bullen?

BULLEN: Bullen, Board.

Actually, I'd like to thank you for your presentation, and compliment you on your forward thinking. And now that the compliment is over, here come the hard questions, I guess.

You mentioned the KTIs, the key technical issues that have to be resolved before license application. I guess the bottom line question is will they be resolved, and how do you expect them to be resolved prior to December of 2004?

CHU: My understanding--I'm looking to Lake again--my understanding is they will be addressed as well as we could. But the point is if they're not resolved in NRC's mind, we will not get a license. Right, Lake? Yeah.

So, I think, yes, I think the project will resolve them before. In our mind, this is our resolution, and it will be part of the license application, and then it's really up to NRC to decide is it good enough for me to grant you license application.

BULLEN: Bullen, Board.

Some of those data, or some of that information will require data that you get prior to the LA, and some of it will be ongoing tests and research. Is it the agreements that you will make with NRC to basically commit to the completion of those tests and that amount of research that's going to be the resolution?

CHU: Is that true, Lake? I'm not sure what the answer

is.

BARRETT: Barrett, DOE.

Those will be incorporated into the performance confirmation aspects, which is part of the license application. So, that will all be in the license on the docket, and worked out between us and the NRC.

BULLEN: Thank you.

Now I want to change gears just a little bit, and maybe transportation is the way to change gears. I had a question because you mentioned that you were going to gear up or ramp up in transportation, and maybe a couple years ago, DOE was actually going to try and privatize the actual shipment of waste. Is that the case, or is the transportation going to be done by DOE itself?

CHU: Lake, again, please. I think it's sort of yes and sort of no.

BARRETT: Barrett, DOE.

The statute says use private industry to the maximum extent practicable. We still want to use the private industry capabilities, but as we look and we find the RFP that's on our website, and it's been there now for almost five years, we need to look at that, learning what's happened at the other DOE complex, and the risks involved, and charges for risk. Our steady state goal, say 20 years out, would basically be, you know, pure private, but we probably are

going to need to do some government aspects to basically start that up.

But, we do want to use both the advantages of the government system, as well as the private system in this country, and it's also worldwide as well.

BULLEN: Bullen, Board.

Just a brief followup before you leave, Lake. This one actually deals with the fact that Margaret mentioned you wanted to interface with the utilities and talk about the receipt schedule, and the like. But one of the disconnects in the transportation system right now is the fact that the dual purpose or storable transportable casks don't interface well with the repository because they're too big. They have too much fuel in them. They're not 21 pwr assemblies, they're 24, or they're larger.

And, so, is there going to be an effort by DOE to basically talk to the utilities and say, you know, look, we understand it's economical to store these in, you know, larger containers on site, but there should be a nice interface so you don't have to handle that fuel again, and are you looking at those kinds of options with respect to the integration of the transportation system?

BARRETT: Yes, we will. Those are exactly the items that Margaret had that we need to work out with the utilities. It's a very complex arrangement because we're in

litigation with most of those utilities over the exact same issues under the contract.

So, yes, we will. The multi-purpose canister concept is in the RFP. We intend to keep that on a privatized basis with the value engineering refund back to the utilities. But these are complicated matters and we'll work these all out in the design evolution optimization, or as close to optimization as we can, as Margaret said earlier. So, all of these issues will be accelerated over the next months.

BULLEN: Thank you, Lake.

Now, back to Margaret, just a question. You mentioned you were looking for breakthrough science. And I guess I was very interested in the breakthrough aspects of what you're looking at, and if you expand it even farther, you know, somebody from outside the program may look at that and say are you looking at breakthroughs for things like waste treatment. Do you limit it to just basically disposal, or do you want to open up those breakthroughs to treatment also? And then now you're going to have the Senator, or the distinguished Senator from your home state asking about some accelerated usage. And, so, I just want to know if you want to go quite that far, or if you want to just basically talk about breakthrough--

CHU: I'm very open minded. I will go as far as that.

I will go very far. If there are advanced nuclear technologies that would reduce toxicity, would reduce volume for the program, I would be more than happy to take those technologies.

BULLEN: One last question. Promise.

Could you elaborate a little bit about the difference between licensing and certification? You mentioned your WIPP experience, and that is, again, an EPA certification versus an NRC licensing. So, could you just give us a little bit of your perspective on that?

CHU: Well, the certification process was not as legally intensive as NRC. An example, for example, we would not be required to give depositions. It's not our job. But we did have a very similar QA program, the same QA-1 and the same scientific rigor, in my opinion, but the legal framework was much, much less. But I think that the contents are very comparable, if you look through, actually look through the certification application, which would stand up taller than me, we didn't do it electronically, and it was very heavy duty.

BULLEN: Thank you.

COHON: Thank you, Dan.

Just to check the line-up, I have five people waiting to ask questions, in the order of Don, Paul, Jeff, Dave Diodato, and Priscilla, and then Richard, and then that

will be it. Don Runnells?

RUNNELLS: Runnells, Board.

Margaret, I wanted to address your vision for the future, and you had two items on your overhead. One was safe and cost effective repository. The other was enhanced public confidence. And it's the enhanced public confidence that I'd like to talk with you about.

You made the point that perhaps the most important aspect of enhanced public confidence is integrity within the program. And nobody is going to disagree with that. But it seems to me that something that you did not mention, and has not really been addressed in the program as effectively as it might, is communication with the public.

If there's anything that we've learned from the international programs, it is how important transparency is. International programs have to have integrity, and they have learned, sometimes very painfully, that they have to communicate with the public, almost a bottoms up approach, starting with the public and going up to the decisions.

I have a strong impression, talking to educated people, to the lay public, Nevadans, people who live around Nevada, that there's precious little known in the public about Yucca Mountain. What most people know or believe they know is that they're going to dump--the word dump is always used--dump a bunch of nuclear waste in a mountain in Nevada.

That comes from people who are highly educated in other fields, and I would urge you to think hard in your vision for the future about other ways, better ways, more ways to communicate the integrity of the program that you're intent on building to the public, and to let the public communicate to you what their concerns are, so that this mistrust that's there, rightly or wrongly, I'm not judging whether or not the public should or should not trust you, whether or not that's the case, but at least the communications lines would be there.

Now, DOE has made strong efforts to improve the communication, their web page, their public meetings, and so on and so forth, but my impression is it has not been adequate.

Could you just--you didn't mention communication in your presentation.

CHU: I agree. I forgot to mention that. Actually, I totally agree with you, and that again using WIPP as an example, I think part of the reason it was successful was because the open, very open communication in that program. And then gradually in the 20 years, we got a lot of public support. And this is actually Lake and I, we have talked internally recently a lot how to improve that, and I personally believe it's something you really have to work on. You have to earn your trust from people.

So, I'm not sure exactly how to do it, what's the first step. But what I would like to do is build credibility one by one slowly, for example, to me, this is the first step with the Board. I would like to establish credibility with the Board. I would like to establish trust. So, when I say I'm committed to have continuous funding, that's the first test on me, and then whether you're going to trust me in September or October or not is whether I can deliver that promise. To me, that's the first step.

Yes, I think gradually, I want to do it with the public also, and have more communication programs. And we are still in the formulating stage right now, how to do that, especially the State of Nevada, which is of course is very difficult, all of you know that. But I think we can work on that. And, to me, you have to work on it. Otherwise, you never get there. And I really appreciate your comment, yes.

RUNNELLS: And I'm delighted to hear that you and Lake have been talking about it. It's very important. But it goes way beyond Nevada, because the transportation issue covers the United States, and people who are not informed, who do not trust the program, live in all of the states. And it's the whole public that must receive the communication, and be allowed to give communication back to the DOE.

Thank you.

CHU: We very appreciate your comment, because it's

going to be a very important part of our program.

COHON: Let me just add as a footnote that in my view, the Secretary's recommendation was very weak in its communication about the uncertainty associated with performance predictions. That's something the Board has been on record about, but we have not had a meeting since the Secretary issued his recommendation document. It was very weak in that regard.

Paul Craig?

CRAIG: Greetings. I am Paul Craig from the University of California at Davis, but with a long tradition of starting out at Los Alamos and Brookhaven and a little work with Livermore and a lot of work with Lawrence Berkeley Laboratory, a little with Sandia indirectly. So, I'm very, very pleased that you, with your, one, scientific background and, second, national laboratory background, are running the program. That's needed. That's really good, and I just love the philosophy that you were talking about.

Back in the early days of Los Alamos, J. Robert Oppenheimer set the place up, and he always had a sound science program, and he believed that it was important to do that, and there were a whole bunch of reasons for it, not the least of which was he didn't want to be blindsided. If something new came along, he wanted to know about it first. He wanted to know about it credibly. He wanted his people to

pick up on those ideas and run with them.

What concerns me is that the program, as it's moving into licensing, is cutting the science program, and our preliminary staff analysis suggests that this year, it may be cut as much as 30 per cent. That's a big hit. Now, I don't know what the right balance is. I don't know what the right balance is between the science and the other stuff, and it's a very difficult question.

But I do observe that in the Board report, we talked about the uncertainty in the mountain and the uncertainty in the metals, and you have the very bad luck that the uncertainty range brackets the range of interest. Our report says for both of those, from a few thousand years up to tens of thousands of years, if the standard had been a thousand years, you would have been home free. If it's 100,000 years, you would have been finished. So, it's right at that critical range, which means that bracketing the uncertainty can do everything to how the repository works, and yet the science looks like it's being cut just at a time when the understanding of these issues is on the horizon. So, I express that concern.

The transportation issue hasn't been looked at very much. That happens to be the area when we go around to the environmental impact hearings, that's the place where the public is really, really concerned, and there's very little

science going on in that area. It has not been high priority, for perfectly understandable reasons, but it may be important that it become high priority.

So, welcome aboard.

CHU: Thank you very much.

CRAIG: We're very, very happy to have you.

CHU: I appreciate your comments. Thank you.

COHON: Thank you, Paul. Jeff Wong?

WONG: Jeff Wong of the Board.

I, too, would like to wish you welcome.

CHU: Thank you.

WONG: And compared to Dr. Bullen, I have four easy questions to ask for your comments on.

On transportation, you said that DOE has a stated preference for rail shipment, and that it requires rail development in Nevada, and I'd like your comments on the condition of the rail system outside of Nevada and what will have to be done for transport of fuel to Nevada.

Second, is this preference for dedicated train shipment and against heavy haul truck?

And the last question is that you'd mentioned that you will work with the states through cooperative agreements, and I'd like to hear some comments about any intent or the ideas with those cooperative agreements.

Thanks.

CHU: I don't know whether I should point to Lake again. There's so much history with the transportation program.

BARRETT: Let's see if I can remember the questions.

Regarding the national rail infrastructure, we believe the national rail infrastructure can easily handle the kind of loads that we're talking about here. They routinely do it, thousands and thousands of shipments every day in the United States. So, as far as national infrastructure, we don't see an issue there.

Within the State of Nevada, we need to develop the capability to move nominal 150 ton loads, which is common on rail, to Yucca Mountain. There is no rail line there today. We looked at five different options in the FEIS, and we want to work with Nevada to develop the appropriate method for that, and that offer stands to the Nevadans. We'll have to wait to see if this program goes forward or not.

Regarding routing, which was one of your questions, is a major issue, certainly within Nevada, and how we get there. But once you establish that, what route it goes nationwide, that we want to work with the states, and with the Indian nations, and through cooperative agreements to determine what are the best routes that we all can use, similar to what EAM did with WIPP, where a lot of work went, Governors had the right on highway shipments, et cetera.

And I think there was another one on rail, and I

don't know what the--

COHON: Heavy haul truck versus dedicated train.

BARRETT: Heavy haul is either rail or heavy haul. We left that option open if the Nevadans would prefer to use heavy haul. The Nevadans don't really want to deal with this now until national decisions are made. But, say, in France in COGEMA, the local people wanted heavy haul from rail to LaHogue, and that's what they wanted. The farmers could use it. So, we left that option open. So, that's really an issue to Nevadans to decide.

Regarding dedicated train or, you know, regular train, we left that option open, certainly for national debate. If there is a common wish nationally for dedicated train, we certainly could use dedicated trains. That's the way most shipments are done. For example, the Carolina Power and Light shipments are done, Navy is done, and we certainly could do that as well.

WONG: Okay. And the last question--well, actually, I have two now. Comment on what are the nature of the cooperative agreements. The other thing that comes to mind is it's true that there are a lot of miles of safe shipment of material on rail. But how will you deal with lack of public confidence in rail when you have in the news spectacular train accidents occurring?

BARRETT: The first question was cooperative agreements.

Back in the Eighties, we had cooperative agreements in the southeast, midwest, western states, so those type of cooperative agreements. We had to discontinue those due to budget cuts. But WIPP had great success with working with the Western Governors Association on determining the routes. That's the model we wish to follow. We want to build on the WIPP experience, and take it to the next level up. So, we would like to emulate what was done a little bit back that we started in the Eighties and unfortunately had to curtail, and then build on the WIPP.

Regarding the public confidence on transportation, that's an issue earlier that Don mentioned about how do we communicate. We need to do a lot more of that. I believe the scientific risk of nuclear transportation is relatively low. However, the public perception is considerably higher, and this is going to be a major thing that we're going to need to work on, you know, over the next years if this goes forward.

WONG: Thank you.

CHU: Maybe you should stay longer and see if there are any more transportation questions.

COHON: For the remaining questioners, I have to ask you to be brief and to the point. Time is disappearing on us.

David Diodato from the Staff, who's way back there, Margaret.

DIODATO: Diodato, Staff.

Dr. Chu, welcome, and thank you for the presentation this morning.

CHU: Thank you.

DIODATO: Tomorrow afternoon, there's going to be a session that Dr. Nelson is running on performance confirmation and R&D testing. I was interested in your example from WIPP about using magnesium oxide to buffer the pH. And what I'm wondering, and I would understand if you've been away from that program for some time, but were there systems in place to evaluate the effectiveness of that buffer subsequently into the data, and what would that show, because we're thinking about similar things.

CHU: Yes, there were continuing programs to evaluate it, yes.

DIODATO: So, how did that work out?

CHU: Last I heard, everything works well, as anticipated. Also, I mentioned that we actually also used the natural analog data from Australia to validate the real long term, the mineral changes from magnesium oxide, and to make sure that eventually, it gets to a state that is truly a stable state that still works. And, so, we have, yes, experimental work ongoing all the time, plus, using analog data, yes.

DIODATO: Thank you.

COHON: Priscilla Nelson?

NELSON: Nelson, Board.

Thanks for coming here today. I've got one quick question, and generally a plea.

You indicated that you wish to seek to reduce life cycle costs. And I guess maybe reduce--I'm not sure about the word reducing. Maybe that's part of the focus. In order to reduce or increase life cycle costs, they must be understood, and the tool to understand them is one that I'm not sure we have on board right now. And understanding the trade-offs for changes in design associated with cost, and impact on expected performance of the safety case or uncertainty is an extreme complication.

As the project moves into this kind of a consideration, the Board would be extremely interested I'm sure in tracking this from the start of that kind of development of an understanding. So, that's a comment.

The quick question is looking at the overall project, are there any particularly interesting parts of the design of the project that you think would benefit from life cycle cost analysis that could result in reduction of costs?

CHU: These are just very personal opinions. I think some of the engineering features are very, very costly, like the drip shield, the waste package design, are extremely costly. And then, so, if you think creatively, say down the

road, suppose, you know, I can have other means, and then all of a sudden, you know, maybe the natural system's behavior is different from what we realize, or the uncertainty of certain things are much smaller, I can afford a broader uncertainty in the engineering part, maybe I can save $12 million. These are very, you know, personal opinions.

If I were working on the program personally as a technical program, I would use some of those as a goal, say are there things we can still do down the road. And that's why I want to show you the future milestone. When you think about the long time, you know, by the time you actually start putting things in, we still have quite a long time in there. So, my personal opinion is whatever will help the program, would take, the best science, the best engineering things, whatever would reduce cost, I think we should continually improve in that direction.

COHON: Richard Parizek?

PARIZEK: Parizek, Board.

Thank you for your vision statement, which we appreciate. Some of the points I had have been answered from other questioners. But first you have an outside the box concept. You invite this. The question is how will you go about doing that? Are you going to have a conference inviting international, national people, beyond DOE people to give you suggestions on what are the out of the box

possibilities for Yucca Mountain? Because there are many suggestions on how to control moisture movement in the mountain that are never mentioned, and these could be thought of as being out of the box.

And then having invited this input, you now have a litany or shopping list which you don't like, and how do you narrow down the out of the box ideas that might be worth pursuing, in view of the need to do the necessary research to show that these are viable?

CHU: Again, these are very preliminary thoughts. The first thing that I think we ought to do is identify those main themes that we want to tackle. And then I need help from you guys, and probably we'll tap into other resources. Once we have a few main themes, I think then we can tap into a smaller set of people in helping us further. And, like I said, I would like to tap into the international arena, not just domestic people in defining. So, it's going to take a little while.

And then I'm going to make another bold commitment here. I'm hoping the next meeting here, I believe it's in September, I'm hoping to give you something much more concrete on what this program might entail. You will give me some pressure to really work on it, because I know I have a September time frame to try to give you as much as I can.

So, I'm sorry I can't answer a lot of things, but I

think it's identifying what those potential big payoff, main points are, and then try to find the right people to help me formulate how to get there.

PARIZEK: I appreciate the comments on the rocks matter, or at least try to get more out of the rocks, but then again to take away the waste package and to take away the drip shield, I mean, be careful what you remove without creating other problems.

CHU: That's why I say just, you know, these are just-- I'm not saying taking away them.

PARIZEK: I'll wait for September.

COHON: Thank you. Just to wrap up, Dr. Chu, I feel it important to say the following for the record, though I don't think you need clarification on this.

The Board is pleased to play the role that it does in critiquing what the program does, making suggestions where we think they're warranted. The Board, however, is not DOE's partner in this. The DOE, it's very clear in the law that we stand alone, and we are not of DOE, we are not connected to DOE in that sense. And I know you know that. We don't certainly want to disabuse you of the attitude of partnership. I think that's very good. And we will come with the same attitude, but we are very cognizant of our Congressional mandate of providing objective, neutral advice.

CHU: I understand.

COHON: We thank you again for your excellent presentation, and especially for your open and candid and substantive response to our questions, and we look forward to many more opportunities to interact in the future.

Congratulations, and welcome again.

CHU: Thank you.

COHON: Thank you. We turn now to Russ Dyer, Director of the Yucca Mountain Project. Dr. Dyer, welcome back.

I wonder if we can dim these lights, or that light in particular, if someone can figure out how to do that? Thank you.

DYER: While we're getting the lights in order, I want to get a mike check. Can you hear me okay in the back? And I'll apologize ahead of time. I made a mistake last night. After dinner, I took advantage of the great weather and took a stroll around the block, and I'd forgotten what blooming plants do. And I'm just really clogged up today.

COHON: That's why you're a geologist and not an ecologist.

DYER: In Nevada.

COHON: Consult with Norm Christensen before you do that next time.

DYER: All right. Next slide, please.

I've got five general topics I want to go over here, and some of them we'll be hearing in more detail from

presenters either this afternoon or tomorrow. Just a general project status; talk about the site recommendation status, although I think we've covered most of this already in discussion this morning; talk a little bit about the detailed work plan through license application and the development of that, although that's going to be covered in considerably more detail later; talk about some of the key testing and design activities; talk about some management actions that have taken place at the project.

Project status. Well, the project, like all of us, is awaiting the Congressional national policy decision on the radioactive waste management. In anticipation of what that direction might be, and as prudent managers, we are planning for the licensing phase of the project. A multi-year plan through license application is being prepared. We have a general outline that has been endorsed by the project. We're putting more details in place through time to complement and supplement that.

The primary multi-year objective is a viable license application with the primary focus on, first, NRC issues and compliance with NRC regulations, but also clearly articulating uncertainties and plans to address them.

The transition from site characterization to licensing will require a lot of change, changes in paradigm, organizational change, and also cultural change.

The site recommendation process, we're all aware we're here in this particular block awaiting the Congressional action, and Dr. Cohon talked about this. Bob Loux talked about it. Margaret talked about it. I'm not going to take too much more time on it, except to say that this is the box at the end of this process, and here we are now.

If one looks at a timeline of what has happened in the past and things that may come, we're sitting right here at a pivotal point. The site designation is the action here that is really everything post the 2002 box from license application on through waste acceptance, et cetera, is all predicated on an action on site designation, which lies in Congress's hand now.

I'll talk a little bit about the detailed work plan through license application. The project endorsed a detailed work plan that describes the necessary work scope for submittal of an application to the Nuclear Regulatory Commission by late 2004 for the authorization to construct a repository.

The scientific and performance assessment work scope in this detailed work plan was prioritized on the basis of a risk informed, performance based approach that considered three general performance criteria. And you'll hear a lot more about this tomorrow, I think it's tomorrow

afternoon from Peter Swift. But the three general criteria were the performance related to dose, regulatory defensibility, and external acceptance. So, it's not what one would call a strictly compliance based criteria here.

To continue the discussion about what's in the detailed work plan, the design detail in the license application will provide sufficient information for the Nuclear Regulatory Commission review and evaluation of safety. The design will provide a basis for the eventual development of facility designs to support procurement and construction.

The detailed work plan also includes development of a licensing strategy that will define an approach for preparation of an LA that satisfies NRC regulations and guidance, the safety strategies for development of preclosure and postclosure safety cases, and an approach for communicating safety cases to oversight organizations, stakeholders and the public. And this, in part, points back to a point made by Dr. Runnells a little earlier.

You'll be hearing more about these a little later. Mark Board will be talking tomorrow morning about the design part of this, and Joe Ziegler will be talking this afternoon about the licensing strategy.

The LA will build on the technical basis that was used for the site recommendation. But it includes, this is

not all encompassing, but it includes work activities to address a couple of things laid out here. Of course, the NRC requirements in 10 CFR Part 63 and 10 CFR 2, including pre and postclosure safety analysis, design description and basis, quality assurance, licensing support network, the computerized discovery assistance system, if you will.

It also must address NRC/DOE key technical issue agreements. We talked about that a little bit earlier. Comments raised by the Nuclear Waste Technical Review Board and other oversight groups, and the work activities will also address updating the process models, development of a TSPA for license application.

The guidance in the Nuclear Regulatory Commission's draft Yucca Mountain Review Plan will be incorporation into the detailed work plan. Of course, comments are due on the review plan, but the draft is the operative document out in the public arena right now.

Let me move now to key testing and design activities. We're looking at model evolution inputs for inclusion in the LA. Some of these include, first, the evaluation of volcanism consequence scenarios, looking at dike propagation and drift interaction analyses, seismic design inputs pre and postclosure, look at flow and transport in the unsaturated zone and saturated zone testing and analysis, look at coupled processes testing and analysis,

waste package material corrosion and environment testing and analysis.

You'll hear a little bit more about some of this a little bit later, specifically down here, refinement of repository design for LA, a continued emphasis on flexibility and constructability, and a consideration of modular construction. You'll hear some of this from Jeff Williams a little later, as we talk about a phased kind of program. Improvement of the technical basis for selecting postclosure thermal conditions, Woody Stroupe will be talking about that tomorrow morning, talking about things that can support both the low temperature operating mode and high temperature operating mode decision.

Of course, the end of site characterization does not mean the end of the scientific and technical program. We have had a robust program. We will continue to have a robust program. There are a lot of activities that are in process that we will continue to monitor, continue the programs. The drift scale thermal test of course we still have over three years of data we intend to acquire from that as we go through the cool-down phase on that. There are a lot of laboratory tests underway and that will be put in place. Similarly, you heard Dr. Chu talk about some of the saturated zone programs. There are tests that are planned in that endeavor.

The natural analog program, we will continue that.

I have hopeful that we finally got a drill rig across the border to get down to Pena Blanca recently. It was stuck there for a prolonged period of time.

Finally, let me talk about management actions. You heard from Dr. Chu some of her main idea and goals, visions. There's a couple of things that we have done in support of her vision. We have taken or are taking some management actions to meet our primary objective of a viable license application, and to ensure the success of the paradigm shift to the licensing phase.

Although the project is transitioning from the site characterization phase, as I said earlier, scientific investigations will continue to increase our understanding of natural and engineered system performance, and enhance confidence in the waste management system.

In my view, the scientific program must be robust enough to challenge the models that are the basis for the performance, the performance assessments, the performance evaluations. That's not a one time thing. That is a continuing challenge that we have.

The project, you heard Dr. Chu spend a lot of time talking about her visions for the science side, and to support this, the project has established a separate task force to focus on long-term scientific activities that could either enhance confidence, improve technology or promote cost

efficiencies in the repository program. And we've made some management changes in the program to accommodate that.

Dr. Steve Brocoum has been moved to head up this task force, and Steve will talk to you I believe tomorrow afternoon, yes, he'll talk to you tomorrow about some of the things that are on the plate for this program. To backfill for Steve in the Office of Licensing and Regulatory Compliance, we've moved Joe Ziegler in as the acting assistant manager in Licensing and Regulatory Compliance.

In summary, in anticipation of a possible site designation, the project is in the process of transitioning from a site characterization to a licensing focus. We have completed a detailed work plan that describes work scope to support submittal of a successful license application by late 2004. The testing, analysis, and design activities in this detailed work plan are focused on preparation of a timely and defensible LA, although as Dr. Chu said, there are other things that can complement, augment and supplement this.

We're committed to the continuation of scientific investigations at Yucca Mountain to enhance our confidence in projections of long-term performance.

As I said earlier, management actions have been taken to ensure the successful transition from the site characterization phase to the licensing phase, and to enhance project performance in effectively meeting its objectives.

And if I could go to the last slide, please? Oh, that was the last slide. I'm sorry. It's broken out a little differently on my talking points.

With that, sir, could I answer any questions from the Board?

COHON: Thank you, Russ.

Questions from the Board? Alberto Sagüés?

SAGÜÉS: Yes, thank you for your presentation.

If we look at the last transparency, your summary transparency, Number 12, I'm very glad to see the inclusion of the third bullet as an assurance of the intent. Now, can you give an indication of what fraction of the resources in the future, should the repository proceed, what fraction of the effort would go into that third bullet, the commitment to a continuation of the scientific investigations to enhance confidence, to indeed probe the models that are being used, the assumptions of the models, and so on, that you so well mentioned, as opposed to effort devoted to obtain parameter information to bring to the models, which would be, I presume, a very strong, very large fraction of the future efforts, should the repository proceed? But, what fraction of the effort? Half of the effort? 5 per cent, 1 per cent?

DYER: That's a difficult one to answer. Because of the way we bucket things, if one were looking at something that supports licensing, I think I would probably categorize it

under licensing rather than under science, even though it may give rise to some fundamental understanding in the science arena.

I'll give you a gut feeling, and I have no numbers to support this. Probably on the order of 3 to 5 per cent would be my gut feeling. That's kind of what one might call a fundamental R&D budget.

SAGÜÉS: Thank you. That was my question.

COHON: Priscilla Nelson?

NELSON: Nelson, Board.

I, too, have picked up whatever this malady is, Russ. So, my voice is getting lower.

You talked about cost efficiencies, and in the context of the long-term scientific activities that could support an understanding of those cost efficiencies, what I'd like to get from you is an idea to what extent will costing exercises, life cycle costing exercises, be conducted to inform LA, and to what extent are you viewing them as being longer term after LA?

DYER: Well, the way the DOE system is set up, it takes you out through the entire life cycle of a project or program. So, there would be one set of considerations for LA. There would be another phase of the program that you would also have to look at. So, the idea is you don't get yourself in a situation where you make a set of decisions,

but you really don't have an understanding of what comes after it.

Now, one of the other things I would point out is that when we talk about cost efficiencies, you can be myopic and look at optimizing the repository program, looking from a broader DOE perspective. There may be things that you can do system wide that are more expensive, marginally more expensive for the repository program, but reap great benefits system wide.

Earlier, somebody mentioned treatment of waste, for instance, or not treatment of waste. There's some system looks, and this is one of the things that Dr. Brocoum is charged at looking at, is interfacing with other parts of DOE, to make sure that we're not narrowing our focus too much so that we miss some of the broader opportunities to look at the broader system.

NELSON: Okay. So, does that mean that most of that focus will actually occur after LA? Or do you expect significant focus on this in the context of the LA time frame work through December of '04?

DYER: There will be some between now and LA. I would expect the bulk of it to happen sometime between the licensing proceedings and later, before the operational phase.

NELSON: Can you give me an example of where focus might

be before LA for these exercises?

DYER: Well, trying to narrow down what the waste stream is, for instance. There are a multitude of waste forms in the DOE inventory. Now, do all of those need to be considered for the initial LA? Does all the information have to be developed as to waste form characteristics prior to LA submittal? Because some of those things, there's not too much known about them right now. Or do you want to take some subset of the inventory, concentrate on that, and then develop information over time to augment and amend the license?

NELSON: Thank you.

COHON: Dan Bullen?

BULLEN: Bullen, Board.

Could we go to Slide 6, please? I was interested in your prioritization efforts and your evaluation of the detailed work plan through LA, and I can understand how you could prioritize with respect to performance relative to dose, and I can even understand how you'd do it with respect to regulatory defensibility. But how did you quantify or prioritize or what was your ranking or methodology for the external acceptance? That's a tough one for me to get my arms around. I just wondered how you guys did it.

DYER: You'll have to wait to hear Peter tomorrow. In the past, we've done this in a multi-attribute utility

analysis kind of approach. I believe that's what they used as a framework here. And it can be a quasi subjective metric low, medium, high.

BULLEN: Okay. Same type of attributes or parameters with respect to relative dose, or did you actually quantify those in some way?

DYER: That's one for Peter.

BULLEN: Okay. I'll wait until tomorrow.

DYER: I believe that was much more quantified.

BULLEN: Okay. Thank you.

COHON: Good. We have something that will bring you back tomorrow. Richard Parizek?

PARIZEK: Parizek, Board.

I had a similar question on Slide 6, but that's been answered.

On 8, Slide 8, it's updated process models. It seems like it's hard to have a cutoff period that takes advantage of the ongoing science and engineering studies in order to build them into the process model updates. And, for instance, the saturated zone modeling effort, it seems like the site scale model hasn't yet taken advantage of the updated regional scale model, and as a result, there may be some constraints there that the site scale model will have, and there's some errors that are propagated because of that.

It looks like the year 2004, you know, seems just--

on the other hand, the cutoff period to include new data, and updated understandings, seems to be almost this year in order to be able to update the models for the LA.

How do you deal with that? I'm sure that it's an ongoing process after maybe license has been submitted, you continue the work, and you have this as backup information. But how best to handle these, not deferred things, but things that take time. And then it's always this need to shut down the incorporation of new findings. There may be faults that come out of the drilling program that are characterized from the Nye County people, for instance, that some of us ask about, but now you have some data. When will that get put in, and how do you use it?

DYER: Excellent question. It is an enormous challenge in a program of this size and complexity to try to schedule out, plan out the data feeds. And, of course, experiments don't always work the way you plan them to happen. We try to schedule our major products around when we think the test will provide meaningful information into the system. And then, of course, the rest of the planning process is how long does it take to analyze, evaluate and document the results.

It is a juggling operation. Sometimes you don't get the results that you hope for on quite the schedule, and you work at mitigating that somehow. The idea is to continually bring information into the program, though,

evaluate your understanding of the system against what this new information provides you, and see whether there's anything about your understanding that would change, anything about your assessment of the system performance that would change based on this new information.

So, that's one way that you get it in. You rightly hit on a technique. In licensing space, one can go in and bring new information into the program continually, and if need be, you can amend the basis for the license application if need be.

COHON: We find ourselves with extra time. And because we do, I invite members of the audience to pose questions to any of the speakers who are still here. If you have them, just raise your hand and I'll recognize you.

Please, if you'd come to the microphone over there, and identify yourself for the record, and then ask your question. And I'm sure Dr. Dyer, Dr. Chu, Lake, Bob Loux, if he's still here, will be happy to answer them.

FITZPATRICK: My name is Charles Fitzpatrick. I'm with Egan and Associates here in Washington.

I guess it's sort of a two-part question, one for probably Mr. Cohon or someone on the board, and then perhaps the followup to that by Mr. Barrett.

I've read numerous NWTRB meeting minutes over the years, and it seems a repetitive theme right up until the

present, or right up until your last meeting, is that there were certain things that you considered to be essential prior to the time that the DOE made a site recommendation. For instance, a thorough knowledge of flow in the unsaturated and saturated zones, transport of radionuclides, knowledge of container corrosion.

You also wanted multiple lines of evidence beyond just the TSPA in support of the TSPA. And perhaps, I think Mr. Cohon addressed, you felt that although it was a policy decision whether to--when and whether to recommend the site, that because of the degree of uncertainties, it was essential that if the site were recommended, that there be a clear communication by DOE or the Secretary to the policy makers, such as Congress right now, of the level of uncertainties with which the recommendation was made.

So, I guess my question is to Mr. Cohon, do you believe any of those objectives were successfully achieved in those areas, and particularly with respect to the transparency, I guess is your word, of the uncertainties as they were conveyed to Congressional policy makers?

COHON: Thank you. Of course I intended that you ask questions of Dr. Chu or Dr. Dyer, but we are fair game since it's our meeting.

First, let me say I thank you and congratulate you on your I think completely correct characterization of what

the Board has said at prior meetings, and what it communicated in various reports that we've made, including letter reports, over the last couple of years. I can elaborate on other Board priorities, but you've certainly captured the main point.

It was exactly for the reasons one could infer from what you said that the Board characterized the technical basis as weak to moderate, and it was exactly for those reasons that the Board said it had limited confidence in the result of TSPA.

So, you're right. You asked the key point, though, about transparency, or I prefer the phrase communication of uncertainty. As I said sort of as a footnote during Dr. Chu's presentation, I felt that in that regard, DOE did not convey clearly or transparently what the uncertainties are associated with their estimates of Yucca Mountain performance.

So, there you are. Thank you for asking.

Other questions?

(No response.)

COHON: Well, this is unprecedented, and just remember for future meetings when we only give you a five minute break, that on this day in 2002, you were given a 40 minute break. Now, we will convene at 11:00. But if Under Secretary Card arrives early, we may start early. So, if

you're really interested in that presentation, I urge you not to stray too far.

We are adjourned for the moment. Thank you all.

(Whereupon, a recess was taken.)

COHON: We have now been joined by the Under Secretary of DOE Robert Card.

Before I introduce him, I have a very important housekeeping item. Apparently, it turns out we've been stealing coffee, and this is something that the Board takes very seriously. Our coffee is in the back of the room. The coffee outside is not ours. So, if you've actually imbibed some of that coffee, please give it back.

I'm glad you interpreted that the way I meant it.

Prior to his selection as the Under Secretary, Robert Card was President and CEO of Kaiser-Hill Company. In that role, he was responsible for the $7 billion, 5,000 person cleanup and closure of the DOE's Rocky Flats site in the Denver, Colorado area.

After assuming responsibility for the Rocky Flats project in 1995, Mr. Card restructured site operations and the closure strategy, and he advanced the planned closure date from 2065 to 2006, quite a gain, and reduced the cost of closure from an estimated $37 billion to approximately $7 billion.

He also served as Director and Senior Vice-

President at CH2M Hill, which had revenues of about $2 billion, and of course is known as one of the world's larger science, engineering, construction and operations firms.

Mr. Card received a Bachelor's Degree in Civil Engineering from the University of Washington, and a Master's of Science in Environmental Engineering from Stanford, and also completed the Program for Management Development at Harvard Business School.

It's our pleasure to welcome Robert Card. Bob?

CARD: Thank you. I'm not used to being trapped behind a podium.

COHON: I just want you to know something, Bob. They have never applauded for me, in my six years on this board.

CARD: Well, I've never been applauded about anything like Yucca Mountain before.

COHON: Don't get used to it.

CARD: I'm not planning on it. Anyway, it's a real pleasure to be here, and I apologize I haven't been in front of the Board previously, but you've been hosting your meetings in garden spots across the country, and I think this is the first time that you've lined up in Washington, D.C. since I've been here. So, it's a pleasure to be able to get together, and hopefully we'll have time than in your next garden spot, I can follow you there as well.

I want to just say a few things, and then I would

be, you know, dialogue would be best from my standpoint. But, first of all, I want to say that we at DOE really appreciate the Board's work. And even though it may not look like we're always in alignment, you know, I think in general, it's in the 90 percentile range of our thinking. And I could explain whatever differences appear to be more one of timing than substance.

So, I encourage the Board, not that they need it, to continue doing what they've been doing, and we look forward to a long productive relationship together.

And I just want to say, for example, with the exception of just a few words in your January report, we really find ourselves very much in agreement with it. And it, frankly, parallels the IAEA report quite substantially.

So, I think you heard from Marvin and others that we plan to take that seriously, so I thought I'd sort of lay out some thinking about the project from here, and then be glad to, you know, respond to questions so somebody gives me the hook.

So, just as a stage setter, as far as the administration is concerned, siting issues behind us, it's in the hands of our elected representatives at this point. So, we are moving on, waiting for that decision, pressing forward with the project as if that's done.

We know that Congress has really only given itself

two choices at this point, and I emphasize Congress has given itself. One, they can allow the process to proceed to an NRC licensing phase; or, two, we discontinue the project completely, unambiguously completely. And I would note that there are no other active alternative permanent disposal options authorized or funded. So, that would be up to them to decide if things should just proceed as they would naturally evolve, or we should have some sort of other program. But, at DOE, we're not engaged in a debate of is this the right time at this point. That's over, and Congress will decide that.

But with respect to moving on, I wanted to make a couple points about the way I think, and I think my team sees this moving forward. And, really, I view the project as partitioned into about four parts, but it's not a hard partition. One of them is is the licensing activity, which has a very structured process that the NRC runs. And that's what I call the core project piece. So, I intend to instill our greatest project management, discipline and focus to that process, meaning that's got to be just a riveting focus on what is required and necessary and sufficient for the licensing activity. And we have our work cut out for us there that goes well beyond science issues.

Then, and real importantly and along the lines of your letter, is what I call an ongoing science activity. Let

me just back up to licensing. Also, I've told my team, based on my experience at WIPP, and Margaret's and others, that the licensing activity will not end in my lifetime. It will simply be a series of steps, because we will continue to optimize and learn about this repository. Again, all my statements are assuming that Congress makes a favorable decision to us on this. And, so, we will be continuing to look at the licensing criteria and our strategies, and putting those in line with each other through ongoing activities.

Then the other issue, one of the other ones along the lines of your letter, is I think one of the core issues the Board has been concerned about is that DOE has been focused on compliance, and whereas we really should be focused on sort of a holistic systems understanding. And I want you to know I buy into that, and plead guilty in that the law was very clear how we were to make the siting decision. It's a compliance based decision. But this repository, should it be approved, is an international treasure. We can't allow anything to cause its failure, any surprise, anything.

So, we intend to take advantage of the decades and centuries of its operation to have a forever study program. And, so, I've instructed my staff to work with you and other people like the Academies to design this ongoing science

program, using, frankly, your letter and the IAEA report as the starting point of what do we need to do that is not required for the licensing process to continue to understand the system, not in a compliance mode, but in a systems understanding mode. So, I see a major enduring role for the Board in helping us through those issues.

That includes, and the other issue that I've mentioned to some of you is that the project has been overwhelming focused on the siting decision, which has caused a lot of narrow thinking, in my opinion. So, I've asked the project to broaden their thinking, and while the licensing process is moving ahead on a riveting focus towards what we have in mind, that we should keep things such as the following in mind.

First of all, I am committed to maintaining a cold option until it is either selected or no longer important, one of the two. And we have done layouts for that option, and I challenge the Board that if you find us moving towards a hot design which does not readily adapt to a cold design, that you should call foul and call me and say hey, wait a minute, you know, you can't move those casks around very easily if you were to switch to a cold design. So, I'm not committing that we will license a cold design, but I'm committing that we will cause no harm in a hot design towards moving to a cold design, until, again, we resolve the

technical question one way or the other. And we have already developed a footprint for the cold design that is within the study area, and we intend to invest in that. And that was a personal commitment I made to you, Jerry, and it will be carried out.

The other thing that I will suggest opening up for question at this point, now the siting decision is behind us anyway, is the waste form. And, you know, if transmutation is technically feasible and will reduce the toxicity of the waste to a point that makes it technically and economically justified, then I think we're wide open to any issue here in fiddling with the entire system, because the system I view is from the time that waste leaves a nuclear power plant or a DOE site, you know, for the next greater, in this context, greater than 10,000 years, because, again, this is not a compliance based look at things.

So, I would encourage the Board to expand their horizons about things that it might consider in advising us technically what to do here, and think of the givens and assumptions that have been put in place over the two decades of trying to get to a siting decision, and rethink whether the right givens and assumptions are in place based on what we know today if this project were to move forward.

And then importantly, the other activity is it's time to begin an earnest transportation plan. We feel quite

confident that we can arrive at a successful transportation plan, based on the amount of material that we've moved in history and we continue to move right this day. There's really hardly a week that goes by that spent fuel or high level waste isn't being moved in this country, even coming in from overseas.

So, really, all forms of transportation are deployed, and we really have, in my opinion, because I was intimately personally involved in it, a fairly successful stakeholder system developed for WIPP. And I would see us modeling, and Margaret of course is quite familiar with that, modeling this system, you know, starting from that successful platform and working from there on how do we include states, communities, other interested stakeholders, and then of course how do we resolve any technical issues that are there.

And, again, I would say, well, we will--NRC is the safety decider. The science program, should it be appropriate, can look at new designs for systems that might be more resistant to whatever we're concerned about.

So, with that backdrop, Jerry, I'll stop there, and why don't we just take some questions until you decide it's been long enough.

COHON: Great. Bob, just so you're aware of it, we're going to invite questions from the Board until--well, for up to about 15 minutes, and then we're going to move into a

public comment period, which we chose specifically in terms of timing so that you'd be here.

CARD: Okay.

COHON: Questions from the Board? Debra?

KNOPMAN: Knopman, Board.

I appreciate your comments, Bob. Let me tell you how it sounds, and then you can correct my impression.

It sounds like we've got parallel universes here. It sound like there is the focus on the compliance that's necessary to gain the NRC approval, and then there is this other realm of interest in improved understanding in maintaining other design options, and the like. And I don't see the connection, and maybe you can walk us through how these concepts actually connect with one another.

CARD: Okay. Well, an example connection is, let's say we started off to further explore Vadose zone water transport, or something like that, pick a technical area. I would expect, and my anticipation is those technical areas will be selected with concurrence or input from you all, based on perceived risk/benefit to the project of understanding that issue.

Should we find something that would materially benefit the project in that, you know, we should modify some part of our design, more or less, it could be either way. Then that would feed into the design process and become

incorporated at the appropriate time into the licensing process.

Now, when it would be incorporated would be dependent on the right time from a project management perspective, because, frankly, I have not heard a bunch of concern about the operating period safety. We're relatively familiar with how to handle spent fuel. It's the long-term issues. So, I think one difference between at least me or us and the Board is that we view we have the operating period to fully resolve anything that we might want to resolve together, and that's a long time. And it's particularly long in the scale of time that we know about this material, plutonium and other elements that have only been around 50 years, and Alloy 20 and other things like that that have only been around 20 years.

So, we'll easily double the experience we have with these materials during this period of time, and perhaps much more, because 300 years is sort of the kind of time frame that we're thinking of to do this.

So, you know, the question that I posed to my folks is when, if we're on this discovery path, licensing path and discovery path, where do we learn things where we must make a change now for near-term safety issues. If we find those, then we're going to make a change immediately. It it's, well, that would be really important for the closure period,

then we may say, well, we don't need to have made that change yet. We can go ahead with the license the way that it is, or some other way of proceeding ahead, and we'll determine what the appropriate time, depending on a whole bunch of different variables might be for incorporating and modification of the design, or maybe the discovery simply improves our understanding about things, which is useful in and of itself.

I don't know if that helps, Debra, but that's kind of the way I see it.

KNOPMAN: Well, it helps. I guess what I'm still curious about is what you're driving at in terms of improvements and understanding in an LA compliance context, that is, do you have targets? One can embark on a 100 year research program, but not be all that focused on driving towards some particular goal of either improving understanding of a process, reducing uncertainty about a process we actually understand but don't have data on. And that's where I guess the disconnect is for me. What are you driving toward in the nearer term that you'd want to get out of the science program? Where do you feel you need more information going into licensing?

CARD: Well, recognizing there are no personal opinions here, but I'll give you one anyway, it will be great if we could find a way to substantially reduce the uncertainty of a significant down side through some surprise in the 10,000

year out time frame.

So, if somebody could say hey, I can get rid of those long half-life highly mobile actinides, or I can absorb them, or I can do something that substantially changes, so that if we imagine--what I've challenged my people to is let's just assume that all this waste gets put in there on a Friday afternoon with--it just gets tossed in, no containment, no nothing, what happens. You know, let's look at the worst case scenario here, what happens?

I think, while I can't imagine that actually happening, you know, to me in my nuclear experience, working on worst case scenarios is a good thing to do. And, so, the more protective we can make this system, the better.

Now, there's a lot of protectives you can do that are way outside of the compliance envelope. That's why I put these in separate paths. For one thing, if you insist on knowing everything about everything, you will never get--no complicated project would be built in this country. We wouldn't have a man on the moon. The Golden Gate Bridge wouldn't be built yet. And at some point, there are systems design for what's safe enough, and we move forward with that.

But, in certain cases where you have these very long times that we're talking about, 10,000 plus years, it's appropriate to continue to study. Whereas, in the Golden Gate Bridge, we're sort of studying it as we drive over it

every day.

COHON: Dan Bullen?

BULLEN: Bullen, Board.

I was particularly interested in your carrying along the cold option until it's either selected or it's no longer important. And I guess the question that I have is that why did you take that approach rather than start with the cold option and then decide that you had enough data to support the decision to go hot?

And I kind of want to ask a question maybe with respect to timing. The cold option, if you keep it, basically is decided the day you put the first two waste packages next to each other. If they're 10 centimeters apart, then you've got a hot design, even if you ventilate, because you can't remove all the heat. If there's a couple meters apart, you have a chance that maybe you can go cold.

And, so, I guess the question arises when will you make that decision? You told us you're going to have a license application that's hot, but the final decision actually occurs in whatever date you put two waste packages next to each other, and that actually has to be precluded by a determination by the NRC in all the public hearings that that's, indeed, the design that you want. So, I'm trying to pin you down on when are you going to decide as opposed to keeping this hot versus cold flexibility open?

CARD: Well, first of all, we believe we have the technical wherewithal to license a hot design now. And the cold is an optimization on that, potentially by certain people who believe, for good reason, you know, that cold may have some attractive features to it.

You know, the principle I would operate on is that we would make every effort to avoid going hot, and I'd want to talk to my folks a little bit more about that before we made that decision. So, if in your opinion the first two packages put us in a hot configuration, then I'd want to check that out before we made that decision. I don't know that we have universal agreement that the first two packages puts us in a hot configuration. But, if you have reason to believe that it does, then we would view that as a major decision.

BULLEN: Thank you. And actually that was an extreme example. I mean, basically, the removal of the heat from the mountain is the key issue, and I'm sure you can argue how you'd do that.

CARD: Yes.

BULLEN: I'd like to change gears just for a second here, because you brought up something that I think Dr. Chu mentioned earlier this morning about her basic science program and thinking out of the box, and you talked about potential treatment options, which include transmutation.

And then as soon as you think of transmutation, then the next thing you think of is maybe actinide burning. And then as soon as you think of actinide burning, then the next thing you think of is the word called reprocessing.

And, so, are you actually proposing that we close the fuel cycle?

CARD: I didn't propose anything.

BULLEN: I know. I'm just inferring. I mean, this is the logical thought process that when someone opens the door to transmutation, which personal opinion here, not a Board opinion, I think it's a great idea because it does the things that you want to do about reducing the longevity of the waste, and the like.

But I guess I just wanted to have you elaborate a little bit more about your thought processes there, keeping in mind that the Senator from New Mexico is down the street and would love to build accelerators.

CARD: Sure. And we're aware of that.

Let me first say that the administration is on record in the NEP of being willing to reopen the reprocessing issue. The important thing to understand, and please quote me on this, there is no known technology which eliminates all actinides yet, and, therefore, would eliminate the need for this repository. So, it doesn't matter right now which of those you choose. The repository need is the same either

way. Plus, we have a bunch of glass waste, another thing that has to go in there. So, we view the issues about waste management and the need for a repository completely decoupled.

Having said that, I don't think there's any issue that this administration said is not on the table. And you can think of it in two ways. One is sort of a good for humanity and science way, or other, just a cold calculating business way. If we're going to spend $50 billion on a repository, we should be looking at science and technology methods to reduce that cost.

And in a discussion with Jerry a while back, I pointed out that just good business sense calls for a long-term science program. You don't have to be dedicated to science. In fact, if I were to somehow gain title to this and the cash, I'd be investing a lot of science, because I think we can pretty dramatically reduce the cost of this facility through it.

So, there's a bunch of drivers for moving on with that, but on that test, though, would say how much does transmutation and reprocessing cost. I think the interests of Nevada at the end of the day in these issues will be very important. Assuming the repository is sited there, Nevada could either take the position I don't want anything done in my state. If you're going to force this, just put it in

there. Or, hey, I'd really like to have this extra work. I mean, those will be important issues when that time comes. There, by the way, is no dialogue going on, obviously, with the State on those issues now. Or some other state may want to host this. We're aware of a couple. But I think those will be decided on economical issues, and they may include broader ones than just Yucca Mountain, or safety issues if we can dramatically reduce the waste load in the mountain.

COHON: Don Runnells?

RUNNELLS: Runnells, Board.

Bob, in looking at the resume and hearing the introduction that Jerry gave, I'm impressed with your ability at Rocky Flats to save 59 years and $30 billion. I'd be fascinated to know how you did that, but this isn't the time for that.

Have you identified at the Yucca Mountain project, any big issues that you feel could substantially save money, or substantially save time?

CARD: I guess I'm not prepared to--well, the answer is no. But it's not that I haven't thought about them. But I don't think we're there yet in our understanding. I mean, I'll just give you some ideas. Many of the scientists that worked on this are disappointed that we haven't taken more credit for the natural systems, and they would argue that the criticism that this project became an engineering project and

not a science project by simply designing a waste package that we could put in a Safeway parking lot was largely due to our conservatism in making sure that we didn't leave anything uncovered in here, and that in fact, you know, there's a lot of credit that could be taken for the natural systems there that hasn't been taken.

In fact, if you really look at it, my opinion is we could come up with a less conservative design with surface storage at Yucca Mountain than under the mountain. You know, the mountain, you know, has created actually in the thinking a problem for us rather than a benefit, which it shouldn't be, because we've assumed the worst of everything going through the mountain.

So, that would certainly be an area I'm interested in looking at, is what do we need to know about what's above and below the drifts, and how the drifts perform, so that we could make an informed, safe decision about the natural system there, and take more credit for that. But, right now, there's very little taken. So, if I were investing, that would be an area I would look at, as an example.

COHON: Richard Parizek?

PARIZEK: Parizek, Board.

Secretary Card, Las Vegas is great for PR. I mean, they do things that many cities could not do. Could you expand on why you think Yucca Mountain is a national

treasure? I mean, I don't think Bob Loux would agree with this characterization of this gift of the nation out there. Now, I know from an international perspective, many people say, you know, you license a repository, that's going to really help the international problem of dealing with radioactive waste, because everybody is really suffering with this same sort of issue. So, from that point of view, there's an international value to this. But please expand on the national treasure characterization of it, because I think this is important to understand the logic of this.

CARD: Well, and bear in mind I'm obviously not trying to represent any perspectives of the State of Nevada. They're well represented, and you'll hear that from them. But stepping out into the broader context, first, I would refer everybody back to the Secretary's letter and decision document, which lays out the core issues. And those documents were not something that were ginned up a few hours before they went out. They were very seriously thought through, the words that went in there.

But just as one example, I think all of us feel that nuclear waste needs to be managed and dealt with appropriately. If the country that has the most need and the most financial resources and a lot of landscape can't get there, how do we expect anybody else to do this. And I think, you know, particularly in the area of dirty bombs, and

other issues, I think all of us would rather have relatively more of this waste in a secure location than not.

So, this is a very important signal, because this issue is no less contentious in any other country that has nuclear waste, either through their defense activities, their nuclear navy, or the power industry. So, they're anxiously looking for this so they can say to their citizens, look, the United States is doing this. We should do it, too.

Furthermore, for the reasons listed in the Secretary's letter and decision document, this is a very important move just for the United States. And I'll just share a personal experience with you that I had, is we were the first out of state site to ship to WIPP. New Mexico, Los Alamos made the first shipment. We made the next many from Rocky Flats. And my deputy, or COO, used the term national treasure for WIPP, because we were grumping over all the stuff that was not safety related that was costing us a fortune in the WIPP Waste Acceptance Criteria that Margaret put in there. So, I brought her here to get even with her.

And it instilled in our people this culture that absolute compliance with the WIPP Waste Acceptance Criteria was critical for the national interest, whether we thought there was a safety case or not, and it really focused our people on just how important every step, following rigorously even step of that, no matter how strange it seemed was,

because we had to protect WIPP's existence. And shipping the wrong thing there was a good way to cause serious problems.

And certainly looking at it in hindsight, you know, WIPP is of critical importance for the environment and safety of our country, and I think Yucca Mountain is, too. And, so, the way I view that personally is in addition to just getting this through the process of, you know, NRC deciding it's safe and blah, blah, blah, that we have a stewardship responsibility for this facility that really extends beyond that. And that's what's, frankly, my personal driver for wanting to continue this exploration.

Does that help?

COHON: Priscilla Nelson?

NELSON: Nelson, Board.

Not to overly belabor what Debra started thinking about, it's clear that you have a belief in ability to license a hot design. And, therefore, it's really not clear, it's still not clear to me what is the main driver for the scientific investigations and what scientific investigations are going to go on, particularly relating to things like ventilation, issues relating to aging and surface storage aspects.

You said stewardship right at the tail end of your previous comment. A stewardship of what aspect? I mean, in what part of the overall project is such stewardship needed?

Is it a reducing cost sort of stewardship? Is there insufficient certainty? What aspect is this stewardship directed towards?

CARD: When I used the word stewardship, I would say business-ship is the reducing cost piece. Stewardship is really expanding one's horizons beyond compliance, as an extra precaution to make sure we haven't left something on the table that should have been discovered or factored in.

I think if you look at the history of complex things, the space program, whatever you're talking about, I think there's a case to be made that you never have as much as would be nice to have. And at this point, we could make the decision we have enough to license this facility and we think we do, so let's just shut down the science program and move on. But I don't think that's the right answer for the country, because there may be a .000000--add as many as you want--1 probability that there's something interesting that we might have found out over the next decades that would have affected how we approach this project. And I think it's important enough that I'm willing to spend money to chase after that in the event that we might find it and be able to deal with it in real time.

It's science. I mean, as my scientists tell me, if you know what you're doing, it's not science, or if you know where you're going, it's not science. And, so, I'm willing

to invest in science for its own sake.

COHON: One of the issues always for the program, like any program, is funding. Margaret Chu, when she was speaking earlier, made a commitment to identifying some minimal level of funding for science, both as a threshold in absolute terms, and as a percentage of total program support, which is great, and we look forward to hearing more about that.

But, nevertheless, you don't fully control your budget, and to a large extent, are completely dependent on what Congress provides.

Have you or your colleagues considered a funding stream going on into the future? What I'm trying to get at is whether there's some minimum level which, if you fall, science is really in trouble as a part of the program? I'll leave it at that.

CARD: Okay.

COHON: Can you respond to that?

CARD: Well, let me sort of lay out the priorities. But, first, there's a bit of a backdrop. I am not aware of any other program in the U.S. Government, that under Democratic and Republican administrations, routinely requests more for it than is appropriated. So, I'm hoping if we get by this, that we come into alignment on that, because our, while we have a commitment to science and plenty of support within OMB and the administration for it, you know, our

priority and the national interest has to be the licensing process.

So, the licensing process bucket is going to get filled first. And there's a lot of science tied up in that as well, but that's what's going to get filled first, because right now, we have this material in the wrong place. That's the fundamental premise here. And the greatest risk that we have as a nation is delaying the repositioning of that material. So, that's the primary risk that we're trying to deal with.

The science risks right now, to our knowledge, are orders and orders of magnitude less than that, because there's a long time horizon to address those.

Now, we sincerely hope for a tens of millions of dollars per year open ended science program, and the core issue will be there will probably be enough to do all the things simultaneously. What we'll be looking for your advice is fees first in this way looks like the optimum in flow of important policy information into the project over the next many years. And that's what we want, you know, yours and the Academy's and the public's input, you know, those are the areas we want to focus on.

So, my commitment is we will work hard to make sure the request gets made, and it will be up to the appropriators to decide how important it is. And I can tell you in every

other program of DOE, the appropriators usually you haven't asked for enough. Have some more. But not in this case.

COHON: We're going to move now to the public comment period. Bob, because it's an open public comment period, and the questions may or may not be for you, I would ask if you could just take a seat, but stay miked.

CARD: Okay.

COHON: But be aware that you're live. So, maybe you should turn it off, yeah. But be available for response in case people have questions for you.

We have three people signed up, Charles Fitzpatrick, Judy Treichel and George Danko.

Charles, do you want to ask again, or do you have more? That's fine. You can even ask the same one if you want. Please identify yourself again for the record.

FITZPATRICK: My name is Charles Fitzpatrick, and I'm with Egan and Associates here in Washington, D.C.

I guess I had a general question, and a specific question, probably for Mr. Card, or anyone, Mr. Barrett or anyone who'd you like to designate.

Given the last question before the break wherein it was discussed that there were four or five very important prerequisites, at least in the NWTRB's mind, that DOE ought to have completed prior to site selection, but did not, I guess my question is the Nuclear Waste--the NWPA--the Nuclear

Waste Policy Act requires that DOE submit its license application within 90 days after the site is selected. Should Congress override the Nevada veto, that would be sometime this summer. DOE now estimates it will be at least 90 days, plus two years or more, before they're ready to do a license application.

Wouldn't it have been prudent for DOE to have waited until approximately 90 days before they were ready to do a license application, since much of the scientific work for site selection and license application are similar, and made the selection in the summer of, say, 2004 and then the license application in December 2004? That's the general question.

COHON: Who would like to respond? Bob?

CARD: Well, let me just say we view the schedule provisions in the Act as intending to drive forward, not backward. So, first of all, we categorically reject the 90 days was designed to make people wait. It was designed to make sure that the system didn't tally. There's a whole number of reasons why normally, I mean, there's no other nuclear process where you would basically be done with the license application before making a siting decision. Bear in mind that law was written in 1982, when the NRC process was somewhat different than it is today.

So, you know, I don't know what else I could say to

respond to that argument other than that we don't think it was intended, and we would like the people who are as concerned about that schedule, to be equally concerned about 1998, which appears to have already been missed. So, that's all I would say.

FITZPATRICK: I guess since this is a comment period as well as a question period, my comment in response would simply be that perhaps the framers of the Nuclear Waste Policy Act had in mind that the site would truly be analyzed for its suitability prior to the time of the license application.

The second, and more specific, question is Mr. Card had indicated that he believes that high temperature design is already licensable. Two months ago, this Board stated in a letter to DOE and the Congress, "Data on aqueous corrosion for Alloy 22 above 120 degree centigrade, under conditions relevant to Yucca Mountain, are essentially non-existence, creating a serious data gap. Consequently, there is great uncertainty about the performance of Alloy 22 under high temperature conditions. Because of this uncertainty, it is difficult to be confident that waste packages would last for 10,000 years."

So, I guess my question is have we discovered something new between January and now, or is there an issue there with the high temperature design?

COHON: Well, actually, let me not respond directly to that, but just point out, again as another way to promote our meetings and make sure you come back, we'll be hearing from Joe Payer, the Chair of the Corrosion Review Task Force, whatever it's called--Waste Package Peer Review, and I believe his comments on behalf of that group will be certainly material to that question. Right, Joe?

Joe Payer said yes, sir. One could only note it was said halfheartedly, but he said it. In any event, it will certainly be relevant to this question about what we know and what we need to know.

Mr. Fitzpatrick, I just want to reiterate something you mentioned during the comment you made before the break, that Egan and Associates I believe is working for the State of Nevada.

FITZPATRICK: That's correct.

COHON: On the Yucca Mountain project. Good. Thank you.

Judy Treichel? Judy, do you want up here, or is that okay?

TREICHEL: Oh, I'll be fine.

COHON: Okay.

TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force.

First, I would like to say both personally and on

behalf of the Task Force, that I share in your sentiments that were expressed about John Arendt. He was a very respectable person, and even though we probably didn't agree at all regarding nuclear technology, I totally respected his style of doing business and his commitment to fairness, which is one of the most important things that the public has gotten, and has gotten more of it from the Board.

COHON: Thank you, Judy.

TREICHEL: That being said, now I can launch into the usual attitude that I have. But I think it was necessary to say that.

All of a sudden at this meeting, it appears that everything has changed, but at the same time, nothing has changed. There is suddenly this brand new attitude and a new focus, and everything becomes new, but it's the same old mountain. And I find it very interesting that the new Director has said that it's in the formulation stage, or just sort of forming up. And that's pretty interesting now that we've already had a site recommendation.

And I think it should go on the record that Yucca Mountain is never going to turn into WIPP. There are tremendous differences between the two places, both scientifically and publicly and politically and in every single way. So, it's just going to fit.

The people in Nevada, as far as the people that I

work with and certainly the State officials and the others, are not going to join Team Yucca, and I was glad that you made the statement that the Board didn't feel it was appropriate for that to happen. And I certainly hope that the NRC feels that they need not get further on board than they already are.

It was mentioned before that Nevada believes that it's being dumped on, and that's absolutely true, and that's not changing, and it's unlikely that it would change. I don't know. There was a lot of talk, and there always is a lot of talk about enhancing communication, and there's all sorts of fancy words used. And I found it was interesting in the presentations this morning, there's still sort of a question in everybody's mind about what a stakeholder is and who a stakeholder is, and I think one of the things that Dr. Chu should add to her learning curve is to get rid of that word. It doesn't work, and it's a bad word.

It appears that the program is still looking for a silver bullet, and that certainly it's obvious that the public in Nevada doesn't think there should have been a site recommendation, and certainly doesn't think that a license should be issued. But to go on and on and on and talk about looking for this silver bullet, or for better ideas as the thing just kind of keeps rolling along, I found it really interesting when Mr. Card was talking about the man on the

moon and the Golden Gate project, or the Gold Gate Bridge.

We all sort of--it was kind of understood in this country that we wanted both of those things, and certainly the man wanted to go to the moon, you know, that did. But this is an entirely different deal. This isn't an overwhelming public supported thing. This is very different, and can't be approached in the same way, and those two projects, we didn't send the guy to the moon and then spend some time to figure out how to get him back. That's sort of the attitude that's being employed here. And you didn't put that bridge out there and see how many cars we had. You know, it wasn't a work in progress. There was pretty good evidence. So, I think descriptions like that just aren't appropriate.

And I guess finally, I think everything is in place and we are in the formulating stage, and it might work out great, and it could be a national treasure if you turned Yucca Mountain into a laboratory that did not contain radioactive material, but that led you to know more about geology and led you to know more about the things you needed to know before you finally did make any sort of permanent decisions on the repository.

Thank you.

COHON: George Danko?

DANKO: George Danko, University of Nevada, Reno.

I would like to spare my public comment for the tomorrow session on the repository design, and use this part to ask two questions to Secretary Card.

One question I would like to ask is how do you define the cold repository option? And the second question is what are the key technical issues related to the cold option?

COHON: Just for the record, and for the benefit of Under Secretary Card, Professor Danko is at the University of Nevada, Reno. So, the two questions were how do we define the cold design, and what are the KTIs associated with cold design. Lake is going to respond. We're going to do a tag team.

BARRETT: The cold design as the Board has defined it is less than 96 degrees celsius on the metal. We've also looked at a range of temperatures. We looked at the wall temperature being less than 96 degrees at a two phase flow, and some of those uncertainties. So, there's different definitions. But the Board has been 96 on the metal.

Regarding the KTIs, Russ?

DYER: In the KTI arena, looking at the thermally dependent KTIs, there would be one subset that would be in the metal behavior arena, and then another subset that would be in the coupled process in the natural system arena. Those are the two general arenas. I can't tell you how they break

out with each of the sub-arenas exactly.

DANKO: Thank you very much. And then the other question was what are the key technical issues related to the feasibility or the licensability of a cold repository? So, what's the issue? I believe it's not the issue of keeping the temperature below 96 degrees C. on the wall of an emplacement drift, because that's in the literature in several published papers, that you can keep this temperature below 96, or you can keep it below 80 degrees, or you can keep it below 60 degrees. It just depends on how far you are spacing the waste packages, and how much air you are blowing over the emplacement drifts. So, that can be kept.

So, what's the key issue? We have enough air. We have fans and we can power this and then cool it down as much as we want. And then I heard the period of consideration for preclosure ventilation to be somewhere between a few decades to up to 300 years.

DYER: I must have misunderstood your question.

DANKO: What are the key issues? What are the key technical issues of licensability of the cold repository option?

DYER: If you look at the KTI agreements, those that are thermally dependent, generally fall in two categories, those that are associated with material processes, material behaviors, and those that are associated with coupled

processes, between the natural and the engineered system. Those are the main areas.

Now, I don't know exactly what the sub-agreements are, but those are the two main categories.

DANKO: So, what needs to be done to be able to check out if it's licensable? So, what's the road to get to the point that the decision can be made whether or not a cold option is licensable? So, what is the roadmap to that?

DYER: For each of the sub-agreements, there's a roadmap that is currently agreed upon between the DOE and the NRC as to a proposed path forward.

Now, there are a number of those. Are you looking for detail as to exactly what those are?

DANKO: Well, the performance assessment results which haven't been investigated?

DYER: Some are performance assessment. Some are material behavior, short-term, long-term. Some involve very long-term tests. Some involve analysis and documentation of the analysis.

COHON: Russ, let me jump in. I think I might have created sort of a miscommunication link here.

Professor Danko used the phrase key technical issues. I then abbreviated it to KTI, which has its own special meaning. I think another dimension of what he's getting at is why not adopt a cold design? I mean, what are

the issues in deciding whether or not you should go with a cold design?

Is that what you were getting at Professor Danko. also, or no?

DANKO: I'm just rephrasing my question, that what I heard from Secretary Card was that when the key issues, key technical issues of licensability will be decided for the low temperature option, then the decision will be made whether to go to the hot option. And then that was my question. What are those key issues? And now we get into very detailed plans, and then I just don't know what those issues are, and that was my question.

COHON: I just wanted to--well, Bob, go ahead.

CARD: I was told that that will be addressed tomorrow in Woody Stroupe's presentation.

COHON: Thank you. Debra?

Excuse us. We're having a little private communication.

(Pause.)

COHON: There are no others prepared to make public comment at this time so, therefore, we're going to bring this to a close.

In doing so, let me thank again all of our speakers, especially Robert Card, the Under Secretary of DOE, for joining us today, and Dr. Chu, and welcome her to her

first meeting and to her new job, and to Lake for participating in what evidently will be his last meeting in his current position.

We're adjourned now until 1:10. See you then.

(Whereupon, the lunch recess was taken.)

AFTERNOON SESSION

COHON: I ask you to take your seats, and I invite anybody outside to come in. We had a nice lunch, not too rushed, and we're refreshed and restored and ready to go for the afternoon session.

We start with a session on the status of corrosion studies, and Member Dan Bullen will serve as Chair of this session. Dan?

BULLEN: Thank you, Jerry.

Well, actually, I can keep us on schedule because I don't have any opening remarks that are prepared.

This session is actually presentations by Joe Payer and by Maury Morgenstein essentially dealing with the corrosion processes as they have been developed over the course of the last few months.

Joe is going to talk to us about the Waste Package Performance Peer Review. And with that, I'll just turn it over to Professor Payer from Case Western Reserve University.

Joe?

PAYER: Thank you, Dan.

My plan here today is to give you folks a synopsis of the DOE Peer Panel on Waste Package Materials Performance that I was the Chair of that panel. It's a large report. It's got a lot of information in it. It's got a lot of detailed information in it as you get back into the chapters of it, and it's certainly not my intent here today to try to, you know, summarize all that for you.

So, what I'm going to try to do is give you some of the overall findings, and also take the opportunity to, as a panel, we tried to put some of the performance of waste packages in a Yucca Mountain type of a facility into perspective, as to how that is similar to and how it's different from a lot of other engineering applications where people are chosen to do material selection and design, and some sort of life assessment prediction on how they're going to perform. So, that's the plan.

A little background on what got us started with this activity. The Peer Panel, the Peer Review was put in place by a request from DOE to Bechtel SAIC, for Bechtel SAIC, the contractor, to carry out a consensus peer review. And that's under the formal parlance of Peer Review as it's specified.

The topic was the prediction of long-term performance of waste package materials. And, so, our role

and our job scope within this Peer Panel was not to evaluate the overall performance of the combination of the waste packages and the barrier systems and the mountain, and all that sort of thing, it wasn't to predict that long-term behavior, but it was very focused on what's the long-term performance, what's the technical basis for that long-term performance, assess the experimental and modeling programs, and focus primarily on Alloy 22 and Titanium, Grade 7, the two primary specified materials of construction.

We carried out that process over about one calendar year. We started back in the March time frame of '01, and we delivered to Bechtel/DOE on February of this year a final report.

For any of you that have not seen that, or care to go back to it, it is posted on the Yucca Mountain site.

In sync with the scope of the program, and the directions and the objectives of the Peer Panel, it was staffed by people that have expertise in materials science and engineering, corrosion, and people that deal with, have dealt with professionally for significant amounts of time predictions of performance of materials.

I Chaired the panel, and in my real life, I'm a professor at Case Western Reserve University. John Beavers is a Vice-President of CC Technologies, a small business just outside of the Columbus area, and CC Technologies specializes

in corrosion work, both experimental and project management type work, materials performance and life assessment type issues.

Tom Devine is professor and chairman of Materials Science and Engineering at Berkeley. Jerry Frankel is professor and Director of the Fontana Corrosion Center at Ohio State University. Russ Jones is a senior scientist and group leader at Pacific Northwest Labs, Batelle-Northwest, and again has expertise in the area of corrosion, materials behavior, alloy stability.

Rob Kelly is a professor at the University of Virginia in the area of corrosion, corrosion science. And Ron Latanision is a professor and director of the Uleg Laboratory at MIT.

So, these people all have background that's relevant to dealing with these issues.

In addition to the Panel, and the report is the final work product of the panel, it's a consensus peer review, meaning that we all signed off on it. We all accept what's in between the covers of that. It doesn't mean we didn't have a lot of dialogue, a lot of discussion, but we came to a document that we all agreed upon.

In addition to that, we had on the order of 15 people that helped us with this that we called subject matter experts. These were international and North American folks

that have expertise in particular areas that we were interested in. So, for example, we had Roger Newman write up his experience and coupling the literature on the effect of mixed anions on localized corrosion. So these are very specific issues typically. These people prepared those reports in hydrogeology, physical metallurgy, and some of the fabrication processes, and they were input to the panel. These folks did not participate in the overall report. They provided input and information for the panel.

Just a quick overview of the content of the report. It has an executive summary and an introduction. There's an overview sections, Section 2 and Section 3. Section 2 presents overall findings and the technical issues to be resolved identified by the panel. Section 3 reports a summary of findings in each of the specific degradation modes, localized corrosion, stress corrosion, uniform corrosion, the specific forms of materials degradation in contact with a wet environment.

Then there are detailed section on each of those degradation modes, and then Section 11 is a summary of abstract of some of those special topic reports. The compilation of special topic reports is due to be issued yet this month, sometime in May is my understanding.

Okay, more to what did we find and conclude. The overall finding is that the panel concludes that based on the

body of technical in formation available, that Alloy 22 is a suitable material of construction for the outer barrier of waste packages. Nevertheless, there's significant technical issues that remain unsettled and that are amenable to study.

The technical basis supporting the behavior of Alloy 22 is substantial and growing, and we did not restrict ourselves only to project data to support this, but we looked specifically at project data, and then we looked at the general information on Alloy 22 and the type of nickel alloys, highly corrosion resistant alloys, of that family to support this conclusion.

We made the observation that there's always going to be uncertainty, particularly when you're dealing with such a long time frame of exposure. So, it's primarily this extremely long life that makes this problem somewhat different than typical problems that we deal with from an engineering standpoint.

The other important observation, I think, and it comes up throughout our report, is that this area in particular, the long-term performance of metals in corrosive and potentially corrosive environments is an area that's amenable to experiments and modeling with current state of the art technology, techniques and procedures. So, it is an area where uncertainty can be reduced, and confidence can be raised by experimental and modeling programs.

Let me just spend a little bit of time putting the Yucca Mountain in perspective, from the perspective that somebody that looks at this from a materials standpoint, will this metal package have--what's its likely behavior, what the odds are, what's the chances are that you could design, fabricate, build and install a number of metal packages in this mountain and expect them to perform for 10,000 years.

And, so, this is all stuff that hopefully will get us off, give you a little bit of insight into our way of looking at these types of problems.

The repository level is some 300 meters below the desert surface. The waste packages would be put in a number of drifts at this level. The water table is down another plus or minus 300 meters. So, the packages sit in what's referred to as an unsaturated zone. There's moisture present in the rock. Water does fall and precipitate and build up on the surface. Some of that water evaporates. Some of it runs off. Some of the water moves down through the mountain to the water table. But the area where the packages sit is in the unsaturated zone. So, they're not fully emersed in water.

Well, what makes this situation different than some of the others we deal with? The particularly challenging thing is this extraordinarily long time period. There's an operational phase of 50 years or so during the emplacement.

There's a monitoring phase that will stretch out to on the order of 300 years. And then the closure phase goes on and the design goal, or the thought process that we're going through of how are these packages going to perform over thousands of years, and up to 10,000 years and beyond.

It's important to consider I think one of the quick things we do in our head, is we say okay, if we've got a waste package that's 2 centimeters thick, and it has to last for 10,000 years, what penetration rate can we accept to get to a given level of penetration. But one of the things that you assume in that, either knowingly or you just take on as a given, is you're assuming that that process, if it's a cracking process or a thinning process, a corrosion process, starts at time zero and goes continuously at that rate over 10,000 years.

That's highly unlikely. The conditions change within the mountain. The conditions change from package to package. They may be moist, they may not be moist at any given time. So, one of the things that's important to consider, and this may be good news, it may be bad news, but it's the way it is, is the potential degradation modes. If you're thinking about uniform corrosion, or some cracking penetration, it's important to consider not only the conditions that would initiate that particular form of damage and arrive at that rate, but also how do those conditions

change over the time period. Would those conditions persist? Would they get more severe and increase the rate? Or, if things dry out, would the processes stop for a while, and then perhaps restart? So, it's important to consider that there's very likely a starting and stopping situation.

If you look at this from a corrosion, design, material selection, there are several things about this application that are favorable. The waste packages are exposed to one, long, slow temperature cycle. That's different than designing a rotating piece of equipment or a piece of equipment that is ramped up in temperature and down in temperature on a daily or weekly basis. Much more severe conditions when you have large fluctuations, either mechanically or chemically.

There's no moving parts in these. So, we don't have wear and abrasion and those types of typical degradation processes that you might have in rotating equipment or moving equipment. It's basically the ultimate static exposure. The waste packages are loaded up. There's the mechanical loads on them. There's the residual stresses that might be involved from the fabrication processes. They're emplaced and they sit there in a static exposure.

The heat fluxes we're talking about, while they're significant and while they're of interest and while they have to be considered, the heat fluxes are very low. There's a

very slow heating cycle, and then even a slower cooling cycle in this application. And in the higher temperature mode, one of the things to consider is that the packages would be dry for a period when the moisture has been driven away from the surrounding rock.

The waste material gives off heat and radiation at a rate that decreases with time. The thermal effects diminish over several thousands of years. The radiation effects diminish over a few hundred years. So, times out beyond that need to consider that.

At the repository level, I mentioned earlier the packages are beneath some 300 meters of rock, and it's another several hundred meters to the water table. The packages sit in basically an ambient air condition. They sit up on support pallets that hold the packages up off the drift flow. They're in ambient air that is essentially saturated with moisture. The moisture is in the rock and it saturates that local air during the closure period.

And while the amounts of moisture that can form on those packages is likely to be small, it is sufficient moisture to start, initiate and control corrosion processes. So, it's critical. It's crucial to understand corrosion resistant materials. Even though this is in a moist air environment, there are certainly conditions that can result in moisture on the waste package surfaces.

It's broadly accepted that when the packages are dry, they will not deteriorate by corrosion processes. No significant metal loss is going to occur during those dry periods. When the metal surfaces are wet, there's a potential for corrosion resistance, and that's why you've seen a lot of emphasis being placed on the time of wetness, what's the composition of that moisture that's on the surface, how does that moisture interact with the metal structures of the waste package and/or the drip shield. And from a corrosion science and technology standpoint, that emphasis is well placed.

Moisture can be present on the surfaces. It's highly unlikely that these waste packages will ever be in a fully emersed metal in a tea cup sort of a scenario. What will happen is two significant sources of water. One is condensation. As the waste package in a high temperature operating mode, and I'll have some comments on that a little bit later in this, but in a high temperature operating mode, the waste packages are put into the drift. During the ventilation, the temperatures are down. They're fairly dry.

When that particular drift is closed, the temperature rises, the moisture comes back up. But as the temperature goes up, they stay dry because of the elevated temperature. Then during this cool-down cycle, you eventually get to a point where you go below the dew point in

that particular area, and moisture will condense onto metal surfaces during that cooling cycle. That will be condensation.

In Washington, D.C. you all appreciate condensation. I mean, you just walk out and you get this moisture.

There's also the possibility and likelihood in some areas of seepage. And, so, water will come through the rock in sufficient magnitude that it will form droplets, and those droplets can go onto the waste packages.

So, the two forms of moisture we're mostly concerned with, or we are concerned with, are this condensation mode, and the seepage mode.

The finding of the Peer Panel with respect to uniform corrosion, this is a damage where on a metal structure, you get a uniform penetration in metal, it wastes away. These have very low corrosion rates. Failure of the waste package during the design life by uniform corrosion is unlikely. These highly resistant corrosion resistant materials have low corrosion rates.

It's highly likely that the passive film--these alloys are inherently reactive, but in their interaction with moisture in the air, they develop a very thin oxide layer on their surface. And it's that oxide layer that's protected. And in the benign environment, if you break that oxide

mechanically, scrape, it reforms. And, so, the overall corrosion rate and the reprotection, the repassivation rate, occurs such that the penetration is very low.

That passive film in that condition is likely to remain stable and the uniform corrosion rates remain very low.

There were two phenomena identified by the panel that could compromise this. One would be if there was a segregation of sulfur to that surface, that could potentially de-stabilize the film, and also there's this issue of transpassive corrosion. Both of these issues get pretty highly technical, but we deem them worthy of study. Two potential areas that could de-stabilize that passive film and should be looked at.

The panel again concludes that there is a substantial and growing technical basis for the evaluation of long-term performance, and these types of technical issues, and some others we identified, we believe are worthy of study to either reduce uncertainty or to raise confidence in the behavior.

Again, this is just sort of in the background area. The waste packages in this environment sitting on their supports in air in the drifts, the behavior of the environment that they're in contact with, the moisture that forms on their surface, is a function of both the engineering

processes, what sort of waste packages, what kind of fuel you put into the waste packages, the age of that, how close they're spaced, how widely they're separated, the amount of ventilation, so, there are engineering processes that are controllable that will impact on the environments, and there's also natural processes, such as the amount of precipitation in a given area, and so forth.

Of particular importance is the temperature of the waste package surface and the chemical composition of the environment in contact with them at that temperature. So, all the emphasis that you've seen and heard about in the detailed studies that are going on by project folks and other folks on this, a major portion of that has been focused at what is the water composition, and what is the temperature range of interest.

There's a typo in a couple places in our report. It's not a typo; it's a word. But there was a mixture of words here, and I'll talk--well, let me just talk about it now. Let me get down to it.

Just a couple comments on the higher temperature versus lower temperature operating modes, and I guess the terminology has been picked up operating modes, because with the same sort of drift spacing and drifts, you can control the temperature profiles by spacing and loading and ventilation and things of that sort.

In the high temperature operating mode, we're talking about a situation where the waste package surface wouldn't get higher than 180 centigrade. In a lower temperature operating mode, the waste package surface would be controlled to on the order of 85 centigrade.

There's no question that there are incentives for a lower operating mode. Corrosion is an electrochemical process. As all activation controlled processes go, if you lower the temperature, the rate goes down. So, lower temperature means reduced corrosion rates.

Certainly, the likelihood of localized corrosion, detrimental metallurgical aging, the stability of the alloy itself, those again are thermally driven processes. Lower temperatures are beneficial.

This should say less opportunity for evaporative concentration, not condensation. And we can thank Carl DiBella for finding that. 6,000 eyes looked at this report and never saw that, and I got an e-mail last week from Carl saying, "Did you mean condensation or concentration?" And seven out of twelve places in the report, we said concentration. But as it got moved forward, someplace along the line, and I don't know how this happened, it got turned to condensation.

The idea is this. If you have water on a surface, just put water in a tea cup, and that water has a dilute

amount of soluble ions in it, put a little salt in it, put a little sulfates and chlorides and calcium and nitrogen, and so on and so forth, as you drive the water off, that becomes a more concentrated solution. That's what we mean by evaporative concentration, and that's the process we were talking about that's of interest on a hot metal surface.

So, if a drop of water forms onto a hot metal surface, or if there's some particulate on the surface and water condenses there, it might be a very dilute solution to start with, but as you drive the water off, it could become more concentrated. And which way it goes in that concentration is a very important issue.

Well, if you went to a lower temperature operating condition, you have less time and less driving force for that evaporative concentration. That's what that point is about. And it's not all necessarily slam dunk good new, though. There could be some disincentives.

You expose the waste packages to wet conditions sooner if you go to the low temperature operation. And by exposing them sooner, they're going to get wet when the radiation field is somewhat higher. There's a lot of evidence and a lot of analysis that says the radiation field doesn't matter anyway. And if that's true, it doesn't matter anyway. But if that's the only issue you look at, you are exposing them to wet conditions perhaps in the radiation

fields.

There's increased costs and risks associated with longer ventilation, and I mean risks from a technological operational standpoint. If you have to actively do something, and in the other case you're not doing anything, there's a greater risk that you're going to be able to continue doing that, and there's not going to be any breakdowns, or that sort of thing. And, also, for a given amount of waste, you need a larger footprint to go to the lower temperature.

So, our opinion on this is we didn't vote higher temperature/lower temperature. We understand the incentives and the driving force for lower temperatures. We point out perhaps some of the maybe trade-offs, and we say like any other design and operating decision, it is clearly a trade-off. It's not a slam dunk, let's go this way.

If the technical case is sufficient that the higher operating condition is okay, then why accept additional costs and that sort of thing to go to the lower case. If you can't make that case, or for confidence, now you're getting into, I think again into the policy decision arena, not necessarily the technical decision.

BULLEN: Bullen, Board.

Joe, I know we professors are all programmed for 50 minutes, but you've got about five left and I want to make

sure that we can get some questions in, too.

PAYER: That's five with questions?

BULLEN: Well, I'll give you five with questions, and then I'll bite into some of Richard Parizek's time later.

PAYER: I'll talk faster.

In the handout and in the report and all, and these are just taken from project data, but it compares the high temperature and low temperature behavior. And the red curve here is for higher temperature, because it's hotter, and the blue is for low temperature, because blue is colder. See, there's a psychological tie there.

In the high temperature operating mode, the waste packages during the ventilation period are cool. When you close, they raise in temperature. And then over a long period of time, they cool down. This is 80 centigrade, 60 centigrade, and so forth. 1,000 years, 10,000 years, 100,000 years, so this is a long cool-down period. This is a function of where the packages are geographically in the waste site, and these are the types of packages. But they tell the same story.

In the high temperature operating mode, they get a lot hotter, and then they cool down over a long period of time. There's a 300 year ventilation period for the cool temperatures, so you follow that sort of profile.

There's similar data for the relative humidity.

And this is for the same conditions, and it shows the relative humidity, 100 per cent is moisture, a lot of condensation. 20 per cent is low relative humidity and dry. And at relative humidities in between, say, pick a number, 20 to 80, it depends upon the composition of the dust that's there, and the types of conditions if one is going to have moisture or not.

So, these packages, higher than 80 per cent relative humidity, it would be a good bet to say they're moist, they've got moisture on them. Packages down here are dry, and packages in here, you need more information.

One of the interesting things you can do with that data is you can make a set and say okay, for the high temperature operating mode and the low temperature operating mode, when will packages get to 120 centigrade. Under the high operating mode, that's after about 500 years. You get to 100 centigrade after about 1,000 years. That's not applicable. The low temperature never was there. 80 centigrade after about 3,000 years high temperature, and then it's at closure with the low temperature, and then they start catching up with each other. So, after long times, they're cool here.

This is not the full information on that. But the point is that it's important to consider both the temperature and relative humidity when you're thinking about these

processes.

Condensation occurs at sufficiently high temperatures. At sufficiently high temperatures, there won't be any condensation. As the package cools, it can get wet. The seepage on the drifts depends upon the amount of water in the area. Even though the moisture levels are going to be small in this, corrosion and the chemical composition of that water has to be determined.

What do we know about some of that water current, based on project findings? The water compositions coming from the rock onto hot metal surfaces will typically drive to an alkaline solution, pH 11 or 12, it will contain sulfate, carbonate, nitrate, chloride. All of these things have implications on corrosion processes. Or it will drive to a near neutral, pH 6 type of environment. And once that water drops onto the surface, then we can get this evaporative concentration and other processes going on.

In the report, the panel identified several technical issues that we suggest to be resolved. The current waste package is likely to meet the desired performance. These technical issues present potential areas that could cause a change of design or material, and comprehensive analysis and testing could resolve these issues. So, we think they're resolvable.

The other main point here, you can read all that,

the other main point here is that this area is particularly amenable to study by experimental and modeling by current available corrosion science and technology.

Final slide, control of corrosion is essential. The project staff approach to that is sound. It's following corrosion science and engineering principles. Although the nominal waters at Yucca Mountain are fairly benign and not corrosive, the composition can change over time with temperature, and so it's important to identify where that occurs.

The panel recommends that a task group of project technical experts be put together to address and resolve that issue.

The corrosion and mechanical behavior of waste packages has to be considered. And the panel, very importantly, and throughout the report, the panel believes it's time to balance the materials and corrosion science with engineering, fabrication and manufacturing processes. That doesn't mean that the same scientists and the same experiments, same models are not appropriate. But, it's really time to focus on welding issues, fabrication issues. How are you going to make these metal cans?

Thank you very much.

BULLEN: Thank you, Joe. I appreciate that.

Questions from the Board? Alberto Sagüés?

SAGÜÉS: Actually I have reserved this first spot here, and I was going to make a prepared statement and ask you two questions, Joe. But because we're behind in time, I'm going to make an unprepared statement and ask you one question.

The unprepared statement is a good job. You all did this on time, and thoroughly, and the Department is to be commended for commissioning this work, and we thank them for setting up its execution.

PAYER: Thank you.

SAGÜÉS: You're more than welcome. And the one question that I wanted to ask is something I didn't see in the report, and that is there seems to be little or no reference to analogues, either natural or man made analogues, and so on.

As you know very well, the materials, the main waste package material would rely on passivity for its long-term performance, and there seems to be no well documented examples of something that has stayed passive for thousands of years in an environment that would be useful. And why was that issue not addressed? Is that because of just one of many other things, or do you have some--

PAYER: Well, I think it wasn't addressed because of just what you said. To date, there has not been any large number of natural analogues. When, you know, they excavate the tombs and that, we don't find mummies with an Alloy 22 nose, or something. It would be kind of neat if we did.

So, I think it's not that we don't think they're a good idea. There weren't a lot available to analyze. I agree with the sentiment. It would be great to find them. And we would certainly vote to continue looking. So, we're not saying it's a bad idea. We just didn't have many to analyze.

SAGÜÉS: Because the main thing is I understand that based on the present knowledge, it is highly unlikely that there would be a certain amount of failure on the material, but it is a brand new material in a historical sense, and on a time scale sense, and we have a huge extrapolation gap.

PAYER: Well, I understand, and, you know, I could give your talk and you could give mine along those lines. But, no, you all organized an outstanding international conference, looking at long-term passivity. It's something we addressed in a lot of detail, and the consensus of the corrosion science in that is if the environment doesn't chemically get into some condition to de-stabilize the film, that the passive films themselves, what we know about them on Alloy 22 and others, is we could not come up with any plausible mechanism known today, and those are the only ones we can deal with, I think, that would de-stabilize that film.

SAGÜÉS: Thank you.

BULLEN: Paul Craig?

CRAIG: Paul Craig. I have a few questions here.

You commented on the sound approach. Does that mean that the science done to date is sound, or that DOE's future proposed work is sound, or both?

PAYER: I think we didn't split it into that sort of thinking, Paul, but I think what that means is that when we look at the types of experiments, the types of techniques, the types of analysis that the project is using to address these corrosion related issues, that it's the way another group of corrosion scientists would do that as well.

So, they're consistent. They're not doing something that's way out of line from the standpoint of what would be typically done by any other group of corrosion scientists.

CRAIG: You identified a research program. Can you assess the risks if that research program is not undertaken?

PAYER: Not quantitatively. Certainly, I think we're in a mode where, to borrow, you know, the phrase from the Board, you really get into a policy making decision, not necessarily a technical issue. As a scientist and an engineer, I want as much data as I can possibly have, balanced with how much time I have and money.

So, it's a matter of raising confidence, lowering uncertainty if that work is done. We can't assess the likelihood or did not take on the process of assessing what the impact of not doing some of that work was.

CRAIG: Yeah, another way to look at that would be your comfort level that there will not be surprises.

PAYER: Again, the panel as a whole did not address that issue. I've got my thoughts on that, but I'm not sure that that's worthwhile.

BULLEN: Debra Knopman, please?

KNOPMAN: Knopman, Board.

Joe, you know in our January 24th letter, we made the statement about the data gap. We said data on aqueous corrosion for Alloy 22 above about 120 degrees C. under conditions relevant to Yucca Mountain are essentially non-existent, creating a serious data gap. What is the panel's view of that?

PAYER: We had a similar statement along the same sentiment, in that we I think stated very clearly that testing for localized corrosion and the other forms of corrosion above 100 centigrade is certainly prudent, needs to be done.

KNOPMAN: Well, let me just extend that. That needs to be done. But in its absence, from whence sprung confidence on the panel on the behavior of the metal in the thousand years, or so, of high temperature conditions likely to exist?

PAYER: These alloys have been tested in a wide range of environments. In order to make them corrode, in order to de-stabilize the passive film, you have to go to very aggressive

environments, boiling ferric chloride, high temperature autoclave type testing, and some other cases at high temperatures. And, so, they truly are highly corrosion resistant materials.

When we look at the kinds of environments that are likely to bound the Yucca Mountain situation, we think there's a very good probability that those other environments are on the extreme. But, I wouldn't license a waste package on that. I wouldn't go forward on a Joe Payer thinks, or any other group thinks. You want the data. So, we're not saying opt out, don't get the data. But, to a certain extent, and this again is now Joe Payer speaking, not the panel, I believe that those tests will show again that these are highly corrosion resistant materials.

And then the big question comes where are the boundaries on realistic environments, and where is this material behavior okay? Personally, I think it's going to be inside that. But, you know, you don't know that. So, you'd better do the testing.

BULLEN: Last question for Priscilla Nelson. I know why they made me Chair, so I wouldn't ask any questions. So, Priscilla?

NELSON: Is that how you do it? Nelson, Board.

You just talked about the characterization of the environment, and I'd like to understand exactly to what

extent this panel considered how well we do know the environment, and the water that when and in what quantity, or to what concentration might impact the performance of the drip shield, under the drip shield, on the waste package. How well is that constrained? Did the panel actually consider that, or was it receiving information from the project when asked?

PAYER: There's a couple issues. We looked at that water composition, water chemistry a lot. We had one of our chapters in the report is focused on the environment, the evolution of the environment. Two of our subject matter experts addressed issues related to that. There were sub-panel meetings with the project staff in that area. So, it's an area that we took very seriously and looked at very seriously, again, moving out to, again, what's Jared's statement here, anything I say is my opinion and not what's in the panel report. I'm not speaking for the panel. But I would rate that as a work in progress, where the progress has been significant and substantial, particularly in the last 12 to 18 months. Some of the work that Godowsky and some of the others are doing on their drip tests and drying tests, we think that this treatment of the water from a physical chemistry, if you would, standpoint of the chemical divide sort of concept makes sense. So, we think it's moving toward some boundaries. We think it's boundable.

But from the standpoint of having water, for example, in between the drip shield and during the condensation mode or cooling mode, how well constrained is that, and how important is knowledge of the water chemistry to the performance of the waste package?

PAYER: Well, in a condensation type mode, our feeling was or is that what will constrain the environment are the soluble species that are in any sort of dust particulate deposits that built up, as opposed to water coming through the mountain that could pick up and give off whatever it does along the way.

The only source, I mean, what you're putting in this condensation mode is pure water, and so anything soluble then, and any moderations that occur on the package, so I think it's boundable by our knowledge of what might be in those deposits, and sorts of things. So, if we look at ground tuff, for example, you could make some estimates.

BULLEN: Bullen, Board.

Actually, I look with trepidation at the afternoon schedule and realized that there's absolutely no break for me to absorb extra time in. So, I actually am going to ask one last question of Dr. Payer, so I lied, I'm sorry.

Your panel made a conclusion about Titanium, Grade 7. Could you, in three sentences or less, tell us what that was?

PAYER: The panel's conclusion was that if the conditions that led to stress corrosion cracking of Titanium, Grade 7 in the laboratory are deemed to be realistic and likely in the repository, that we would not recommend the use of Titanium, Grade 7 as a drip shield.

BULLEN: Thank you very much. Thank you, Joe.

Our next speaker, and I hate to rush into this, but I did realize our Chairman points out there's no break this afternoon, guys, so our next presentation is on near-field corrosion processes evaluation for the State of California, and it's Maury Morgenstein. Is that correct?

MORGENSTEIN: Yes, Steen.

BULLEN: Steen, okay.

MORGENSTEIN: And you said State of California--

BULLEN: Oh, State of Nevada. I'm sorry. It will end up there in Death Valley anyway. But, Maury, if you'll--

MORGENSTEIN: Yes, I'm going to try to get through--

BULLEN: Don't hurry. We want to hear everything you have to say. You don't have to keep us on schedule. I'll dictate my part of the schedule to Richard. It's his fault, not mine.

MORGENSTEIN: Okay, thanks.

The State of Nevada program on the EBS deals essentially with the range of service environments, which we're really concentrating on now, and of course the behavior

of metal within that range.

Don is going to turn slides for me, and I asked him up here just in case you guys have some really neat technical questions that I can pass over to him.

Very briefly, the range of service environments is essentially dry environments during ventilation, moist dust/scale/bacterial environments. You notice we plugged in bacterial because they likely will be there. They're likely there now. Aqueous-dryout combination environments, such as episodic drip, which we think is the most important, and to a lesser extent, episodic flow, and these may be very short period episodic flows that are responding to some sort of a surface event. Surface condensate from humidity, which we think is probably one of the most important aspects. Surface condensate associated with hydroscopic salts that might be on the metal itself, standing near-field water in various conditions. To put it down in common terms, baby puddles. It may be very important for localized corrosion effects, but in the overall sense and commonality, probably not. But it's something that needs to be taken into account.

The range of service environments from a geochemical point of view, as we see it, range from Vadose fracture zone water, and I'm saying Vadose fracture zone water and not saturated zone water, and you'll see why, Vadose Matrix pore water, and a variety of other waters. But

most important I think in the whole list is condensate and mixtures.

I do have a biotic transfer water in there. And, very briefly, this is an unknown. We're thinking that above the repository at about 45 degrees C., and so this is a function of repository heating, one might acquire a zone where biotic action is active in the fractures, just because we've elevated the temperatures.

In many of the horizons in Topopah Springs tuff and higher up, there's sufficient manganese oxyhydroxides and apatite, for example, that could support as phosphates, containing phosphates, that could support bacterial action. So, there's food. And if we perturbate the environment sufficiently, we might have biotic transfer zones that are above the repository. This is not something that we can go out and test.

We look at Yucca Mountain waters as waters that evolve, that have some sort of a--I hate to use the term--maturity to them, real mature waters that we think of when we think of water maturity are like brines, oil field brines. And at Yucca Mountain, the surface waters that would, you know, form from rain and snow on soils are very immature. They don't have much CDS in them.

As they go down the system to the saturated zone, they interact and react with the rocks. These are the

reactions that commonly take place, cation exchange with the zeolites and clays, hydration base exchange, which is similar to cation exchange, of volcanic glasses, the weathering of feldspars, pyroxenes, oxyhydroxides, oxides, and of course evaporation and precip of calcite. These are the common reactions that take place.

When we look at waters from the saturated zone, many of these waters, for example J-13, undergo a long transport pathway, which is certainly way north of Yucca Mountain where it starts, is added to as time goes on, and it's more mature than the waters passing past the repository itself.

When we look at a perturbated environment, we see a series of things that I'm not going to spend much time on that essentially Joe has gone over just before me, and they are very similar. We have a tremendous amount of agreement.

So, other than this area of incubator zones, which is a total unknown, we bring it out just as something that we think about, because it might have tremendous influence on the nitrate, sulfate chemistry.

The next cartoon with Wally down here at out, and the Roadrunner at in, gives you some sort of a summary of our idea of how the water chemistry matures through the system. And if this is the repository central, near-field, you can see that we're really concerned about condensate as a liquid

left behind during evaporation, and as a liquid going into the atmosphere of the repository. There's two different types of condensate that we are concerned about.

When water gets to the saturated zone like J-13, it's dominated as a sodium bicarbonate. But when water starts out in the Vadose zone, as we'll see very shortly, it starts out as a calcium bicarbonate. Experiments that are being done by the project are dealing with saturated zone water, simulated saturated zone water, none of which goes into the repository central.

To get at some sort of a chemistry balance in the system on what was happening, the easiest place we could go to start collecting real water, and this is with the assistance of the program, was to establish two lysimeter holes, two lysimeter locations so far, one in Midway Valley, one in Coyote Wash, which were in place this winter. They are in the process of collecting surface water, which is Vadose water, on its way down to meet the repository. The goal also is to collect surface water of opportunity when it rains, when it snows.

We analyzed water when we collected for trace elements, for major elements, for isotopes, as much as we could get, on as much water as we can get. These are the locations for water sampling so far. These locations are expanding as we've just started the program.

Up near Mount Charleston, two locations. McWilliams and Dolomite, Dolomite is not Dolomite the rock, it's the location of the campground. One at Coyote Wash, and Midway for the lysimeter.

To give you some indication of the chemistry of snow waters we've collected this winter in various locations, these are pure snow samples that have not interacted with the soil, and this is just a trace element composition on them. The trace element composition varies, depending upon what samples we are looking at. So, we can't come up with averages at present, but we can tell you that, for example, this is in snow now, so it's not, you know, there isn't much dissolve, there's very high manganese, aluminum, barium, kinds of things we see in desert varnish.

So, what we think we're seeing in some of these samples is actually desert varnish aerosol, dust being deposited along with snow that are giving us a signal. So, we're not precipitating pure water on the surface of the ground.

Here's a sample of snow we collected at Coyote Wash. But also we collected the sediment underneath the snow, and we allowed, we ran the snow itself, and then we allowed the water to contact the sediment as it melted, and we ran the melt as a simulated first signal of what one might see going into the fracture networks. And although this is

very similar to what we showed you before on the unreacted samples, what we see also is when we react it, we get a much larger signal. What I'm not showing you on these diagrams is--give me the next, and I'll come back to this in about a minute.

We see a lot of trace elements that look like they're contamination, human contamination, in the melted samples in particular, things that we shouldn't really see that are that high in concentration. And what we think we're going to be faced with is the fact that human contamination in soil samples and in rain and in snow is what is normally happening now, and we have to take it into account. It's not contamination. It's real. We have affected the environment, and we need to consider that when we look at the chemistry.

When we look at majors, the snow samples and reacted samples, actually these are snow samples, they're essentially calcium bicarbonates. So, these are not saturated zone samples. They're precursors to saturated zone. They have to mature. They have to react with the surrounding rocks on the pathway down through the system before they get to the saturated zone.

The saturated zone waters are highly mixed because they have a host of different source areas contributing to the flow log. These are not highly mixed. They are dependent on much simpler flow paths, much shorter flow

paths.

When we look at the all-important ratio of chloride to sulfate plus nitrate, we see that the snow samples are certainly under mature. They're immature samples. They have, as anticipated, very low chloride, and these are just snow, they have not been reacted with the soil. So, the next stage in this evolution would be that the chloride would go up a bit as they are reacted, and one would see in the soil zone, a little bit more chloride. And as one matured these samples more and more, the chloride content would go up and, so, the ratio would go up. And we see that for other simulated J-13 waters, et cetera.

Turning our attention to condensate, we ran an experiment where we took pore water, four liters, and boiled it. And what you're looking at is not the condensate in the beaker left behind during boiling, but is the vapor that has come off the condensate itself, and we measured the chloride, sulfate and pH. And what we're finding is that as time goes on, that vapor, if we chose droplet by droplet over time, would change in composition, so that this chloride, sulfate plus nitrate is not a fixed ratio, and experiments at fixed ratios probably don't represent the real world.

Second, we find that we can get pHs that are unrealistically low, frighteningly low, in the condensate. Now, of course, if you took all that condensate, put it back

in the beaker, collected it all back, you'd have about the same pH as you started with. But if those droplets don't come back in the same beaker in the repository, then you pH is going to be different.

This does not mean, and I underline this, this does not mean that that condensate would drip on C-22 canisters. It's probably unlikely that that would occur. If you're boiling from that location, if that's the heat source, it's probably going to drip and precipitate out on something like the drip shield, rock bolts above the repository ceiling, and of course tuff, react with those items and change the chemistry of the near-field waters.

So, we're not suggesting at all, and please be really clear on that, that this, if you wish, and I hate to use the term, acid reflux as a sickness--I'm sorry, I had to do that--we're not using this as a term which addresses the canister, but does address the near-field environment.

If we look at the geochemists' workbench modeling program, and we choose an isothermal and polythermal condition, we see that the chloride, sulfate, nitrate ratios are not static. They change. Again, so that using static ratios for experimentation is probably quite misleading.

Finally, as we're going through this hopefully within my time, I want to show you a typical experiment on C-22. The reason for this experiment is we're looking only at

pH. We're not saying to you right now that this is a service environment, although it's likely that it might be one that was very specialized in a crevice under unique conditions. We're not suggesting that this has anything to do with, at this point in time, actual conditions.

We are suggesting, however, that under these kinds of conditions, pH certain affects the behavior of C-22. And it does so in a fairly remarkable way. So, if we're going to design service experiments that need to address a variety of aqueous conditions, pH is one of those conditions that we should be looking at, and we should be looking at in ranges that are both within the service environment and just outside of what we think the normal service environment would be.

Our conclusions are the saturated zone waters, although they're an interesting composition, and certainly not wrong to play with in the laboratory, are likely not going to be the waters of exposure, natural exposure, to the Yucca Mountain near-field system. We're not going to likely see a sodium bicarbonate flying down the fractures into the system to start off these reactions.

And we should probably start looking at things that are more realistic, that might happen at Yucca Mountain itself rather than what might happen in a textbook example of how one makes precipitates by precipitating calcium carbonate and gypsum and magnesium carbonate. It's more complicated,

and it doesn't lend itself to those easy generalities that we've been I think very conveniently falling back on.

We only looked at five samples of snow. So, I hesitate to make any major conclusions, other than the fact that they are all, no matter where we looked at them, calcium bicarbonates. They appear to have particulates that are aerosol, that are going to find their way down the system, such as what we interpret at this point very loosely as desert varnish type materials, and they appear to be also affected to a fairly decent extent by human involvement. And I don't want to use the term contamination, because that indicates there's something wrong with the sample, and there isn't anything wrong with the samples. They have just been affected by us. We're part of the environment.

And then when we look at the chloride, sulfate, nitrate ratios, we see that the experimentation uses ratios that are pretty low and static, and we're suggesting that that may not be realistic, that one might want to look at ratios that are more broad in composition, as is the natural environment.

We see evidence for that when we just look at the workbench, and when we boil water on hot surfaces, and when we look at condensates that have extreme ratios, as well as extreme pH.

And then, of course, things like the corrosion of

C-22, a pH has to be considered, and the full ranges of pH should be considered in experimentation, as they will be experienced in the environment.

Thank you.

BULLEN: Thank you, Dr. Morgenstein. Questions from the Board? Actually, I have one.

If you would put Figure 15 back up? And I know I'm eating into Richard's time. I apologize for that. But I just had a quick question on the corrosion data you showed there. You noted that it was a relatively high fluoride concentration. The temperature at 160 C., was this in an autoclave, or was this in a condensing surface?

MORGENSTEIN: It's an autoclave.

BULLEN: Autoclave. So that the pressure was on the order of about a thousand psi? I don't know what pd equals rt equals, translates that to.

MORGENSTEIN: About 1500.

BULLEN: 1500 psi. Okay, thank you.

The other question that I had dealt essentially with the fact that you said it was a carbonate water that was coming in. But where does the carbonate go? I mean, it was prompted by the fact that you had acid reflux, and you said we needed a Yucca Mountain Tums, and I'm thinking, well, there's carbonate there. So, where is the carbonate in--

MORGENSTEIN: The carbonate comes out as calcite.

BULLEN: So, it precipitates out first?

MORGENSTEIN: It comes out fairly early, and you'll see that the fractures and fault zones at Yucca usually have carbonate, you know, calcite coatings on them, especially high up in the system. When you change the CO2 pressure, you know, you'll drop out calcite. You also drop out gypsum up there in the soil zone. So, the bicarbonate starts to mature, is one of the first things that goes on toward water maturity. The other one that's very, very prevalent is actually CEC reactions.

BULLEN: Don Runnells?

RUNNELLS: Runnells, Board.

On your Slide 13, this is the chemistry of the condensate, you emphasized three or four or five times that this water would probably not be a water to consider in contact with the waste packages. Is that right?

MORGENSTEIN: Yeah, I want to try to be conservative at this point.

RUNNELLS: But why would you emphasize that?

MORGENSTEIN: Well, the reason I was saying that is because and I'm emphasizing that because I think what might happen here first, and this is, you know, a thought process, because we don't know, what might happen first is that this-- your waste package is the heat sink, and so that you could get this precipitating out on the waste package if you had,

for example, a lot of debris on top.

RUNNELLS: But why wouldn't it drip down onto the waste package and leave a salt behind, for example?

MORGENSTEIN: It could drip down on the waste package, but when it precipitates first, it's going to precipitate like on the underside of the drip shield, and react with the drip shield. And, so, I can't tell you what the chemistry of that is, because I didn't react it with the drip shield.

RUNNELLS: Right.

MORGENSTEIN: And, also, I didn't react it with the country rock, which is a tuff, which is going to buffer it.

RUNNELLS: Have you modeled this as well as experimentally determined this chemistry?

SHETTEL: Don Shettel, GMI, for the State. No, we have not modeled this data yet. We just got it late last week.

RUNNELLS: Okay. You know, it's a really surprising result, I would say, to be talking about pHs of 1.5. And we're dealing essentially with distilled water, so that the presence in the laboratory of a bottle of acid is a concern, let alone opening the bottle. It would be very important I think to go ahead and model this and see if you can come up with an explanation for those kinds of extreme pHs.

SHETTEL: Well, we have chemical--Catholic University has chemistry on these condensates, and they actually, towards the end there, they do not resemble distilled water.

They have high concentrations of chloride, nitrate, and from my looking at the data, it looks like the drop in pH there is due primarily to nitrate, and to some extent, to fluoride.

RUNNELLS: I'm not doubting what's in the water. I'm trying to understand why that stuff is in the water, the mechanism.

SHETTEL: Well, it can be volatile under these temperature conditions.

RUNNELLS: I just had experience with this kind of water, very, very pure water, and then found out it's a laboratory artifact. If the modeling scenario would, you know, verify what you just said, the volatile halogens, for example, then that would be great to verify the lab data for these low concentrations. I'm sure they're low concentrations.

So, one last comment or question, your observations are sort of like a bunch of red flags. I mean, they're important red flags, I'm not demeaning them, they're a series of observations that may be very important. But it seems to me to be helpful to the project, or to be helpful in any realistic way, you almost have to give specifics as to what would be done next, so what, in other words. You said a broader range of chloride to sulfate ratios. How broad? And why? I think that would be extremely valuable.

MORGENSTEIN: We would love to be there now, and we're

not there yet.

RUNNELLS: But you're headed there; is that right?

MORGENSTEIN: We're headed there, and as soon as we're there, we'll let you know.

RUNNELLS: Okay, very good. Thank you.

BULLEN: I would like to express my thanks to both speakers for this session, and apologize for the next session Chair for taking ten minutes out of his time, and I'll turn it over to Jerry Cohon.

COHON: I took Dan's observation before about no break as a hint. We will have a break after the next presentation, while a brief one, but we'll get to that when we get to it.

Our next session focuses on the safety case, and Richard Parizek will serve as Chair. Richard?

PARIZEK: We have four speakers on the safety case. There will be an international perspective first given by Claudio Pescatore. That will be followed by Tim McCartin of the Nuclear Regulatory Commission on that view. and then Joe Ziegler will give us the DOE version, and then Steve Frishman will look at the State of Nevada issues.

So, if we could begin perhaps with our first speaker? We have a tight schedule, but after the first speaker, we'll take ten minutes. So, is Mr. Pescatore available?

I'll have to cut back on the introductions, due to

the time constraints. I apologize to the speaker for mispronouncing a common name.

PESCATORE: Thank you, Mr. Chairman.

I will start my presentation. I'm Claudio Pescatore. I work with the OECD/NEA. I will just spend a few moments about what is the OECD/NEA, and perhaps also will show why perhaps I was invited to give this talk.

My presentation, again, will talk about the OECD/NEA, the NEA sources I will quote. In fact, in the past 10, 15 years, I would say that our organization is the one that's developed the concept of safety case, at least at the international level, has defined it.

I will give some reading, my own reading of the trends, and especially, I will talk about confidence. I will use NEA sources before I give indication of NEA sources. You will be able to get the documents from our website or by writing to me. And then I'll provide some conclusions.

So, the OECD, NEA is a club, if you like, of 27 developed countries, or developed economies. In fact, the OECD is an economic organization of cooperation. It is unlike, let's say, the International Atomic Energy Agency, which is based in Austria, which is in fact an agency of the United Nations. It's a political organization.

The blue countries here are part of the organization. You will see that it basically is the western

world. The countries who do not have nuclear programs, they're not really part of the NEA.

Within the NEA, we have several platforms for cooperation, for information, and the idea is to try to help all governments or all organizations who are part of the organization to go up to speed, and to have the safe, similar understanding of what the key issues are, and perhaps also to harmonize, if possible, what they do amongst themselves.

We, over the past ten years, have been working in the area of the safety case especially. We have gone through three phases of a program called IPAG, Integrated Performance Assessment Group. I will talk a little bit about that.

This culminated also, there were a lot of things ongoing, with a confidence document, which in fact is a safety case document, where the safety case is explained in more detail, and others, so there was the creation of a new group, the Integration Group for the Safety Case, which is an ongoing group.

At the same time, part of what I will be telling you has also matured through International Peer Reviews that we have given of PA studies. In the past ten years, we did Holland. We did three International Peer Reviews in Sweden, one of the regulator, Japan and the USA. In fact, it was the NEA who led the peer review of Yucca Mountain, and early on, we also led the peer review of the WIPP certification

application.

It is interesting, the language here, because safety case does not appear all of a sudden. Of course, it was in the NEA work, but was not, as I understand, part of the language here in this country, and also I would like to note that the WIPP PA was in fact a compliance certification application. So, the real safety compliance is something which probably is worth discussing, not necessarily in my presentation, but I would like to reiterate the importance of this.

Just for, again, a little bit of data, I believe we have assembled an analysis, a database of safety cases in the past ten years, and there are three that I found. The first part was developing and documenting. What is in this document? This document is a database of information. And these questions are documented, and then of course there are lessons learned through discussion.

And the second part, we looked at the regulatory experience of reviews of the PAs, and 17 of the organizations responded, and we could see how the regulator and the implementor felt about the review.

And then approaches and arguments for establishing confidence. Now, from the beginning, you will notice that we talk about Integrated Performance Assessment because PA used to be perhaps dominated from one discipline. We really, from

the beginning, wanted it to be an integrated type of thing. And then later on, you will see we're talking about confidence.

My reading of the world trends is as follows. There's been a shift from what can be called PA to what can be called the safety case, whereby PA is only part of the safety case. It's not its driver. The safety case should also have things like clearly stated strategy, within it, safety assessment. So, safety is really the goal, and the statement of confidence or the documentation of confidence.

The idea is that one of the problems that PA implies, validation, and of course there's been a debate in the late Seventies and the Eighties, well we cannot really validate these things, especially long-term predictions, and in the end, we are not about performance of something, we are about to determine whether this is good enough to make a decision. So, we want confidence in our decision.

Also, PA in a way can be a science product independent of decision making, whereas, the safety case is something which should be done by decision making, and we should have to accept, in a way, the decision informed by science, but is not a science product. In other words, I cannot write a paper and ask all the people to validate what I did. The best thing I can do, in fact, is to try to help people by doing my work in a transparent manner so they can

redo my calculations, or they can recheck my assumptions, which is in fact what the one program especially does in Europe, is the finished program, very thin studies, but people are able to look at it and to redo all the analysis, which helps in fact for confidence.

I believe also that the safety case is what society wants and what we can do, in fact. And, for instance, in this country, in a way, when Secretary Abraham announced his intentions to propose Yucca Mountain, propose to Nevada, he did not say, you know, just we did some calculations. I mean, he made many statements about the fact that the research program was going on. For instance, he gave a lot of reasons why he felt that things could go ahead.

So, we have introduced now another word in the game, and this word is confidence, and we don't want it to be just another word, in fact. It should be important. And confidence is to be somehow looked with an eye with respect to uncertainty, and with uncertainty, of course, will exist in any endeavor. Decision making has to take into account uncertainty.

However, the real issue is how confident we are about this decision, about what we know at this stage. And decision making is not necessary based on a value for uncertainty. Even the reactors in this country and everywhere in the world are not based on a number for the

uncertainty. They are based on the fact whether they're safe or not.

However, of course we have to recognize that confidence does require that uncertainties are being dealt with. But these are not only technical uncertainties. They are also uncertainties for perhaps the fact that the applicants have not had a good record of being open, for instance. These are uncertainties which can also be taken into account in the making of the decision. So, confidence is a broader concept.

So, when it comes to scientific uncertainty, this is what I said earlier, there are means to deal with it, which are the typical ones applied in the data analysis and model testing.

When it comes to long-term predictions, we get out from the narrow or strict validation type scientific domain, and we have to get a mixture of quantitative and qualitative analyses, and the arguments also can still be science based, but are not the same strengths of reproducible quantitative.

So, the reason for this confidence in support of the decision has to be provided, both by the reviewer, of course, and also by the applicant.

So, I guess we engender confidence, is the way we get to a point, by showing, for instance, various strategies to eliminate uncertainty, that all viewpoints have been taken

into account, that methods have been applied to have quality assurance, that all the data and uncertainties have been disclosed.

In fact, confidence we can say is a broader concept than validation. It exposes the fact that the reasonable expectation is really what we're after, and the context is for decision making.

Now, we cannot ask people to have confidence in us. This would be trust, in a way. Basically, we should make sure that there's a rationale for this confidence, and this is very important, I believe. So, confidence must rely on a deliberate set of actions or procedures to achieve this confidence.

Therefore, the safety case, or those who are providing for the safety case, should create a framework by which confidence is not only a criterion, but is a way to check on it. So there must be ways to basically have criteria to evaluate, communicate and to enhance this confidence.

And, therefore, in a way, confidence management is really the basis, one of the important bases, for the safety case.

Management should be of confidence, in a way, and this is what we say indirectly in our document, in the confidence document, and this is the definition of the safety

case we give. It is a collection of arguments at a given stage of repository development, in support of the long-term safety of the repository. A safety case comprises the findings of a safety assessment, and a statement of confidence in these findings. It should acknowledge the existence of any unresolved issues and provide guidance for work to resolve these issues in future development stages.

I would say it's more than a statement of confidence; documentation of confidence is more correct.

Now, about this rationale, how this can be shown, and how it should be apparent in the safety case. This morning, there was somebody who said well, you know, perhaps it was a joke in a way, but in fact it's not that much of a joke, it was said, well, if the container did not have--there would be less uncertainty. But uncertainty with respect to what? I mean, there cannot be uncertainty with respect to safety. We know that if there is--there is a container that's safer. So, we have taken really perhaps this uncertainty in the way we do the calculation. But it's something that does not have to do with safety.

Let's give another example. If we build something which eventually we can do the calculation and say this is safe, and then we do the calculation again, somebody else does the calculation, and it's not safe. However, this does not change this thing being safe or not safe. It is really

the intrinsic, there is intrinsic safety about things, the way we go about doing things.

So, in a safety case, there is a certain part which it is the higher level, which is a combination of three things, basically, the safety strategy, which is the strategy to help us to define what we mean by safety, and that achieve safety, this thing which is there intrinsically safe, and those are hard to demonstrate safety, so how do we go about to construct, if you like, assessment cases to demonstrate that this is true. And, of course, in trying to achieve this safety, we use principles, we use criteria, so that we get the system concept which is robust.

On the other hand, we also try to, depending on the level of understanding we have at that moment in time, we construct an assessment capability. That is, we look at which are the assessment cases, which are the data, so that allows eventually to analyze also this concept.

And this of course is a loop inside this management perspective. Eventually confidence, we would like to say, well, we have a robust system concept. And robust, in fact, can be more than the technical sense. The example is this one you have that--and let's say the EPA, it's found that the EPA criteria are not acceptable by law. Well, it doesn't mean that it all should be thrown away.

Well, perhaps in that type of reasoning, where

going for safety is taken into account, perhaps there's no need for this. This is the case in Sweden. In Sweden, they developed a container which will last--apparently nobody is able to fill them all over a million years, and now they have extremely strict criteria from the regulators. Well, they can still meet it, because they went through this idea of safety, of robustness. So, eventually, you want to say that the system is robust. There are some ways to say this is robust. It's analyzable for those things, the type of materials we've chosen have been accepted, been chosen and accepted, and also the system, the quality of our data, our models are good, and we pride them in a reliable manner. So, these are the most important aspects of confidence.

And there are two things, robustness versus the analysis. I mean, they're complimentary. We cannot say that we can compensate fully for one or the other, not a robust impression, and then have more data, more models, or vice versa. So, there is a balance here that has to be reached about robustness and assessment capability.

Some examples when you want to argue safety basically, you have to declare the role of the barriers and the system functions. We have to identify and explain the assessment cases. We have to verify the quality of tools, the data, the analyses. We have to explain that PA is for testing the performance of the system. And it would be good

also if we analyze the system beyond its design basis, and beyond also the regulatory compliance points. And also use other indicators of safety and performance. This is for arguing safety.

And one example for achieving safety is try to apply principle by which we avoid or forcing to low probability of consequences most phenomena and uncertainties that can be detrimental to safety and its evaluation.

So, we look at the safety case as a larger thing in a way than performance assessment, but, of course, you know, the definition varies from place to place. Most likely, performance assessment in the United States is not exactly this one. But, we look for the safety assessment, which is part of something larger, which is a safety case, and within the safety assessment is the performance assessment. So, in the safety assessment, there should be the establishment of the assessment basis, the safety strategies, as I mentioned earlier, the definition of the system concept, and the idea why this system concept is to be built in a robust manner. Perhaps there should be references to how we got there.

Then we carry out the performance assessment, which evaluated the performance for the assessment cases, which have been explained before why they are important. We can, of course, or we should, of course, assess compliance with the acceptable guidelines, with the guidelines we have. We

also have sensitivity analysis, but still in the end, we should say, you know, how good all this is, and criteria that we have established to evaluate our safety in this. If this is good enough, perhaps we can go to the next step, which is in fact compile the safety case, which documents all of the steps, and also documents why one has confidence at this point for the decision at hand.

The confidence statement is basically the fact that a rational assessment procedure has been followed, following definite principles and criteria, that all relevant data and information and their uncertainty have been given consideration, that all models have been tested, the results have been fully disclosed, and subjected to QA and review procedures, that the safety strategy in fact remaining is appropriate to handle remaining, not fully resolved safety-related issues.

In fact, the discipline itself, by doing these things, also would enhance confidence in the quality of the safety case.

If I have to assume the feedback from the IPAG exercises, I would say that these are the key messages. There's been an evolution from calculation to integration. Communication also to and with stakeholders are important issues for building confidence in a safety case. Traceability and transparency are extremely important, in

fact, very large improvements have been made over the years in these two areas.

The safety case is more than a report of technical results. There is a need to describe clearly what it is, in fact. Terminology is very important in this. It is important to clarify terms and the way they are used in the safety case. We have a bunch of--IPAG exercises have a set of questions, so this could be used as a check list in fact for producing future safety cases. And, of course, the identification of weakness points should be part of the safety case.

We have a group which is called Integration Group for the Safety Case, as I mentioned, and these are some of the feedback we have received from them. Multiple lines of reasoning should include additional safety measures and indicators. It is not possible to rigorously demonstrate compliance. The only possible objective is to achieve adequate confidence. The way in which different bodies of scientific opinion are dealt with in the safety case is an important and outstanding issue. This is true sometimes. This is the experience of eight peer reviews now. It does not bode well, I mean, it does not give a good feeling when one sees that there is a tension between the scientists and those who have written this document.

And then, of course, it is important to accept or

to present the fact that there is disagreement on some of these issues, and why one path was taken and not the other.

These are some of the other messages. The safety case involves mediation with society. We should take a common sense definition of the safety case. It looks pretty complex, the one we provided. It's a presentation and linking of information and arguments on the safety needed to support the decision making process.

It is also dependent, the safety case, of course on programs, and in the regulatory context, and the implications of retrievability, perhaps that should be part of the safety case. And, of course, different countries are at different stages and, therefore, opinions can be expected to vary on where the key issues remain.

In conclusion, I would say that the safety case is more than just the safety assessment or performance assessment, at least the way we have developed this concept. It must be seen as a basis for informing decisions, and facilitating dialogue in the context of incremental development of a repository, therefore, is for decision making.

The management of confidence should be placed high in the management scheme. It must be forward looking, and many decision points in the future. Regulations may change, so perhaps it's good to take that into account. Regulatory

environment may change. Science basis may change, hence, the need to build a robust strategy based on safety first.

The safety case is about managing and integrating technical and non-technical information. It is not, per se, a science product. It is mostly a management challenge, requiring vision towards avoiding later problems.

At the technical level, the most important issue is how to manage dialogue with technical experts both in-house and outside. And some of the key words are management, safety culture, strategy, confidence.

I started with some questions. Perhaps I could repeat them for you. What is safety is something that is to be I think discussed when discussing the safety case. And, also, who provides for a safety case? To me, it's not so clear in the end. It depends really on the regulatory context. The case of WIPP is one. It was a certification application. It was a compliance certification. Then perhaps the regulator in that case did the safety case for the applicant, or after the applicant provided the application.

Thank you.

PARIZEK: Thank you very much for a clear presentation on a topic that's evolved. That's one of the clearer presentations on the topic I'm familiar with. I read your paper, which is helpful to me. Some Board questions? Norm?

CHRISTENSEN: Christensen, Board.

Thank you as well. It was a very helpful presentation. I think one of the issues that we're faced with, and has come up today a number of times, is the fact that at any given time, the knowledge base is going to change, that at any given time, there's going to be uncertainty. And it's clear that whatever process moves forward is going to involve the need for some flexibility, the proposal for a staged or flexible process.

And it seems to me that the concept of a safety case ought not to be seen as an individual product, but rather an ongoing process. And I wonder if you'd comment on the challenge of doing this in a situation where we never produce, or is it possible that we never really produce a final safety case. Can the safety case, in fact, be the basis for developing a meaningful and transparent process for developing, let's say, a staged repository, or a more flexible kind of process?

PESCATORE: There are many components of your question. Let's see, I followed at least one-third, and perhaps we can follow other later, if you like. There are people who say, in fact, that because you are building this step-wise decision-making process supposedly exists, then only the final one should be the safety case. Basically, what you're doing is you're updating your studies as well. This I think

is semantics.

But, in fact, you could build towards that. I have in mind, for instance, in Sweden, they have constructed with this idea what is a template, a template of documents, that they're going to update every three years. So, how the safety case will look, the chapters, how the science base is being documents, and basically every three years, or even-- well, every three years for sure, because this is mandated by law, they are updating this document. So, they have this common basis to accompany them over the many years that the problem is going on, is ongoing. And they plan to have these reviews of the safety case, even not at regulatory decision points. So, it is in between. So, in guess, in a sense, it's a way to progressively build something which is more and more solid. Hopefully, this answers your question.

CHRISTENSEN: I think that's the kind of question that I was after. Thank you.

PARIZEK: Dan Bullen?

BULLEN: Bullen, Board.

Maybe you could share with us a little bit more of the international perspective. One of the more successful programs has been Finland in the development of their repository site. Could you tell us were they part of the Integrated Performance Assessment Groups, and did they participate? And how do you think they have developed their

safety case along with the entire siting process?

PESCATORE: Okay, they participated in this group, and the Chairman of this group, in fact, the first IPAG-1 was in fact a Fin, was in charge of the PA for this. And that was in fact one of the most interesting phases, because for the first time, we're looking at this, and some messages were very clear. For instance, the message of transparency and traceability.

And, as I mentioned, the Fins have a specificity that others do not have. That is they have made a choice that these PAs, and they are more in the sense of PAs, and they think they will build a safety case. They say, well, they do not have a safety case, but we have--this is what we call a safety analysis, but we're going to build a safety case, which will come later.

They've built in reproducability. For them, it is important that somebody reads it and is able to reproduce what is written in there, and then also to check. That has forced them to, of course, to utilize a simpler model, at least in the final documents--above the experience, which is very, very wide. But that is how they achieved this. And I believe they've been successful in terms of--I'm not sure how to reply to your question on site characterization.

It's a very small team, the Finnish team. And there's an enormous degree of interaction between the

modelers and the people who take the data. I mean, we are talking at management level, 20 people, and the rest of the country is like 70 people who working on this. So it is very little, and highly integrated, and they can do even things which are, because of this high cohesion, lately, for instance, the guy who was in charge of site characterization has decided, well, enough. I've done this for 20 years, and now I want to be in charge of engineering. Now he's in charge of engineering. And the guy who was in charge of PA, is now in charge of I guess site characterization. So, it's a very special program.

BULLEN: Thank you.

PARIZEK: Parizek, Board.

One question. You had Sweden mentioned twice in your listing of places you visited with this in mind. Have you seen progress, a second iteration? Because obviously, if a PA is updated, that's part of the safety case. You'd expect these to evolve. And, so, the concept is somewhat new, but have you seen progress when you've gone back a second time?

PESCATORE: Okay. In Sweden, yes and no. To answer your question, because in Sweden, what we did, of the three analyses, two were of the regulator. So, did we see an improvement of the regulatory analysis? Yes. In the case of the implementor, there was only one, it was, like, two years

ago. But, then, we watched what they had done afterwards, and I do believe that they are moving in this direction, in the sense, again, of having a stable basis of documenting things. For instance, the questions they received, how they have been able to respond to them, which are the open question, and so on, so they have these documents which are there for update, and they are improving on this. So, this I have seen.

PARIZEK: In think in view of the time, we should take a break. We have ten minutes maximum, and we will start exactly on time, meaning in nine minutes. We'll be back for the next three speakers. Thank you very much.

(Whereupon, a brief recess was taken.)

PARIZEK: Our next presenter on the safety case will be Tim McCartin from the Nuclear Regulatory Commission, and will give the Regulatory Commission's view on the safety case.

Tim?

MC CARTIN: Thank you. Good afternoon. I'll be presenting the Part 63 requirements for the safety case in relationship to the postclosure performance. We won't be going into a lot of the other details preclosure, et cetera.

And in that discussion, I'll go into two really main aspects of 63. One is the roles and responsibilities of the DOE and the NRC, and then go into the regulatory framework in a lot more detail.

In terms of the role and responsibilities, DOE and NRC have decidedly different roles in this process. If the project goes forward, the Department of Energy has the responsibility to design, construct and operate the repository. NRC has the role to make sure that DOE obeys the rules.

As was brought up this morning by Judy Treichel, NRC is an independent agency. We take that role very seriously. We do not participate in design. We did not have anything to do with site selection. We are an independent regulator. And I think it's useful. I think NRC has had a number of public meetings in Nevada. We've participated at times at Board meetings in Nevada. I think the citizens of Nevada, the citizen groups, remind us of that independent role of the NRC, and I think that is important.

In terms of the review of a potential license application, that scope of our review is determined by what the Department of Energy submits. DOE has the flexibility in that license application to present the analyses they think portray the safety case, also the presentation of those results.

The Board I think has interacted with the Department many, many times in terms of what types of analyses, what needs to be presented, et cetera. That's up to the Department of Energy to decide. It's their safety

case. It's not for NRC to dictate what should--how to present the results, what you'll see in the regulatory framework, what are the types of information that the Nuclear Regulatory Commission needs to make the decision, but DOE does have that flexibility on how to present it.

In going through the Part 63 requirements, there's really five aspects that I'd like to talk to with respect to the safety case. First, of course, is the performance objectives. Next, the demonstration of safety, which I think in a previous Board meeting, the last one, as a matter of fact, I would call that the performance assessment. I think we've tried to at times characterize the performance assessment as encompassing everything.

I think in terms of communication, I think the Board has suggested performance assessment is one part, as you saw with Claudio Pescatore's presentation. Performance assessment was one part. I think it makes sense. I think in looking at the safety case, there's these five aspects, performance objectives, demonstration of safety, or the performance assessment, confidence in safety, what I'll call as forward looking, and documentation. And I'll go into each of those five points in more detail.

Performance objectives, there's really four performance objectives. Three of them are quantitative. Individual protection is the 15 millirem annual dose limit

from all pathways. There's also the ground-water protection requirements that have concentration limits for certain nuclides, a dose limit for others. And the human intrusion calculation is specified. Those are the three quantitative ones.

The fourth one is multiple barriers. The requirement for multiple barriers is in the rule. It's required to have both a natural barrier, as well as engineered barriers. And you'll see in the subsequent parts that I present that that's a very significant part of the evaluation in the safety case.

With those performance objectives, then going to demonstration of safety, the regulation has a requirement to do a performance assessment. For convenience, if you see a few of these funny numbers, it's Part 63, and that Section 114, and I just put that if people want to go back and look at exactly what's in the regulation. In some cases, I've obviously paraphrased for plain English purposes what's in the regulation. But one can go back and check to see exactly what's in the regulation.

In terms of the performance assessment, first, I'll say there's an integration process. What's required is evaluation of FEPs, features, events, and processes. These are the kinds of things that can both adversely effect the performance of the repository, as well as things that can

enhance the performance of the repository. But a first step, the Department of Energy is required to evaluate all these FEPs, and explain what's in the performance assessment, what's not in the performance assessment, and why.

Certainly there has to be then a technical basis for assumptions and models used to represent the FEPs that are included in the performance assessment.

Certainly any part of performance assessment requires some understanding of uncertainty. And, obviously, there's an interesting aspect, I will say uncertainty, the computers here do the slides differently than they do at NRC. That should be indented, and they work on the NRC computers, not here. Interesting.

Understanding uncertainty, there's a couple aspects. One is parameter values. Certainly it's pretty routine to see a parameter sensitivity uncertainty analysis. RECNW has used the word evidence based. I think the Board has used similar kinds of words in terms of what is used for parameter values and ranges should be based on evidence. The Department, in a number of different reviews, has been cautioned against being overly conservative, using evidence supporting whatever parameter values and ranges.

Along the same lines, consideration of alternative conceptual models. Clearly, we've heard some discussion this morning and early this afternoon. There is uncertainty in

exactly the near-field environment for the repository, be it the water chemistry, temperature, corrosion rates, et cetera. There could be alternative models that need to be evaluated.

I think the NRC tries to be cautious whenever the word "realism" is used. And that's not to say we have to have a realistic model. You can have simple approaches that still incorporate realism.

For example, I think the chemistry of the water is a good example, that to realistically model the evolution of the repository chemistry, temperature phases over time, it would be a daunting task. But as we've heard today, there are certain water chemistries, there are certain minerals in the rock that need to be evaluated, and you would probably get a set of different water chemistries that need to be evaluated to look at the corrosion rates. And you might have some simple approaches for looking at a set of water chemistries, rather than evaluating accurately and realistically what the behavior of the repository chemistry would be over time.

After having demonstrated safety in terms of meeting the performance objectives, how do you get confidence in the safety? I think Claudio had a number of useful slides in terms of its confidence in the safety, not necessarily validation.

I think that a key part of the regulation is an

overall understanding of the repository system. I think we point to the capabilities of each of the barriers as a very important part of getting that confidence.

Specifically, here's something I did put in quotes, but we're looking at you can look at the degree of diversity of the barriers as giving you some idea of the resilience of the repository to a variety of things that could go wrong, could happen. And that kind of, as Claudio indicated, isn't necessarily quantitative. It can be somewhat qualitative. But we're looking at, in the safety case, certainly the capabilities of each of the barrier.

Those barriers are evaluated, and most importantly, both the natural features of the geologic setting, as well as the engineering. It doesn't matter whether there's a 10,000, 50,000 year, 100,000 year waste container. The natural features of the geologic setting must be evaluated, and we are expecting capabilities from the geologic setting.

Also, as the Board at least a few years ago, maybe earlier, talked about independent lines of evidence, we do not use the words "independent lines of evidence" in the regulation, but we do point to how the models, how you get some confidence in the safety, and we point to comparisons with process level models, laboratory testing, field testing, natural analogues, and there are all kinds of things that would give you, I think consistent with the Board's

recommendation for independent lines of evidence, support.

Once again, as Claudio indicated, some of this will be qualitative. Certainly some of the natural analog information may not be necessarily that quantitative, but it will give some qualitative indication of safety.

In terms of forward looking, in that context, the regulation does specifically call for a performance confirmation program. There is a plan, performance confirmation plan, that we believe needs to identify the extent and nature of confirmatory information.

I think Dr. Cohon earlier today talked about challenging the safety case. I believe that's what was intended by that part of the regulation. Challenging the safety case. What are those assumptions, the parameters, et cetera, that need to be confirmed more fully. What can go wrong? And it's to challenge, truly challenge the safety case. By performance confirmation, no one should get an idea that we're just remeasuring measurements the Department made. But you're testing and, as indicated, challenging the understanding.

Clearly, there's a number of activities, in-situ experiments, monitoring, laboratory and field testing, et cetera. In the regulation, there's words suggesting barriers are functioning as intended and anticipated. And certainly in this regard, when you're looking at a performance

confirmation plan, you certainly have the results of the performance assessment, the capabilities of the barriers. We would expect the barriers that have the largest capability, most important to performance, would be tested and challenged to the greatest extent.

That's the planning for performance confirmation. What do you do with these results? Well, the performance confirmation program is intended to confirm the basis for the prior decisions. If you look in the regulation, there's really three primary decision points, construction authorization, amendment to receive and possess, and closure.

The performance assessment would be updated. All this information collected during performance confirmation brought in, analyzed to determine has my basis for safety changed? And that update is required at each of those steps.

Documentation. Probably the hardest part is to document a safety case as complex as the Yucca Mountain repository. I'll say the regulation provides a comprehensive list of the kinds of information DOE has to provide us. That list isn't necessarily very useful, because everyone could have a different interpretation of, well, what's really intended there? I can provide, as the Board I think has had many questions of DOE can present analyses, but, well, can't you present it a different way? You've left this off, et cetera.

The Yucca Mountain Review Plan does attempt to supplement how much level of detailed information we're expecting in the safety case. And there's things certainly in terms of the identification and description of the barriers, there's some sections up front in the review plan.

Most notably, if anyone looks at our review plan, it's rather extensive. But for the postclosure performance, the very first thing we look at is the identification and description of barriers. For DOE, that's really the last thing they can do. It's really the performance assessment or analyses will have a better sense of the capability of those barriers.

We, on the other hand, going into it, we want DOE to describe up front what is this information. We want to look at that first, so that when we go through our review, and sometime hear the term risk informed, well, we want to know where they're getting the biggest bang for their buck, as they say. And that's to inform our review up front. It doesn't necessarily mean we agree with it. But as we go through the entire review of their model abstractions, their results, their evidence, et cetera, we have in mind what really was causing the major impact to performance.

There's also integrated sub-issues. We've identified 14 integrated sub-issues that talk to particular technical areas, large areas, for the performance of the

repository.

And I guess if there's one thing that I feel the regulation has been misrepresented is in terms of the dose curve. Some people have implied that we would, look, it's either, oh, if it's below 15 millirem, DOE gets a license or not. It goes far deeper than that, and you'll see in the review plan a lot with respect to the calculation of the annual dose.

We want to see the distribution of all the single realizations of the runs, we want to see things as the Board has pointed out. You want to see results with probabilities, without probabilities. There is a final dose curve. There is no question about that. But how you got that final dose curve, be it the consequences, the probabilities, et cetera, that needs to be very carefully explained and laid out.

And I think in the review plan, we've tried to give DOE a sense of that. We'll certainly be--our meetings with DOE are technical exchanges, are ways that we continue to work with the Department to make sure we get the type of information that we need to review the license application.

And, in summary, the safety case, it includes a demonstration of safety, the performance assessment. It includes information that provides confidence in the expected performance of the site, and engineering. There's a performance confirmation program that looks to the future as

information is continued to be collected, to confirm the basis for safety. And, finally, clear documentation, and we think all those are very important in terms of making a safety case.

And, with that, I'm more than happy to answer any questions, if I can.

PARIZEK: Thank you, Tim. Right on schedule.

Debra Knopman?

KNOPMAN: Knopman, Board.

Tim, where in your safety case do you account for post 9/11 changes, specifically in scenarios, human intrusion scenarios, for example.

MC CARTIN: Well, human intrusion is a stylized calculation. And, so, that's done by the EPA standard specified, a single bore hole going through a waste package, through to the water table. And that, for postclosure, that is how human intrusion is evaluated.

In terms of 9/11, in terms of a preclosure, during operations, the Commission is reevaluating its requirements for all facilities. And as part of that reevaluation, if changes are needed, the regulation will be changed. At this time, the Commission was not aware of any changes that they felt were necessary. But that reevaluation has not been completed. If necessary, the regulation will be changed.

But that is a preclosure operational phase, which

my slides were not intended to address that issue.

PARIZEK: Chairman Cohon?

COHON: I was wondering about examples of the sub-issues referred to in Slide 12. Is that the 14 model abstractions on Slide 16, your backup?

MC CARTIN: Yes.

COHON: Okay. Actually, while I've got the microphone, this slide that you have up here where you talk about--oh, no, I'm sorry, not that one. You talk about confidence in expected performance, and I appreciate what you said before also about how though there is a final annual dose curve, you're also very interested in all the detail under it and then the full range of possible doses. And maybe I'm just reacting to the wording you chose here, it's confidence in performance, not just in expected performance; right?

MC CARTIN: I put that as much to put in that, including the probability. I mean, it's performance. We have used expected dose to imply a probability weighted dose, but it's not to say, and maybe it was a mistake, but it was put in there to--we're interested in both the probability of what can occur, and the consequences when they occur.

COHON: Okay, thanks.

PARIZEK: Dan Bullen?

BULLEN: Bullen, Board.

Could you go to Slide 10, please, since we're

flipping through slides here? I was very interested in essentially, you know, you're looking forward and you're taking a look at the performance confirmation plan. And the second little barriers functioning as intended and anticipated brings to mind, you know, some in situ experiments, some laboratory experiments, maybe some field experiments.

What kind of things did you envision, particularly in light of the fact that during the performance confirmation period, it doesn't look like there's going to be much aggressive environment around, so what did you expect to see in the performance confirmation plan that would address those barriers functioning, you know, say 8,000 years from now when they start to fail, or whenever their projection is? What kind of work would you expect DOE to be proposing?

MC CARTIN: Well, those words actually are in the regulation, and certainly it is very possible, once the repository is, if it's fully loaded and it's ventilated, there won't be any dripping water, there won't be much to see in a repository during this time period.

There could be other types of tests, laboratory tests, maybe other field tests. They could do some tests to get some sense of how the barriers might function. But, in the repository itself, I would agree that you may not see anything.

BULLEN: Thank you. I expect the same. But I would have guessed that there would be an aggressive test that they'd do somewhere, maybe laboratory, and maybe outside the repository, that would look at what they would expect to have happen. And then when they want to make the case that we would like to close it, this is our projection of the X thousand year performance of the repository, and this is why we think, you know, the dose will be such, based on the calculations.

MC CARTIN: Absolutely. And that's why I said, I mean, in performance confirmation, we're looking for them to challenge the safety case. And it isn't about just watching a dry waste package for 50 years and saying, well, nothing happened, we're done. That is not what's intended. And in that case, I think they will have to do tests outside of the repository. We still would like monitoring in. You never know what you might see, and it's always useful to monitor inside. But, I think there will need to be additional tests outside of the repository, absolutely.

BULLEN: Thank you.

PARIZEK: Paul Craig?

CRAIG: Craig, Board.

I've got to follow that line of discussion. I'm interested in surprise. Claudio Pescatore talked about the management of confidence, and I'm interested in confidence,

as it does relate to surprise. We have this recent example with the reactor where there was apparently no functioning way to detect unanticipated corrosion. Apparently the detection process failed at both the level of the people running the reactor, and at the level of the regulator, and there were signals there that were missed.

So, I'm just wondering how the concept of confidence in your ability to detect surprises shows up in the concept of the safety case. I didn't see it as an explicit item, and it seems to me that one does need to be prepared for that.

MC CARTIN: Right. Well, I think part of that is the NRC licensing process. And DOE will propose a performance confirmation plan that has various attributes for it. We will comment on that plan. It will be the subject in a public hearing. Other people will be able to comment on it, and hopefully through that process, you have a comprehensive evaluation of that plan.

Other than getting the full comment in the hearing process, in terms of if there's something out there we don't know, you can't have a plan that addresses something you don't know.

PARIZEK: Other Board? Alberto?

SAGÜÉS: Yes, this is a question that preoccupies many of us along the lines of what Dr. Craig was saying. And

along the lines of your last statement, that, you know, you cannot anticipate that which you don't know, and so on, that's fine, but if you go, for example, to materials of construction, you have the choice in this particular case, of dealing with materials of known, maybe not standard performance, for relatively known performance, primarily through the evidence of analogues, say plain carbon steel, some such thing, and there is a long-term basis of engineering and human experience with those materials. In that case, you have some direct evidence of how the material will perform.

Or, conversely, you may have a fantastic material, or, rather, a material that looks fantastic based on a very short level of experience.

Now, in the first one, you have relatively mediocre performance, but well known. And in the other case, we have the promise of fantastic performance, but without any kind of long-term direct evidence that this is working. How does that enter into this kind of analysis?

MC CARTIN: Well, generally, that's a design decision that the Department will have to make. We cannot participate in those design decisions. In terms of whatever the Department comes forward with, they have to support. They have to have information to support their assertions for the longevity, the corrosion rates for whatever material they

select.

I think from a regulatory standpoint, for those things that are newer, for those things that potentially have very, very long lifetimes, our review will be more focused. The scrutiny will be turned up in those areas. But, it's the Department's safety case, they're the ones that have to decide whether they believe they have sufficient information to support their safety case in that regard.

As indicated, I think the NRC regulations, risk informed performance based, part of that is providing to the licensee flexibility to decide how they want to present a safety case. Risk informed for us means where there are the largest risk contributors, that's where our regulatory review will be the most stringent.

SAGÜÉS: Okay. But, nevertheless, you do end up with situations in which the decision comes framed in the following way. We in the scientific community cannot think of any way in which this material may fail over the long-term, sort of a negative kind of information.

MC CARTIN: Well, the licensing board will weigh all the information presented before them in making that decision, and it's a decision of reasonable expectation.

PARIZEK: Norm Christensen?

CHRISTENSEN: Christensen, Board.

I just want to follow on, this is maybe an

extension of both Alberto's question and Paul Craig's question. I think history would demonstrate that one of the great truisms is that surprise is inevitable, and that there are unknown unknowns. There are things we don't know, and they're going to happen out there. Which argues for a really explicit consideration of safety margin, or some kind of buffer. And I wonder, I don't see that as an explicit part of the consideration here. Or maybe I'm missing something in terms of how one builds that in.

MC CARTIN: There's no explicit requirement for margin in the regulation, in that the limit is 15 millirem, and actually, DOE, you'd better come in at .1 millirem because we want two orders of magnitude of margin. There is nothing in the regulation. The limit is 15 millirem.

Where margin may come in, there are other things being done in this situation, and one would be the performance confirmation program. There is no question that things are going to occur during construction, during emplacement, and possibly a little bit beyond to the time of closure. That performance confirmation program is there, once again, to challenge the safety case, look at the soft spots.

And as was indicated, if this material hasn't been tested long, you have potentially 50 to 100 years to further test it to look for weaknesses in the assumptions, in the

models, in the understanding.

There's also the requirement for multiple barriers, so that you're not relying merely on an engineered waste package. You are relying both on an engineered waste package and the properties of the site. And, so, those kinds of things are--if I had to say what gives you some margin, I think it's the multiple barriers and the performance confirmation program, that it will continue.

CHRISTENSEN: I would just say that from the standpoint of a relatively well-informed citizen, it's those issues that are probably the most critical issues, the issue of safety margin, defense in depth, and multiple barriers, that are going to be most compelling. And, I think, you know, the recent experiences with regard to failures of plan sort of demonstrate and maybe reinforce that.

So, I would display that more prominently, and as a safety case issue, that makes it something more than, considerably more than the performance assessment.

MC CARTIN: Yes.

PARIZEK: No other Board questions. Staff? Dave Diodato?

DIODATO: Diodato, Staff.

Tim, on your Slide 10, you're talking about Part 63, Section 131. And the bottom bullet there says identify risk significant assumptions and uncertainties. And my

question is how do you figure out which assumptions are risk significant? You talked about performance assessment. What tool or methodology do you use to discriminate between which assumptions are risk significant and which are not risk significant, or risk insignificant assumptions?

MC CARTIN: Well, generally, it's the performance assessment, is the computational tool to assess that, although, and I think it's important when we talk to risk significant assumptions, you are looking at a look of aspects. You're also looking at not just the dose, sensitivity to a dose. I think that is far too narrow a description for risk significance. You are looking at capabilities of the barriers, et cetera, and you're looking at what barriers have the potential to have the largest impact on providing safety. And computationally, it is the performance assessment that gives you that insight.

DIODATO: I mean, doesn't that necessarily imply in an infinitely sensitive PA, that everything is in there and it's perfectly coupled and you've got all the critical processes that may or may not be significant, and then afterwards you-- do you see where I'm going with that?

MC CARTIN: Right. Well, we are expecting that the performance assessment has looked at a large number of FEPs, and has made a justification for including, excluding all those FEPs, and that that's your best quantitative

information that you have. You have evidence for the models. You have the independent lines of evidence that could also give you some insights, that all need to be factored in.

That's why I didn't want to say that risk significance isn't just, say, doing a sensitivity analysis and getting a set of parameters from the sensitivity analysis, these are the important parameters and that's it.

As I indicated, the corrosion of the waste package, there might be different chemistries you look at, and a particular chemistry might provide the most serious challenge to the waste package. You might look at, well, how could that kind of chemistry evolve? And those are the kinds of things that you might put into a performance confirmation program.

I don't know if that helps, but it's not just the calculation of the number, but you do need to understand, and this is the hard part in explaining performance assessment. There are just a variety of assumptions. The Department recently has tried to lay out some of the assumptions in the models, conservatisms, et cetera. All that is factored in.

PARIZEK: We have to go on now. We have two more speakers, and then time for public comment. Thank you very much, Tim.

The DOE position will be given by Joe Ziegler. And this has to do again with the safety case. It's their

responsibility to present the safety case, and so we know the national emphasis and we know the NRC is looking for it, and so let's see what DOE has to say.

ZIEGLER: Thank you. I have some notes I want to use.

I, too, am going to focus, like Tim did, on the postclosure case, although I would like to begin by saying that the heart of the decisions that we ultimately have to make about, you know, the detailed design and the path we go forward, may depend on preclosure safety and environmental impacts as well. So, I don't want to discount the importance of preclosure part of the analysis in presenting an overall safety case.

The process that we use is basically defined in the Nuclear Waste Policy Act and the NRC regulations as a step-wise development process. And each step of the process that we have gone through already, and that we will go through in the future, we have varying degrees of knowledge and an ever increasing degree of knowledge, whether it was at the time of the environmental assessment when it was decided to go ahead with site characterization, or what we've just gone through with a tremendous body of data that was used and information for the site recommendation, and then on to the next steps following that designation and beyond.

This process began many years ago, many sites, and it will continue to move into the future. Our decision

making requires that the safety case being compiled give adequate confidence, and that decisions be made that are adequate with the level of information and data that exists at each step of that process.

We believe we're in general agreement with the international community, and that the repository should proceed in stages. And that's steps in many respects similar to staged development concept that Jeff Williams will talk to you a little bit tomorrow.

This graph just shows a little bit about the step-wise process, beginning, the first block here is the approval for site characterization, but there were actually steps before that when we looked at many sites and narrowed it down to a fewer number of sites.

The process leading to site recommendation, including an FEIS, updated performance assessment, sensitivity analyses associated with those TSPA analyses, the SSPA, other documents and analyses that we perform.

We're in between site recommendation and site designation. We've had the state's notice of disapproval. It's up to Congressional action now. But assuming that we go beyond and the site is designated, then we get into a license application phase. The information that we're gathering, the tests, the analyses that we do, the input from both the public, the state, the political processes will continue as

we move into license application and construction authorization.

A couple things that we're considering, and there will be more discussion tomorrow, as far as going into construction authorization, the possibility of modular construction or phases or steps, to go into this process. If that takes place, and we first started looking at that as a cost levelizing thing, looked at levelizing the annual cost, because we're funded by Congressional budget authority every year, even though the money set aside mostly comes from the utilities, but in addition to levelizing costs, if we go into some sort of modular development where we go into phases or steps, then surely then there will be consideration of improvements or changes or enhancements between the modules. And, again, in essence, that's staged development, and that would take place during the construction, and even into operational phases.

Then we get to the license and receive phase, and ultimately to closure. At each of these steps, we go through additional analyses. There will be additional not only performance confirmation, but additional tests and analyses programs that may go beyond what's required for simple performance confirmation.

The way our safety case fits in with NRC licensing decisions, basically, we have NRC performance objections and

evaluation requirements written into Part 63. The regulations establish an acceptable and quantitative level of safety for environmental protection.

The requirements are defined and the general evaluation methods and information to be used for that presentation exist in the regulations. But there are several things that are up to the Department of Energy as the licensee. The degree of conservatism in the analysis, the body of data, the tests, the analysis and the timing of the subsequent steps are in DOE's control.

Also, the treatment of uncertainty and gaps in the data will have to be addressed by DOE, because regardless, when you're trying to predict the future for 10,000 years and beyond, there will always be uncertainty. There will always be gaps and that it will never be a perfect dataset, and the regulations and the law recognize that.

But the requirement for preclosure, reasonable assurance and postclosure reasonable expectation are the tests that have to be met through the regulations.

DOE will present a safety case that demonstrates compliance, and because testing and analysis that are already going on, have continued for a long time, will continue beyond license application, beyond receipt of license, probably as long as the repository remains open, that the requisite degree of confidence at each of those steps will

have to be in place at the time. That was true at EA, it was true at the time of the SR, it will be true at the time of the license application, construction authorization, and ultimately, the license and beyond.

We believe that the NRC requirements and the approach that DOE is taking is generally consistent with the views of the international community and of oversight bodies within this country, including yourselves and the ACNW.

More is required than just a quantitative performance assessment and comparing the result to performance, although it seems like the quantitative results receive most of the focus. And at a lot of your meetings that you've had and a lot of what we present, and certainly in a lot of the documentation that we present, we focus on TSPA.

But more than that is required. We need to show an adequate understanding of the systems and components, that's both the engineered systems and the natural systems and barriers that exist. We need to show how that understanding is factored into the evaluation of performance. That's the subsystem models, sensitivity cases, ultimately adding up to a TSPA, but it's more than just the one answer that spits out the end of the computer modeling.

And we need to provide requisite confidence in the basis for the evaluation and the results, and that comes from

several sources. Recognized experts, primarily in our program, from the national labs and the USGS are an important part of the problem, although not quantitative.

We must show that we have been able to implement a rigorous quality assurance program in performing our analysis, and that's a central part in the safety case and in receiving an NRC license. And ultimately, we must show reasonable expectation according to the regulations.

Multiple lines of evidence and argument we believe are required. And, again, that can be qualitative or quantitative. We looked at alternative conceptual models, sometimes in a quantitative sense, as part of our TSPA analysis. We looked at multiple barriers. We looked at the degree of diversity from the multiple barriers, whether they're engineered or natural. Do we have dissimilar materials? You know, if we go with the drip shield, Titanium versus a waste package made out of Alloy 22, is there a difference there? Is it a discernable difference?

We have performance confirmation and ongoing tests and analyses programs that go beyond the ultimate license application, and will continue to evolve as more data and analysis are collected and analyzed.

We looked at natural analogues, and natural analogues in large part may not fit into the quantitative analysis, and yet they may still provide important

qualitative information that gives us confidence in the analyses that are performed.

I'm going to flip the way I present this slide a little bit and talk about the safety strategy first. Basically, we have defined the safety strategy that is essential in defining our safety case. Our safety strategy concentrates on the elements most important to performance. That means it's risk informed. And how do you know what's most important for performance? Well, we've had different iterations of our TSPA analysis. We're done sensitivity analysis. We've done one-off or barrier analysis, where we're removing this barrier or that to see how the repository would perform taking those factors into consideration.

We look at multiple barriers. Even though it might not add specifically to performance, the fact that we have multiple barriers should add to confidence in overall performance being what it should be. We look at the way uncertainty is handled by modeling the full range of possible parameter values. We look at the basis for the stated considerations and conservatisms, and we must clearly articulate how and why we know things are conservative if we so state that they are.

And, ultimately, what's very important is that we be transparent and that we be able to communicate this analysis, such that it's understandable.

Within that framework, we need the flexibility to accommodate new information and to update the safety case at future decision points, the future now being at the time of the license application, construction authorization, the license, and closure.

New information can come from a myriad of sources, testing, design, analyses, policy changes. Work under the performance confirmation and test program will be ongoing. the results of that work should be factored in as we go, and we will add to the safety analysis and the safety case at the appropriate stages of the process.

Just to give you a little bit of an idea of the evolution of the safety case as we perceive it, we've presented several iterations of the repository safety strategy, the last being I think towards the end of the year 2000. That showed the basis, our TSPA, the basis for our TSPA results that existed at that time, and it showed sensitivity cases. It showed barrier analysis where we removed one barrier or multiple barriers to see how the repository would perform with removal of those potential barriers.

DOE most recently has evaluated performance of the site in the site suitability evaluation in preparation for the site recommendation. And that was done in accordance with the Suite Suitability Guidelines under our regulations

under 10 CFR 963. But there were a lot of documentation and analyses that went into that. The Final Environmental Impact Statement was completed, the TSPA-SR was completed, the SSPA or Supplemental Science and Performance Analysis were completed, and there was a variety of information that went into that body of evidence that supported the site recommendation.

The safety case for construction authorization will be presented in our license application, and most of that will be contained in the safety analysis report portion of that license application as far as our quantitative analysis is concerned.

It will incorporate the results of these ongoing tests and analysis that I've already mentioned. It will be made in the context of the NRC requirements under 10 CFR 63, and the Yucca Mountain Review Plan, and our safety strategy for development of that safety case will be as I just presented in the previous slide.

This next graph shows a little bit about the way--graphically shows how our safety strategy is structured, and I'll kind of work my way from left to the right.

Basically, our strategy will be documented in our license application and the supporting documents to support that application. The application will also be accompanied by a final EIS, and any necessary supplemental analyses that

result as we define in more detail the design that we go forward with, and we refine that moving into the license application stage.

The safety analysis report will have both preclosure and postclosure repository safety analyses and we'll talk about an R&D program to resolve any outstanding safety questions that we see that need resolution at that point in time. And it will discuss our performance confirmation program.

Moving to the right of the slide, we talk about our safety strategy for the safety case, and that's in an overall licensing strategy. And, by the way, the licensing strategy is being documented right now. We should have that strategy document complete within the next few weeks.

We go into our postclosure safety strategy as part of that licensing strategy. And as I went over before, it includes various elements, including performance objectives, multiple barriers, engineered and natural, the performance assessment itself that will concentrate on the most important factors so as to be risk informed, performance confirmation program that will provide information for updates at subsequent stages of the process. It will include alternate lines of evidence, alternate conceptual models, and discuss natural analogues, and the like.

And I'd like to close with something that probably,

and it may go beyond, you know, shear requirements and the licensing regulations and NRC's regulations. NRC will evaluate DOE's safety case in making their licensing decisions. The license application will be written as an applicant for the regulator's review, and it will be written in technical terms for the most part. We believe that stringent quantitative regulations are an important part of the safety case and the licensing strategy.

Without a set of quantitative requirements, the desire for an even better understanding and an ever better understanding of performance, might just never to be able to get to the step of actually making a license application.

The safety case will be available, and the license application will be available to other parties to the licensing proceeding, the state, intervenors, anyone else who desires to see the document.

But in addition to that, because our license application is basically written for the regulator and written in technical terms that we know they'll understanding, we're considering the need to provide additional information to help other audiences understand the safety case. And this additional information, one way to do that would be to develop a simplified, plain language description of the safety case that covers a lot of the things that were discussed here already today, and basically

develop that so that the general public can understand better the case that we're making and how we're making it.

And, I guess with that, I'd like to close and ask for any questions.

PARIZEK: Board questions? Don?

RUNNELLS: Runnells, Board.

I think just a clarification, please. Your Slide Number 6, down there at the third bullet, I didn't understand the approach should be separated from the result.

ZIEGLER: Let me try again. What we're trying to say is that if you start and know the results, then that may affect your approach. In other words, if I know I'm going to depend on the drip shield for about 100 per cent of my performance, then I could, I shouldn't, but I could come to the conclusion that the natural systems aren't important at all and, therefore, I don't need to evaluate them.

But, if I go from an approach standpoint and concentrate on the elements most important to safety, which is an iterative decision making process, and I look at things like multiple barriers, regardless of what is most important, then from that approach standpoint, then I know that I've got complete coverage, and then if something changes down the line or new information comes to light that is unexpected, then the approach is to make sure that I'm covered across the board.

Does that help, Don?

PARIZEK: Dan Bullen?

BULLEN: Bullen, Board.

Again, on Slide 6, I think I remember, or I wrote down here, that you concentrate on the elements that are most important to performance as you evaluate your safety case. And one of the examples that you used was by doing the one-off analysis based on TSPA.

Any possibility there that a one-off analysis might mask some important results?

ZIEGLER: Yeah, there is, and we've been thinking about instead of one-off, doing one-on, so that if you look at each element of the barriers and see how much those elements of the barriers, how important they are in and of themselves, and you're right, and we've had that discussion internally. So, that's a good point.

BULLEN: I personally think that's a great idea.

Now, if you could also go to I guess it's your second to the last slide where you talk about general elements of the licensing strategy? That one. Dr. Wong asked this question, so I'll ask it anyway, but what design are we licensing for? Hot or cold? And does your strategy change for either of those?

ZIEGLER: And I guess I would argue that the design is neither hot nor cold, but we should go forward with a design

that's capable of being either hot or cold.

You know, clearly, if we put the material in the mountain and put it two meters apart or three meters apart, and close the repository in 50 years, it would still be a higher temperature than if we closed it in 300 years.

So, I think the question is is what configuration are we going to take to licensing. And you'll hear more about that tomorrow, but we're considering a configuration that can easily be operated at higher or lower temperatures.

BULLEN: So, your postclosure safety strategy, performance objectives, and the multiple barriers, and all of the boxes that fall under that, are encompassed by both operating modes, and so you have a broad enough net that you can cast in all of your analyses for licensing strategy that either operating parameter, hot of cold, works?

ZIEGLER: I think from a broad perspective, our strategy is to be able to cover the range of possible operating modes, from a--I use the work all, that scares me, because you'll find an example where something doesn't fit--but from a practical perspective, is that the decision on higher temperature or lower temperature may not need to be made right now. So, to artificially make it, you know, before it needs to be made, may lead us in the wrong path as well.

So, I think we have some work to do in defining the configuration that we take into the license application, and

I think we have a goal, probably more than a goal, to make sure that we are able to reasonably make whatever decision makes sense down the road.

BULLEN: Bullen, Board. Just one last followup question.

You said since the decision doesn't need to be made, when you finally do decide what the operating mode is when you're going to ask for your license modification to close, then will you have to have done all of the appropriate calculations, analysis, safety case bases that would address that issue? And are you confident--I guess I'm a little bit concerned is it a license modification like you're changing your text specs to operate in a different mode, or is it a significant change in the actual operation of the postclosure safety of the repository?

ZIEGLER: Operation of the postclosure safety?

BULLEN: Well, performance--I mean, you're not operating postclosure. It's performing postclosure.

ZIEGLER: I think certainly our analysis has to be appropriate for the case at hand. So, if that's the question, then it has to be. So, the question then becomes is if I analyze the repository at a higher temperature operation or a lower temperature operation, then how applicable is that analysis to the other case, or something in between. So, I think at the time before you close,

certainly, hopefully we will have made those decisions, or we will have at the time we close, because the situation will exist then.

PARIZEK: Debra Knopman, Board?

KNOPMAN: Same slide. I find this really confusing, and maybe it's just me. But the word safety, or the phrasing of safety analysis and safety case appears under the box for license application. And then over on the right side, and those boxes don't connect, you've got safety strategy for safety case. And I'm left quite confused as to whether or not the safety case is part of the license application.

Now, I heard Tim McCartin say that the NRC is going to be looking at the safety case. I just don't understand why you have this arrayed this way, and what you're actually trying to communicate to us. It's a bifurcated process. You've got folks who do license application, but they don't do the safety case. You've got folks who do safety case who are not involved in the license application. And you're just going to have all this paper kind of go in front of the NRC.

Can you explain this? It sounds like you've got two significantly different documents with two significantly different teams of people working on these things.

ZIEGLER: Okay, let me, one, I don't think that's true. So, I'll apologize for the confusion. And maybe this is an artifact of what we're trying to do and to documenting our

licensing strategy. Because we have a licensing strategy document that's in preparation right now.

Part of that licensing strategy is the safety strategy. But the primary part of the document is what it takes to put an adequate license application together. But part of that is the safety strategy.

I believe I stated, and I would reiterate that I believe that our license application in large part does contain the safety case. The one element of that that may be missing, especially from an international perspective, but I think it applies here as well, is that the license application is written for a technical regulator, you know, to review according to their regulations, and that to communicate the safety case may require more than just the license application, something that's written in plain English.

Does that help at all?

KNOPMAN: Well, I'll leave it at that right now. I think you have some work to do in terms of communicating why they're not one in the same.

Now, if they're written in different languages, that's one thing. But if they're substantially different sets of arguments or, you know, different comprehensiveness, then, you know, I think that needs to be explained further.

PARIZEK: Are there staff questions? Leon Reiter?

REITER: Leon Reiter, Staff.

Joe, a week or so ago, I heard a presentation of preclosure safety strategy, I think that was the title of it, and in it, they talked about specific quantitative safety margin for preclosure. And, in your old discussions of safety case under repository safety strategy, at one time, you also proposed having a safety margin for postclosure. I think it was an order of magnitude below the criteria. Are you contemplating having that, including that in the safety case, or something like that?

ZIEGLER: I wasn't at that meeting, but just knowing what our preclosure strategy is is basically in development of our license application, from a preclosure, but I think this would equally apply to postclosure without a specific quantification on it, is that there are standards set by the Nuclear Regulatory Commission that have to be met as far as, you know, meeting applicable safety requirements.

From a preclosure perspective, I think we use something like a factor of two, but I can't remember. During our calculational process, as we're preparing, you know, the analysis that will go into our license application, from a preclosure basis, if we're starting to get about a factor of two or a factor of one-half from what the regulation is, we think it's of significant note that we should stand up and be concerned about it and see whether or not our analysis is

adequate, or maybe we've oversimplified and things are really better than that.

I think from a postclosure standpoint, and I'm not going to give you a number, but an order of magnitude maybe, is that depending on where that order of magnitude comes from, we need to keep in mind if we start doing preliminary performance assessment and the numbers we're coming up with on a preliminary basis start to approach the 15 millirem standard, then we should sit up and be concerned about it and make sure that our analysis is adequate, or maybe we have built in or oversimplified and have too many conservatisms in the analysis, or maybe we've got a real problem, and maybe there's a way to deal with it, and maybe there's not.

But, that discussion I believe was in the context of giving us a head start and not waiting to submit our license application. I guess theoretically we could submit a license application that's got 14.99 millirem as the postclosure dose, although I don't think anybody here from DOE's side would be comfortable in doing that. So, I think some degree of margin is probably prudent.

PARIZEK: Jeff Wong? I bypassed you. Then Jerry.

WONG: Going to your Slide Number 3, I'm trying to understand the message that you're giving to us. Are you implying up there--well, mine are pink boxes, your's are orange boxes--with increasing confidence, are you implying

that the threshold that the NRC is going to apply of meeting reasonable expectation is going to increase with each step?

ZIEGLER: No, I'm not really trying to imply anything what NRC is going to do. What I'm trying to imply here is that our performance confirmation and our test and analysis programs will be ongoing. And as we gather more data and analysis, then the degree of confidence that we have in our analysis should go up.

WONG: Okay. Then going back to the slide that we've resting on, the one with the gray, is it Number 8? Yes, that one. I'm confused, and maybe I'm confused with Debra. In essence, are you preparing three safety case documents with each row? Because, to me, it would seem that the safety case, that a license application is going to be weaker than the safety case related to postclosure safety. I mean, maybe that's what you're implying there, the other diagram, because it looks like you're going to have performance confirmation data to support the safety case over there on the right, versus your application on the left.

ZIEGLER: Okay. And I'll never show this slide again.

WONG: It's all about confidence and communication transparency.

ZIEGLER: Right. And obviously this doesn't meet the test.

What we plan to do is we've got a licensing

strategy. That's a document. It's about 50 or 60 pages, probably more than that by now. And, so, no, at most, we will prepare our safety case and our safety analysis within the safety analysis report part of the license application. What we're saying as a communications tool, we may need to do more, and it's simply to better communicate in plain language, which a lot of our documents, I mean, we've been out to public meetings all over the place, and we get accused all the time that TSPA is not a reader friendly document, you know, for members of the public, and you probably feel the same way.

So, a simpler, more plain language description of the same safety case, not two different safety cases, no.

WONG: Thank you.

PARIZEK: Jerry Cohon?

COHON: I don't have a question. I guess I have sort of a statement, a mini-tirade. I'll try not to make it a tirade. And don't take it personally, whatever I say.

I find nothing over here that I would care to criticize. I think it's fine, though my colleagues have raised questions and expressed their confusion about this particular diagram.

To me, the question is whether you'll do it, and what it will look like when you're done. And maybe my problem has to do with communication more than anything else,

and I suspect it does.

The phrase or the idea, I won't give an exact quote, of confidence appropriate to the decision at hand, makes great sense. But I don't think DOE has been very successful in conveying the basis for that confidence up to now at every decision point. So, I'm thinking about the Secretary's statement in which he conveyed his recommendation to the president. In that, he offers the estimated mean dose, and he talks about the volume of work that's been done, scientific and technical work, but that's it. There is no quantification of the uncertainty or, putting it in a positive way, quantification of his confidence.

Now, the confidence is more than just quantification of some measure of uncertainty. But that's not to say that quantification isn't important also. And DOE has not communicated that well, and this is true throughout my history with the program, not just with the current decision.

So, I worry that now projecting ahead to LA and beyond, that DOE will be equally unsuccessful in communicating that part of its message. Now, it may be that the uncertainty analysis and the plan for uncertainty analysis and uncertainty communication just simply wasn't able to catch up with the SR. I would hope that that plan is continued to be followed, and it does catch up with LA. But,

to date, you have not done a good job on that.

PARIZEK: Paul Craig?

CRAIG: And I think I'm probably even a little bit grumpier than Jerry.

COHON: I can get grumpier if you want.

CRAIG: Let's not compete. We've managed to avoid it so far.

Looking at this same chart, there are boxes that hang out on the left and on the right-hand side that aren't connected to anything else, and I just observe that that seems to me to be an accurate representation of my perception of importance in the DOE licensing strategy.

The environmental impact statement seems to have very little to do with anything. It was done because the law said to do it. But it sort of hung out there. And communications with the stakeholders seemed to fall into the same category. So, I find that part of the document accurate. But it doesn't make me feel comfortable.

ZIEGLER: Is there a question there I should respond to?

CRAIG: No, no, I just thought I was going to be grumpy. But, you know, if you choose not to use this chart again, that's probably a good decision.

PARIZEK: No other board questions. But Claudio Pescatore I guess has asked for a chance to ask a question. I got the message that you might want to ask a question.

Because if you do, we could let the staff also ask a question of you. I didn't give them time to cross-examine you.

PESCATORE: Since you've given me this opportunity, I have a simple question. Does the writing of the new safety case require a thorough overall overhaul of the past documentation? Is this really something that will require a big effort for you guys to put together a safety case and a safety strategy? And, also, what is the fate of the old repository safety strategy documentation you had and then it stopped?

ZIEGLER: Okay, the first question was will it be a big effort in putting together the safety case under this concept I've presented. And I guess I think what we've already done was a large effort, so, yes, it will be a large effort, and I think we need to concentrate more on communication is the message I'm hearing.

And what was the second part of the question again? I can only think in single digits.

PESCATORE: What's the fate of the document you already started on the safety strategy, the repository safety strategy document that in fact DOE started?

ZIEGLER: All right, let me try to address that. In the past on our safety strategy documents that we put together tended to be analytical based, and I guess the image I've tried to project here is that instead of the strategy being

analytical based, it's more of a pointer as to where we need to go into the future. So, again, and I think that really actually is more of a strategy because it tells you how we should proceed versus, or tells us how to proceed versus justifying where we've been.

So, no, there's not been a lot of work that needs to be redone there. We're trying to look to the future and what it needs to be.

NELSON: Nelson, Board. I think he's referring to the repository safety strategy, the RSS, that was around, what, a year and a half ago?

ZIEGLER: Yes, right at the end of 2000?

NELSON: Two years ago. And what its status is. You've stopped working on that, and the next document that will be seen is this document with the LA? I mean, is that the strategy?

ZIEGLER: Right now, I don't think there's any plans to revise that document in its current context, although it did provide a lot of useful information, and that information is still very valuable in how we move into the future. But, right now, I don't believe, and somebody correct me from the audience if I'm wrong, there's no plan on the books to basically update that document in its current format.

NELSON: So, the next we see will be with the license application?

ZIEGLER: Yes.

NEWBERRY: This is Claudia Newberry, DOE.

I think there's a little bit of a confusion. The licensing strategy that Joe has shown up here, and I'm responsible for this slide, I'll take all the blame, this is a document that we're producing that is the strategy for approaching development of the license application itself, which includes the safety case, and the safety strategy, which is a strategy for developing the safety case that's going to be in the LA.

So, there are two parts of it, as he said, in the previous slide. We separated the safety strategy from the actual safety case. And this document, the licensing strategy lays out what the safety strategy is, and tells us how to develop the safety case, if you will.

This licensing strategy document, as Joe said, is nearing completion. It's in review and should be accepted and out this summer. So, you will see a licensing strategy this summer. You won't see a safety case until we develop a license application.

PARIZEK: Thank you. One more point of clarification for DOE?

MC COMBIE: Charles McCombie.

Actually, I wanted to defend this slide. I think the only thing wrong with it, it's typographically wrong.

The message that's in here which says that into the safety case postclosure and preclosure goes all this stuff on the left, if you turn the slide on its side, it would give a very good message that the safety case is not just TSPA, but all of the six elements should go on the right--go into the block on the left. And what Debra was bothered about, and I was, too, it doesn't show the linkage the way that it should be.

So, I think the elements are probably okay. I do think they're okay. But, it's just not showing connection.

PARIZEK: I think we should now allow time for the last speaker. Steve Frishman from the State of Nevada giving a safety case view from Nevada's perspective.

FRISHMAN: Well, thank you. For the record, it's Steve Frishman with the State of Nevada.

I appreciate being asked to talk on this subject, since the last discussion that went on gave me the opportunity to completely revise what I was going to say.

But at the same time, it's just a revision. The same stuff is still there. I'm just going to present it in a different way. And I guess what I hope to be able to do is help out with Debra's and Jeff's confusion by explaining what I think is going on that that chart represents, and why it doesn't represent it very clearly, and probably when I'm done, it never will appear again.

First of all, let's go through a little bit of what

we heard that sort of links into where I think all this is going. You had Tim's summary slide that gave us essentially the four elements when he's talking about the safety case, which is demonstration of safety, confidence in the expected performance of the site, and engineering, performance confirmation program, and clear documentation.

Well, that is essentially the requirement for the safety analysis report, the safety analysis report being the operative part of the license application.

Now, Joe says that DOE will present a safety case that, one, demonstrates compliance; two, provides the requisite degree of confidence for the decision at hand, the part that kept coming back up. And what that is sort of supported by is the need for flexibility to include new information, and an updated safety case at future decision points.

Now, if you look at the difference in those two, it's really brought home by something that Bob Card said this morning, and that's we believe we have the operational period to fully explore the long-term safety issues. And that's a paraphrase of what he said.

And, now, you link that to Margaret Chu's new emphasis on science that will go on for as long as the repository is open, and then think about the NRC's requirement for performance confirmation, but what do you do

with all this other testing, which is really a continuation of site characterization that is incomplete now, plus anything new they can think of. You have to put it in something. So, you put it in the new sort of test and evaluation or science program, and that runs alongside.

Now, what does this all mean? What it means is the Department of Energy is going to do a safety analysis report as required for license application, but they're defining a safety case. The safety case is the safety analysis report, plus the flexibility that they want to have in the future to have improved confidence in the decision point at hand.

So, what that says is that the Department believes that at each stage of decision for the Nuclear Regulatory Commission, its construction authorization, its amendment to receive and possess, and amendment for closure, the Department is saying that at each stage, there is going to be new information, as well as performance confirmation information, that is supposed to improve confidence in the safety analysis report.

We have talked about this approach in very different language on many occasions. What it comes down to is the Department expects that they are going to be able to carry out a phased licensing program.

The NRC regulations do not permit that at this point, and it's more than just an oversight or something that

maybe you could fit in if you read the regs differently. As I understand it, and I have been hammering on this point for years, which some of you know, as I understand it, it's intentional that Part 60 and now Part 63 were not a phase licensing program.

The point of the licensing regulation is that a disposal decision is made with the original license, the construction authorization, meaning that you've got to--the Department has to demonstrate its case at that time through the safety analysis report, and the idea of performance confirmation is to essentially confirm, or at least challenge, the validity of the information that was used for that original decision.

And I have looked at the NRC's Yucca Mountain Review Plan to make sure that my understanding of this was still in line, and I believe it is, because I was specifically looking for things like the license application must be complete at the time it is submitted for construction authorization.

So, what we have, at least from my observation, is another way to talk about, or for the Department to talk about a phased licensing approach that they think they can somehow legitimize to where, through time, their assumption is that through time, we will find more things that will make it better. So, give us a break at the beginning. We'll have

it maybe good enough at the beginning, but rest assured, it will get better.

Well, experience over the last few years has shown that the more information that is gathered, the more questionable some of the original information really was.

So, the assumption that it's going to get better, and expecting the Nuclear Regulatory Commission to give a license on something less than what the Department believes to be its best shot is contrary to the whole regulatory philosophy, and this will be at least one of the areas that we're going to be very rigorous about.

So, I think that sort of explains why that diagram is confusing, and I think it explains some of the language, and puts it in the larger context of something that has been going on for a long time. I've tried to point it out. The evidence just keeps building, and I think it's pretty compelling now, because we're right up to where things are going to start happening, and the Department is ready to go off in a direction of having things happen that are not in accord with what at least many of us expected from a licensing approach and philosophy at the very beginning.

Now, safety strategy. The safety strategy essentially provides is what Tim said is one component that must be in the safety analysis report, and that is the identification of barriers. And what the safety strategy was

very largely doing the last time we saw it was it was identifying what the Department thought were the key barriers in the system, not just in terms of okay, there's engineered and natural. They identified--well, the number kept switching around. I just took the one that had five.

So, they identified five things that they think are essentially barriers in the system, and many of you I think will remember that list when I remind you of it. It's limited water entering the waste emplacement drifts, long live waste package, and drip shields, limited release of radionuclides from engineered barriers, delay and dilution of radionuclide concentration by the natural barriers, and limiting general dose--or limiting annual dose, considering potentially disruptive events.

So, this is what they thought was sort of the barrier function in the system, the ones that they thought were most important to making a demonstration in the safety analysis report.

There is no safety case per se that's required by the Nuclear Regulatory Commission. Safety case is a word that is out there in the international language that has a meaning, and the Department is trying to borrow a piece of meaning that they want, which is the flexibility for new information later, and asking for some flexibility on the part of the regulatory to let me get by, because it's going

to get better. And I think you've heard some of this before.

Now, if you go back to a couple documents that I've been referring to also, go back to like the original 1980 EIS that selected geologic disposal. In there, there are some things that are, you know, expectations that might lead to people's view that the site might be safe. And they're very simple things, they're broad, but they're really foundational to geologic disposal.

And, for instance, in the final environmental impact statement, and I've read these to you before, but here we are back in another context, that's all, geologic barriers are expected to provide isolation for at least 10,000 years after the waste is emplaced, and probably will provide isolation for a millennia thereafter.

Engineered barriers are designed to assure total containment within the disposal package during the initial period, during which most of intermediate live fission products decay. The period might be as long as a thousand years.

Tectonic stability and non-communicating hydrologic regime combine with rock properties to maintain repository strength and isolation integrity.

Now, these are the foundations of geologic disposal. And without further discussion, I ask you to compare that list in the safety strategy to where we're

going, or where the EIS said that we should be going, and see if we're talking about the same thing. And I think you'll find there's some disparity.

The Department, back in 1985, did its mission plan, and it wrote its mission plan indicating that the Nuclear Waste Policy Act had been written based on the 1980 EIS and its findings. So, we had the establishment of geologic disposal as national policy. And then DOE, reading this, states in their 1985 mission plan, which really was intended by Congress to be the blueprint for all things into the future, how the Department was going to carry out this assignment given them by the Nuclear Waste Policy Act.

And just a couple short statements from there. "DOE intends to place primary importance on the capabilities of the natural system for waste isolation. In evaluating the suitability of sites, the use of the engineered barrier system will be considered to the extent necessary to meet the performance requirements specified by the NRC and EPA, but will not be relied on to compensate for significant deficiencies in the natural system." That's 1985.

So, I guess just one final point that I heard this morning from Margaret Chu, and that's in response to the question about--or the observation that maybe the program has not been putting enough reliance on the natural system, so, therefore, the engineered barrier looks like it's vastly

overshadowing the natural system and its capabilities.

Well, first of all, I think that the site hasn't changed. It's only people's perception of how they want it to look. So, in the case of giving more performance credit to the natural system, the example, when there was a question, the example was, well, maybe we've been too conservative about the saturated zone. And that came up when there was a question about, well, if you get more reliance on natural barriers, does this somehow affect cost.

So, if you put more reliance on the saturated zone, what that means is maybe you can put less reliance on, well, the drip shield she already said may go away, and we heard other evidence today that suggested probably they will, but if you put less reliance on C 22, well, maybe you can use less C 22. So, you can cheapen it up that way. But at what cost? At what cost is on paper, you're putting more reliance on the saturated zone.

But what that's doing is it's putting more reliance on such things as dilution in the 18 kilometer dilution zone that's out there, saying that dilution will take place more than we expected, or more than we want to account for in a conservative way. It also takes in diffusion, takes in matrix diffusion, and all of these things that have come and gone in the program, and they keep recycling as they're needed.

So, in the desire to get away from the I believe correct allegation that the site for a repository relies extraordinarily highly on an engineer barrier, or a system of engineer barriers, in order to get away from it, what you do is you actually put further at risk the person that you're trying to protect.

So, anyway, this is sort of an unwinding of the confusion part that I saw growing this afternoon. And tomorrow, when I talk about staging, I'll say a little bit more about what's wrong, from my perspective, what's wrong with the concept of phased licensing, which is a form of staging.

As usual, I'm sure you have questions.

PARIZEK: Board members? Jerry?

COHON: How would you advise DOE to create a safety strategy or a safety case? What do you think a safety case should include, and how should they go about creating it?

FRISHMAN: It's too late. Claudio described what a lot of people have put into thinking about what a safety case might be separate from a safety analysis report, as we have in our regulation. And, for Yucca Mountain, it's too late. There isn't any way that we could go back and try to make this site a safer site. We know enough about it.

If that process had been followed, and if it had been overlayed with Margaret Chu's approach to let's get some

science on this thing that is sort of ongoing and tells us about such things as, you know, how to build confidence, real data which helps build confidence, and using scientific approaches to looking at such things as model uncertainty, then if we were starting at the beginning, I think we could lead to a safety case that had meaning.

But as it stands right now, you can't make Yucca Mountain itself any better than it is, and from our perspective, it's unacceptable as a repository, and you can call it a safety case, you can call it anything you want, but the site itself doesn't provide what many of us over 20 years ago thought we needed to have before we could get to a safety case.

COHON: I'm still processing what you said.

As I listened to Dr. Pescatore's presentation, I did not interpret that to--well, let me start a different way. I understand what you're saying to mean that because of the heavy reliance on the package and less on the site, that a safety case for the site cannot be created. And if that's one valid interpretation of what you said, my response to that is from listening to Dr. Pescatore, it didn't sound to me like a safety case was just related to the natural system, it was for the whole system.

FRISHMAN: Where it's too late, the information about the natural versus the engineered barrier has sort of led me

to the it's too late, because the part about the international approach to the safety case that's important is that it provides the flexibility to make sequential decisions, and we're beyond that.

You know, we have a sequence of decisions, but the information, and in the international case, the presumption is that you have a sound enough basis to make a decision to continue, and we're past that. The decision to continue has already been made by the implementer, and so now the only decisions left are a primary decision by the regulator, and a primary decision by the regulator that we know is going to be based on information that is different and more favorable to the site than even the site recommendation. So, we already missed the next step in terms of taking a decision and then looking at the information for the next.

The Department is already exercising this flexibility to give more, and what they then want to do is carry on with the approach of the international program with its flexibility, where they want to for receive and possess, they want to grow on what they provided to the regulator at the construction authorization level. And they're relying on being able to grow on that, because they want to be able to make a better case, because they're concerned, and they rightfully are concerned, that their first case may not be good enough.

COHON: Thanks.

PARIZEK: Dan Bullen?

BULLEN: Bullen, Board.

Actually, you just answered my question, but I want to make sure I get this point correctly. One of your criticisms was that during the performance confirmation phase, you're going to gain more information. And I guess the question that I had was regardless of whether or not you had the right safety case at the beginning, if you gained more information, that would be a valuable piece of information. But what you're saying was that the site wasn't suitable to begin with, or excuse me, the site wasn't safe within whatever regulations to begin with, and so now gaining more information isn't going to make it more safe, even if I, you know, increase my confidence.

I was a little bit confused, because I looked here and said, you know, my question is do you think performance confirmation will make PA look worse, and I guess the follow-on is, you're predicating on the fact that the site is not suitable to begin with.

FRISHMAN: Right. And performance confirmation could make it look better or worse, but recent history shows that it's more likely it will make it look worse than better.

BULLEN: Okay. And, so, you're predicating the safety case on that DOE needs to make their case right now, that

they've got enough information, regardless, I mean, enough information that the site is safe, and not base it on a promise of future research or future information or future performance, it should be safe now?

FRISHMAN: It should be safe at the time of site recommendation. But that's behind us. So, now what I'm saying is DOE must, if the program is even getting to a license application, which it may not, but DOE must make its case at the time of its license application, the case that should have been made and that has been missed, but that's lost. But the next place where they have to make their case is at the submission of a license application for a construction authorization.

BULLEN: Okay.

FRISHMAN: And that case must be as good as they think it has to be to get a license for disposal.

BULLEN: Okay. Well, I would argue that they would say it's safe enough now because it's as good as it has to be to make this suitability determination. But you disagree with that?

FRISHMAN: Well, that's back to the 90 day question. The Act intended that there be a license application submitted 90 days after site recommendation, which implies very strongly that it was intended that the information used for site recommendation would be essentially the same

information about the safety that is used in a license application. The Department has chosen not to go that direction because they've chosen only to follow the parts of the schedule that they wanted to.

BULLEN: Okay. Actually, a point of clarification. I think Bob Card said this morning that was meant to not delay it, right, as opposed to drive it forward? But one of the other. I guess I'm confused about the 90 days in the law, too.

FRISHMAN: Everything in the Waste Policy Act is meant to not delay.

BULLEN: Okay, thank you.

PARIZEK: Board questions? Dave Diodato, Staff?

DIODATO: Yes, the questions were asked and answered. Thanks.

PARIZEK: Any other questions? We have a few minutes ahead of schedule, so, one, did anybody from the staff have any questions at all for Claudio Pescatore? Because we didn't allow them to ask him questions, and we allowed him to ask a question. Leon Reiter?

REITER: Yes. Claudio, you mentioned there were other safety indicators. Can you give examples of some other safety indicators aside from performance assessment that are used in different parts of the world?

PESCATORE: Well, I can. The latest study that we are

going to publish officially, but it already available, so I can give this to you, there is a list of multiple safety indicators, and at least multiple lines of reasoning. There's about ten here. I can read some to you if you wish.

People have indicated the following. The comparison of dose rates with natural background radiation levels is one. Two, corrected dose calculation. Three, calculation of radionuclide fluxes from various bodies to illustrate the relative effect in the release of different radionuclides. Four, comparison with radionuclide concentrations at selected points with naturally occurring levels. Assessment of chemical toxicity impacts by comparing estimated concentration with naturally occurring concentrations with the environmental increment, and so on.

So, these are a few. Calculation of the current evolution of selected radionuclides in different components of the repository system. So, there's a few. People have come up with some of them. And I guess if they're written here, it means that one program or another has used these different indicators.

REITER: Just a followup, Claudio. Have these listed in these international countries, are they like criteria? Say dose requirement and also at least some sort of other safety indicator, or are they just as background kind of information? How are they used?

PESCATORE: I would say that they are used, besides the primary indicators, the implementers use it to show additional assurance, and the regulator uses them for additional assurance. It may be possible, but I would not really bet my house on this, is that some new regulatory regimes, which are coming up, are requesting for more than one, in fact, but I would have to check on that.

For instance, probably the Canadians are coming up with something new right now. They're revising the regulation. They may be asking for more than one. And the Swedes also. But, again, I'm not totally sure about this.

PARIZEK: Thank you. That's I think the end of this session, and I want to thank each of the four speakers. I'm sorry? I'm sorry.

MC COMBIE: I'd just finish the day with a question that nobody has asked all day, but it's still in the room. It sits in the room. It sits like a cloud over everybody here. It has to do with the connection between the site and suitability, license application and safety case, and how they fit together. One is the safety case will be updated. It should be good enough for the whole system in the beginning. I think that's clear. You should be clear. If you're not sufficiently confident that the whole system will be safe for the total foreseen event at the beginning, you shouldn't be doing the job.

If you do the job and you get a total system which is judged by the NRC to be safe, you then continue with the science program, which we've heard about a lot this morning in particular. And then there seems to be like two schools of thought. In some people's head, there's a thought that the science program can only bring good results. It can only make you feel more comfortable. It can only bring confirmation, and so on.

But, of course, in the real world, the thing that's worrying lots of people I guess is the worry that the science program will bring negative results, maybe not now, maybe in ten years, maybe in 100 years.

And then the big question that nobody has asked, what if the results are so negative that your site suitability determination turns out to have been the wrong decision? That's the big question.

Now, we heard from Rob Card that we should be looking at scenarios with probabilities of, I don't know how many zeros, but that's the kind of open question--that's the kind of question that people get asked all the time, internationally and the whole world, and I'm sure you get asked it here. And what I'd like to hear is one from the DOE side. How do you answer the question when somebody in Nevada comes and says what if in 50 years time, all these marvelous new science shows that Steve Frishman, who probably be around

then, was right and we shouldn't have picked it? What do you tell them?

And the second part, just to make sure you're not the only one on the hook, I'd like to hear from Steve Frishman what he thinks to the answer.

DYER: I think the key to this is making sure, we can call it steps or stages or phases, that no decision point, no action that you take is totally irreversible. I mean, our current concept of a repository is that you could have an operating repository, and at some time in the future, decades, perhaps a century in the future, if it's still operational, and if you determine that there is some fatal flaw about your understanding of the system, whatever that might be, you can exercise the option to take everything out of the repository and do something else with it.

Now, we don't know right now what that something might be. But you'd have to make a risk-informed decision as to whether taking it out and doing something with it poses a greater risk than leaving it there and experiencing whatever bad thing you've become aware of.

So, I think the concept of reversibility and retrievability is central to the concept of a repository system and building confidence in the idea of a repository system.

PARIZEK: Again, I want to thank all the speakers for

our stimulating afternoon. Oh, Tim, you had a question or comment?

COHON: Tim. And we invited Steve, or Dr. McCombie invited Steve to react. So, Tim, go ahead, and then we'll ask Steve.

MC CARTIN: Just one quick thing. Tim McCartin, NRC.

DOE isn't there by themselves. NRC is the regulator, and they're required in the regulation, if they learn anything that suggests the decision, the performance assessment is changed by information they have learned, they are required to report that to the NRC. And, so, it's not just, I guess I wanted to clarify that, it's not the DOE sitting there by themselves. The regulator is looking over their shoulders. During operations, we certainly inspect and we audit what's going on.

And, so, in addition to the DOE, there's an NRC looking over their shoulder for that if there's any information that comes forward.

FRISHMAN: I guess it puts me in the terrible position of having to talk about trust, because that's where Russ's answer takes us. We have to believe that a decision about retrieval will be made at an appropriate level of understanding of the risk. And I guess all we can say is that we don't see any history that would support that type of a decision.

In fact, we see things going the other direction, and I'll give you just the most recent example, which is the current proposal to grout the bottoms of the tanks at Hanford instead of remove all of the waste and glassify it as it was originally suggested. And that's based on a risk and cost decision for Hanford workers as much as anything else.

Oh, I guess there's discussion at INEL, too, about the calcion just being put in a container. So, you know, through time, the last thing that we in Nevada are going to do is rely on DOE 50 years from now, or their successor, making a decision that is based on values that they violated in the beginning. And 50 years from now, there isn't going to be a waste fund. One of the reasons that we predicted all along that there would never be a drip shield is because once the waste fund has run out, can you imagine Congress over a ten year period putting up $8 billion for something the Department itself says is defense in depth, which is essentially cosmetic in this case? It isn't going to happen.

So, it's hard to conceive of them finding anything in the repository in 50 years, just as one of the questions was earlier today, that would be so compelling about the future performance assessment that they'd want to undo 11,000 containers in a repository, or 17,000 containers, when they have no place to take them.

So, you know, I can't read the future any better

than anyone else, but I can tell you we would trust DOE to make a risk based decision to leave it there.

COHON: Dr. McCombie, you raised an interesting specific question, though, and that's the distinction between a suitability determination and a license application. And we've never had a good distinction between those two things. That is in the law and in the regulations, in the program. It's always been rather fuzzy. The things we know for sure are that the LA has to come after the SR. The SR has to come before the LA. There are times indicated in the law, as we've heard.

But the most reliable definition is if the President recommends it and the Congress overrules Nevada's veto, then it's suitable. Which is very unsatisfying, especially when you're talking about decision criteria, degrees of uncertainty, levels of confidence, and I'm just going to repeat my tirade if I go any further. But that is a real issue.

I don't mean to embarrass you, but you've probably been told you resemble a certain Scottsman who was the founder of a certain university in Pittsburgh very much. It's kind of spooky, folks. I have a full sized portrait in my office of one Andrew Carnegie, and I look at this guy every day, every morning.

The only person who signed up for public comment is

Don Shettel, and I'll call him forward at this time.

SHETTEL: I'll change the subject somewhat here. But DOE has long studied the high temperature option for the repository design, and we heard this morning that they believe that this is a licensable option.

The problem with this is there's large thermal gradients in the near-field environment, and I've talked about this many times over the past more years than I care to remember. But this leads to significant mass transport in this thermal gradient, and this is very difficult to model. As we've seen, we can get refluxing zones above the repository, boiling condensation fluid, and heat pipes.

This leads to changes in porosity and permeability in these zones. If you look at any of the models I believe that DOE has shown on the hydrogeology, they show no changes in porosity and permeability when they model this region.

Part of this problem may be that you can't model this with isothermal equilibrium type models, such as EQ 36 and other higher level models that include this as a component or module. You really need to use irreversible or non-equilibrium thermodynamics. This requires perimeters that really can only be determined by experiments. They're not very amenable to prediction. And, also, any changes in the systems that you make require that you redo the experiments, because the perimeters are essentially empirical

and not predictable.

And, to support these accusations, such as they are, I offer to the Board, just in case they haven't seen it, a reprint of a paper by Sun and Rimstidt on silica transport and thermal gradients recently published in February in the Journal of Environmental and Engineering Geosciences.

COHON: Thank you. If you'd give that to Bill?

Thank you, Don. Is there anybody else who would like to comment or ask a question? Go ahead, Judy.

TREICHEL: At the risk of earning the Sally Devlin Award, Judy Treichel, Nevada Nuclear Waste Task Force.

I find tremendous contradictions between just the presentations that we had this afternoon. In the one that Tim McCartin did, he made the statement that it was hard to document a safety case as complex as that at Yucca Mountain.

And then we heard from Ron Ziegler that they're going to have a safety case. It will go with the license application. And it will be available to other parties to the licensing proceeding, and we've been having major debates about whether or not the public will be a party. And it's very clear that they will not.

And, so, now it's being said that the safety case is so complex that possibly one would be written in regular language. And I find that really, really difficult, because there's a whole lot of terminology that's used in these

meetings that the public would have a real hard time with, that are difficult to understand. And I've had to be here a long time to get most of this.

But safety is a word that they really don't have any problem with. They know exactly what safety is. And when Claudio was speaking, he had one slide that isn't in the presentation about the definition of safety, and the public knows what that is. They know what they expect. And their expectation isn't something that's very difficult to document, and it isn't something that may or may not be available to them in its first iteration when it's very technical and may be written later.

So, something is really strange here, and it seems as though we're back to the cart and horse thing, because Claudio had said a safety case is required as a basis for making decisions. Well, an awfully important decision has already been made, and it's possible that other important decisions will be made while safety decisions, or safety determinations, or even definitions, are being put off.

And Claudio also said that a safety case is what society wants, and what we can do. So, that's pretty easy, and that shouldn't be hard, and you should be able to have something that's down on paper that people can see and they either say it's acceptable or it's not acceptable, it reasonable or it's not reasonable. But, to me, it represents

safety, and we don't have anything like that.

Thanks.

COHON: Thank you. Charles?

FITZPATRICK: I'll probably be quick. Charles Fitzpatrick, Egan and Associates.

I had a comment about the issue of timing. Certainly I wasn't going to argue with Under Secretary Card this morning, but the suggestion was made that the recommendation was made when it was made this year as opposed to 90 days before license application will be ready in 2004 to keep the process moving, to not delay.

Well, if the license application isn't going to be until December 2004, whether you recommend the site this past February, or whether you recommend the site in the summer of 2004 when some more questions posed by the Board have been answered, does not slow the process. The license application still sticks at December '04.

And as far as I think he also suggested that keeping the process moving is more important than meeting the individual statutory deadlines, and gave an example that the January '98 deadline for having a repository ready was exceeded, has obviously been exceeded, but that's less important, this 90 day deadline is less important than keeping the process moving.

I would only point out that courts have already

found damages to utilities in excess of $10 billion, payable by DOE, for missing that '98 deadline, and estimates run over 50 billion as to what that exposure will be before it's over.

So, when statutory deadlines are sacrificed and not met, there are legal consequences, and DOE has met them.

The second thing was just a question for Tim McCartin. Tim emphasized that there must be multiple barriers, even suggested that even if the waste package were shown to be effective for 100,000 or indefinitely, nonetheless, there would still be a requirement for multiple barriers.

And in the NRC regulation 10 CFR 63, there indeed are at least two requirements that I've seen. One to describe the multiple barriers in one place, and another to I think analyze the contribution of the multiple barriers.

But what I do not see in 10 CFR 63, and I have not heard, is any minimum quantification or qualification of what contribution needs to be made by any of the barriers. So, using that hypothesis, okay, make believe that DOE demonstrates that the waste container will last 100,000 years, and then the assessment turns to multiple barriers, what, if anything, must be shown as far as the level of contribution of any of the barriers. To describe it really is meaningless. To assess its contribution can be meaningless if the answer is insignificant contribution.

So, although the regulation 10 CFR 63 uses words, redundancy, defense in depth, multiple barriers, I don't understand what NRC will literally look for beyond compliance with the dosage requirement, if that can be met by the waste container. And I guess that's my question.

MC CARTIN: Yes, that's correct that there is no quantitative limit for the performance of particular barriers. The NAS recommendations for Yucca Mountain standards cautioned against using any type of sub-system, quantitative sub-system requirements. The Commission took that recommendation from the NAS seriously.

We did get comments during the comment period during the proposed 63 to suggest using a quantitative value. The Commission evaluated that. Ultimately, the Commission felt no, they would leave it qualitative.

The capabilities of the barriers need to be described, and that is the only requirement in the rule. So, we would have the quantitative information of what the barriers are doing. There is no requirement for contribution to a dose, per se.

The Department needs to describe those capabilities. The barriers were defined as having a significant effect on affecting the movement of water, of the contact of water with waste, or the movement of radionuclides or water. And, so, that would be the context of that

description.

It was a Commission decision. In terms of can there be an insignificant contribution? I would say quite clearly no. The rule is very clear. It has to be significant. What that level is, the Commission, by leaving it unstated, it will be in a licensing hearing. And that information will be presented to a licensing board, and it will be decided at that time.

COHON: Thank you. Any other questions or comments?

(No response.)

COHON: We thank you all for your comments and your participation. I thank all the speakers and all the Board members who acted as Chairs today.

We reconvene tomorrow morning at 8 o'clock in this room. We're adjourned.

(Whereupon, at 5:08 p.m., the meeting was adjourned.)