UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

REPOSITORY DESIGN UPDATE

PANEL ON THE ENGINEERED SYSTEM

January 20, 2004

Crowne Plaza Hotel
4255 South Paradise Road
Las Vegas, Nevada 89109

NWTRB BOARD MEMBERS PRESENT

Dr. Mark Abkowitz
Dr. Daniel B. Bullen, Afternoon Chair
Dr. Thure Cerling
Dr. David Duquette, Morning Chair
Dr. Ronald Latanision, Chair, Panel on the Engineered System
Dr. Priscilla P. Nelson
Dr. Richard R. Parizek

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P R O C E E D I N G S

8:00 a.m.

LATANISION: I'm Ron Latanision, and I Chair the Board's Panel on the Engineered System. It is my pleasure to welcome you this morning to a U.S. Nuclear Waste Technical Review Board Panel meeting, Panel on Engineered Systems meeting.

The last meeting of this Panel was eleven months ago, when we had a joint session on Seismic Issues with the Board's Panel on the Natural System literally a few blocks from where we are this morning. This is the first meeting of the Panel since I became its Chair.

I'm going to introduce the Board members and preview today's meeting in just a minute. But, I do have a few personal remarks to make about some recent events that do affect the Board.

You are all aware that the Board's Chairman, Mike Corradini, tendered his resignation to the President three weeks ago, effective Monday of last week. I have known Mike for many years. We both held appointments in nuclear engineering departments, Mike at the University of Wisconsin, and I at MIT. He, of course, studied at MIT, and I've always enjoyed my association with him on both a personal and professional level. I expect that our paths are going to cross again in the future on many occasions, and I look forward to it.

Mike gave the reasons for his resignation in a personal letter to the President. The letter has been widely reported in the press, and it is available on the Board's website. The letter speaks for itself, so I will really have nothing more to say about the circumstances of Mike's decision. I do want to say, however, that I really do commend his decision, because in the final analysis, it was for the good of the Board, and I do respect his decision to move in that direction.

Since this is the first public meeting since Mike's resignation, I should also explain how the Board will function in the absence of a Chair. The Board has an executive committee. The committee consists of Dave Duquette, Mark Abkowitz, and Norm Christensen. Dave chairs the committee and, as such, acts in the absence of a Chairman. I've known Dave for a long time. We literally finished our Ph.D. programs in the very same time period, back a few years ago. Maybe more than a few years ago. He's older than I am. I've known Dave for a long time. He's a terrific leader. And, there are some administrative functions, however, that by law can only be performed by the Chair, and having the authority of a Presidentiallydesignated Chairman is obviously something that is necessary. We hope the President will designate a Chairman reasonably soon. In the meantime, the lack of a Chair will in no way hamper the Board's carrying out any part of its mission regarding scientific or technical issues that are of interest and concern to us.

Paul Craig has also resigned recently after seven years of service on the Board. His resignation was effective yesterday, and I believe his letter to the President is also now on the Board's website. I did not really know Paul before I joined the Board 18 months ago, but I have enjoyed working with him as a member. His special perspective and inquisitive mind were clear to all of us from the beginning of our association. I will miss that, and I will miss him. We valued Paul's contributions and commitments to the Board's activities.

As many of you know, the Board was created in 1987 in amendments to the Nuclear Waste Policy Act. Congress established the Board as an independent federal agency to evaluate the technical and scientific validity of the activities of the Secretary of Energy related to the disposal of commercial spent nuclear fuel and defense high-level waste.

By law, the Board reports its findings, conclusions and recommendations at least twice a year to Congress and to the Secretary of Energy. The President appoints Board members from a list of nominees submitted by the National Academy of Sciences and designates a member to serve as its Chair. The Board is, by law, as well as by design, a multi-disciplinary group with a range of expertise. A full Board consists of eleven members. There are, of course, three vacancies at this point.

Now, let me introduce the members of the Panel on the Engineered System and the other Board members who are here today. Let me also remind you, before I do that, that we all, all the Board members, serve in a part-time capacity. We all have day jobs. In my case, I am a principal at a venturing consulting firm, Exponent, as well as a Professor emeritus of Nuclear Engineering and Materials Science and Engineering at MIT. My interests of expertise include materials processing, the corrosion of metals and other materials in aqueous and non-aqueous environments.

Now, members of the Panel on the Engineered System are Dan Bullen, Dave Duquette, Priscilla Nelson, and myself.

Dan is from the great state of Iowa, which spoke loudly last night for Massachusetts news. He is on a leave of absence from the Mechanical Engineering Department at Iowa State. He joined the Chicago office of a firm that I know very well, Exponent, at the beginning of this month. His areas of expertise include nuclear engineering, performance assessment, modeling, and materials science. Dan chairs the Board's Panel on Repository System Performance and Integration.

David Duquette is Department Head and Professor of Materials Science at Rensselaer Polytechnic Institute in Troy, New York. His expertise is in physical, chemical, and mechanical properties of metals and alloys, with special emphases on environmental interactions.

Priscilla Nelson is Senior Advisor to the Directorate for Engineering at the National Science Foundation. Her areas of expertise include rock engineering and underground construction.

There are other Board members present for this Panel meeting today, Dick Parizek, Thure Cerling and Mark Abkowitz.

Mark, the casual member--I have to tell you the airline has not delivered Mark's luggage, so despite his California outlook, he is normally more formal than that. Mark is a Professor of Civil Engineering and Management Technology at Vanderbilt University in Nashville, and is Director of the Vanderbilt Center for Environmental Management Studies. His expertise is in the areas of transportation, risk management and risk assessment. He will Chair tomorrow's meeting on Transportation Strategic Planning Considerations.

Thure Cerling is Distinguished Professor Geology and Geophysics and Distinguished Professor Biology at the University of Utah in Salt Lake City. He is a geochemist, with a particular interest in applying geochemistry to a wide range of geological, climatological, and anthropological studies.

Dick Parizek is a Professor of Geology and Geoenvironmental Engineering at Penn State, my undergraduate alma mater, and also President of Richard Parizek and Associates, Consulting Hydrologists and Environmental Geologist. His areas of expertise include hydrogeology and environmental geology.

The only Board member not here is Norm Christensen. He may arrive later this afternoon, but certainly will be here for tomorrow's Panel meeting on the Waste Management System. For your information, Norm is a Professor of Ecology and former Dean of the Nicholas School of Environment at Duke University.

At the side of the room on the right-hand side from your perspective are the staff of the Board. I expect the staff will be actively involved in our deliberations today, and, so, you will certainly hear from them as we proceed.

So, let's now turn to today's meeting. Let me first tell you that this is not a meeting focused on two very important documents that were released by the Board during the fall. This is not a meeting which addresses the issues related to corrosion of the waste package. We submitted in October, a letter and a white paper a bit later in November, that addressed some of the Board's concern about corrosion issues that we would like to have discussed. The project, DOE is studying our reports and our letter, and we expect that they will finish their evaluation sometime in February. We're hoping for a March meeting on that subject. But, that is not the subject of conversation today.

The theme of today's meeting is design, and in fact a design update, and we have a number of interesting presentations scheduled. First, we'll hear from John Arthur, the Director of the Office of Repository Development, who will update us on the status of the project. We are really looking forward to this, since it is the first Board meeting since the passage and signing of the fiscal 2004 appropriations for the program, which gave the program a very substantial increase.

We will then hear an update on surface, subsurface and engineered barrier system designs from Paul Harrington. We understand that there have been several changes, and we are anxious to hear about them, as well as general progress of the design of the repository.

After lunch, we'll hear more on the design issue, this time, input from a representative of the Nuclear Energy

Institute regarding the proposed surface facilities at Yucca Mountain. I anticipate that this will be a very interesting discussion, because of the need to view the waste management system as a total system.

In the past, the Board has heard much from Nye County regarding their activities, and particularly on the subject of Nye County's Early Warning Drilling Program. Nye County, however, also sponsors other technical investigations, including work on the engineered system itself, and this afternoon, we will hear about some of that work. This will be followed by an update from Bob Budnitz on the Office of Civilian Radioactive Waste Management's science and technology program. The last time Bob talked to the Board was in May of 2003, and, once again, we understand there have been a number of developments in the science and technology program that are of interest to us.

This is a Panel meeting, and not a meeting of the full Board. Panel meetings, in general, are more focused on particular topics and less formal than Board meetings. Normally, we do not solicit questions from the audience at full Board meetings. Today, time permitting, we will, after the Board and Staff have their opportunities to address the speakers, we will make such time available. The Board does value public participation, so we have given the public a variety of ways to comment during this meeting. We have set aside time for public comments before lunch, and then again at the end of the afternoon. The period before lunch is intended for people who, for one reason or another, cannot wait until the public comment period at the end of the day. Some people may simply not be able to stay for the entire program. If you would like to speak during these times, please add your name to the sign-up sheets for public comment at the registration table where Linda Coultry and Alvina Hayes are located.

If you, Ladies, would just raise your hand so they'd know where to find you? In the back of the room right at the entrance.

Most of you who have attended our meetings know that we try very hard to accommodate everyone, but as you can see, as usual, we have a relatively tight agenda and a fairly long day. Depending on the number of people who wish to speak, we may find it necessary to limit the time for those presentations. But, as always, we welcome your comments, even to the point of written comments following the meeting if time does not permit you to speak.

These Board and Panel meetings are spontaneous by design. Board members speak quite frankly and openly about their opinions. But, I have to emphasize that when we speak, they are our own opinions, and we're speaking on behalf of ourselves and not on behalf of the Board. When we do articulate a Board position, we will, of course, make that very clear, and Board positions are typically stated in letters and reports, and they are available on the Board's website.

So, having made that disclaimer, we're now ready to introduce our first speaker. Before I do that, I should mention there are a number of people in the audience who will not be speaking today, but who I'm very pleased to see. One, of course, is Margaret Chu, who is the Director of the Office. Margaret is here, and has raised her hand in the front row. I'm sure she is known to everyone in this room. But, Margaret, we're happy to see you today.

Let me now introduce our first speaker. John Arthur is the Deputy Director of the Office. He leads the Office of Repository Development, ORD, which oversees the development of the Yucca Mountain Repository. John has more than 23 years of experience of DOE in environmental restoration, waste management, and nuclear related programs, including uranium mill tailing remedial action project, the Waste Isolate Pilot Plant, and others which I'm sure you are very familiar with.

John, it's a pleasure to have you back with us. Welcome, and the floor is yours.

ARTHUR: Thank you. Good morning, and also a welcome to all the members to Las Vegas.

My objectives today are to provide a brief summary of our overall project status, as well as discuss some specific topics and issues associated with the repository licensing and operations.

Our current high priorities remain submittal of a high quality license application to the Nuclear Regulatory Commission in December of 2004, this year, including completion of all the necessary design work and demonstration of an operating environment that's appropriate for an NRC licensee. Also, a principal goal is also beginning of repository operations in 2010.

I want to start today by first talking a little bit about some management organizational areas, and then I'll get into licensing and our overall program.

Right now, inside the Department of Energy, we're finalizing the necessary documentation of the designated, my position as the signator of the license, as well as the Chief Nuclear Office for the Operations, and also certifying official for the license support network.

A couple changes that have occurred since our last meeting. I had Ken Powers join our Office of Repository Development. He's my associate. The Deputy Director, Ken, could not be here today. He's running the work over at our office, but he has 29 years of management, business and financial experience in the National Nuclear Security

Administration, and other DOE offices, as well as strong contract management experience. His most recent position was Deputy Manager of Nevada Operation Office here at Las Vegas.

Also, Dr. Russ Dyer was appointed as my Assistant Deputy Director of Technical and Regulatory Programs. This now allows Russ to focus on the critical defense in depth of our license application, key scientific programs, and other expertise required for a defensible license.

In the areas of program management, we were very pleased, Margaret, myself, and all of our program members, of the appropriations for this year, the $580 million allocated from Congress, of which $404 million is associated with the repository project. That's the design, the various experimental programs, and the license activities, very adequate funds available still to maintain our December '04 license submittal.

Areas of goals for this year with the license, we have critical areas coming up would be license design complete, and the preclosure safety analysis in the spring time frame. And, then, if you move, this is on the upper right, the total systems performance assessment, as well as the license support network initial certification, and that's a major goal. All the necessary documentation would be certified in the June time frame, which would be six months prior to license application submittal to NRC.

If I could have the next exhibit? We also, on December 23rd of last year, announced our preference for the Caliente rail corridor for construction of a rail line to serve the Yucca Mountain repository if the NRC authorizes repository construction, and issues an operating license. The Carlin Route, which is the one that comes in from the top down through Crescent Valley and joins in on the northwest part of the site, was identified as the second and backup choice.

Having now identified the preferred corridor, we intend to proceed with selection of the transportation mode, and if that is mostly rail selected, the actual selection of the rail corridor. This would be followed by development of an Environment Impact Statement on the specific alignment within the selected corridor.

In tomorrow's meeting, and that's most of the meeting topic, Gary Lanthrum will provide more information and answer any questions on this important subject.

Now I'd like to talk a little bit about progress towards the license application. At this time, we estimated just a little over 50 per cent complete of the work needed to submit a license application, and still a lot of hard work to occur this year. Our current focus in the project is completing all of the analysis and modeling reports, and ensuring consistency and integration across all of the analysis and modeling reports. So, a lot of these individual models, we now are taking a cross-cut look to make sure the foundations are built within and across all of those AMRs.

We are also developing the necessary level design information to support completion of the preclosure safety analysis, and Paul Harrington will be talking on that next.

Other critical areas and equally important to all the above is to make sure that all the data of the models and the software meet the necessary qualifications and verifications required in our quality assurance requirements document.

In the area of key technical issues, we have revised our approach and schedule for completing the KTI agreements, and it is the plan by September of this year, to have addressed all of the necessary KTIs that are required in order to support the license application. We're currently using an integrated approach to address groups of agreements in the context of the relationship to overall system performance, and to accelerate submittal of this information to the Nuclear Regulatory Commission.

We have technical basis documents which are being developed to describe the physical processes and technical basis relevant to evaluation of performance. There are no plans to update these documents, since the technical basis for licensing will be presented in the license application and its supporting documents, which are the AMRs, analysis modeling reports I talked about earlier. The Board is on distribution for the technical basis documents, and all KTI agreement responses sent to NRC.

The overall 293 agreements, we have submitted 213 agreement responses to date. Out of these, NRC considers 82 complete, and another 87 are currently under NRC review. The remainder are in a position where we're actually providing additional documentation analysis back to the Nuclear Regulatory Commission. All but one of the remaining 124 agreements, which include additional information needed by NRC, again, will be addressed by September 2004. And, again, if you look at this particular figure, you can actually see the scheduled versus submitted. And, again, earlier in the year, about August and September of last year, we were actually placing these into the new documentation packages, so we fell behind, and then we have a real peak of submittal of about 41 in the October time frame, and we're very sensitive to this because we know our regulator has limited resources, as we do, so we're trying to balance out the workload to match what they can review also. It's a big challenge we have again coming up as we get into March and April of this year.

You obviously asked a question, and might save a question until later is why do you have a big down time in

January and February? And, again, a lot of this is when the available analysis and modeling reports, and all the documentation is done and ready. That's what really drives the schedule.

Now I'd like to talk a little bit about multiple staged licensing and phased operations. Bob Card told you, I believe it was in May of last year, we believe that we have the technical capability to license a hotter operating design, but we are committed to maintaining the cold option until technical questions about the merits of each option are resolved one way or the other. We do appreciate the NWTRB Board report that was provided last year, and provided additional analysis supporting your concerns regarding the waste package corrosion.

I can assure you, and our office, since the letter came in and the report, we've been doing a very detailed analysis. And, again, we do look forward to the meetings I think are going to occur in the March time frame. Obviously, in some areas we're trying to strengthen some of the earlier presentations provided. We're also looking at additional analysis and other information that allows us to be responsive, to have a very meaningful meeting in March.

We also continue to work with the Nuclear Regulatory Commission as we proceed with development and evaluation of design for licensing. NRC must ultimately review the basis for the preclosure safety analysis, and the total systems performance assessment, including design information to decide whether or not to issue a construction authorization and ultimately a license.

Our license application will provide a complete description of the design, preclosure safety analysis and TSPA for the entire repository. The level of detail will be sufficient to support a risk informed decision by NRC on a construction authorization.

During construction, the license application will be updated and submitted to NRC for a second decision on issuance of the license to receive and possess waste. To receive a license, construction of the surface and subsurface facilities needed to support the initial phase of operations must be substantially complete.

Construction of surface and subsurface facilities to support subsequent phases of repository operations will take place sequentially and in parallel with ongoing waste receipt and emplacement operations.

The design of the repository will permit it to be maintained and kept in an open condition for performance confirmation and monitoring for up to 300 years, until an application is submitted to NRC for a license amendment and decision is made to permanent closure.

I now want to talk a little bit before I conclude, in the last meeting, we had a lot of discussions about performance confirmation, and also science and technology. And, again, I want to remind the Board that we will be conducting many different kinds of testing programs during repository construction and operations.

Performance confirmation and science and technology are only two of these programs. Other categories of testing and monitoring, mostly which are required by NRC rule, include the following. Engineering test and evaluation associated with start-up, and periodic testing of systems and components. This is required. Monitoring of radiological affluence and radiological exposures required. Research and development to resolve safety questions that may be identified in licensing, required if safety questions are identified. And, also, scientific testing and evaluation that we may elect to perform outside the scope of the performance confirmation and other testing programs. An example of this might be short-term studies such as volcanic hazard studies that would take 12 to 18 months to conduct. Some of these tests obviously will address issues of interest to the Board.

Performance confirmation is a Regulatory requirement defined by the Nuclear Regulatory Commission. This program is required to begin site characterization, the baseline phase, and must continue until NRC authorizes permanent closure. The specified Regulatory purpose of performance confirmation is to indicate where practicable whether surface and subsurface conditions and changes in those conditions resulting from construction and emplacement are within the limits assumed in the license application.

Natural and engineering systems and components required for operations, and design to operate as barriers after closure, are functioning as intended and anticipated. Again, that's another purpose of our performance confirmation. We will describe our performance confirmation program in the license application, and NRC will review it for acceptability.

If you recall, the performance confirmation program, I believe, was provided at the meeting at Amargosa Valley, and we haven't taken a hard look at that program since that time, making necessary changes and modifications to the program. We're currently in the process of refining it, and narrowing it down to absolutely meet the necessary regulatory requirements.

The science and technology program, and Bob Budnitz will be here to discuss that later today, its purpose is to increase understanding of science and technology related to repository development and performance. It will allow us to have better and more efficient repository development and operations, and it's separate and distinct from our licensing activities. The role of the S&T is not to fill in real or perceived gaps or weaknesses in the technical basis for licensing, but to look ahead and allow us better technologies for the future.

I know I've had many discussions with Bob on areas such as future technologies for underground mining. Various types of technical areas, if it can apply, ultimately it will be more efficient as we operate.

I'd like to now summarize. We've had a very busy last year as we transitioned from over 20 years of science and characterization with the repository in towards setting the criteria for a license application, and trying to develop the proper internal program culture to be conducive of an NRC licensee.

2004 is going to be a very busy year. Again, we'll continue our current emphasis on the programmatic and also organizational improvements, continue to complete the necessary documentation of all of our technical basis for submittal of the license application, as well as certifying the license support network in June of this year.

One of the key areas that I should have stated earlier is we're in the process right now of developing the internal management plan for the approval and review of the actual license. That's going to be a very detailed document with a lot of supporting documentations. I want to make sure all the necessary quality assurance is met, as well as all the technical assumptions are met, and also that the license is user friendly for our regulators, so that you could look, for instance, to various sections of Yucca Mountain Review Plan, or 10 CFR 63, and really cross-track into the license to see the applicable sections where we provide our necessary analysis in defense in depth.

So, a lot of work underway. I look forward to the discussions over the next two days with you. And, with that, let me stop and entertain any questions. Thank you.

LATANISION: Thank you, John.

Questions from the Board? Mark?

ABKOWITZ: Abkowitz, Board.

John, thank you very much for the update. It's always helpful to get to learn from your perspective where things are at, and I certainly appreciate the manner in which you've tackled a complex scheduling project, and kept up with performance methods.

My question really comes down to the license application date. I certainly appreciate the upswing in the activity and completion of certain things, but a project of this scale, it would strike me that if you could be king, you would like to have had all of this work done and be in QC mode from now until December, because that's probably the way you would want it to be done. And, so, I'm curious as to the risks, if you will, or uncertainties that, from a scheduling standpoint, that you now face, given that you have all these KTIs that are yet to be completed. They interlock, supposedly, and yet you don't really know what you're getting from one place, and how it fits with another.

And, so, I guess my main question, you can comment on that, but my main question comes down to what exactly would the license application look like in December of '04, and does your client, the NRC, have perhaps a different expectation of what will be contained in that application than DOE does?

ARTHUR: Thanks, Mark. Let me respond to a couple areas. You are correct. I mean, one of the areas that is the biggest challenge right now is taking all of the individual analysis and modeling reports, and doing the cross-integration. And, that particular aspect is proceeding real good.

As far as the Nuclear Regulatory Commission, they actually have been doing a series of independent reviews. They have taken the three, what they feel are the higher risk analysis and modeling reports, and doing what is called a vertical cross-cut. They're looking at actually the assumptions, documentations, and everything supporting that, and they will probably be completing their evaluation and issuing some sort of report, I would assume, in the

March/April time frame of this year.

As we set out the schedules, I always do look ahead, and always felt that about March or April of this year, once we look at where we are on the actual design and preclosure safety analysis, and a few other data points, I'd have a better estimate on the 12/04, and where we actually stand. In fact, I think I mentioned that to the Board at one of the earlier meetings.

Right now, I feel very comfortable. One of the areas we're going to talk about a little, later we've been looking at what our first phase of actual construction with the repository would be. In fact, we had an independent team in actually assisting us in a review last week on that. That could cause some slight slippage in the surface design and completion, but in talking with John Mitchell, my counterpart at Bechtel, we feel we can still, because a lot of that is bounded by previous work we've done, have that in the license.

When you look at the actual license itself, and let me try to frame it a different way. Right now, I'd say we're in the preliminary draft stages. We're continuing to review and make sure the quality is in as we go. Bechtel SAIC will provide a draft license application to the Department of Energy in July of this year, and then we allow that, again, remaining six months to do the necessary reviews and changes.

And, finally, the commitment is that neither Margaret or myself will allow that license to leave the Department of Energy until we're satisfied we've met the necessary quality requirements, and the legal and regulatory basis to submit it to NRC.

LATANISION: Dan Bullen?

BULLEN: Bullen, Board.

Actually, just two quick questions. The first one may well be out of your control, but you didn't comment at all about the recent court rulings, or the recent court case, it's not a ruling yet until maybe early summer, with respect to the Regulatory time period of 10,000 years versus peak dose, and how that might impact the license application process.

ARTHUR: Well, first of all, I probably won't comment because you will hear a lot of--there's many different interpretations as we have people in this room as to what might come out of that. But last week was a very busy day in court for the appeals court. They heard the consolidated cases. It's anybody's guess on when that ruling might occur.

Obviously, there would be impacts to the project should standards be remanded, or other changes. It's clear to me that the license would have to change in a number of other areas. So, again, I would just as soon wait and see what comes out before we try to make guesses. But, it clearly would be an impact on the license and our whole schedule should that happen.

BULLEN: Okay, fair enough. The last question I have basically goes to Figure 4. If you could just go back one, that would be great. This, again, was with the percentages, the plan percentage complete versus the total percent complete, and it looks like you're pretty much on schedule.

My question deals with the second column, is that by the time once this application comes in, will that planned complete be 100 per cent for everything, or will it be a fraction of it with respect to what you're going to have done for license?

ARTHUR: Thanks for the question, because I sort of went through this one quick. I want to cover another point, if I can, Dan.

It would have to be 100 per cent, and obviously, the big question, as well as license, why is it only 14 per cent. Well, that's written as you have the key sections together, so obviously, you would expect that to be behind.

I have also, and the way we look at this metric, this could change, this could actually go down. For instance, the design area that says 56 per cent, again, while we're measuring that, that's the percentage of the actual design that's required to meet the license application for construction authorization. If we go back and make some revisions to that, that number could drop back to 45 per cent. So, we will make adjustments. It doesn't always go up. It can go down also.

The other one that we do not show there that's equally important, and I can't emphasize that enough, is all of the models, all of the datasets and software qualify to meet the quality assurance requirements. That's been a real challenge, one of the internal issues we've had, and it's been recognized by the Nuclear Regulatory Commission when we use unqualified software in models, to make sure that you have the right, what I call, downstream controls to make sure that things aren't finalized. And, we have had issues on that and, again, we're trying to make sure that's tightened up.

BULLEN: Thank you.

LATANISION: Latanision, Board.

John, on the issue of the KTI agreements, my understanding is, and you did comment on this, I just want to make sure I understood it, but my understanding is that the NRC has come back to you with a comment that they feel the technical basis for a number of the KTI submissions that have been made is inadequate or not there, and the project has come back and said, well, the basis is available, but in draft form.

Now, where does all that stand? I mean, what is the resolution of that issue?

ARTHUR: I want to make sure I answer that question correct. We've had a number of letters going back and forth with the NRC on a couple issues. One, the actual documents that we're sending across in all cases did not have documents that were fully in final form to support them. And, if you go back in time, we probably wouldn't have referenced documents to support those KTIs or technical basis documents, if you would. What we've actually done is incorporate the necessary text so they're stand alone. I can't go back and change history, so what we're trying to do now is get the supporting documents final, because NRC will not approve those until such as all the documents are in a final stage and publicly available. So, that's the one issue.

The other area that I see, and, again, I guess that's one of the beauties when you actually look at KTIs and early licensing agreements, prelicensing agreements, as we have, we're learning as we go, both I think the NRC and our agency, and the real issue has been one in some cases, we did not make those user friendly. I mean, we had references in there, and in some cases, the reviewer would have to look at 100, 200 pages in order to conclude what were our writers including. Was it a table? Was it a figure? Was it 15 pages? So, that's one area we've been doing and trying to improve also.

There's issues there, I'll admit it. And, the other point I might make is with the KTIs we've said that we would address all of those prior to the license submittal. We fully don't expect all those to be in approval position by NRC at that time. From that time, a transition is from KTIs into the actual license.

LATANISION: Right. Dave Duquette, and then Richard Parizek.

DUQUETTE: Duquette, Board.

John, at our last meeting, and again at this meeting, you have reaffirmed the concept that if the license application isn't of a quality you would like it to be, you could perhaps delay its submission. However, it's my understanding that the 12/04 submission date was really set at the highest levels in the Department of Energy. You've got an election coming along that might change some of the leadership in the Department. Even if it doesn't, you think that you and Margaret have enough, I'll use the word, clout to convince the Secretary that it should be delayed if you think it's necessary to be delayed?

ARTHUR: Well, first of all, we do regular internal meeting summaries with the management above Margaret and I in the Department on a regular basis on percent complete. We talk over many of the internal issues here, but, again, I haven't given up on that date, nor has Margaret yet, but I do believe that if we have enough reasons and justification for that, we could support that. Again, we'll have to watch closely where we are, because there are a number of things going just perfectly well, and there's some internal issues, and, again, I'd say about April of this year, we'll have a lot better estimate.

DUQUETTE: Thank you.

LATANISION: Richard?

PARIZEK: Yeah, Parizek, Board.

Would you elaborate a little bit more about the confirmation testing plan. We heard a rather detailed discussion from Debbie Barr in the May time frame, and now you're sort of revising. Can you give a sense of the nature of revisions, or the time frame for producing a document that shows those revisions? Because I guess that's required at the time of the LA.

ARTHUR: That's correct, and I'm going to have to get some help from my staff. I didn't actually--maybe Claudia or someone can help me on the actual date when we'll have our revisions to the performance confirmation plan. But, what we've been actually doing is taking a hard look. I think some of the comments we had at first were it was a good plan, but it had too much details. We're trying to look at those that are absolutely required for performance confirmation, and that's the revisions that are underway internally now.

Claudia?

NEWBERRY: This is Claudia Newberry, DOE. The version of the performance confirmation plan that you saw briefed in September is undergoing major revision. We're looking at it in terms of what do we truly need to have in that plan for the NRC. And, so, it will probably be shorter. A lot of the information that was in that original plan related to the methodology that we used will be stripped out of it, and it will be a tighter, easier document for the NRC to review and comment on when it comes over.

We're looking at in the, I think it's now the March time frame to get that document over and reviewed and approved, and it will be Rev 3.

PARIZEK: Well, the question raised construction. You can't construct anything without that authorization, I guess, whether it's the rail or pad, you know, for the 20,000 metric tons, I mean all of these are part of the license submission, you have to have approval for; right?

ARTHUR: But, we're still internally doing some reviews of that, but the current legal interpretations inside the Department, there's no construction prior to that license for construction authorization. So, that would include railroads, the actual site itself, upgrades, those kind of things. We clearly know that it would take us about a year to year and a half just for some of the utilities. We had electrical, water, all of you have been out there before, you know that that's a temporary facility we have there. It wasn't built for actual operation of a nuclear repository. So, a lot of upgrades needed, including rail into that.

PARIZEK: That's different, though, than say shipping casks. I mean, those are components that you need to have prototypes or something for them; right?

ARTHUR: Absolutely. We're actually also looking at all the advanced procurements that we can do now. Some of the things, and you're well aware of the waste, the prototype, that's out under procurement now. We can do pallet scale, we want to develop welding, and those. But, before you start the big dollar procurements, we're going to want to make sure that we have a good chance of getting the construction authorization.

PARIZEK: Thank you.

LATANISION: Mark?

ABKOWITZ: Abkowitz, Board.

John, one of the I think helpful analogues from a management of complex operation standpoint is the NASA program. And, if you go back to the Challenger situation, the engineers knew that the O rim was going to be a problem with the temperatures that were prevalent during the launch that day. And, in the inquiries that went on afterwards, it became clear that there was some discontinuity in the message coming forward for whatever reasons. And, it kind of, not that we have a similar situation here, but we certainly have a situation where you have many contractors under tight deadlines trying to get something done. Do you have a mechanism for enabling someone who's in the trenches worrying about these things to get directly to you without fear of reprisal?

ARTHUR: Very good comment, Mark. And, I remember well the comments you had at an earlier meeting about some of the earlier analysis of risk and what's really caused problems in design and operations, and actually personally reviewed much of the review reports from the recent space shuttle accident. And, one of the areas I'd say--I typically don't bring that up in these meetings, because a lot of times we're talking design or other areas of science, but one of the things, when I talk about the culture, the right culture of a nuclear licensee, it makes the point I'm talking is what's called safety conscious work environment, effective employee's concerns program, the corrective action program, so, if any employees feel there's an issue, they can raise it up either to their supervisors to the right line, it gets to mine and other senior manager's attention.

That's an area that has had challenges in earlier years, but I think we've made a significant amount of improvements in the program. We've brought in some of the tops in industry to help that have worked in the areas that have had challenges, in the nuclear industry to help in improving our employees' concerns program. We have established a leadership council, which I chair. In fact, I have to go back to the office for a couple hours today to chair a meeting, where it's all the leadership, the national labs, as well as USGS, Bechtel and my office. We sit there and try to look at various issues and deal with them.

And, also, I've tried to be visible throughout the ranks, if it's a laboratory employee or others, so they can get ahold of me, or their managers can, to let me know of concerns. I fully don't know that issues like this that we're seeing are similar to other big complex programs. The big issue we've had, I think you realize, is trying to take 15, 20 years of very good science, characterization, then you try to take all that and transition it into a Regulatory and a licensee. That just doesn't happen with the chance of a wand.

So, we are having areas, and this is one I'm internally trying to work on right now, what's called differing professional opinions. In a program of this caliber, we realize there's going to be a science report over here that maybe says this is the conclusion, and over here there might be a different conclusion. So, we want to have an open process by which we can deal with that, fully openly evaluate it, document it, and get back to the respective principal investigators and talk to them about the basis for our decision. So, we're trying to improve in that, and I think the metric show, based on some internal surveys, we're getting much better, but we have a ways to go.

It's a long answer. I apologize, but, to me, that's as important as the total systems performance assessment, design, and all the other things we talk about.

LATANISION: Priscilla Nelson?

NELSON: Nelson, Board.

I was interested in your last comments, because it gets into some of the aspects of the various kinds of uncertainties that exist, and may not be explicitly addressed, and I sort of suspect that will arise in the interaction between the project and NRC as time goes on.

But, another thing that has been a source of some interaction is the term safety case. And, there's been some conversation back and forth, and I would like you to tell me what you think the situation is, and if there's been an agreed upon definition of a safety case, and if one will be presented in recognizable form as the safety case.

ARTHUR: Let me try this way. I know I've had a lot of discussion, and we've had Abe Van Luik of our staff and others, and many of the international panels, and what's going on with the safety case, but we're right now, obviously, in all the work we do trying to look at 10 CFR 63, the Yucca Mountain Review Plan, plus the interactions of the public between the NRC and our office to really say how we are ultimately going to build our case for compliance of the repository. Everything we're doing goes towards that end.

We also, Priscilla, recognize that that license is going to be very, very technically complex, a lot of supporting engineering and other documentation. One of the areas we're considering is how do you, in parallel to the license, make a document that's a little bit more user friendly that the public and others can understand when we make that decision, or recommendation, what is meant by that.

So, that's where we stand currently on it, and a lot of the interactions that we're making on the KTIs, we're learning more every day from the NRC about our basis for what it's going to take to ultimately show compliance in the safety performance.

LATANISION: Thure?

CERLING: Cerling, Board.

Just sort of following on that theme with your license application at sort of 14 per cent completed, and needing to be 100 per cent by then, how are you sort of doing your internal evaluation to make sure that all of the pieces, you know, by December 1st, or 2nd, are internally compatible?

ARTHUR: Very good question. I mentioned a little bit earlier about a license called a Management Plan, I haven't put a title to it, but I know what the content needs to be. We have detailed schedules for each section of that license, and there would be another metric I could show that supports this, that shows for every section, management, organization, all the various key areas, when the schedules are for internal review. What we're going to do is have a series of reviews before it gets to me, as well as coordination with the Secretary, with Margaret and Bob Card in Washington. So, again, we're going to be looking at those individual schedules for the right times to receive it.

And, also, what I'm trying to do is it's not just reading that, we're having a series of internal meetings where we actually take a look at technical defensibility and the logic, so you look again, like we did previously with the Board, at the whole story. You know, what's the particular part of Yucca Mountain review plan we're trying to satisfy, what's our actual conclusions, our defense in depth? So, we're meeting with the PIs, all the engineers and everybody, looking at that on a case by case basis. So, the reviews become after that. It's a very big workload, but right now, it's starting to proceed at a pretty good pace, and things are on schedule in that area.

LATANISION: Great. Any further questions from the Board or the Staff? If not, John, thank you very, very much for a terrific update. That was very helpful to us.

Our next speaker, in fact, wins the Iron Man trophy for today, Paul Harrington, is somewhere. He's going to give the next four presentations, beginning with an Introduction to Preclosure Safety Analysis. Paul has been with the Department for twelve years. He is currently the Systems Engineering Lead for the Office of License Application and Strategy. He leads the effort within that office to develop engineering processes and products.

Paul was the acting Director of Engineering for DOE at their Rocky Flats Environmental Technology Site from 1994 until 1995, and was then the Engineering Branch Chief prior to that. His responsibilities include developing the engineering package for all the construction project activities at Rocky Flats. Between 1988 and 1991, he worked for a utility in a supervisory engineering role with responsibilities for materials procurement during both operational and decommissioning phases of a nuclear power plant, sets of experiences that I think bode well in terms of the issue of surface facilities.

Paul, welcome. Thank you very much for the performances you are about to give. And, if you need some water, let us know, we'll bring it up to you. Welcome.

HARRINGTON: All right, thank you.

Actually, what I'd like to do at this time is invite four folks up to sit at the table there, because I'm not going to be answering every question by myself. And, the first of those is Dennis Richardson. He's the preclosure safety analysis manager for Bechtel SAIC. Preston McDaniel is surface engineering lead. Mark Board for subsurface engineering, and Mike Anderson for engineered barrier systems. So, as you ask questions, I will likely defer some of those to these gentlemen.

The presentation itself is going to focus on the design, but also talk about the preclosure safety analysis. I don't believe that we've really spoken about the preclosure safety analysis to any extent with the NWTRB, so I'll go through what that is, what we do for it, the various sets of analyses. Then I'll go through the design solutions that are on the table today, and give the results of the preliminary PCSA that we did the end of September on the design as of April, talk about where we're going in the design, and the likely results of that.

We did adopt a change in terminology from PSA to PCSA. It was recommended to avoid confusion with other terms that use the same acronym. So, we've done that.

We will need to complete the design for license application beyond what we had had in April. The design solutions that I show you will be those that are current today. We'll talk about some that are being evaluated for adoption. The preliminary PCSA was done as of an April design, so some of that will need to be updated. There were some things that were not included in the design as of April of '03 that are now. So, the final PCSA for the license application will have to adopt those, incorporate them.

The surface facilities, the main change over the last year or so has been to adopt the Cogema experience, the French contractor that runs the La Hague facility. We brought them in as a subcontract to BSC about a year ago, and wanted to get their experience in running their facility. So, we've taken some lessons learned from that.

Subsurface facility, we have done some layout changes, and changes to the ground support details, and some relatively minor details to waste package closure and support mechanisms.

The PSA process, PCSA process--it will take me some time to unlearn that several years of history with the other--goes through several steps. The first is to identify what the facility hazards are, both internal and external. So, there are a series of internal hazard identification analyses, external hazard identification analyses. We will whittle those down. Those that can be screened out based on the facility location, such as tsunamis, don't go further. Those that cannot be screened out are taken to further analyses. There are aircraft hazard analyses, wind and tornado, seismic hazard analyses that all role into the hazard identification.

Then, we will do a set of categorization analyses that estimate the frequencies of those event sequences. We need to look at event sequences rather than simply initiating events. The next slide will have definitions of Category 1 and 2 event sequences. Basically, Category 1 event sequences are those that have a likelihood of happening at least one time during the life of the facility. This was the preclosure lift, nominally 100 years. Category 2 event sequences are those that have a one in 10,000 chance of happening during the preclosure life of the facility.

We then do consequence analyses to estimate the dose to the public and to the workers of those event sequences. And, then, that results in a classification analyses, and that will look at the various event sequences. The system structures and components that contribute to dose prevention or mitigation within that event sequence, and those SSCs that are important to dose prevention or mitigation are classed as important to safety.

Finally, we prepare a nuclear safety design basis document that captures the design basis of the facility. One of the reasons for that was some of the difficulties that the utilities had had over time, over decades, losing the design basis of the facility through mods that were made over time.

They had to go back and reconstitute that. We're trying to create a document to capture that that will be maintained through the life of the facility to ensure that that design basis is not lost over time through mods.

These are the definitions of Category 1 and 2. One or more times before closure, or one in 10,000. So, for a nominal 100 year preclosure duration, Category 2 would be a one in 10^{-6} per year.

The status. We did the preliminary PCSA that was deliverable to the DOE the end of September of last year, based on the design as of April. We'll take the results of that, we are taking the results of that to influence the completion of the design activities. What that does is tells the design organization which SSCs, systems, structures and components, are likely important to safety.

So, as they do their design for that, they can apply the appropriate code and standards, and introduce redundancies, if necessary. That's an iterative activity that goes back and forth between the design and the preclosure safety analysis group. The preclosure safety analysis group will then take the results of the iterated design, rerun the analyses based on that, that's why John's slide showed this as about 45 per cent complete. They've done the first iteration. They need to do the second iteration based on a conclusion of the LA design solutions.

Because of the similarity, though, of the functions that happen in the buildings, that were on the table in April of '03, to what is likely to be the final LA design solutions, we expect that there will not be significant differences in the final PCSA.

The functions of receiving the transportation cask, sampling it, opening it, removing the waste, be it individual fuel assemblies or canisters, if they're non-disposable canisters, opening those canisters, loading waste packages, sealing, inspecting, testing, and then sending underground, all those functions will continue to happen. So, we don't really anticipate significant differences in the results of the PCSA.

Any questions on the preclosure safety analysis process before I go into the surface facility discussion itself? Through the facility discussion, surface, subsurface, et cetera, I'll talk more about the results of the PCSA process, what SSEs were identified as important to safety, the barriers that are identified as important to waste isolation. That actually comes out of the TSPA. We'll capture it in the PSA documents, though.

LATANISION: Well, let's just take a moment and see if there are any questions from Staff or Board. Priscilla?

NELSON: Nelson, Board.

I have not heard the addition of beyond design of design solutions per se. In the project's mind, I mean, is there--is a design solution, putting design solutions, is there some importance to that term?

HARRINGTON: In my mind, they were simply trying to differentiate between the product versus the process. Yes, it's the design, the design is the output of the design process.

NELSON: Okay. Let me just ask one followup question, and it might be a question that stands through the subsequent presentations. The two things that I would like to understand is I think the fact that an event sequence is like a scenario, from what I take, and the idea that the events themselves can interact and be inter-dependent and affect design as opposed to just isolated scenarios would be interesting to see developed. And, also, the thinking about preclosure safety potentially having an impact on postclosure safety, and that aspect of design would be interesting to hear about. So, if I miss it, hit me over the head when you're saying those things.

HARRINGTON: Okay.

NELSON: Thanks.

LATANISION: Carl Di Bella, did you have a question?

DI BELLA: Yes, thanks. Carl Di Bella, Staff.

A clarification, please. The period for the PCSA, I think I've heard 100 years and 300 years this morning.

What is the period going to be for it?

HARRINGTON: The period that will be the basis of the analyses is 100 years. What we have said is that we would have a design that would not preclude the ability to be kept open longer if people at that point of potential closure decided that they were not comfortable in closing it, and wanted to extend the preclosure duration for additional data collection, or whatever other reason, the design could be extended. Obviously, what would happen there, though, is that you would have to redo these frequency calculations using whatever the revised period would be. And, that would then have some bearing on whether or not things may fall between Cat 1 and Cat 2, for example.

LATANISION: Leon?

REITER: Leon Reiter, Staff.

I have a question about the preclosure safety analysis and seismic concerns. Maybe Dennis or Mark might know more about this. At the last Board/Panel meeting on seismic issues, one of DOE's consultants, Bob Kennedy, expressed concern that looking--having to look at sequences that are up to 10^{-6} per year, one over 10,000 for 100 years, could result if these kinds of very low ground motions we use were considered great difficulties, or inappropriateness of design motions. And, then, I hear some sort of agreement was made with the NRC on this. I wonder if you'd clarify this issue for me?

HARRINGTON: Possibly Mark can. I haven't been involved in the seismic discussions.

RICHARDSON: I'll try. Dennis Richardson, BSC.

On preclosure, of course, we're looking at ground motion seismic driven rock wall and ground motions up to 10^{-4}. Postclosure, of course, goes up to 10^{-6}, and we will design our structures of the buildings and stuff to ensure that any of the required safety functions, design basis, if you will, that are credited in the preclosure safety analysis, that at that ground motion, 10^{-4}, that that safety function is maintained. So, we would give a design basis, and the designers would have to design, for example, structures to meet our safety functions at that 10^{-4} seismic event.

Likewise, we might have the seismic requirements on the different handling devices, say cranes, where we might require the cranes not to drop the loads that they're carrying if you have a seismic event, other situations like that. The transporter, we have a design basis such that the transporter wouldn't overturn. It's designed such that it won't overturn, drop a canister, for example, or a waste package at those seismic levels.

So, part of our design basis would be to also identify the various seismic design criteria for the important to safety structure systems for the regulation.

REITER: I'm not quite sure I understand it. The question is how does the 10^{-6} per year for Category 2 fit in? Is that always consistent with using 10^{-4} ground motions, or there might be situations where you could, because of--you could actually increase design to these very low probabilities?

RICHARDSON: Yes. Remember, on the preclosure, as Paul said, our cutoff for Category 2 is at least one chance in 10,000 over the operating lifetime. So, that one chance in 10,000 is your 10^{-4}.

REITER: Well, I thought you were designing at the 10^{-4} per year, and 10^{-4} over 100 years boils down to 10^{-6} per year, and that was a concern I think that Bob Kennedy raised as to whether or not this could lead you to consider what he considered highly unrealistic ground motions. And, I've heard various kinds of things back and forth, and I wonder if you've--that's what I was getting at.

LATANISION: Richard?

PARIZEK: Ignoring, say, 911 concerns, we've read about some airplane crash recently, I guess late last year, a military aircraft, and you have about three of these within 30 miles, there's a history of risk. And, if the number of flights in the region are going to be higher, then the risk could go up. Are you involved in this concern in terms of--

HARRINGTON: Yes, we are.
PARIZEK: And, if so, then how do you build for this?
HARRINGTON: There are actually a couple of slides toward the end of the surface on the aircraft crash.
PARIZEK: Okay, I'll wait.
LATANISION: Latanision, Board.
Paul, you also mentioned in your first slide, waste package design detail changes. Are you going to elaborate on that later on?
HARRINGTON: Yes.
LATANISION: Okay, great.
HARRINGTON: In the waste package section, there's a graphic that shows what those are.
LATANISION: Good. Okay, let's continue.
HARRINGTON: Okay. In the surface facilities, we did pick up the Cogema subcontractor, and have brought in their facility experience. We have adopted that for the Yucca Mountain, and some of those recent changes include addition of a transportation cask receipt facility with a buffer area. The buffer area particularly was not something that was in earlier facilities. That was something lifted fairly directly from La Hague, and we'll show it graphically two or three slides later.
But, the concept is to have a national rail conveyance or truck conveyance come to the site, have the

transportation cask removed from that conveyance and put onto a site rail transport cart, have that site rail transport cart then be the mechanism, the vehicle that actually accesses the waste transfer buildings. They can then stage transportation casks on that site rail transfer cart, and that's called the buffer area. That's a concept that Cogema uses to allow them to, one, return the national rail conveyances fairly readily, and, also, stage the waste to be transferred as best meets their thermal and other needs.

There's a canister handling facility. That's a relatively new addition that came on board about nine months ago. You will remember that the surface facilities were fairly large. That gave us some challenges in looking at the schedule to see if it would be able to be operational in 2010. Those were very aggressive schedules. So, we have looked at what can we do to increase the likelihood of being able to be operational in 2010. A smaller, simpler facility seemed like certainly a likely approach to do that. So, the canister handling facility--and there's a graphic on that we'll get to a little bit later--is basically conceptually a smaller facility than the large does everything, dry transfer facilities. It only can transfer canisters. It would be technologically simpler, because it doesn't involve bare fuel assembly transfer, and can be built more rapidly.

Integrated, the dry transfer facility with remediation capability, we'll expect to require the ability to remediate fuel assemblies that might be problematic. If they get stuck being removed from a transportation cask, or inserted into a waste package, or if there are problems making the weld on a waste package that local weld repair cannot accommodate, we want to have a remediation facility to be able to accommodate that.

There had been a separate remediation facility in earlier designs. But, because we think that's really needed early on, and there would be efficiencies to incorporate it with the dry transfer facility, it's done so. That also eliminated the question about what do you do if you have this problem in trying to move it physically from one building to another across the yard. That wouldn't have been the right thing to do. So, incorporation is more appropriate.

A second dry transfer facility would be built later in a second phase of surface operations.

The processing is primarily dry. There's a very small pool there, primarily for remediation purposes. Several years ago at the viability assessment stage, there was 5,000 MTHM worth of pool storage that was to be used for blending. That has shifted from inside the building in pools to outside the building on aging pads. That does a couple of things. It removes this large pool area. It also, from a through-put perspective, eliminates the drying step that would have been required there.

And, we have gone back to a rail-based transportation system for taking waste packages from the surface facilities to the subsurface. Several years ago, that had been rail-based, and we were considering a wheel-based system, had a number of different wheels. We've decided for several reasons to go back to the rail-based system.

This is the overall site plan. The existing ESF tunnel and cross-drift, existing north portal area. Now, a couple of additions, changes, on here. There's a new north construction ramp that would be built to access the development toward the north end of the repository. The south ramp would still be used to access construction for the south end. Panel one is right here in the middle, basically across from the drift scale heater test. The second panel to be built and emplaced would be this panel two down below. The south ramp would be used for access for that.

Concurrent with that, would be development of the north construction ramp, and then panels three east and west, and then, finally, panel four. Aging pads, somewhat removed from the north portal area.

The bulk of the surface facilities are adjacent to the pad. There are some that are remote, a refueling station, for example, some of the visitor center type facilities.

On the north portal itself, there are a series of waste transfer buildings and support buildings. This is the rail yard. The truck parking comes also in through this gate down here. And, waste packages, the empty waste packages, would be received in one building, and transportation casks would be received in another building. There's actually been a very recent baseline change package approved to combine these two buildings. The functions within them stay the same, though.

This is the buffer area. Now, this long set of tracks that runs down here is the site rail transfer cart track system. Basically, it's a transfer table that waste packages would be put onto the cart in the transportation cask receipt building. I'm sorry, I said waste packages. Transportation casks would be put on there. Then, they would be moved down here. They can either be put into a buffer slot, or taken into a waste transfer building. There's the caster handling facility. This is the dry transfer facility number one, with the attached remediation building, and this is the dry transfer facility two. That tunnel there is for access from DTF-2 to the remediation building.

In the ACNW briefing, the briefing to the ACNW last November, there was a question about the radiologically controlled area. At that time, my answer was it was the fenceline here. That's what I had understood. As a result of that, I went back and talked to the radiation folks, and understand that we are now considering having RCAs local to the individual building.

In the transportation cask receipt building, it's fairly straightforward. There are three bays for truck access, and three bays for national rail access, and six rail sets that come down to the SRTC cart. So, the concept is this site rail transfer cart would be moved into an available bay, and a national transportation conveyance would be brought in adjacent to it. The waste package would be--or the transportation cask would be picked up off of the national conveyance, and put onto the site rail conveyance.

Now, if the supporting cradle for the transportation cask can be moved along with the transportation cask, that whole assembly then may be moved onto the site rail system. If the supporting cradle is fixed to the national rail conveyance, then the site conveyance would have to have a suitable cradle to support that.

If the transfer is able to be made with the impact limiters on, they would be left on. Some transportation casks, though, have an interference, if you will, between the impact limiter and the lifting trunnions. So, in those cases, the impact limiters would be taken off to give access to the lifting trunnions, then the move would be made.

So, once the transportation cask is put onto that site rail transfer cart, it's then moved out and is available to go either into the buffer area, or directly to a waste transfer building.

The canister handling facility would likely come on line before the dry transfer facilities. It's smaller, it's simpler. The basic concept in this is a series of three wells here. The transportation cask would be put into the first one. An empty waste package into the second, and an empty site specific storage cask into the third. So, the SRTC, site rail transfer cart, would come in the entry door here. The waste package would be--or transportation cask would be vented, cooled, sampled, all that, upended, and then lowered into the transfer pit there.

If the waste were going directly into a waste package, then that empty waste package would be in the adjacent pit, and the waste would be simply transferred from the transportation cask directly into the waste package. If that waste were, instead, going out to the aging pad to be cooled prior to emplacement, then it would be moved over to the site specific storage cask for loading, and that would then be taken out to the aging pad.

Now, notice that there are a series of small canister receivers there, wells, if you will. Some of the canisters are 18 and 24 inch diameter. The DOE SNF are both

18 and 24 inch diameter, 10 and 15 feet long. The DOE high-level waste comes in canisters 24 inch diameter, and 10 and 14 feet long. And, there is not a one for one transfer from a transportation cask to a waste package, or to a storage cask. So, that's a mechanism to stage those for then loading of the waste packages or storage casks.

There is not a storage well for a full diameter canister, such as the Navy. That would simply be transferred directly to its waste package. There would be no staging of that, no reason to stage that in this building. Again, this is canister handling facility. There's no bare fuel handling capability in this structure.

Once a waste package is loaded, it's then moved to the closure cell. The lids, there are still three lids on the waste package, they're installed, welded, examined, non-destructive examination. There is the helium purge that's put on the waste package. After that's all finished and inspected, then it's brought out and put onto the waste package transporter for taking underground. The design on that, we'll have in the EBS section. It's fundamentally the same as it has been for the last several years.

The storage cask, if we were loading canisters into storage casks, then those would be taken by a transporter out to the aging pad. So, functionally, this is a fairly straightforward building. Transportation casks and canister transfer to waste package, or storage cask. Closure of waste package, and then out to either the subsurface emplacement or aging pad.

The dry transfer facility and remediation looks a little more complicated. Functionally, though, it is relatively straightforward. The transportation casks come in through here. The preparation for them, the cooling, unbolting, sampling happens in an anteroom here. Then they're brought into a turn table, and fed to a loading port here or there. The empty waste packages are brought in through a pair of doors here, and there are loading ports here and here. This is one cell. It's a waste transfer cell there that can accommodate bare fuel and it can also accommodate canisters. There's a fuel handling machine, if you will, in there that would do the bare fuel assembly transfer, and a bridge crane for the larger heavier canisters.

There's some relatively small amount of staging racks at the north end of that. It's on the order of 48 PWR and 72 BWR, approximately, and about ten of those small canisters, 18 and 24 inch diameter canisters, again, no large full diameter canisters. There's no reason to stage those. The reason for that is the same. There would not be a one for one volume between transportation casks and waste packages, so there needs to be some small buffer area in there.

Once the transportation cask is brought in, the waste is transferred through the ports. You can either go from either of these transportation cask ports to either of these waste package loading ports, do the loading. The inner-stainless steel lid would be put on at that time, not sealed, but put into place just to minimize any potential for contamination exiting the package while it's being moved over to the closure cells. So, these waste packages are vertically oriented on carts at that point. The cart would be rolled out into this chamber, gallery, and an overhead crane picks it and puts it onto a different cart for movement into one of three or four closure cells here. We've been looking at three. There may well be additional through-put advantages to be gained by adding that fourth one on the top there.

The mechanism, the activities in those closure cells are the same as in the canister handling building. We'll go through in the waste package discussion what those individual lids are and the closure mechanisms for them now, but the lids would all be installed, the welds made, inspected. The helium would be put into the inside of the waste package, not in the interstitials, but NDE performed. When they're done, when they're finished after they've been inspected, they're brought out, and this is the location where they would be down ended, placed onto the transporter to be taken underground, the same transporter as would access the canister handling building.

Note that there are some storage spots here for in process work, if you needed to stage a waste package for some reason, possibly it had failed its non-destructive examination, you had to do some additional remediation to that weld before being able to accept it, there's a little bit of staging there to accomplish that. Local repairs would generally be done inside the closure cell. That welding system will have the ability to remotely access, grind out welds, re-establish configuration, reweld them. If there were some significant problem with that weld, or other, that required remediation you could not do, did not want to do in that weld cell, then the waste packages can be brought down and moved into the remediation area. This lower part of the DTF building is the remediation facility.

The pool that we've talked about is down here. Transportation casks, if there were a problem in trying to do an unloading, for example, can be brought down this hallway down into the remediation to either be done dry or wet, if necessary. Waste packages can be brought down and accessed in that site.

So, functionally, it's fairly straightforward in that transportation casks come in, they're fed to one of a pair of ports. Empty waste packages come into one of a pair of a pair of lines. The waste transfer is made in the transfer cell, then the waste packages are taken out to the closure cells, closures made, and then they're taken out the back end. Likewise, the site specific storage casks can also be loaded in lieu of a waste package in one of this lines. So, if bare fuel assemblies were needed to be taken to aging to allow them to cool before being packaged for disposal, that's the mechanism that would be used for that.

The aging itself. Note that this says up to 40,000 metric tons. The reason for that is in the EIS, we had as much as 40,000 metric tons. We did not want to give up that value, that quantity, so the preclosure analyses that we're doing now are being done based on 40,000 rather than 20,000. Several months ago, we were considering having that be as large as 20,000, but because we had the 40,000 in the EIS, we want the additional flexibility for thermal operations, so we're doing the analyses based on 40,000. So, I changed the slides here to 40.

There's 1,000 MTHM that is local to the north portal. It will be relatively readily retrievable. There are pads that would have a nominal 5,000 MTHM capacity that would be built in a series of them as necessary for up to an additional 39,000 MTHM, for a total of up to 40,000 MTHM.

Currently, conceptually, we're looking at being able to accommodate several different types of aging casks. There are existing dual purpose canisters that are in place at various utilities around the country. Some of them are horizontally based, some of them are vertically based. They're cylindrical. One style of them has basically a large concrete module with a series of horizontal holes in it. So, those that are already packaged like that, if we were not ready to put them into waste packages for disposal right away, we would expect simply to take that existing canister and put it in an aging device here to allow it to continue to decay and reject heat.

For those that are either in vertical canisters, or that have not yet been put into any sort of canister, we would need to age, then we'd be looking primarily at the individual vertical storage cask. This shows a nominal breakdown of 20 per cent, 80 per cent. What would actually be built would correspond to whatever was out there. So, our safety analyses certainly has to address the variability of this, so they will do that.

Phased implementation. We would not expect to build everything at the same time. Physically, it would be difficult to try and work on both DTFs that are funding profiles that will play there from a through-put perspective. We wouldn't need the entire facility through-put capability on the first day. We want to begin with a relatively small initial disposal capability that will give us increased confidence in being operational in 2010 versus one very large facility that does everything at through-put rate.

Remediation integral of fuel handling makes for more efficient processing. We can learn from the first facility in design of DTF-2. We will expect to have DTF-2 for licensing purposes be effectively identical to DTF-1. If we learn through the DRF-1 process that some enhancements are made, there are provisions in Part 63 to accommodate changes.

In that first phase, that would include the transportation cask receipt facility, the canister handling facility, start construction of the dry transfer facility, provide some aging capability, nominally 6,000 MTHM, and some of the balance of plant facilities. Certainly we'll have to have the personnel support, the warehousing, the medical facilities, those sorts of things that will be needed to support thousands of craft workers out there will have to have that also.

And, the second phase, we'd come back with the second try transfer facility to bring us up to the through-put rate that we need, and finish the balance of plant. There would be additional warehousing, for example, that would likely be needed.

The preliminary preclosure safety analysis results. There were no Category 1 or 2 external event sequences identified. There were two Category 1 internal event sequences that were identified. Those involved drops or collisions of bare fuel assemblies inside the DTF. The reason for that is simply the shear number of individual fuel assembly transfers that have to be made. There are many, many, many of them, and we're not likely to screen them out as not happening at least once during the life of the facility. So, that's where those two Category 1 event sequences came from.

There are 31 Category 2 internal event sequences. Those deal with cask, canister, assembly handling drops or collisions in the surface facilities.

There were no Category 1 or 2 event sequences for that 1,000 MTHM worth of aging facility. And, when we talk about the aircraft, I'll come back to that point.

The canister handling facility and the larger aging facility, though, were not addressed in the April '03 design. Therefore, they were not part of the preliminary preclosure safety analysis. That's something that will have to be taken into consideration as we conclude the design and update the PCSA.

Okay, dose consequences. The sum of the offsite doses from normal ops, and the frequency weighted Category 1 event sequence doses were below regulatory limits. The sum of the worker doses from normal ops and the Cat 1 event sequences were below regulatory limits. And, the Category 2 offsite doses were below regulatory limits. So, the design that we have that was evaluated last fall would satisfy the regulatory dose limits.

Classification analyses, this is a reminder, if you will, of the process. The next page gets into the results. SSCs that are credited for prevention or mitigation of Cat 1 or 2 event sequences are important to safety, and are classified as Safety Category.

Natural or engineered barriers that are important to meeting the 63.113 performance objectives are important to waste isolation and then are parlance for classifying them also as Safety Category.

SSCs that are neither ITS or ITWI are Non-Safety Category.

Shifting to results, the structures in which the spent fuel assemblies, canisters, or casks without impact limiters are handled, are for important to safety.

The subsystems in the cask receipt and return that are important to safety include the cask receipt, the cask prep, the cask buffer subsystems.

The same theme through all of these is handling of the waste packages, of the material. So, in all of these event sequences, you're seeing the structure itself for the confinement that it provides, the envelopes provided by the waste package transporter, and the handling mechanisms, cranes, lifting points, all of those things.

Okay, important safety systems in the dry transfer include the cask prep, the waste package itself, the canister. We're crediting the DOE canister as a barrier. For commercial fuel, commercial SNF, many of them are not in canisters. Those canisters that are out there, we have not yet determined to be disposable. There are some ongoing issues with them. So, we're not crediting canister performance for commercial fuel. We are crediting canister performance for DOE fuel. We have some very robust canister designs. We've done drop tests on them up at Idaho. They have come out very well, so we are going to credit the DOE canister as a performance barrier.

Other systems include the waste packages themselves, remediation, emplacement and retrieval, and the aging. Again, it's the waste handling systems, confinement, lifting, those sorts of things.

But, now, here's the question on the aircraft hazard evaluation. The hazards come from two sources, the military flights within the Nevada Test and Training Range and the Nevada Test Site, and also the commercial and general aviation out in the Beatty corridor. That is at least eight miles away. The NTTR is as close as about five miles away.

So, our approach in the last year's aircraft crash hazard evaluation and the preceding one from the year before was to see if we could screen out aircraft crash. What we were looking at at that time consisted of the surface facilities, and 1000 MTHM worth of aging pad structure facilities because they're hundreds of feet underground and don't really play in that.

We used methods that were similar to NUREG-0800. The similar to is because the NUREG-0800 anticipates a facility that's adjacent to a flight path. Ours effectively is in the middle of the NTS, so we did some modifications to that. If you reduce it to where it's on the boundary, it comes out to the same thing. We got flight counts of the commercial aircraft from the FAA. We got flight counts from the Air Force for the NTTR, and we looked at historical crash rates by types of aircraft.

The study that we did last year screened out that hazard for a 100 year facility operation, and 1000 MTHM worth of aging pads. Now, since then, the Air Force has reached an agreement with DOE where, because of the reduction in the DOE activities on the Nevada Test Site, the Air Force is going to have more access to the NTS area. So, we will see more flights that will be closer to the north portal area than we have used as the basis for last year's evaluation.

We had had very little margin on the screening out on last year's evaluation. It was on the order of 20 per cent. So, given that change in likely flight activity, we're obviously needing to redo that aircraft crash evaluation. We're doing that. We've been speaking with the Air Force, collecting additional data from them and from the FAA. There's an organization in Albuquerque that records Air Force flight safety information. We've gotten the types of information that they have. We're putting together our list of what it is we need from them, and we'll use that as a basis for updating that aircraft crash hazard analysis in the April/May time frame.

Worker dose. ALARA, the three principals are time, distance and shielding. Our goal is 500, no more than 500 millirem per year for rad workers. To implement that, we're looking at minimizing any manual operations that might be done and contaminated, or radiation zones, improving the reliability of remote equipment so that you won't have to have workers access to do repairs or refurbishments, increased distances, decreased exposure times. These are the basic approaches that people do for rad worker protection.

with that, I'll take questions on the surface before shifting to subsurface.

LATANISION: Thank you, Paul.

Dave Duquette, Priscilla, Richard, Dan?

DUQUETTE: Duquette, Board.

On the aircraft situation, as you're aware, the high risk that was indicated over the last holiday period included the possibility of basically hijacking, or something else, of commercial aircraft. And, even Las Vegas I think was a target, or potential target at that point. Do your safety analyses take into account any terrorists acts at all?

HARRINGTON: The existing criteria don't address intentional crashes. We have to look at unintentional. There are other criteria that we're having to evaluate that do address intentional crashes. So, yes, we'll be looking at both of them.

LATANISION: Priscilla?

NELSON: Nelson, Board.

I'm wondering about off-site events that viewing this entire facility as a system, including where the fuel is now on transportation, and coming here as an overall system, events that might happen not on this site that might actually put stress on this site, and wondering about to what extent that's being thought about in the design. Just, for example, if you had a very, because of some specific event or because of unexpected deterioration in fuel assemblies, you encountered a whole lot more of the remediation required than what would have been anticipated. Is that kind of thinking involved in the design solution that you're arriving at? I mean, that's evaluated as an uncertainty?

HARRINGTON: Yes, that's one of the reasons for having that remediation facility, especially having it local. Fuel assemblies were generally in pretty good shape as they were put into the pools. Many of them have sat there for a long time. Fuel has been in dry storage in some locations for quite some time. It's going to be shipped across the country in some cases, subject to mechanical vibrations. So, we're expecting that we will have to deal with at least crud coming off fuel assemblies, and possibly physically degraded fuel assemblies. So, one of the considerations of that transfer cell I showed you that had the series of quartz is to have that be able to accommodate anything that might happen. If you had a fuel assembly that was dropping crud off of it as you did the transfer, fine, that would be something you'd have to go clean up.

If, instead, it were skewed and hung up part way out, you'd have to have the ability to in some manner deal with that. We have talked about what mechanisms through the remote manipulators you could get in there to tug on it harder, or if you had no ability to unstick it, cut it off. You'd be able to move it through the building. But, those are the things that are going into that facility design, is worst case, what can happen and what do you do to remediate it.

NELSON: Well, I guess from the standpoint of a really unexpected capacity load coming in, say there were some event that happened at some of the remote--the pools on site that had to be responded to, is there a possibility that this facility could just be not able to handle that level of remediation requirements? I'm just trying to understand how robust, how much capacity setting has been thought about, because of events not on site.

HARRINGTON: Well, you said a transportation cask coming in that seemed to be unexpected. I guess I'd note that DOE is doing the transportation. DOE is responsible for all of the transportation from commercial and EM facilities, environmental management. So, nothing will be coming to the repository that the repository is not aware of. If the question is more toward might there be more operational difficulties once that arrives than were anticipated, then the answer is that that would slow the through-put through, but would not be something that could not be accommodated.

NELSON: Yeah.

HARRINGTON: But, we're not going to have shipments arriving that we don't know about.

NELSON: Right. I guess the sense of how slow is slow? That sense of how much of the uncertainty--at what level of uncertainty are you setting the design, is my question. There's got to be some level of through-put where so much--a certain percentage of design, and a certain percentage of the casks that come in that require some remediation is assumed.

HARRINGTON: Okay. Preston, do you have a number like that?

MC DANIEL: Preston McDaniel, Bechtel SAIC.

Our design basis right now is approximately 1 per cent of the fuel assemblies, the commercial spent nuclear fuel assemblies could be damaged in some way, and we would accommodate that in the design. As Paul mentioned, we're building flexibility into the design so that we can move the transportation casks or the waste into a remediation area, and that area is designed so that we could design tools, or operating methods as needed to remediate a specific problem. So, we're building flexibility into the design with areas, and to be able to accommodate uncertainties. There are a number of scenarios that we will have to run through our existing design to make sure that it can accommodate.

NELSON: Will those scenarios be run through for license application?

MC DANIEL: Some of them will, yes.

LATANISION: Professor Cerling.

CERLING: Cerling, Board.

I just have two questions to do with time. In Slides 12 and 13, you have sort of a normal mode of cooperative canisters, and then you have the problems with difficulties, and I was just wondering how much time in either of those cases is there between when the canister

comes in, and then heads out the other door towards disposal?
HARRINGTON: The through-put of this canister handling facility, with the one closure cell that's shown here, is about 80 waste packages per year, on the order of three days per. The through-put of the other facility is on the order of 1500 MTHM, which is approximately 160, or so, waste packages per year. That's assuming all three of these are up and running, and both lines are being used.
CERLING: Okay. And, then, 17, I was just wondering if you could put years on those, especially Phase 2, what sort of time are you anticipating for those?
HARRINGTON: Construction of this DTF-2 would not begin until sometime after 2010. We would want to get the resources into getting a facility up and operational. So, I'll say somewhere in the 2010 to 2015 time range. Part of your question might be ramp up rates. Okay. For that first year, we're looking at getting 400 MTHM.
LATANISION: Dr. Parizek?
PARIZEK: Yeah, Parizek, Board.
My questions were somewhat similar. It's really the choke points that might exist on Pages 12 or 13 that might not have been anticipated, but nevertheless shipments are coming. So, there needs to be some sort of integration between what can happen on the site, and where the choke points are versus what's coming down the rail, or down the

pike. How does one decide, you know, when to ship, to begin to ship? Because I'm sure the industry would love to get the waste out of their plant site as promptly as possible, and commercial carriers would love to ship down the roads of America and say here they come. And, so, how do you slow it down, because you can't have it all backing up in the wrong place at the wrong time, I imagine.

HARRINGTON: Right. Tomorrow, you'll get a presentation from Gary Lanthrum on the transportation. In there, he will talk about integration of transportation with the design. His focus is right now going to be more on integrating the design solution with the transportation side to make sure that we can actually accommodate waste packages of different configurations that they will expect to get.

Part of that, though, will be what the transportation organization goes to pick up. Several things. We wouldn't pick it up unless we had a place to put it. Okay? At the repository, there are a couple of places that you could stage transportation casks prior to actually unloading them. The first one is the actual rail receipt yard, assuming it came in on a rail car. There is also the truck parking. So, prior to even taking it into the transportation cask receipt building for transfer onto that site rail transfer cart, there is a parking lot where you can stage transportation casks on the national conveyance.

Once you have done the transfer to the site rail transfer cart, there is the buffer area that you can use for additional staging. So, between those two areas, plus the ability not to pick up fuel unless the system were able to dispose of it on the back end, we think that we have that covered.

LATANISION: Professor Abkowitz?

ABKOWITZ: Abkowitz, Board.

I wanted to visit in greater detail some comments made by Dr. Duquette about the aircraft hazard evaluation. First of all, I think it's probably a better term, risk evaluation, since you have both probability and consequence in your slide. But, you mentioned that security was not explicitly addressed up to now because the criteria don't require it, I think is what you said, and it would be handled somewhere else. Could you elaborate on what you meant by those comments?

HARRINGTON: The regulations, the NRC regulations require that we look at hazards as not intentional. Okay? Within DOE, we have a set of design basis threats that are classified, that we also need to look at. And, that's as much as I can really say about it.

ABKOWITZ: Okay. Abkowitz, Board.

My concern stems from a statement you also made, which was that based on the unintentional risk assessment of aircraft, unintentional accidents, you were close to the margin. I think you said you were within 20 per cent of getting into, what it Category 1?

HARRINGTON: Two.

ABKOWITZ: Or two. What would happen if you did exceed that, since it would be your first external risk that would cut that threshold?

HARRINGTON: Then we'd need to get into consequence based. If an event sequence were beyond Category 2, then we do not need to look at the consequences that might happen, or result, from that. It's an unlikely event sequence. If it's Category 2, or 1, we have to look at consequences of that event sequence. So, that would mean that we'd have to do the evaluation of what happens if an aircraft were to hit a storage cask. Those are robust. We may well find ourselves in that space. We simply need to do the analysis to, one, determine if we are now in a Category 2 event sequence space that we have not been in. And, if so, then what the consequences of that are.

ABKOWITZ: Abkowitz, Board.

My understanding is when one does a hazard evaluation, they're aware of the consequences, and it's a matter of tying that with the likelihood to come up with assessment of whether the risks are great enough to hit a threshold. So, embedded in the work that you've done up to now should be an understanding of the potential consequences. That's what drives whether or not it's in a Category 1 or 2, or something else.

So, my suggestion is that the folks that are working on this piece rethink their methodology. And also I think to the external public, this is all about the likelihood of a failure associated with an aircraft hitting the surface facilities, and it should be a combined effect of safety and security issues, and you're only looking at part of it right now, and you're already up against the edge. So, I would suggest that a great deal more work and integrated work be done in this area.

HARRINGTON: That's being done. Thank you.

LATANISION: Professor Bullen?

BULLEN: Bullen, Board.

Could we go to the next Slide 13, please? I just kind of have a quick question here, specifically with a term you called the site specific storage cask?

HARRINGTON: Yes.

BULLEN: Is that just a waste disposal container that's loaded and taken out to a dry storage--

HARRINGTON: No, it's not a waste package. It would be a canister with an overpack for storage, similar to commercial ones. We haven't chosen what that would be. Conceptually, though, it's similar to the current dry storage canisters.

BULLEN: Is there a problem with using current waste package design so that you could just use that for dry storage, or is it too difficult to license?

HARRINGTON: One problem might be that those were not qualified for aircraft crash. So, that's one of the considerations we're doing in the aircraft evaluation.

BULLEN: Bullen, Board.

Actually, I guess the key question there is it depends on what kind of container you put it into; right? I mean, isn't the qualification for aircraft crashes basically both the external container, like the concrete silo, and the internal container?

HARRINGTON: They got licensed as a system.

BULLEN: I understand. Moving on to Figure 15, please. This is just another follow-on question with respect to dry storage. You mentioned that the horizontal storage containers may actually be brought to the site, and then reused. Are they licensed for that purpose?

HARRINGTON: They're licensed for transport and storage. They're dual purpose.

BULLEN: Correct. But are they licensed for storage, and transport and storage? I mean, can you use a canister again? Has that been approved by the NRC?

HARRINGTON: I don't know.

BULLEN: I don't know either. That's why I'm asking the question.

HARRINGTON: That's certainly something we would have to consider doing.

BULLEN: I would have concerns about that, because a canister could have been placed in an environment for 15 or 20 years, then transported, and maybe the conditions of the canister or its internal may change. And, then, to approve that, to basically slide it back into a horizontal, or even a vertical one, I guess you might want to really consider whether or not the NRC will allow you to do storage and transport, and storage, because I think they're only licensed for storage and transport. So, it's just a question. Thanks, Paul.

HARRINGTON: All right.

LATANISION: Carl Di Bella?

DI BELLA: Paul, Carl Di Bella, Staff.

I'm confused about whether DOE intends to include the 40,000 metric ton storage pad in the license application that's intended to be submitted in December of this year. You don't yet have the analysis for it, which means if you want to have it in there, you'd have to develop the analysis between now and June, I suppose.

HARRINGTON: Yes, that's right, we do intend on having it in there. That is part of what the safety analysis folks are looking at.

DI BELLA: Thank you. And, the initial design of the surface facilities, will it be able to handle all types of fuel that the industry has that you're obligated to take at that time, except failed fuel? Will it be able to handle that in 2010, or when will it be able to handle all types of fuel?

HARRINGTON: Handling of bare fuel would happen in the dry transfer facility. The schedule for that shows 2010. That's a very aggressive schedule. That's why we're looking at the canister handling facility. Unless there were a canister that could take all of the commercial fuel, then there may be some set that would come to the canister facility.

ARTHUR: Arthur, DOE.

Additionally, we're looking at some minimal bare fuel handling capabilities. Paul is right. When you look at the diverse amount of different fuels that would come in from the various utilities, the dry transfer facility is a critical path to that. We are looking from the initial operations, the casks or handling facility, as well as some options for some bare fuel handling, minimal capabilities, to demonstrate before we go into the DTF. So, again, that's what we're looking at now. We're looking at the construction schedules, and sequencing there from which we'll start in the

Phase 1 operations.

LATANISION: Last question I will ask myself, and then we'll take a break.

I find it an odd sense of interagency planning or timing that the Air Force would have decided at this moment to expand its use at the Test Site. Was that known? Was that a known development in advance, or is it a mystery?

HARRINGTON: it was not known to me or to our preclosure safety folks. They coordinated that with the Nevada Ops Office, and obviously there could have been a little better communication there.

LATANISION: Do we know what they plan to do in terms of this expanded routes?

HARRINGTON: As far as specific number of flights, no, we don't. I don't know that they do either. They have the ability to come down there with more flights. Some of it might be driven by introduction of the F-22. They're looking at that might offset some other flight patterns down there.

ARTHUR: Additionally, we're having, and a lot of it is in a classified setting, regularly quarterly, probably stepped it up more as a program, meetings between our office and Nellis Air Force squad commander. So, we are looking at things, and actually have had a number of good meetings where they're actually sharing some of their aircraft information with us for the preclosure safety analysis, and also we're looking at development, as parallel to the license application, strong memorandum of agreement, so should there be expansion of some of the flight operations, we have far in advance knowledge of that. So, we are stepping up that interface on a regular basis.

LATANISION: Thank you, Paul. Let's take a 15 minute break, and that would mean we'll reconvene at just about a quarter after 10:00. Thank you.

(Whereupon, a brief recess was taken.)

DUQUETTE: I have a brief announcement to make. I wonder if you could give us the courtesy of turning off your cell phones for the remainder of the meeting. If you need to make cell phone calls, please step outside the meeting room.

I'm going to chair this next session of the meeting, but it's really not much of a chairmanship, because we're just going to continue with Paul and the role of, this time, the subsurface facilities. So, I'm going to turn the meeting over to him immediately.

HARRINGTON: I would like to do two go-backs to the previous discussion, if I may. Well, the first one is the frequency thing, the question about the Category 1 and 2 analyses, and do you do those calculations independent of frequencies. I wanted to reiterate that we're following the criteria laid out in Part 63 in that we are identifying the frequency, and for those event sequences that do turn into

Category 1 and 2 event sequences, then we do the dose calculations on them. For those that are beyond Category 2 event sequences, we're not doing the dose evaluations on them.

Secondly, there was a question on the seismic and the probabilities. Dennis Richardson was going to add a little more to that, I think.

RICHARDSON: Dennis Richardson, BSC.

On the Part 63 does allow for certain external events considerations to use what would be reasonable commercial nuclear precedence and practice. Seismic is one for the operational period, NRC has agreed to the 10,000 year return period, which is also normally used for the commercial nuclear plants, as the seismic compliance level to show for any of the safety--the safety SSCs that we've determined to do in the preclosure period. So, that's where the 10^{-4} is for the 10,000 year return period, a seismic event for preclosure.

This strategy and how we pursue that and show compliance to that is also outlined in our topical report on seismic, and the Rev for that will be coming out to DOE shortly.

HARRINGTON: We're shifting to the subsurface facility. We have a series of thermal goals there that the facility is intended to accomplish. One is to limit the spent fuel cladding temperature to no more than 350 degrees C. Second is to limit the drift wall temperature during the preclosure period to no more than 96 degrees C. Another is to limit that same rock wall face to no more than 200 C. during the postclosure phase. Another is to keep some portion of the rock pillar in between adjacent emplacement drifts below the boiling temperature of water to allow drainage of liquid phase water between drifts. And, to accomplish that, we want to have the ventilation system deliver at least 15 cubic meters per second per emplacement drift for at least a 50 year duration. Waste packages themselves are emplaced a tenth of a meter end to end.

Recent changes in the subsurface layout were to the panel layouts and the ventilation system, also, to the ground control, ground support mechanism, the return to the rail system for that waste package transporter. To do that, we increased the radius of the turnouts from the perimeter drifts, the access drifts, to the individual emplacement drifts. That was one of the reasons that we had gotten away from rail emplacement initially, was a relatively tight radius turnout, a concern over having that transporter come off the tracks, and then having to deal with recovery. What we have ultimately decided to do is just significantly increase the radius of that turnout to solve that problem.

We've also moved the ventilation control doors from the end of the straight portion of the emplacement drift basically in between--or at the interface of the emplacement drift to the turnout, out to the outer end of the turnout adjacent to the access main. Those are not shield doors per se. They are not thick with shielding. We rely on the rock at that turnout to provide the shielding. These are there for personnel access control and for ventilation control.

Subsurface configuration. We saw this briefly before. This is Panel 1 in green, Panel 2 underneath it, Panels 3 east and west, and Panel 4. I believe that we have shown you the revised panel layouts that involve access from one end and takes the ventilation air through to the other end collecting it at the far end, rather than through the ventilation main that used to be in the middle.

In this first panel for 2010, we'll have eight drifts developed. At least three of them finished, trimmed out to be able to accept emplacement of waste packages. The second phase for that would be the rest of those eight. The second panel has 17 drifts, excluding the contingency. There's about another dozen additional emplacement drifts down at the bottom of the second panel for contingency purposes. It's about 12 per cent of the total.

And, notice also that there are no drifts in what had been earlier the lower block area. Should thermal management or other considerations change in the future, that area would still be available for drifts. There's nothing that would preclude it from being used.

In Panel 1, these are the eight drifts, there is a performance confirmation test area, a drift that runs below, slightly off center of one of the emplacement drifts. That would be very heavily instrumented. We're still working on the performance confirmation plan, as you heard earlier today. That would provide relatively close access to do a lot of real time monitoring during the performance confirmation phase. There would be additional performance confirmation measurement devices through the repository, but that one test area would allow a lot of very local access.

Panel 1 is about half in the lower lithophysal and half in the middle non-lithophysal. Ventilation, the supply is from coming down the north ramp, and there's an exhaust shaft that comes off the back end.

This is a cut away of the center section of an emplacement drift. The overall hole, the invert structure, still fabricated steel structure down on the bottom as the invert. The rails for the emplacement gantry and any other performance confirmation type gantries would be mounted on that structural steel invert segment. The space in between the structural steel would be filled with a ballast. The waste packages still sit on pallets, one V-shaped support on each end connected by a series of tube steels. Waste packages have varying diameters. The DOE co-disposal package is the lightest one. It's a little over two meters in diameter. The commercial spent fuel packages are slightly smaller. It's about a meter and a half in diameter. Then, this also shows the drip shield that is still intended to be installed at closure, not beforehand, not during the preclosure period.

The most significant change here is the ground control. Earlier versions had had steel sets, basically rolled structural steel supporting wire mesh. We're now looking at a perforated steel liner, supported by rock bolts.

Here's the interface of the emplacement drift itself to the turnout. There's a transfer dock that would allow the emplacement gantry to come out and straddle the waste package transporter. The transporter still has the bed that comes out of the shielded cavity to be straddled by the emplacement gantry. It will stick pick up the support pallet by the four lugs or offsets that are on the bottom of the pallet. The emplacement gantry will pick up the waste package and move down the drift.

The locomotives that would deliver the transporter from the surface facility to the subsurface would be powered by an overhead gantry system. The emplacement gantry itself, though, would use a third rail for a power supply.

The invert. The fabricated structural steel sitting on a support base with the rails and ballast in between that has really not changed for some time.

The invert is still carbon steel. That will support the rails and the waste packages and drip shields during preclosure. The ballast material will be crushed tuff, graded two inch minus to no more than 5 per cent fines, compacted. That still provides an engineered barrier for diffusive flow, and is the support for the waste package and drip shields during the postclosure period. I'm not crediting the invert structure during the postclosure period.

The main support over about a 240 degree arc is this thin perforated sheet along the entire length of the emplacement drift. This is for the emplacement drifts. That perforated sheet is supported by friction rock bolts. Both the bolts and the sheets are made out of stainless steel. We're trying to minimize the potential for degradation of ground control, ground support, that would cause us to need to access the emplacement drifts during the preclosure facility to do maintenance. We've gone to what we believe to be a more robust, longer lived ground control, ground support, methodology that should minimize the need for any future access into those for maintenance purposes. That's suitable for various ground conditions, and can prevent a rock fall.

This is for the non-emplacement openings. These are, therefore, remote from the waste packages themselves. For the access and exhaust mains and ramps, fully grouted rock bolts supporting a welded wire fabric is your carbon steel materials. At the turnouts and intersections, fully grouted rock bolts, wire mesh and shotcrete with lattice girders, if necessary, for the spans that would be involved. And, in the shafts, ventilation shafts, use of rock bolts and shotcrete or concrete.

The ventilation system for subsurface consists of a series of three shafts and three ramps. For the intake, the supply air, the existing north ramp, the south ramp and the new north construction ramp will be supplied along with three supply shafts in blue. It takes a total of 1700 cubic meters per second to deliver the 15 cubic meters per second per emplacement drift. The exhausts are all by shafts or raises, the red dots. That would take a total of 1900 cubic meters per second. Those are not specific because of the expansion of the air as it heats up flowing down the drift.

Waste package transporter. Other than going back to a rail based system, this is similar to what I believe you have last been shown. It now uses a series of trucks on each end to spread the load, provide allowable real contact pressures. The rail turnout has been increased to allow that to traverse it. Weight: 350 tons loaded, 265 unloaded. That's due primarily to the shielding that's involved. The waste packages themselves are not shielded. For transfer of the waste package from the surface building to the emplacement drift, we're relying on the shielding provided by this waste package transporter.

Two locomotives still used to take it underground, one in front, one behind. Those are manned during that operation. When the locomotive is cut off, the lead locomotive, say, to back the transporter into the drift, and the other locomotive is used for that, that's done under remote control. There's no manual manning of that locomotive as it moves into the turnout there.

Emplacement gantry itself weighs between 40 to 60 tons. It has the support hooks under each end to engage the offset and the pallet. That's fundamentally unchanged from before. Running on the rail system, there's a third rail pickup, relatively slow speed, remote controlled.

The preclosure safety analysis and classification results. There are no Category 1 or 2 event sequences in the subsurface facilities. The systems, structures and components, SSCs, that prevent those Category 1 or 2 event sequences are important to safety, and those then are the waste package, the transporter and the gantry. All four support the waste package itself. The waste package is providing a confinement mechanism. The transporter and the gantry are moving it. So, to ensure that the waste package is not moved beyond its design basis, those components that handle it are important to safety.

The following features are important to waste isolation. Now, this does not come out of the preclosure safety analysis. This comes out of the total system performance assessment. But, part of the PSA result, PCSA result, is to create a Q-list. To be complete in the Q-list, we'll identify those components and barriers not only that are important to safety, but also that are important to waste isolation. So, we're flagging those. These are important to waste isolation because of their role in meeting the 63.113 performance objective.

The subsurface facility as a whole, the inverts, the drip shields, saturated zone, unsaturated zone, the waste package, the cladding on commercial and naval fuel, we are crediting the performance of that and the waste form. Note that we are not crediting any cladding in DOE fuel. Much of that fuel is not robust, not intact. That's being loaded into the canisters. That's why we're putting the performance on the canisters that that fuel sits in.

Okay, worker safety underground. The waste packages themselves are unshielded, so they're transported in a shielded transporter. The drift turnouts are long. The geometry of them provides a shielding mechanism for the shine that would come down the emplacement drifts. The rock face there in the turnout provides that shielding. The emplacement drift control doors moved out to the outer end of the turnouts provide personnel access control so that we don't have people going into that turnout area. There's also differential ventilation pressure between the emplacement and development side, so if there were any leakage, it would be from the development side, where workers are continuing to excavate new subsurface emplacement tunnels. That air leakage would be from that area to the emplacement side.

Any questions on subsurface?

DUQUETTE: Duquette, Board.

Changing over to the stainless steel ground support system surely is going to give you more time on that system. Do you have any estimates on how much more time, and is any work being done to categorize the corrosion behavior of either the rock bolts or the stainless steel mesh that's going to be put in place under those conditions?

HARRINGTON: This change came as a result of a value engineering study that Mark Board was involved with. So, I think I'll ask him to answer the questions, please.

BOARD: This is Mark Board, BSC.

The primary reason for going from carbon steel components to stainless steel components was what Paul mentioned earlier, which is to minimize or eliminate maintenance in the emplacement drifts over the 100 year time frame that we've envisioned. We haven't examined how much greater length of time the ground support might last beyond that. We don't view it as a--we're not using it as a postclosure measure to stabilize emplacement drifts. All of our postclosure drift degradation analyses are all assuming that we have no ground support present after a short period of time, maybe several hundred years, or something like that. So, the intention of that was not to have a postclosure function of the ground support.

LATANISION: Latanision, Board.

Just a question about the chemistry, the compositions of the stainless steel as it will be used for the rock bolts and the screen. Do you know which grades of stainless steel are intended?

BOARD: Well, nominally, we had assumed 316, and I think I'll turn over any questions you have specifically on that to someone else who's in the audience right now. But, as far as the feed-off to the in drift chemistry people, I think about last April, or so, when we decided to go this route, instead of using carbon steel components, we originally passed off the information of quantities and things to the in drift chemistry folks in the EBS Department.

We've got a process called interface exchange drawings, where we actually pass the information off. So, they're certainly taking the composition of this into account in their modeling work. As far as the exact composition of what we have come up with, maybe I'd ask David Tang to answer that question, please.

TANG: David Tang from BSC.

We have done corrosion evaluation for the steel ground support components, and based on the old corrosion mechanism for the emplacement drift environment, and based on this, we concluded that ground support made of stainless steel 316 equivalent or better can sustain 100 year service life.

LATANISION: I guess I'm curious to know whether you would use the same grade of stainless steel for the bolts and the screen.

TANG: Yes.

LATANISION: 316 has the strength that you need for that?

TANG: Yes, it does.

BOARD: I would just point out that the loads that we expect on this support are actually quite small. The tunnels are self-supporting. I think you've been out and looked at it right now. Actually, the tunnels have minimal ground support in them right now, typically about 4 or 5 rock bolts across a given section in the crown, and typically no support in the walls, and they've been there for five to seven years with no recorded rock falls that we've had, or instability since the time it was excavated. And, we've done a significant amount of analysis work to look at loading of the ground support structures, and really the function of it is more a confinement function to the surface to prevent any sort of raveling development that might start.

LATANISION: Right. I do understand that. What I was concerned about would be using two different grades of stainless steel, and particularly high strand bolt that might be susceptible to embrittlement and other potential problems.

BOARD: The deformations we expect are quite small.

NELSON: Nelson, Board.

I view this as a design that's going to be changed before it's ultimately emplaced, so I'm not sort of over concerned at the moment. But, the impacts of the design and various things that you've been talking about today, and other aspects of performance arise. I think there's still the intention of having sections of tunnel skipped for emplacement purposes if ground is relatively poor. And, we've got the offset from various features that may discretely get encountered. We have movement of a ventilation door further away from the last waste package. All of these things, to me, open up the prospect along with having this membrane of stainless steel that the boundary conditions for this thermal pulse become less and less certain to me in terms of uniformity of the thermal pulse, in terms of internal air fluxes, moisture exchange. I don't know what's happening anymore. It seems like we're getting more complex and perhaps more difficult to predict what's going to happen. So, can you calm me about that?

HARRINGTON: Mark mentioned the interface exchange drawings, the IEDs. That's the mechanism that the engineers are using to keep current with the scientists about who's doing what in there, so that the science folks know exactly what the sets of materials are, where the locations of the structures are, to roll into their performance analyses.

Mark, I think you can probably elaborate on that, please.

NELSON: Let me just ask has there been just the kind of a brute analysis that might say exactly how many things get skipped, waste emplacement locations, would you skip before you start having concerns about the assumptions regarding temperature or relative humidity, or what was going on inside the openings? Has that kind of analysis been done so that we start understanding at what point TSPA and its assumptions can start getting impacted?

BOARD: Good question. First of all, about the complexity of the design, I think in reality, the design has changed very little. I know that it sounds like these are radical differences, but in actual fact, I think they're actually quite small.

The increase of the turnout for the rail, for example, when we did that, we attempted to keep the waste packages in exactly the same locations, if possible, from the previous design. So, we did things like switch the direction upon which the waste transporter enters from opposite sides of the drift to minimize the amount of movement of a waste package. And, so, if you actually looked at the impact of the turnout, even though it's longer, most waste packages, the very first one in line, essentially, because the thought is the longer the turnout is, the farther in you're moving the waste package, actually most of them move by two meters or less in lengthening this turnout.

The turnout itself increased in length perhaps, I think an average of about 21 meters. But, the first waste package itself, we tried to keep them in the same position, so that from a thermal standpoint, there weren't going to be different calculations than were done for previous analyses. We didn't change the thermal loading density at all in this. So, the thermal loading density remains the same. Essentially, the only difference that it makes with this increased turnout length is you have to use one or one and a half of the drifts at the south end of Panel 2 in that contingency area. That's sort of the upshot of the whole thing.

As far as the change in ground support, as you know, we're not using cementitious materials in the emplacement drifts, and that's the primary reason for going to steel components as opposed to using shotcrete or concrete, which are typical sorts of ground support methods that you might see. The stainless steel sheet is quite thin. It's slotted specifically--well, it's a standard sort of sheet that's used in ground support. We didn't invent anything new here. It's called Burnow sheets. It's a Swiss manufacturer, and it's used in tunnelling quite extensively.

And, so, it's nothing new that we invented here, and it's slotted, that allows air circulation behind the sheets, so we're not preventing the drying mechanism or anything like that that occurs with typical wire mesh that we have underground right now. It's sort of the way that I look at it, is it's not so radical, it's just sort of a different form of wire mesh, if you want to look at it that way. It provides the same function, except in our case, we feel it provides a better uniform confinement mechanism to the rock surface that wire mesh doesn't, because of its flexibility, the deformation type flexibility.

NELSON: Let me just follow up briefly.

The question about--I mean, I'm not sure that the thermal modeling has actually included a whole lot of interaction with the rock anyway. So, it might not be affecting TSPA. But, at some point, is there some point where the local heat load is reduced so much because of skipping or non-placement that other things then assumed for TSPA's purposes, can happen, like cool areas, or other things can happen that really do fundamentally change. Does the project have an understanding of where that limit it?

BOARD: I'm sure that you're right. If you skipped enough spots it would have an impact, obviously, because it starts to affect the aerial thermal load and the local thermal loading. I'll turn over the question about how the project is examining that. I'm not exactly sure I know. But, let me just state about skipping areas.

The only areas that we feel right now are areas that might potentially have to be skipped would be areas where you have fault intersections, where the fault has a significant shear zone on it. Right now, the only faults that we've really seen in that regard that would resemble that sort of thing are block bounding faults, which are the Bow Ridge and, in our case, the Bow Ridge and the Solitario Canyon, which are outside of the repository area.

In normal circumstances, we don't envision that we're going to have to skip areas because the rock is actually, we feel, in a lateral sense, is quite uniform, and it's of quite uniform quality. Really, the only changes in quality that we see are potentially at interfaces between different sections of the flow boundaries. For example, the middle non and the lower lithophysal unit. The rock quality decreases slightly because the fracturing increases there. But, in nothing that we've seen would it constitute having to take drastic measures of ground support.

For example, in the ESF main where you hit the south lateral, that is an area where we intersect the poorest quality material, and I think I've taken you down there and showed you that, in fact, where the middle non-lithophysal unit hits the lower lith unit. There's no special ground support down there at all. It's a 25 foot diameter tunnel as opposed to 18 feet, with emplacement drifts. The walls aren't bolted. We've got bolting and light meshing on the roof. That's about, other than the fault intersections, about the poorest ground quality we've seen, and we don't foresee that there's going to be a significant percentage of the area that we're going to have to leave out.

DUQUETTE: Richard Parizek?

PARIZEK: Parizek, Board.

The drift has ventilation doors, or closing doors at emplacement drifts in order to ensure ventilation or human access. That's a little bit different than the doors that might be used for volcanic hazards mitigation. Are you dealing with that design at this point, or is that in the process if you have to deal with the bulkhead for volcanic?

HARRINGTON: You're right. These are certainly not considered to be used for volcanic intrusion. Mark, do we have some design other than the backfilling? The question was our ventilation control doors are not really suitable for volcanic intrusion, so are we coming up with design features specific to that?

BOARD: Yes, we're currently looking at two different options that could be used. We're looking at, essentially, a key way excavation with backfill in the access mains themselves, or the turnouts. And, the other thing we've looked at is a keyed in concrete isolation log, if you want to call it that, that could prevent flow of magma. I task a consulting group, which is the group that has helped us with a lot of our numerical work, has done some pretty extensive numerical analysis of what happens when you pressurize a backfilled plug, and by putting a key way in the roof and backfilling into the key way, the dilatency of the crushed tuff fill as you pressure it is sufficient to stop the flow of the material. So, we think we've got two optional features that can be used in that regard, and that work is ongoing.

PARIZEK: Thank you. And, one other question related to surface facilities, and that's the geological substrate or the soils. If you want to comment or not comment, we'd understand, but there's a lot of these surface facilities get put out on the landscape, but exactly what's going to be under them, and whether or not there's foundation? Did you do any drilling that's been done or to be done, and make sure that all that subsurface condition is suitable?

HARRINGTON: Can we go to Slide 10, please? The face of the mountain runs more or less along that direction. If you'll notice, before we even get into that, separate from the characterization of the subsurface facilities for the repository, we've also been doing some characterization of the north portal pad area, specifically for surface facility design. There are a series of boreholes and trenches that have been dug and cut. I think it's on the order of about 40. That was done with the idea when we had the larger single building, that it would be located somewhere around there. So, that's where most of that characterization activity was focused.

What we have there now is the north portal pad, which was not engineered fill. It was material that was put in there. And, there's also a muck pile that's roughly in that area. All of that, both the pad material and the muck pile, would have to come out and be replaced with engineered fill. This particular facility arrangement requires on the order of 8 million cubic yards of fill. That's driven by the rail yard being out here needing to be at effectively the same elevation as the unloading building. As you come away from the mountain, the natural alluvium is sloping down, so that becomes pretty significant.

One of the things that's under consideration that's not yet been adopted is relocating these facilities, keeping the rail yard in closer to the mountain, running these more along the face of the mountain, so that you would reduce that amount of fill needed. Conceptually, we could limit that to on the order of 2 million cubic yards of fill. So, there has been some site characterization work for pad design that has gone on. Because we'll take a larger space than that one single building had taken, we'll need to expand the amount of that surface characterization to be done, and we may well choose to lay it up a little closer to the mountain to minimize the amount of fill that would have to be done.

PARIZEK: Thank you.

HARRINGTON: Certainly by LA, all of that has to be concluded.

DUQUETTE: Dr. Bullen?

BULLEN: Bullen, Board.

Could we go to Slide 29, please? Just a quick question, and I assume I'm assuming right here, is that that is the drift scale heater test that you're extending to make the proposed confirmation test area?

HARRINGTON: Yes.

BULLEN: Okay. The second one is there a small rise from the Panel 1 emplacement to the ECRB shaft for air flow?

Do I see that there on the drawing kind of near the bottom? Is there a rise right there?

HARRINGTON: Yes, there is.

BULLEN: Okay. And, I guess the last question I have on this one is which of the emplacement drifts and which one is the perimeter drift? Are there eight emplacement drifts, and are they starting as the second one from the south and going all the way up to the north, so that the most northern one is also an emplacement drift?

HARRINGTON: The most northern one is Drift Number 1, isn't it, Mark?

BOARD: Yes.

HARRINGTON: And then 2 through 8 stretch down. This is the perimeter access drift, and placement would be done from this drift. That turns into the exhaust ventilation collection. That's why it has that cross-connect there to the ECRB to get it over to the exhaust shaft.

BULLEN: So, the southern most extension is just a turnout, it's not an emplacement drift?

HARRINGTON: This one, you mean?

BULLEN: Yes.

HARRINGTON: Yes.

BULLEN: Okay, thank you. The last question that I have is Slide 40, and I'll be quick, Mr. Chairman. You were looking at the classification results, and you get down to that second to the last bullet where it says commercial and spent nuclear fuel cladding will be essentially part of the performance objectives. The question I have is that what additional data will you need to provide the Nuclear Regulatory Commission to justify the use of commercial cladding, and how will you obtain that data?

HARRINGTON: Cladding exists, and there is some information out there on how much of it has degraded. So, the TSPA folks are rolling that in there. We are not intending on getting to a situation where we would do inspections of individual fuel assemblies, and we've talked about that a number of times in the past. We would not do that, but we recognize that it does exist, so they are making some conservative assumptions in the PA as to that existence.

BULLEN: Bullen, Board.

The follow-on question is obviously the fact that a majority of the fuel hasn't even been constructed yet, let alone burned up in a reactor, I guess the key issue there is that as the reactors are now run to longer lifetimes of the core, and are going to higher burnups, the integrity of the cladding is becoming more and more critical, if you will, and actually it's a problem now that if you talk to the operating nuclear power plants, fuel integrity isn't as good as--well, is good still, but it's not as good as it might expect it to be when you go to those high burnups. They're actually running into problems. And, so, I guess I would encourage you to incorporate those types of knowledge bases and that information into your evaluation of this.

And, I guess the follow-on question is have you negotiated with the NRC to see what's acceptable to them, and are they willing to accept the TSPA evaluation of existing databases, or will they require additional information?

HARRINGTON: That's a better question for the TSPA folks. I don't know what agreement they have with them.

DUQUETTE: Thure Cerling?

CERLING: Cerling, Board.

Slide 26. You say that one of the goals is to limit the postclosure drift wall temperature to 200 degrees C., and I was just wondering what that corresponds to with the temperature at the waste package surface?

HARRINGTON: Final waste package surface temperature was a little bit higher than that. I don't remember just how much. Mark or Mike, do you have that number?

ANDERSON: Mike Anderson, BSC.

I think that the temperatures are typically around the 260 to 280 celsius range. It depends on where it is in the repository, and how close it is to the edge, and things like that.

DUQUETTE: John Pye?

PYE: Pye, Staff.

A point of clarification. The 10 drop bolt and friction stabilizers are used concurrently. I assume you really mean the friction stabilizer, a Swellex type bolt; is that correct?

HARRINGTON: I'll defer to Mark.

BOARD: Yes, John, we haven't exactly decided what type of bolt. It would either be split set or Swellex, but, yeah, we haven't exactly decided.

PYE: Okay, thanks. Again, there's reference to the value engineering study. What were the criteria used to deselect the steel set, rock bolt wire mesh concepts, and what was the rationale behind it?

BOARD: Well, I assume you want me to answer.

HARRINGTON: Sure.

BOARD: It's Mark Board, BSC.

The criteria involves longevity of the ground support, which was the 100 year time we're using, the ability to minimize maintenance or eliminate maintenance, the ability of the ground support to prevent loosening of the ground surface, the tunnel surface, and prevent raveling of small particles, small rock particles, which we feel would be the potential failure mode in the lithophysal rock, which is about 85 per cent of the emplacement drifts, and to be compatible with performance assessment requirements.

So, in the value engineering study that we had, and

I mentioned I think earlier that we got a group of people from both inside the project and outside the project, both performance assessment people, engineering, and we had three consultants on the value engineering panel from outside, which included Nick Barton from Norway, George Yaggi from Master Builders, who's a concrete shotcrete specialist, and Patrick Andrio, who is the chief ground control engineer for Nuranda Mining Company in Canada. And we went through a relatively detailed sort of brain storming session after we had the requirements that I just mentioned, and initially, I think the preferred ground support method from a purely geotechnical mining standpoint would have been to use shotcrete products, which is a fiber reinforced shotcrete, which is typical of the tunnelling industry.

But, based on performance assessment concerns of cementitious materials in the tunnels, we went to steel components. Steel sets and wire mesh were eliminated. Steel sets obviously are not a preferred type of ground support in ground that breaks into small--potentially breaks into small pieces, so that was eliminated. Wire mesh made out of carbon steel components we felt would have to be, to meet this 100 year limit with corrosion resistance, would have to be quite thick and difficult to install. We felt that a thin sheet could be automated very well, provides flexibility and meets our other performance requirements. That's the reason we went to that.

PYE: Why are you designing with 100 years service life, when there's a real potential it could go out as long as 300 years?

BOARD: Well, I think, John, our service life here is, I think the important part is what Paul said earlier, which was that we wouldn't preclude going to longer time periods. Obviously, from an engineering standpoint, I think that we felt the most important thing was to meet the preclosure time periods that were established here on the project first, but not preclude going beyond that. So, that's really the reason we went to 100 years. Dennis reminded me the thing that we also come down to, the conclusion, is that the ground support isn't an important to safety component. We've done a significant number of rock fall analyses to examine the size, distribution of rock particles that could be produced from an unsupported tunnel, given both thermal, preclosure thermal in situ stresses and seismic loading, and we've come to the conclusion that we cannot produce rock sizes large enough to breach waste packages. And, so, that's the reason that you don't see rock support as being important to safety in the considerations.

PYE: Again, constructability issues, it's quite important, the difference between the installation related issues for Swellex versus a split set, for example, split sets, you essentially drive the support unit right to the wall, which is good because it makes it nice and tight. With Swellex, obviously, you have a head sticking out. If there's any potential for overbreak during construction, my question relates to installation and tolerance. How do you hold everything together, if it lines up, in those types of conditions? Have you looked at constructability issues?

BOARD: We actually think that constructability of these sheets can be automated and controlled quite well. What we envision, although that's part of our detailed design phase that's coming up, and obviously, there will likely be modifications to what we have. However, what we envision is a track mounted bolter machine, similar to a McClain Bolter, in which we have a swivelling rotating head with a mass for the drill and the bolting machine on the head, and hydraulic lifters that will lift two sheets at a time, overlapped. The sheets are predrilled and prerecessed for rock bolt plates to be placed. They will be put up in an automated fashion up to the rock wall. The holes drilled, and bolts installed all in one, essentially one operation. So, we feel it's quite possible to highly automate this process.

PYE: Okay. One last question. Slide 32, the ballast and the flow--that one, yes. Can you tell me how you're going to place and backfill and compact to 95 per cent, given that structure? How are you going to do it?

BOARD: Well, we haven't--I'll have to see the details of placement of the fill is something that we're going to deal with, and the invert structure itself is something that we're going to deal with during the detailed design phase. The requirements for the invert fill itself are things that come from the PA group. The 95 per cent compaction is something that's come from engineering.

We've got a group of people from Bechtel in San Francisco that are helping us on the placement and compaction of the material, and all I was going to say is that's an issue that we don't see as a big issue. It's something that's a standard engineering practice, we think, and something that we can address during the detailed design phase.

PYE: Thank you.

NELSON: Could I just do a fast follow-up? 95 per cent compaction is going to require quite a bit of water added to the aggregate in order to do the compaction, I'd imagine, and is that--

BOARD: I don't think so, Priscilla.

NELSON: You don't think so?

BOARD: No. It's really a standard spec, I think, in what we have there. I'm not a civil engineer, and I'm not, my area of expertise isn't in soils and compaction, but I believe that that's not an outlandish specification. I think it's quite standard, in fact.

NELSON: Nelson, Board.

I don't think it's at all outlandish from standard civil practice. But, the water added in order to achieve that, given normal construction practice, can be significant.

BOARD: Keep in mind that the particle size is fairly large. It doesn't include a lot of fines.

NELSON: Well, okay, I don't have the information to argue about it, but it just seems like it is a source of water that's being introduced in a systematic way, and it's being introduced underneath the drip shield. I get a little nervous about introducing water in interior places. So, I hope the project is going to analyze it.

BOARD: Yes, we are. We're actually doing an introduced materials study right now in which this is part of it. Obviously, for dust control and things, we do have to have a certain amount of water that's added to the system, and that's something that we're doing right now with this introduced materials study, and before the LA, we will have that study completed, obviously.

DUQUETTE: One last quick question from David Diodato.

DIODATO: Yeah, Diodato, Staff.

Paul, I appreciate your recognition that engineering choices can impact performance, and the recognition of that with the hand-off of the drawings, and so on. So, I just had one question, and that relates to this performance confirmation drift. And, I know that everything isn't settled yet, but from your perspective, you had to put together a list of things. Is there a list that you had of things that you would like to see come out of performance confirmation that would help you to evaluate your confidence in your designs and your choices that you make in engineering?

HARRINGTON: Certainly. I think each of us have our own lists as to what that might be. I don't know how mine corresponds with theirs. But, temperature, water movement, air flow, those are the kinds of things that I hear as driving performance postclosure, and that I would want to measure during a preclosure period to see if the modeling that we're doing would accurately be reflected in the reality. I'm sure they have other things in there, too.

BOARD: Paul, if I could add? Dave, I think that I wouldn't look at the performance confirmation program as being that drift and that facility. You know, I think it's important that we view the performance confirmation process is something that occurs over time with the excavation. So, rather than just looking at that particular drift and the instrumentation that's involved, we have a lot of other activities, detailed geotechnical mapping, geologic mapping, instrumentation behind the headings as they're advanced to confirm that we understand how geologic variability is affecting the mechanical response of the system. There's a lot of other types of testing that goes on. So, in my own mind, that's because I'm an engineer, I don't view that particular drift as being the most important thing for confirmation. It's really learning as we have more and more kilometers of excavation driven, our knowledge increases dramatically, I think.

DUQUETTE: Thank you. The last DOE presentation this morning is by our marathon man, Paul Harrington, on the waste package.

HARRINGTON: Okay, in the waste package, there's a fundamental difference between preclosure and postclosure. For the preclosure period, we have to design for that. For the postclosure, we're really analyzing the performance during that period.

So, in that preclosure period, we're designing to make breach of the waste package beyond a Category 2 event sequences for those postulated event sequences. The event sequences that we'll look at for that include falls of objects onto the waste package, drops of the waste package, dynamic events such as seismic swing-downs, tip overs, vibratory, parametric fires, and rock falls. All of those have to be incorporated into the design basis of the waste package, such that breach of that package would be a beyond

Category 2 event.

For the postclosure, though, we have to analyze the performance of that waste package out over 10,000 years. So, the sorts of things that get analyzed for include damage from rock fall, vibratory ground motion, weld flaw distribution, the weld area stress state.

Recent changes that we've made to the waste package are that the previous extended outer lid, Alloy-22, one had been fairly thick, had sort of a build-up on the periphery of it, has been replaced with a flat lid. Because that's still a full penetration weld, it made stress mitigation. We've changed the technique for that, though, from induction of annealing to either laser peening or low plasticity burnishing.

The middle weld had been a full penetration Alloy-22 weld. That's now a fillet weld. Because of that, it doesn't require the stress mitigation step. And, the inner lid became much thinner, and is now not a full penetration weld, but instead, a shear ring with seal welds on both interfaces. That's very similar to the Navy closure, Navy canister closure, if you remember that.

The trunnion is still a collar. It's to be mounted onto the waste package. Earlier versions had had that trunnion support be a two-piece ring that was bolted together. That posed some operational difficulties, so, we've switched to a single piece ring that is keyed onto the end of the waste package. Think of it like a bayonet camera lens. It will go on, and then get about 100 degrees turn, twist, and stay engaged. The removal of that will be simpler than--the trunnion collar still comes off prior to emplacement. It's only mounted on the waste package during the surface facility handling.

The gap in between the inner stainless steel vessel and the outer Alloy-22 vessel is slightly increased to minimize the tensile stress on the Alloy-22 while the waste package is hot.

We've done a series of mockups in the past, and have more planned for the waste package. In fiscal year 2000, we have mockups based on the site recommendation design. It was quarter length tests to look at the feasibility of fabrication of it. We did some residual stress measurements, both before and after the welding. That was, in part, to demonstrate that we could do the welding by machine remotely with high confidence in the quality of those welds. That's been one of the areas considered as a potential problem area, is making this series of welds, particularly when they're with three full penetration welds, remotely, not being able to have someone go in and manually rework those if there were rejectable indications. So, changing to simpler welds certainly has improved that. But, we also want to demonstrate to ourselves through mockup testing that those welds really will be achievable with high quality.

The spread-ring mockup was more recent. This is the shear ring on the inner stainless steel lid. This was a mockup that was done up in Idaho. We have looked at several multi-piece rings, three piece, four piece rings. What the Idaho folks did in their mockup was look at a single piece, a one piece ring. And this is a spreading mechanism. There's overlap here between the two ends of the split ring, and it will retract it, lower it down into place, and then push it out. That was to show could that be done remotely with a high likelihood of equipment working. That was successful. That was done on the smallest diameter waste package, just to ensure that it would be able to be used on all different diameters.

So, the development studies will serve several purposes. It will give us information for the design and fabrication, support the analyses and model reports that we're developing for the TSPA. We have completed a series of them on weld flaw distribution, induction annealing, laser peening, controlled plasticity burnishing. Those were stress mitigation techniques. Residual stress measurement analyses, and neutron diffraction analyses. All of those are focused on ensuring that the closure welds on the waste packages can be made, can be stress mitigated, can be inspected, and result in waste packages that will perform.

For fiscal '04, we're continuing some weld material and base metal variability studies. That comes out of one of the NRC key technical issues. Also, looking at laser peening and controlled plasticity burnishing, fracture toughness and weld interpass temperatures.

Prototyping is integral. It's, again, for fabrication purposes.

We have 15 various waste package mockups planned, prototypes planned, scheduled and budgeted in the coming couple of years, produce them over a six-year period. Now, this doesn't mean that there will necessarily be one each of the ten different waste package configurations. For example, the only difference between Navy short and Navy long is the length. Other than that, they're exactly the same in diameter, in weld joint. Physically, it would be more difficult to fabricate the long than the short. The insertion of the inner into the outer, with the extra length, may be a little more problematic. So, it's not to say that we've opted to fabricate a waste package for each of the ten waste package types, but rather, to spread over the 15.

What are the key parameters that these prototypes can tell us? We haven't yet decided just which they will be, but it's to use them to, as best we can, validate that the waste packages are constructable, inspectable, need to be able to run MDE on them in a high rate environment. That's their purpose.

We've gone out with an RFP for them. It was issued in July of '03, and the award of that contract is in progress.

These are the ten configurations. These are not changed from what you've seen before. The change is on the trunnion collar. This is a collar that has three lugs on it, if you will, that would engage onto the waste package, be rotated to lock it into place, and then permit picking the package by the trunnions. When the waste package is finally lowered down into its horizontal configuration onto the pallet to be put into the transporter for taking underground, then those collars would be taken off. If they were left on, they would simply be a potential corrosion point.

I don't know if the Board, all of the Board members, have been briefed on the ten different configurations. Have you seen this, or should I spend some time on it? The main point I wanted to talk to was the change here.

BULLEN: It's depicted on the PWR 21, it is not necessarily three sections?

HARRINGTON: That actually shows four. Right now, we're looking at a multi-piece, but we may well go to a single piece. That prototype showed a single piece can work.

This is the change. This is the older design site recommendation. This is the current design that we'll take in for license application. Note the much thicker, on the order of four inch stainless steel lid, with a full penetration weld. Done additional structural analyses and find that we don't need four inches. This is approximately two inches. This is a shear ring, spread ring, with seal welds at both interface points. So, that will provide a barrier for entrainment of the helium inside that stainless steel cylinder.

The middle lid is still Alloy-22. This had been a full penetration weld here, with a little fillet addition. That's gone to simply a fillet weld configuration. The outer lid doesn't have this large build-up any longer, and the joint is simplified a little bit. It's gone to just a flat plate, still a full penetration weld, though, and then a little simpler orientation. So, that's the significant difference to the waste package. It will improve the fabricability, the inspectability.

Drip shield. We'll analyze that for postclosure. It plays no role in preclosure. It's not installed until the end of the preclosure period, and the decision is made to proceed with closure. So, it is analyzed for rock fall and vibratory ground motion.

We're looking at making some changes to the drip shield. The basic configuration is as you've seen before, as was on that earlier cross-section in the subsurface area. But, to increase the distance from the inside of the top of the drip shield to the waste package, to increase the stiffness of the drip shield for bending loads, to add some stiffener beams, and to simplify the lifting in the interlocking features are being considered now. They may well be taken. Materials are still the same.

This is the graphic of actually the one that's under consideration. Fundamentally, it's very similar to the old one. The pick points are a little bit different. The heights from here down to the waste package is a little higher. Fundamentally, it serves the same purpose.

Preclosure safety consideration for the waste package. The waste package design has to look at both Category 1 and 2 event sequences. Those event sequences are taken as part of the design basis for the waste package. Therefore, a breach of that waste package is beyond a Category 2 event sequence. The waste package itself becomes an important to safety component because of the role that it's playing in this performance, though.

And, because of that, the waste package is important to safety. The important to waste isolation input from the total system performance analysis that we're capturing on the Q-list includes the waste package and the drip shield, because of their ITWI role.

So, in summary, the preliminary preclosure safety analysis that we did, based on the April of '03 design, said that we would be able to meet all of the performance analyses, performance objectives. We have identified those systems, structures and components that are important to safety.

Engineered features which are important to the waste isolation are identified. We do need to complete the design development to support the license application. The preclosure safety analysis needs to be updated based on that completed LA design for the LA.

We don't anticipate new event sequences, though. The functions that happen in the buildings will be the same. So, we expect that the LA design will also be able to meet the regulatory criteria.

I think that's it.

DUQUETTE: Thank you very much. Questions from the Board? Dan Bullen?

BULLEN: Bullen, Board.

Could I go to Slide 49 first? With respect to your mockup program, when did you expect the mockups to be delivered? I realize you're just getting ready to let the contract, but what's the time lag with respect to construction and when you'll actually have them in hand?

HARRINGTON: Mike, I'll ask you to answer that.

ANDERSON: This is Mike Anderson, BSC.

I assume you mean the prototypes rather than mockups?

BULLEN: Yes. I'm sorry, prototypes.

ANDERSON: The first prototype is in the fiscal year 2005 time frame.

BULLEN: Okay. So, post-LA?

ANDERSON: Yes.

BULLEN: Okay, thank you. Then, I only have one more question that's mine, and that's on Slide 52. And, that deals with the reduction in the stainless steel lid. I guess the question is what's the reduction--or the increase in radiation dose at the surface of the waste package container when you take two inches of steel out of the lid? Is that an adverse design effect?

HARRINGTON: No, because in both events, there's still more material here than there is on the side. So, practically speaking, it's not going to affect the radiation field around the waste package.

BULLEN: My only concern is the fact that did you ever expect to have a requirement for human access to the surface of the waste package, and any event to remediate welds, to fix a welding machine, to go in and retrieve, or is it all going to have to be remote?

HARRINGTON: It will be remote.

BULLEN: Okay, thank you.

DUQUETTE: Other questions from the Board members? Dr. Latanision?

LATANISION: Latanision, Board.

If we look at this redesign, it appears to me that you now have a second weld on the exterior, the top right.

HARRINGTON: Are you talking about that?

LATANISION: Yes.

HARRINGTON: Okay. That is effectively this. This is just the trunnion collar, the sleeve that the trunnion collar will engage. That had been there before, so that's not part of the closure of the waste package lid. That's part of the initial fabrication of this outer cylinder. The only weld that gets made at closure is this inner one right here.

LATANISION: Okay, thank you.

DUQUETTE: Duquette, Board.

With that design, will that outer weld be inspected with the same degree as the seal welds that go inside the container, the trunnion collar weld?

HARRINGTON: They'll all be inspected as necessary to meet the ASME Section 3 criteria. As far as what specific ones, I think I'll defer to Mike as to the NDE techniques.

ANDERSON: I'm at a bad angle to see that illustration.

I assume it's the change. Which welds in particular are you talking about?

DUQUETTE: Well, it's obvious that there will be a considerable amount of care taken in the inspection of the last seal weld that welds the outer lid to the container wall. The weld that I'm concerned about is the weld that joins the trunnion collar to the C-22 wall on the outside. That's not a structural weld, and I wondered if it was--it's a structure weld, certainly, but it doesn't serve the same function as the weld that seals the container. Will that have the same inspection criteria as the weld that seals the container?

ANDERSON: You're referring to the weld immediately adjacent to the final closure weld?

DUQUETTE: Yes, it's the one, it's the top weld on the trunnion collar.

ANDERSON: That weld is inspected, or planned to be inspected at the fabricator by visually liquid penetrant testing, ultrasonic and radiography.

DUQUETTE: Is that the same amount of inspection that will be done on the weld that joins the outer lid to the outer wall of the container?

ANDERSON: No, because the final closure lid, we cannot do radiography on. It's going to be ultrasonics, then visual inspection.

DUQUETTE: Okay, thank you.

Dr. Latanision?

HARRINGTON: In case that didn't come across, what he said was that shop weld actually gets more inspection because they physically can RT it.

DUQUETTE: I understood that.

HARRINGTON: Okay.

LATANISION: In reference to Slide 46, you mention having performed residual stress measurements? You had listed perform residual stress measurements before and after, have those--

HARRINGTON: Yes, that was done.

LATANISION: That was done? And, what's the upshot of that?

HARRINGTON: Mike, can you talk to that, please?

ANDERSON: Now, the fiscal year 2000 mockup was the site recommendation and closure design, so it had the induction annealing closure, and, so, the measurements were done on that geometry, particularly with regard to an entrance to how deep that stress was relieved, and also the effect further down on the shell of the waste package. That work is finished, and there is a report on it. I'm not sure exactly how much further, you know, what particular information you'd like to know about it.

DUQUETTE: Dr. Bullen?

BULLEN: Bullen, Board.

I was handed a question, or actually, a series of questions by a member of the audience, and actually for illuminating purposes, it would probably be appropriate to answer them here. The first question was what's the design of the internal pressure of the waste package itself? Is that atmospheric or slightly above?

HARRINGTON: Don't know. It's appreciably above.

BULLEN: Internal design pressure of the waste package, Mike?

ANDERSON: The design pressure in terms of what's the maximum pressure of the waste package?

BULLEN: Yes.

ANDERSON: It's on the order of like 170 psi. It assumes that there's a fire, a transportation type fire, and there's a simultaneous rupture of all the cladding.

BULLEN: Okay. Bullen, Board.

What's the nominal design pressure? What's the nominal operating pressure, I mean?

ANDERSON: Two atmospheric--or excuse me--one atmosphere of gage, so two atmospheres of absolute.

BULLEN: Right. And, the question then actually follows onto exactly what you just said. They want to know that basically, at 360 degrees C., cladding is going to have an internal pressure that may be on the order of a couple thousand psi. Now, granted, that's a very small volume. So, if you breached all the cladding, what's the maximum pressure that you'd expect to see inside the container?

ANDERSON: Certainly less than like the 160 psi, because the temperatures are lower than what we assume in the fire calculation.

BULLEN: Okay. So, basically, you're not concerned about cladding breach giving you an internal pressure that would rupture the containers?

ANDERSON: No. In fact, the inner vessel is designed as an ASME pressure vessel code, or boiler and pressure vessel code vessel, and, so, the actual thickness to retain the design pressure is much less than the thickness that we have in the design that's really for other structural purposes.

BULLEN: Thank you.

DUQUETTE: Is that it?

BULLEN: Yes.

DUQUETTE: I do have one last question on Slide 52, and it's going to be a naive question because as far as the design is concerned, I'm relative new to the Board. That's a very complex design, can you take about two minutes and tell me why it's so complex and why it wasn't just a single cap, such as the Swedish design on their copper containers?

HARRINGTON: Well, we have a two jacket waste package. The outer jacket is for corrosion protection. That's the

Alloy-22 material. And, the inner is for structural support for that outer corrosion barrier. So, we would have at least two lids on this, one for the stainless steel inner liner, and at least one for the outer Alloy-22 liner. We chose to create two as a defense in depth, as an additional barrier.

Mike, if there's something you'd want to add to that, please do.

ANDERSON: No, I think that's a good summary.

HARRINGTON: Thank you.

DUQUETTE: Any other questions from the Board or from the Staff?

NEWBERRY: Before we finish up, I wanted to address one of the questions that Dr. Bullen asked earlier on waste form cladding, which he and I have been discussing for I think eight years now.

It is in the TSPA conservatively. However, whether or not we're going to take credit for it as a barrier in the license, as in it's important to waste isolation, is still something that we're discussing. So, it may or may not be important to waste isolation, but it definitely is in the TSPA.

BULLEN: Thank you.

DUQUETTE: I'm going to turn the--you have another question on this issue?

LATANISION: Yes, one more. Latanision, Board.

You know, you guys have got to stop meeting this way. Slide 47. There's a long list of studies which have been completed that I would be very interested in seeing. Are we going to hear something about them sometime soon, or what's the plan there?

HARRINGTON: We had not, to my knowledge, planned on briefings on those. I'm sure that we can if that's--

LATANISION: I think it would be very informative for a number of reasons, some of which affect corrosion concerns that were expressed by the Board in the October and November documents. So, this kind of information is particularly of interest to me.

HARRINGTON: To the extent that it relates to the probable March meeting, that would be something we ought to consider for that.

LATANISION: That's just what I was thinking. Thank you.

DUQUETTE: Thank you. Thank you very much, Paul. I appreciate your efforts up there, and I guess it wasn't as bad as a bicycle race, but probably close.

I'm going to turn the chair back over to the Panel Chairman, Dr. Latanision, who will handle public comment.

LATANISION: We do have four public people who would like to express some comments, and we're a bit ahead of schedule, so I don't think we have a time problem here. We will first invite Judy Treichel to speak.

TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force.

Just very quickly, I think it's a problem that the performance confirmation list, or whatever it is, plan, is still in the thinking stage, and it's still being discussed and it's not really known yet what that is. And, that sort of goes along with the second thing that I wanted to bring up, which follows on Priscilla Nelson's concerns over things being done one at a time, and then you get these roll-backs, where there is an effect on something that happened before, because of something that happens now. And, I guess that's why I've always hated the word staging, because it appears to be a way of just doing one thing at a time and getting the camel's nose under the tent to the extent that you have to go on and you can't go back.

And, what I see is the new design and the presentations that we got shows how you get waste there, and you might be stacking it up outside, you might be doing whatever it is you do, but you do get a chance to get it off the train so you can send the train back. But, then there it sits, and it's there. And, then the next one is to get it handled and get something underground, so you take off the wheels, you put on the tracks, and then you take it off the tracks, and you put it on wheels. But, everything just keeps happening to get one thing done, and it seems as though it's always we're going to worry about that later.

And, I'm not an engineer, but I've sat in enough of these meetings for long enough and seen design changes that happen between the time somebody walked up to the podium and the time they walked back. So, it's all just to get something happening at that particular point, and I don't think that's a clear design for what we here in Nevada were told was going to be a working repository.

Thank you.

LATANISION: Thank you, Judy. The next speaker is Mr. Atef Elzeftany.

ELZEFTANY: I have my hat on here, so the first few words, I'll say is for the Las Vegas Piute Tribe as a sovereign nation. So, I'll just take off my hat.

The vice-chairman mentioned to me a couple-- actually, a couple months ago when we were talking about the Yucca Mountains, and nuclear waste, and so on, and after about three or four hours of discussion, and asking simple questions, he said, well, if it is safe, and I'm quoting him, "If it is safe as they say, why don't they fly it in instead of bring it in in terms of transportation."

This is a very, very small statement. However, it speaks volumes about the human mind. I'm not going to preach at you here. But, most of you are Ph.Ds. and master thesis and professors and engineers, and I think we have a problem with Yucca Mountain as a geologic repository. I want you to remember what I have here in my hand. I tried to do this yesterday to get my torch, and I have a CD about the site, Yucca Mountain Science and Engineering Report, I tried to burn the dumb CD. You know what, with a torch, a blue light, anybody knows what the temperature of a blue light torch is? The dumb thing even didn't burn. I thought first it was just plastic, maybe the sun will take care of it, or something.

We have a problem I think with Yucca Mountain, and we need to look at it carefully. For the Board members, I have been reading all your annual reports very carefully. I'm not very eloquent or an outstanding person in English language, but I know the little subtleties of it. And I remember the late Pat Domenico when we used to be together in the University of Illinois, after I got my ORD from the National Academy of Science. I went there to work in civil engineering with Chester Sees of the Highway Engineers, because they have a problem with the highway system they built. I--in engineering, subgrade soils, and they built at the time one million miles for one lane, and all of a sudden, five or six years, everything goes to pieces. And, here it is, I'm coming out from the University of Florida. They got me there to work on them, and I said, "What do you have in engineering here? What do you do with this? What's underneath that thing?"

I was good in computers, modeling, water flow, unsaturated flow, heat flow, salt transport, or solute transport, and all that, and I got to work with Chester Sees on the Alaska pipeline. I wish I had patented my idea as to put it up there. I would have been a rich man now. But, I am the one who told him put it up there and make it a zig zag, and you know the rest of the story if you have gone there. Those who live in the midwest, Illinois, all that, they probably noticed what they did to the side of the road. They've got all these underground or vinage ditches.

You add salt, you add cold heat, you add water in the spring, you add unsaturated zone, you get a very complex problem. The only problem with the DOE here that I have not seen in terms of data about the engineering barrier and the heat flow and the water flow and the gas flow and the corrosion problem. Why did I say all that? I said all this because when I read this report, the last report of the Board last year, when I got on the internet, I said I don't like to say that, but I said hallalujia, the Board members finally saw a couple things, I'm sorry, I'm not trying to put you down, I do realize that you're all good people. Finally, they came up with a boldness to say what they mean. I wish Pat Domenico had been here. I would have dragged him to put him up here and remind him what my discussion with him about the corrosion, about the unsaturated flow, about how the condition is going to look like.

10 CFR 60 used to be in the geologic repository. We scratched that now. Now, we have 10 CFR 63, which is almost to me 90 per cent engineering. When I worked for the NRC from 1983 to 1986, we were appalled about the 300 years waste package. John Reeves can tell you that, and all the other guys can tell you that.

What I'm saying to the Board, and the Board members, you need to ask bold questions. You need, from the technical point of view, this is a time of history. The President is going to address the nation again tonight, which I'm going to hear. He didn't tell me the truth a year ago. That is a very sobering thing. My President didn't tell me the truth. My ex-president in Egypt told me the truth when I left Egypt 40 years ago--36 years ago to become a citizen of the United States and get a second Ph.D.

So, for the Board members, I appreciate what this gentleman said, be bold, be courageous. I wrote Margaret Chu a letter, I said oh, boy, she is really bullying these guys. She got the letter and she said the Board, dah, dah, dah, you can't do this, premature. Be bold. If you get a lot of--when I went to work for the NRC, they told me if you have five or six stocks in a utility company, get rid of it. I got rid of it, and I've never had stock since then. I left the NRC in 1987. I had a 401(k) plan. I spend $80,000 a year on my two kids in Berkeley to go through school.

So, what I'm saying to you, this is not jobs, jobs, jobs, this is reality, because this thing is going to be for a long, long time. For almost eight, nine years, I decided the last eight, nine years in the Nineties, I decided I'm not going to have anything to do with Yucca Mountain. I'm going to do something else in my own personal reading. When I read the engineering report, I wrote to myself on September of the year 2001, before the Twin Towers collapsed, it's the main story, it's still unsaturated zone problem, it's still saturated zone flow problems, and transport of nuclear, or nuclides, and models. I used to be the excellent modeler that I could model everything. I could model your DNA, if Ii wanted to. But, you know what? If you change one little base, it would give you a cycle cell anemia, or whatever. That's one out of 3 billion. Anybody can understand that? You switch it.

So, before you go to lunch today, think about your mission. Think about what you're going to say. Think what you're going to be doing, because that's going to carry on for a long time. I was there in 1986 when the first shuttle worked, when I met Richard finally. You know what? Four degrees ice in water, put it in, it was hard as a rock, the little tiny piece of rubber. You leave it at room temperature about 70 or 68, it's nice and flexible. He mentioned that about the communication. Now, we have another shuttle problem.

What I'm saying here to you is communication between John Arthur and Margaret has to be almost exactly the same. Between John Arthur and you has to be exactly the same. Between John Arthur and everybody in the program has to be the same. But, it's appalling to me that when you go to a meeting, and three weeks ago, or four weeks ago we had the NRC staff working with some of the tribe people, Presenter Brown here, everybody, there was about 21 or 22 people in the room, chairmen or chairwomen and vice-chairs and members, with the exception of one. Everybody had the negative comments.

Two or three weeks later, she went to the NRC quarterly management meeting, and she said, well, we just had last week, we had a good meeting with the tribes, and everybody was supportive of the NRC, and supportive of the DOE program. I was there. How did you transfer that information from--there is only one person who worked with the WIPP where John Arthur came from, and he works for the tribe now, and he used to work with the WIPP program, a young fellow, and he said his tribe was from New Mexico, and he made some kind of a favorable comment. One out of 21. This is very, very important. You need to address that. You need to address the communication in your writing. It's very, very important, because sooner or later, the thing is going to come and they say, well, Pat Domenico passed away. I wish I had recorded his conversation, hours upon hours, but it's too late now.

I have a question for John, just a matter of observation. I attended the meeting for the Las Vegas management meeting, and in his presentation, he listed management assessment and progress towards license application, he had the KTI, the license document, and the TSPA, and dah, dah, dah, percent completed. And I noticed that he had two dates, June and then October. And, then, this one he presented today, and, John, you must be going in your DOE program with the speed of light. The KTI agreement addressed was 70 per cent complete. Back then in October, or that meeting was November the 13th, which was before Thanksgiving holiday, before the New Year's, only said 42 per cent. So, we went from 42 to 70. That's a tremendous amount of changes.

LA document, we went from 7 per cent complete to 14 per cent. That's a double. I wonder about these numbers. I'll tell you why I wonder. From 51 to 45, why the preclosure assessment went down from 51. It shouldn't go down if it's really completed 51 per cent, now it says 45.

There's some problem there, or maybe it's 54. Somebody needs to switch it. The design went from 40 per cent to 56 per cent.

I think we need to be accountable for whatever we do, whatever we say, and I said that because I see a whole lot of contradiction in things. And, the public is not here most of the time. The people who come here mostly, you work for the DOE, work for the NRC, work for the State, or they get some support from the Department of Energy or from someplace else. I'm glad I don't have any money from these people for the last 14 years. So, I'm clear on that.

So, Victor, Owen--I think that's your name, I don't recall your first name--and the gentleman over there about the communication, and the rest of the Board, Priscilla, I think, I'm not sure, I'm just trying to look at the numbers here and the faces, this is to you, the Board, you are the one who are going to tell us about science. So, dig deep. Work on this Staff. Hire a double Staff, or get them, whatever it is. But, bring about some reports, critical like the last report.

If I go to the doctor, and the doctor tells me oh, you're fine, and another doctor tells me that I have a cancer, I'm going to go to the first doctor. You know what? I'm going to get so angry, and if I have my own way of saying I'll just give him a prayer of a heart attack, tell me the truth, the whole truth, but the truth. We need to hear that in this country on the highest level, the lowest level, and every place, like the American I used to know 35 years ago when I came here and I gave up everything that I had in Egypt, my money, my family, my everything. You need to rededicate yourself to the truth, regardless if the President of the United States has a gun on your head, tell the truth. Don't be afraid. Be courageous, and keep going.

Thank you very much for this beautiful opportunity, and this is probably going to be good bye, because I'm not really planning to do that again. Thank you very much.

LATANISION: Thank you. Sally Devlin is our next speaker.

DEVLIN: Good morning, everybody. This is Sally Devlin from Pahrump, Nye County, Nevada, who lives in the shade and the shadow of Yucca Mountain. And, as always, I notice there are no officials here. I welcome you on behalf of Nevada for holding the meeting here. I do hope next year's will be in Pahrump. It's our turn, and I won't poison you with cookies. I promise.

I brought with me today an old report, because, you know, I'm old and everything I have goes to the University for my archives, and is now the 20 foot cell. But, this is the technical basis for Yucca Mountain standards by the National Research Council. And, the reason that I brought it is because we're talking about the health and the welfare and the safety of the people affected by Yucca Mountain. And, we don't recommend that a release limit be adopted. This is from them. This is 1995, remember. We also have that they say you are only allowed one millirem, and I see Ray Clark, who is one of my mentors on all this radionuclide stuff, and I just want you to know that that was in there. This, of course, is CFR 10, not 63.

But, anyway, the reason that I'm telling you about this old report is it is very important to me for you people here to realize that Nye County is where the repository is, that Nye County is where the test site is. And, in the report that he just mentioned, when you said about the five different things that were wrong with Alloy-22, and my bugs were almost mentioned, you know, my bugs had better be tested. But, also, the most important thing to me is the safety of this repository, and the whole project. And, of course, transportation is my field, and you're planning transportation where we had the '92 floods. I think that ought to be looked at.

And, I remember talking to John Cantlon and he said when they were starting 200 feet with the tunnel boring machine, and I said it floods, why don't you drop four inches of water in an hour on the tunnel, and see if it floods. And, he said, "We don't do that." Well, next year, we had a flood and, of course, everything was washed away, the trucks, the roads, everything was soaked. So, you have flooding. This is weather stuff here in Nevada.

But, the reason that I'm talking about millirems and the health and safety is that's not a requirement as far as I know for the KTIs and the LAs and all the rest of the stuff. And, it really bothers me, because as far as I am concerned, and I'm talking to Bechtel, in particular, are you listening? No. But that's all right. I'm talking to you because I got the figures last night on the workers, and you're going to have 3,000-some odd workers for the repository, and only 600 of them from Nye County. And, we are the host of it.

Now, my feeling is that businesses should be fabricating this stuff in Nye County, and I am going to propose a law that in order to get to the repository on 95, which is a 9 hazard road, or 160, either way, or some rail/truck facility, that you need a passport to get into Nye County, and we're going to charge you a tax if you're from out of county and you don't give us the money. Because, unless you live there, fabricate, and so on and so forth, you're not doing us any good. We are just suffering.

And, to get back to the 1 millirem, and so on, as everybody knows, I'm really talking about health, and we don't have any health in Nye County. We have no hospital.

We have nothing. Absolutely for 18,300 square miles, 97 per cent of which is federal, we have nothing. The test site, which is 1,730 square miles has nothing, and yet we, in Nye County, are the first responders. So, you see what an impossible situation it is.

So, where is John Arthur, III? He left. Who is here to represent him? Oh, okay, I can't see you that far, darling. I'm so sorry. So, anyway, what I am here for is I asked, and I don't know if Russ Dyer is here--is he here?

ARTHUR: No, he's not.

DEVLIN: Okay. Anyway, but years ago, he was sitting next to your predecessor, Ken Hess, and I gave everybody in the room a formal paper where I asked for $100 million for a medical research facility. I am not going to ask for $100 million. I am going to ask you in front of God and everybody in the audience, because I consider you all Gods, and that is for $25 million for a health facility, and I want you and Margaret to figure out how we're going to get the money, because if we don't have one, then Yucca Mountain is the most dangerous project that ever was. And, you may have two years of my life to get it in. So, that's what I'm saying. I know you're busy, but again, and I want everybody in the room to formally note that I am asking them for the 25 million. I've come down 75 million, and that's hard.

Now, the other thing, and realize when I say this I am not kidding. It is a terrifying situation. You will get a report on this that there are no facilities, medical emergency, fire, anything in Nye County, and that's where all this is going, regardless, and you'd better start realizing it now.

The other thing, and of course I always bring you jokes. I brought a paper that I wrote, and these were on three of the seven KTI LA things on the colloids, on the volcano, and on the biosphere, and I really, these were on disk, and I had them copied, and so on. And, before I get into this, I do want everybody to know I brought a copy of the FACO Agreement, and I hope everybody in the audience has seen that. And, the reason is the FACO Agreement is the agreement formalized in March of '99 between the State of Nevada, DOE and DOD, giving them the test site, which is 1,730 square miles. And the reason I am so hot on this FACO agreement is I thoroughly disagree with you that things do not move from outside the parameters of Yucca Mountain.

You've got 100 above ground bombings, you've got over 2,000 documented on the 400 pages just on the bombings, and stuff, at the test site. And, as far as I'm concerned, the bugs and the colloids and the water and everything else are going to go. And, what was interesting about the three reports that I read, and I'd like the other four, if April Gill is here, is what is important to me is we're talking about a volcano that is 29 miles from my door at Lathrop Wells, or Crater Lake. And, it is a basaltic magma stromboli, and I call it in the report an Ingrid Bergman. Now, everybody who understands what I'm saying, raise your hand. Okay, we have to have a little humor.

So, you will get that. It's open. Every one of these reports, and I also included two things that are not mentioned, and there are many things not mentioned in these three reports, and that is fugitive dust. I also mentioned that you went blind and deaf because you didn't see the 400 foot dune in Amargosa, the sand dune. But, there's a lot of other stuff, but this is very important because I know that the dust, and so forth, from the volcano will totally blast the repository, and you say it will kill the world.

And, the other thing is since the dust, and so on, can't go anyplace but Amargosa, it can't go to Beatty, it can't go to Death Valley, it can't go to Pahrump, I think you have a magic formula that I don't know about, and I'd like to know.

So, thank you again. Remember, John, I want 25 million, Margaret, I want 25 million. I will give you my report. I have the FACO report, and of course I have it for my friends, and anybody else who wants it. So, thank you again for your time, and again, welcome to Nevada. I gave you very little hell. I just want money.

LATANISION: Grand Hudlow is our final clean-up matter.

HUDLOW: Hi, and I'm going to reiterate Sally's welcome by putting up with Backwoods, Hicksville, Nevada is, for people like you, is painful, and I appreciate your doing it.

I have some new information for you, and one concern. The new information is that the transmutation reaction, a very simple one, has had a successful test. And, they came up with a new configuration for it, and they were able to test it at the Deuterium/Deuterium reaction, which is one of the more difficult ones, very low bonds for that to happen.

I just have a new brief on it. I don't have the details. I don't know what the voltage is. They used x-rays, and so forth. So, as I get--the University of NLV will get more details, I will get them to you. What that does is it eliminates the need for storage of nuclear waste. And, instead of having all these problems, you get a trillion dollars worth of electricity. So, to me, that's a no brainer, that's something that we ought to be looking at. I'd like the Board to request a presentation on that.

The other thing that I have a concern about is that we're not working on the canister. I've got 20 years experience at Oak Ridge with that canister, and 20 years of testing. That's something that I think it's so obvious I don't even need to say the advantages of not having radiation come out of that canister. You could hit it with a tow missile, with no damage. So, the terrorist, which is the number one concern in the country, the terrorist problem goes away.

And, again, I would like for the Board to get a presentation on that so that they have some understanding of it, and I'm talking to the DOE and the NRC both to get this implemented.

And, thanks again for putting up with us.

LATANISION: Thank you very much, Grant. I can tell you that the Board remains interested in the comments of all the presenters from the public who are here today, as always. So, I want to thank you all, all four presenters, for being here.

We will now take a break, a lunch break, and reconvene at 1:35, according to schedule. Thank you.

(Whereupon, the lunch recess was taken.)

AFTERNOON SESSION

BULLEN: I'm Dan Bullen, and I'm going to chair the beginning of this afternoon's session as we continue our Panel meeting on engineered systems.

Our next presentation is by Mr. Steven Kraft from the Nuclear Energy Institute. Steve is the Director of Waste Management in the Nuclear Energy Institute, where he leads policy development and program management for used nuclear fuel, nuclear waste, nuclear power plant decommissioning and transportation on behalf of the Nuclear Energy Industry. He joined NEI at its formation in 1994 as it's merger of a number of nuclear industry associations. Prior to joining NEI, he served as the industry and its customers in a similar capacities at Edison Electric Institute, beginning in 1979.

Before '79, he'd held engineering project positions in research and engineering at GPU Nuclear Services, starting in 1973. Steve has a Bachelor of Engineering in mechanical engineering from New York University. He holds two masters from Stevens Institute of Technology in mechanical engineering and management science, and he's a member of the American Nuclear Social and the American Society of

Mechanical Engineers. Steve?

KRAFT: Thanks, Dan. Good afternoon. I am mindful that everyone has just come back from lunch and is probably looking for a little snooze. So, feel free. I will not be insulted. Just wake me up if I bore myself.

I appreciate the invitation from the Board and the Staff, Carl, thank you, to talk about these subjects.

The design of the service facility, which is what I'm going to focus my comments on, is of extreme importance to nuclear power plants, the operating facilities, because the back end of our facilities have to match the front end of the DOE facilities. Very practical consideration. It touches on a lot of operational questions for ourselves, and touches on a lot of licensing issues that DOE needs to focus on.

The key aspect of this relationship between DOE--is that it is a contract. Now, a lot of people don't realize, I think, that this is, in fact, a true contractual relationship. Congress passed a law in '82. It said to DOE go thee forward and make contract with the generators of the spent nuclear fuel and high level waste, and that contract should specify a number of things, terms and conditions, it's where the one kilowatt hour fee is put into effect that the utilities collect from their customers, and then pay into the nuclear waste fund, all kinds of things like that.

It is a document worth reading, not because you might enjoy reading the contract, because it says a lot of things in great detail about how you remit the payment and how you fill out the payment form, and how they're going to do scheduling, and how they're going to notify each other, and we can do all kinds of things with our waste allocation. And there's a lot of things it doesn't say. It doesn't say how we're going to accomplish the verification inspections, for example, which is an issue, believe it or not, we touched on earlier today when you asked questions about how do you know the cladding is still intact. Well, what procedures are we going to use for verifying the fuel.

For example, we are permitted under the contract to containerize damaged fuel. In fact, it implies that damaged fuel has somehow got to be containerized. It goes on to say that damaged fuel does not fit into the normal acceptance Q. So, early on in the program when the question was asked about, well, how are you going to know what the condition of the fuel is that you're going to accept. Well, you're going to know what the condition of the fuel is you're going to accept, because the industry has to tell DOE what that condition of the fuel is. But, at the same time, if it's damaged fuel, which is defined in the contract as being not able to be handled by normal means, whatever that means, maybe there's a debate there, then it goes into some never

never land of scheduling.

So, this contractual obligation between the two parties is extremely important when you think about surface facility design. And, also, keep in mind that they're individual contracts, each entity. And, I believe, well, there are certainly over 100. I'm persuaded to think there are about 120, 130. DOE would have to tell you exactly how many there are, because when the contracts got signed, DOE dealt with multiple ownership of power plants in whatever way the local owners wanted to deal with them.

For example, there may be a single contract with the operating owner, and then there's some relationship in the contracts between the operating owner and just the owners. Or, in some instances, each owner, operating or otherwise, signed their own contract. And, then, there are a lot of miscellaneous contracts with holders of used fuel and high level waste that are not electric utilities. And, in fact, some of those contracts come first in the Q, because some of that material is extremely old sitting in--Air General has a tiny bit. General Atomics has a tiny bit, various research activities.

And, the bottom line here of the contract is that the only quid pro quo in that contract is the utilities pay the money, and DOE conducts waste disposal. That's all it says. It doesn't say how they're going to do it. It doesn't say what containers it's going to be in. It doesn't say how they're going to--the containers are going to show up at the site. It does say that the utilities are responsible--the purchasers, let's say that, are responsible for loading the canisters on their own sites. And, that's obviously true. The utilities wouldn't be comfortable with DOE coming anyway, because it's their site, their license, whatever.

So, that's what drives a lot of the thinking that we do about the--about how DOE ought to be going about designing that surface facility, because of the contractual relationship. And, we'll talk about that. I'll keep referring to that as we go through.

Well, what do we want? I'll let you read that first bullet. That's what we want, we've always wanted it. Okay? Now, the fact that January 31, 1998 was a Tuesday--no, it was a Monday, came and went without fuel moving doesn't mean we still don't want that. And, I say that because the utilities, and this is an important consideration, there are probably over a dozen utilities in litigation with DOE right now in the Court of Federal Claims, and we expect by the end of this month, that just about everyone else will have filed a lawsuit because the way the lawyers explained it to me is that January 31st of this year is the first date under which you could be out of time in filing one of those lawsuits.

So, what do you think? We think there will be more getting in there, and, in fact, a bunch of utility owners just filed suit the other day. They call themselves the seller's group. This is a group of utilities which sold their nuclear properties to other utilities, and are suing DOE for damages claiming because this program wasn't moving along the way it was supposed to, the value of their properties were, in fact, lower and they want to recover. It's a very complicated legal situation. I'm not a lawyer. I won't go into it. But, that's just an example of the kind of complications that get involved in all of this.

So, the current DOE milestone, as everyone knows, to operate this facility is 2010. And, the question is what constitutes success to get to 2010. Obviously, the license application is December '04, but the completion of the facility design--now, someone asked a question of John Arthur when he had all those percentages, what did those percentages mean. Those percentages, the way I interpret them, and, of course, I can't speak for DOE, but when they say they will have 100 per cent of the design done for LA, it means that amount of the design necessary to file the license application. It is not 100 per cent of the design that you would think about in terms of go out and build it. It's not going to be construction drawings. I would imagine it's that necessary in order to do the analysis that's needed to get the license application.

So, there will be a lot of facility design going on, much as we did in the early power plants under the original Part 50 during the licensing process. Development of the transportation system, you will hear about that a lot tomorrow, and, of course, coordination with the states and tribes, which is absolutely critical, and we're glad to see that DOE finally released that strategy they had promised for so long, and we'll talk about that.

That first bullet is a given, that the industry has a stake in the success of the repository and its licensing. But, the next one is an interesting point. It must be practical and must be licensable and will support operations in 2010. I didn't hear anyone on the Board asking DOE any operational questions. Those are the questions we ask DOE. Those drawings that Paul had up here, earlier versions of those, you know, around. They're a little different, they're oriented a little differently. But, you know, you might want to ask questions about--I think someone got to ask questions about choke points. I would encourage you to keep looking at choke points. I now want to step back and ask a question about that turn table. I always wondered about that.

I'm not saying these are not good things to do. I just think that there needs to be some examination of whether or not you hit the licensable and practical aspect of it. Licensability, did you all hear Paul say that part of the design basis is that the cask drop accident is going to be screened out? Well, think about what it takes to get a cask drop event, such a low probability of occurrence, such that it screens out. Think about what that's going to take in terms of handling and everything else, and is that really the right way to go about doing it? Every nuclear facility that I'm familiar with licenses in their license, there's a certain about of accident, off site release involved. And, you do that because you know that you will operate in a way where you might have a release, and you have to compare it to your license.

I mean, I don't pretend to know the reasons why they're doing these things, because I'm not involved in that design, that's something that they're doing, but when I hear that stuff said in public, I kind of wonder why are they doing that. And, maybe there are good and sufficient reasons, but I wonder.

Clearly you have to have design done for the LA. And, the acceptance rates, there was some minor discussion of acceptance rates, but keep in mind that their plan, as they've always described it, is to ramp up--that MTU in the first year, and 3000 MTU after five years. Now, that's not a contractual matter, by the way. In fact, that is the dispute that's occurring in the Court of Claims right now in terms of damages.

You probably all know that the Court of Claims decided a number of years ago DOE was in breach of the contract, and they're in the damages phase. Those damages phases go on for very, very, very long times. But, a lot of it turns on what the acceptance rates are going to be. And, of course, the question was asked about all types of commercial. Clearly, the design should accommodate all types of commercial fuel, and we say from the beginning of operation. I know that question got asked.

But, remember, it's a contract. And, inherent in a contract is the ability to negotiate. And, DOE, if they've got a concept for design, particularly in the early years when they're going to have to phase in the ability to begin receiving used fuel from commercial facilities, along with Navy fuel and DOE's own material, and there's going to have to--Paul had Phase 1 and Phase 2, and Phase 1 included the full DTF. There may be some earlier phase that will have to be done, and that might have to touch on utilities as to what these utilities can provide in those years.

That requires negotiations, and that's nothing new in a sense that about ten years ago when DOE, for the purposes of transportation, had issued for comment a series of draft RPs for the transportation services contract, which I think is a concept that they're no longer going to use, where they had the regional--it would set up regional contractors and they would deal with utilities in their regions, what have you. For a lot of reasons, we didn't think that was terribly workable, nor did the transport industry.

But, having said that, what was in that concept was that that contractor could incentivize the utility to provide certain kind of fuel at a certain time that would meet the right kind of casks that they had available and could go into the DOE system, however that was going to be imagined back in those days. So, this notion of using the contract as a negotiating tool was--needs to be explored.

And, the reasons, at the moment, utilities can select the fuel. The contract says oldest fuel first. What that means is there's a whole list that DOE has delivery acceptance schedule that says, you know, in the global scheme of things, the very first discharged fuel bundle is at such and such a facility, and that goes first. And, then, because this material tends to be discharged in batches, you know, you've got the batch, what they say in the contract, the lot that will be shipped.

Well, in point of fact, because there is a trading allowance in the contract, allowable in the contract, where Plant A has a real desperate need to get rid of fuel for storage consideration, but they're not early in the Q, Plant B is early in the Q and they have this transport, this allocation for shipping, but they could go a few more years, well, there could be considerations made between the two utilities, and this transfer could occur of a shipping slot for shipping slot, much the same way utilities trade uranium, what have you. In fact, that provision of the contract was modelling after some of the original contracts that DOE used to have with the utilities. And that is complicated. That is a complicated feature to this, because it makes DOE not know for a long time as to what fuel--they know from the chart what fuel will come when, but they don't know who's going to trade allocations, and that needs to be worked out.

And, again, I point to the fact that it's a contract, and if DOE is going to begin the job a certain way, and say, look, we can only accept this kind of fuel, we can only accept, you know, green fuel for the first five years, there are utilities with green fuel that you might have to kind of do some incentivizing to get the utilities to trade their rights around in order to get that fuel moved appropriately for that design. So, that's the way the contract fits in all this.

We are in the business of generating electricity at very large, very complicated facilities that now have an enormous amount of security requirements put on them, far beyond what we had--we were secure before 2001, we're even more secure than we were. And, what cannot happen is that this program have requirements on our plants that interfere with those plant operations.

Now, I know this is the federal government, and I know it's a law that makes it work. But, it is in fact a service contract. It says that in the contract. And, so, that's the direction it goes in, that the utilities are purchasing the service, so there needs to be a lot more conversations between utilities and DOE as to when, where, how, why green fuel, blue fuel, you know, whatever the requirements are, because the utilities cannot afford to have these operations interfere with their power plant operations.

Design not impact transport operations. Operations are going to be DOE. But, what I mean by that is that there are certain tried and true transportation things that are done in this country already that you'll probably hear more about tomorrow, and that the design ought to take advantage of them, not put new requirements on transportation that can't be met, or makes meeting it more difficult, or requires some novel licensing requirements, or certification requirements, things like that.

Design must use certified transport. That's in the law. They have to use certified transport systems. And, of course, we have about 2,500 ton right now in dry storage. I think that's the right number. 5,000, thank you. 5,000 ton, and it's going to go up, and for every year going forward, we have about 2,000 ton of used fuel generated every year, going forward. Half of that goes into dry storage going forward. So, there's going to be a lot in dry storage, and the question got asked, Dan, you asked the question, storage transport, storage. Okay?

The way I think that problem gets solved, if it is a problem, is that these casks have to be recertified every 20 years. So, you'll know whether the cask is usable. The real issue, as I see it, is that if I'm a utility and I'm using a design of a cask that's listed as a usable cask, is that cask system usable at the Nevada Test Site? That's not one of the sites in the NRC rule. That's got to get looked at, and there are some systems that are, like, they're limited. You can't go to this site or that site in this part of the country. So, that needs to be looked at.

But, what DOE has always said, and it's always been verbal, and you can't hold anyone to a verbal statement, but they said if the cask is licensable and usable on your site, then we'll use it on our site. Well, there's a regulatory step they've got to go through to get there.

So, the question Carl put to me when he asked me if I would speak to the group today was what is the industry willing to do? And, I believe the question was what is the industry willing to do on its sites to make the DOE system work better, faster, more efficiently. And, I may be putting words in your mouth, Carl, but I thought that's what I heard you say. The answer is we're not there yet. We don't know what that facility is really going to look like to the point where we could say okay, for the right consideration, we might be willing to do the following on our site, or not do the following on our site.

So, all I could really do is give you some examples of what we've done so far. We have responded to every data request that DOE or Bechtel or Bechtel TRW has made. We have a group of utilities that participate in NEI, and we know a great deal about their spent fuel, and there's questions about fuel type, fuel characteristics. There's questions about what kind of spent fuel handling incidents do you see at your site that we might have to think about for our site, those kinds of requests that we respond to.

Used fuel handling information based on utility experience is primarily what I just meant in terms of thing that occur on our sites that they need to think about.

Provided used fuel transportation on extensive utility experience. I think we told this group, or maybe it's in tomorrow's presentation, we have a transport policy that the industry adopted the middle of last year that one of the key features of is that the utilities have a lot of experience, very good experience in moving this material from Point A to Point B, that we think the DOE needs to rely on very heavily in planning its transportation routing and its transportation operations. And, I think that what I really mean is they ought not be developing anything truly novel to do this. These are tried and true activities. And, again, you don't know what they're really thinking about, maybe they'll say tomorrow, because what's the front end of that system going to look like. What's the mating end of that system going to look like that these casks have to come in that might drive something that's new to the cask manufacturers or new to the NRC reviewers.

Exchange information on used fuel and plant operating procedures. Questions got asked earlier in the day of John Arthur about the NASA experience was raised, I believe, based on the Challenger and then the Columbia. And, I'm no rocket expert, but I'll tell you from reading some of the summaries of those reports, my impression is that what NASA was lacking is a good operating management driven condition reporting system. Because what came out in that report were the existence of the e-mails that said if this goes on, we'll have this problem.

This is the kind of thing that our industry has been dealing with for a very, very long time, and we have condition reporting systems, and we have made available through industry experts, as John said, he brought in some industry experts, on how you construct and operate those kinds of systems, condition reporting, employee concerns. There's a whole series of things. I can't remember all the names of them. Everything from employees being concerned, that they don't think they're being taken seriously, to someone says, okay, I've got to change something in one of the models, and I put that in the condition reporting system, which is dealt with by everybody else, this is the kind of thing utilities have done a lot of, and we have made that available to DOE.

Some utilities have actually given DOE this is the system we use, and DOE does participate in various meetings of the Institute and can compare operations, which is where we look to maintain our excellent, safety excellence for our industry.

Industry will work with DOE to make transport as efficient as possible. That's not a platitude. We really would like to see this done in a way that makes a tremendous amount of sense. We have a lot of experience doing it. PFS has its rail car design, and has learned a great deal about how you do those sorts of things. We want to make that available to them.

Again, surface facility design is important to the operation, and acceptance of industry used fuel, we take a great deal of interest in it. It can't impact on our operations at our plants, or the transportation system must accommodate all fuel. But, again, like I said, this is a contract. Things could be worked out. And, of course, we'll respond to any requests that DOE/BSC has.

That's all I have to say. Thank you very much.

BULLEN: Thank you, Steve. Questions from the Board? Dr. Duquette first?

DUQUETTE: Duquette, Board. This isn't a technical questions, but do you view your relationship with DOE as adversarial, forgetting about the litigation?

KRAFT: No, we don't.

DUQUETTE: You don't?

KRAFT: No. We view our relationship as--the industry views its relationship, as I said, it's a relationship with someone who will provide a service.

DUQUETTE: Well, let me ask the question a different way. Do you view DOE as being unresponsive to your requests?

KRAFT: No, I don't. I think that DOE is taking the information we're giving them, and using it. I think that it's like ignoring the elephant in a room. The lawsuits do prevent DOE from having the kind of engagement with individual contract holders that we think needs to go on, and they need to sort of get that resolved so they can do that.

Now, look, I take no sides in that stuff. That's between individual contract holders. We're not a contract holder, and we're not representing the utilities on those disputes. But, in terms of what we do generically as an industry with DOE, I think that they are--John said it this morning, they look for best practices, they bring in people who can help them out. So, we think they are being responsible.

LATANISION: Latanision, Board.

Actually, I don't see a number on your slide. This was the next to last. It had to do with industry assistance.

KRAFT: Yes, sorry. We did not number the slides.

LATANISION: I'm curious about--this is also not a technical question, but the issue of assessing the public sentiment related to the question of transport, you have listed here that you've got--you might provide as an industry assist, fuel transportation information based on extensive utility experience. And, I'm just curious about the nature of the dialogue with the public in terms of transport based on the experience the industry has had. That's clearly going to be an issue in terms of the longer scale here.

KRAFT: Those utilities that have done transport of material, principally returning fuel from former reprocessing sites, GPU took a few back from West Valley, as did Point Beach, a couple facilities took fuel back from Morris, and Progress Energy was in the process of shipping a lot of fuel from its plants in--Brunswick Plant in the southern part of North Carolina up to Harris where they had bigger storage facilities, although they're stopping it.

There has been no real specific transfer of that experience in the sense of having people who dealt with the public on behalf of those utilities specifically talking to DOE people. I think that the DOE would do well to request that, to do that. I think that after a lot of--for example, we know there was an experience where there was a lot of opposition in certain locations, and the utilities had to deal with that and overcame enough of it so they could begin transferring the fuel, and it went fairly smoothly. And, how that was done is something that DOE should be taking advantage of.

LATANISION: It really is the latter point that I'm most interest in where there have been issues, and the public has been vocal about them, how the utilities have dealt with that.

KRAFT: Well, to date, there has been nothing formally done in that regard.

LATANISION: Can you give me an example, though, of a case where the industry has interacted with the public on an issue of transport?

KRAFT: I'll give you one--I'll give you a few examples that all seem to have the same characteristic to it. When GPU was returning fuel from West Valley to Oyster Creek, and they were building a dry fuel storage facility at Oyster

Creek for that purpose, the individual responsible made it a point to more or less walk around. Well, when he visited with the first responders, you know, with the sheriffs, with the school systems, to make sure that there was knowledge that this was happening, they didn't expect people to embrace it right away, made sure there was knowledge, provide them with the information, there was no real resistance that I'm aware of in those shipments, but there's sort of these stories that have come to light.

For example, their shipment was announced to occur--you know, you don't announce when it's specifically occurring, that's safeguarded information, but you do, there's a general time period that you can talk about. And, there was a contact by the school principal wondering whether the school ought to be closed that day, because two or three miles away from that roadway, that interstate that you're going to be going down, and the fellow from GPU went and visited with that school, and showed the information and described, you know, the relative risks involved. And, frankly, you know, our view is that those children are far safer in school than not in school, forget the transportation, they had really very little to do with it.

And, I think that he was able to sort of calm some fears. And, those sorts of things happened over and over again. Interestingly enough, there were some--when Point

Beach Plant was returning fuel from West Valley, and they had to go through Ohio to do that, there was a lot of resistance in Ohio, and there were protests and there were people going to block the trains, and the police had to get--interestingly enough, is that the story I recall is with all the opinion polling done in advance, it was an attempt to, you know, move the fuel at certain times, and avoid certain--not stop the trucks at certain places, you know, things to accommodate as much as you can, but the fact is, the fuel has to move.

Three weeks after, they began moving the fuel and the furor died down. I went out and did an opinion poll, and that fueling took place I think over a period of a year, their reaction was are you still moving the fuel? So, there seems to be a learning experience that if you just keep providing the information and accommodate as much as you can accommodate, and then when you finally start doing it and people see that it's not as frightening as it initially sounded, perhaps they become more comfortable with it. Those are the two or three experiences.

LATANISION: Thank you.

BULLEN: Mark Abkowitz?

ABKOWITZ: Abkowitz, Board.

Steve, I had a couple questions, the first one is longer than the second, so I'll start with it. It would seem to me from a transportation systems planning standpoint, that square one has to include an understanding of where your shipping margins are, how much they're shipping, what type, when, and so much of the transportation planning lays out, based on that understanding. I guess I'd like to know a little bit more specifically what kind of conversations have taken place to date with DOE? Has anyone actually approached the utility industry and asked information to the level of specificity that would be necessary to get that information?

KRAFT: Oh, yeah, there's a requirement in the contract that the individual utilities provide information on a regular basis in terms of a certain survey form that DOE has, in terms of the fuel, what the fuel is, when they expect it to be shipped, by what. The industry defines what fuel will go when and in what time period, according to the allocation they've been given, and then DOE gets to say yes, we'll come and get that, or we won't. And, lots of that information has been provided over the years in terms of the fuel, the specific elements, the conditions of the elements, the location of the elements, things like that.

What the utilities have not been obligated to do yet is tell DOE if they're going to do any swaps. I think that's five years before shipment, or some time period in the contract like that. So, we're not near that. We're not really at that yet. I expect the utilities will be thinking about that. So, there has been a lot of that kind of information.

From the standpoint of what the capabilities are at the point of origin and shipment, about 15 years ago, there were two major studies, survey studies, DOE did. One was called the Facility Interface Capability Assessment, the other one was called the Near-Site Transportation Infrastructure. The question was what is on your site? What is your crane capability? What do your overheads look like? What size casks can you handle? Does the rail line go into your garage? How does that work? And, then, how are we going to be able--what kind of casks do we need to show up, do we need to come with special handling yokes to handle casks, the cask that DOE designs?

Then, the next question was okay, what happens in the immediate vicinity around the plant? A lot of plants had rail lines put in for the sake of construction, but then got abandoned. So, are those rail lines still in place? What weight capacity do the bridges hold, are the bridges still in working condition? That was the second part, the Near-Site Transportation Infrastructure.

DOE has said in their latest strategy that they are going to go and update. That requires a tremendous amount of interaction with individual contract holders to gather that information. So, the information is there in databases from which it's updated for DOE to use.

What you saw today in the discussion on the design was some--concern isn't the right word--but DOE, because they don't have a good idea yet of how the fuel will phase in, what fuel will phase in, because the only fuel that we, under contract, cannot give them right away is fuel that's non-standard, damaged fuel, fuel that's too long, I mean, there's a few categories of fuel, but most of it, we can say get this element here and get that element there and that element there, and that may not be consistent with some early design. So, that's why the cask handling facility and the dry handling--the bigger building--are so complicated in some respect from the very start, because they don't know what's going to come.

They could take advantage of the contract and talk to the individual utilities about what is it you're going to send. Now, maybe they'll do that in the transportation contract, but the transportation contractor would be that integrated link between the two. We haven't seen that yet, but suggest that's going to happen. That would be another way to handle it.

ABKOWITZ: And, just so part of that response is also based on cask availability and cask designs that have been certified in the context of the timing and swapping?

KRAFT: Yeah, that's true, although the number of casks that are needed to get up to 3,000 MTU are so much greater than we had. I suspect there's going to be a whole new generation of casks that DOE contractors will develop, or DOE will just inspects out, and contractors will develop and sell into the system somehow. We haven't seen that developed yet either, but there is certainly a need.

ABKOWITZ: Now, my second question.

KRAFT: Oh, that was one question?

ABKOWITZ: That was one question. In the middle of November of 2003, DOE issued their strategic plan, and the focus of that plan is to put strong emphasis on stakeholder interactions. I was just curious if in the utility industry, a draft of that strategic plan was vetted before it was published? In other words, before this strategic plan was published by DOE, as a stakeholder, were you ever shown a draft of that, so you could provide your input as a stakeholder?

KRAFT: No, we were not shown that report. I understand that some other parties were, but that's fine. We were not bashful, though, over the years in telling DOE here's what you should do next. We gave them lots of unsolicited advice over the years about if we were doing a job, here's what we would do next. So, they had the benefit of our input, but no, that document was not issued for comment, and we did not see it until it got mailed to us.

ABKOWITZ: Thank you.

BULLEN: Bullen, Board. I'll just take the last question as the chairman's prerogative. And, this is a rhetorical question, which I think you can answer, but it's in your professional opinion, not in the fact that you have a contract with DOE, or anything like that.

The multi-purpose container concept, which has risen and died, and risen and died, a number of times, basically seems to make a lot of sense. In your estimate what would it take to revitalize that effort from an industry perspective?

KRAFT: Okay, you're presuming that I'm accepting your premise?

BULLEN: That we'd want to revitalize it, yes.

KRAFT: Yes.

BULLEN: What would it take for the utilities to agree to something like that?

KRAFT: MPCs have an interesting, if not spotted, history and a lot of people in this room are more closely involved than perhaps they want to admit over the years in that concept. A lot of utilities think it's a real winning solution, that they button up the canister on their site, and it's just far more efficient, you know, to then just have it go through the system and go right into somebody's package, and go into site specific storage package and be cooled, or to go into waste packages underground, what have you.

On the other hand, I'm told by the people who are looking at this in DOE that it's more expensive than what they're thinking about now. But that is leaving out something that was said at the very, very top of this morning. It's a system you have to look at. And, for us, that always made MPCs work was you would incur costs at a utility that ultimately were useful in the system that DOE could then use. And, again, this is all subject to contract.

So, what would it take? It would probably take a commitment on the part of DOE to utilize that concept, and then work with the utilities to have that back into their own system. It's not clear to me that every utility would want to do that. But, if you just keep in mind what you saw here this morning that all showed a relatively small container facility, and a relatively large bare fuel facility, if you went into empty seats to the degree I think that you're perhaps suggesting by your question, Dan, you might see the relative sizes switch on those. But, that again, that's something that's never been really discussed with the utilities.

Back ten years ago, it was something that the utilities innovated as an idea that they liked. Since then, a lot of words have gone under the bridge in terms of what utilities have on their sites. So, I don't want to speak for any of them, but, you know, that's what I think has to happen.

BULLEN: Thank you very much, Steve.

With that, I think we need to move along to our next presenter. We're going to change gears here and talk a little bit about alternative conceptual models for engineered barrier system chemistry and performance. The presentation will actually be made, he'll make the next two presentations, it's Dr. John Walton.

Dr. Walton is currently professor in the Department of Civil Engineering, and the Program Director for Environmental Sciences and Engineering at the University of Texas, El Paso. He has a BS, MS and Ph.D. degrees from Western Illinois, Virginia, University of Washington, and University of Idaho respectively. So, a well travelled scholar. And, I turn it over to John.

WALTON: This presentation was done with Drew Hall, my master student. Some of the detail comes right out of his master's thesis. He now has a job doing ground water remediation, and has graduated.

We can start off the talk by looking at the map here. We've got a digital elevation map, and there's Death Valley, there's Yucca Mountain, there's Forty Mile Wash. It just shows an analysis of the ground water chemistry from the wells, and, so, it's a really interesting trend along Forty Mile Wash.

But, the real question today, although that's quite fascinating, the real question today is how do we go from the chemistry in the ground water, in the pore water, in the precipitation, to chemistry in the waste package. And, so, we're going to look at some alternative conceptual models for that. And, also, I want to talk about performance credit for partially failed waste containers. Can we maybe give a little more credit for that.

Here's a cartoon at the bottom. It shows some of the things that could happen in a drift. But evaporation and condensation are important in a lot of places, in a lot of times, and they don't tend to go away. At the repository, we have high permeabilities of them, and after closure, the repository is going to breathe. There's going to be air moving through it, and the air is going to go in some places of the repository more than others. And, so, it's going to vary. And, some parts of the repository may have met evaporation, others may see condensation.

Likewise, if we go down a drift, like here maybe air flows this way, and some parts of the drift may see evaporation, some parts condensation. We could move down, if we have rubble here, we might have a hot waste container because it's insulated by rubble, and then we get condensation on a cooler waste package.

So, a lot of things. It also can happen inside a partially filled waste container. Rubble can cause a lot of issues, if it occurs. The thermal conductivity of rocks about 2. Thermal conductivity of dry soil is about an order of magnitude less. Thermal conductivity of rubble, well, we don't know, but it's somewhere in there. Corrosion products, well, we don't know, but somewhere in there. And, temperature drops tend to be proportional to thermal conductivity and heat generation rate.

So, we can get a lot of complexity in here, and you can get hot containers even in a cold repository, for example, if you had roof collapse.

And, when we start looking at convection, like these little air currents we've drawn in the cartoon, then the repository starts to look more heterogeneous, because we can get evaporation and condensation a lot of places.

Here's a picture to provide some perspective. All we've done is taking the heat generation rate of a ton of heavy metal, applied over time, and divided by the latent heat vaporization. So, you can look at how many kilograms per year you could evaporate. And, while the numbers aren't huge, early on, it goes off the chart here, really high. That's the thermal period.

But, even after the thermal period, these are significant numbers. And, so, evaporation doesn't go away. It just becomes subtle.

Here's a little picture that looks at a couple other things that will affect the waste package environment and waste package chemistry. We see a lot of slides that show the effect of salinity. Here, we just show sodium nitrate, because it was simple. Age increased the concentration of sodium nitrate. You get a vapor pressure, relative humidity. You can also get a similar effect from tension. We forget that, as condensation in small pores, if we look at that, here, when we get a lot of tension, we'll get vapor pressure lowering. And when we get both of these together, you get even greater vapor pressure lowering. So, you can really stabilize water in some low relative humidities when you consider both of these processes.

Now, let's look at an alternative conceptual model for the waste package chemistry, one Drew developed in his master's thesis. There's a lot of processes that may be important. Most of these aren't in codes and experiments, and some of them shouldn't be, but some of them maybe they should be, too.

We look at one physical process here, and that is physical separation of soluble salts based on differential solubility.

This is common when we go to real world environments. If you look at a playa deposit, you don't see a homogeneous mass of salts. You find a gypsum bed here, and a halide bed over there. And, there are a number of reasons for that, and you see the same thing, of course, in springs and arid regions. One of the reasons is is that water moves mostly when it evaporates. It doesn't stay still. And, so, if the water is moving and it evaporates, then the most soluble materials will be at one place, and the high solubility materials, the halites, will precipitate at a different location. So, they tend to separate. And, then, if you have deliquescence or seepage later on, now, the salts are separate. They're not mixed anymore.

This is a picture from a sidewalk in El Paso. Just have a little rock wall, somebody has irrigated it, it seeps out the bottom. And, you see around the wet spot, some characteristic banding, some evidence that maybe there's some separation process going on here, although it's just a picture. We don't have any analysis.

Here's a figure where we're trying to describe the conceptual model, so I'll try to walk you through this. A is the conceptual model that DOE has been using. This is what was presented last spring to the Board. Here, we show a fracture in the drift at some place where there's evaporation. Of course, the fracture would be a lot narrow than this, but we need to blow it up to see it. Here, the water is arriving all at once, and, so, the salts precipitate right here, and they precipitate as a homogeneous mass, all mixed together.

Over to the right in B, we show an alternative conceptualization of the process. Now, the water flows parallel to the fracture. And, since there's evaporation along here, we get the lower solubility of things here, the calcium carbonates, the gypsum, and the higher solubility things, halite, at the other end.

Now, let's go from the conceptual to a mathematical model. For this model here, we use what we call a single cell mixing model. This is what DOE has presented to you. And, what happens is is that all the things are precipitated together, and what dissolves, depends just on relative humidity. The ultimate conceptual model.

Now, since we have this trip along here and water is evaporating, we can describe this as a series of stirred tank reactors. And, in each reactor, a little bit more water dissolves, and the appropriate amount of salt precipitates. So, this would go like here, you might have calcium carbonate precipitate, might go out in the first cell, and you might see it right here in the results. You might see halite down here, might precipitate in this bin, and you'd see it down there.

Now, this doesn't force separation, because sometimes multiple things can precipitate at once. And, if you showed things on a log scale, you'd see a lot of other things.

Here is a difficult one to explain, but this is the way to try to explain how the model works. I hope you bear with me. I'll try. Single cell mixing tank that dries out, you get a dry period in the repository, relative humidity rises in time, hits the deliquescence point. We have a concentrate solution, you know, the mag. chlorides and sodium chlorides, and sodium nitrates dissolve. And, then, as relative humidity rises, it becomes more dilute, and the composition evolves because the less soluble things are coming back in.

Alternate model. The waters evaporate as it moves. The water is moving in this direction. Calcium carbonates, low solubilities, will precipitate here. The halites will precipitate up there. Now, if we move out in time, relative humidity hit the deliquescence point, and now it's diagonal because for halite, you hit the deliquescence point pretty quickly, whereas for calcium carbonate, it doesn't hit deliquescence until you get 100 per cent relative humidity because it's low solubility.

Now, once we hit that, they evolve and become more dilute, but the solution composition doesn't change, because everything dissolved right here. So, in one case, we change in time the amount and space; another one, we change in space, and less so in time. Now, these are two extreme ways of doing the previous model. This is a single cell; and this one we'll call the infinite cell, there's enough cells that we maximize the process. Realities like to be in between.

So, we've tried to look mathematical. What happened with this, we don't have a lot of resources, so we use the simple equilibrium model. So, our results are just semi-quantitative. We're not running the picture equations here. That's really what you need to do it real accurately.

There's two endpoints. Single cell mixing tank, and infinite cell mixing tank, maximum degree of separation possible.

We've done a number of water chemistries. It all depends on what chemistry you start with. We've run some of the bin chemistries that DOE has, but I couldn't present those because at the last minute, I found my student made a mistake. So, I put these in off his thesis. This is from Paintbrush Tuff, non-welded pore water. So, it's one possible log to hit the waste package. This is the single cell result. We show it as activity of water, although, again, this is not very accurate. It's really just a fraction of water in our model. We see a mixture of chloride and nitrate. And, if you brought this on a log scale, you'd see a bunch of other stuff in here, too. It's just been kind of lost in the first step right there.

Now, we move to the infinite cell mixing tank.

Now, we're looking at different physical locations. So, this location, we've got all the--this is calcite, there's some gypsum, and some kind of carbonate in here. And, then, out here in the concentrate stuff, we've got a pure band of chloride there, maybe sodium chloride, I'm not certain, a mixture of chloride and nitrate, and then we've got pretty pure chloride. Now, again, if you show log scale, a little bit of everything shows up out here.

Same sort of model. This is Topopah Spring pore water here. Single cell mixing tank, we get a nice lot of nitrate, it's what we like to see, and a fair amount of chloride. You see some sulfate, and everything else is off the chart, and none of it is compressed into here. If we blew this up, you'd see a bunch of action back here.

Now, we look at the infinite cell mixing tank. We do get a band of pure chloride, but most of the places, the chloride and nitrate don't separate. So, what happens still depends on the initial water conditions. But, you can definitely get separation of the salts, and it's not clear that the nitrate will always be present with the chloride.

So, you might ask when does this occur? It's nice to talk about processes that could occur in the repository, but we want to talk about, or look at things, that are not only possible, but probable, that really will happen. So, here, we tried to derive some diminsionless groups that form the Peclet number, called a separation factor. It looks at the ratio of diffusion to advection, because what happens when the water is moving is that advection tends to move it along, but diffusion will counteract the concentration gradients. And, if diffusion is higher than advection, then you'll never see this physical separation process because it will smear everything out. We'll get a uniform mass.

But, when advection--then you see physical separation. We do two derivations. One is in a water film. The idea is water is dripping on a container, you get a wetter air, and it evaporates. The second one is for flow in the porous media, like we showed in the crack.

I don't want to spend a lot of time on these graphs. This is the one for physical separation in a water film. It depends on a variety of parameters, especially drip rate and evaporation rate. If the drip rate is real low, relative evaporation over here, here's the log of the separation factor, if that were zero, you'd expect--or less than that, you'd expect no physical separation. If it's positive, you'd expect to see physical separation.

So, if we have a real low drip rate relative to evaporation, then everything flashes off, and we get separation. But, when evaporation and drip rates are closely matched, then you'd predict some physical separation of the ions.

Here is the same sort of thing, but in the porous media. In this case, the derivation is only a function of-- properties, and the moisture tension. And, in both cases, basically, the separation factor is high, and as long as the flow is parallel to the surface, which is what's required, you'd expect to see some degree of physical separation.

Now, let's shift gears a little bit, and try to look at partial credit for--the failure for partially failed waste containers. We'll start off by looking at simple diffusion, and make a couple of observations. One is that most people I talk to believe that if the Alloy-22 fails, it's going to fail locally by small penetrations, but it's not just going to disappear. There will be some substantial protection left, if we know how to take credit for it.

And, just as an observation, most of the time we get this localized corrosion with aggressive solutions, and there's no reason to think those aggressive solutions will be lined up for seepage. As a matter of fact, just the opposite might be true, because if you have seepage, you tend to get more dilute waters.

One of the things we could take credit for, and there's some credit for this in the PA, is diffusion out of stagnant zones. I'm going to give an example calculation without retardation. One meter region.

So, this assumes that you have a one meter stagnant zone in the waste package. Assume that you can treat it as a porous media. And let diffusion rate out of here. Here is the log, diffusion coefficient. Here would be diffusion pure water at this far end here. Down here, lower diffusion coefficients would be more characteristic of a complex porous media. This is the fraction of the amount that's released. We assume that it's completely soluble and completely released instantaneously. And, you see that over a 5,000 year period, it doesn't all get out. I mean, there's substantial credit available here. And, it gets better, I think.

Here's a little cartoon where we talk about a particular physical process. What happens a lot of times when we have a heat source in a porous media and it's relatively dry, is under the right conditions, you set up a circulation system where the vapor is--at the hot source, the vapor moves away from the hot source, and the liquid comes back by capillary suction, and you set up this circulation system.

Well, what happens is the flow of the liquid is always towards the heat source, and it's a very robust thing. Here, we've shown it right here, and what happens in this porous media, for example, is that you tend to get accumulation at the heat source. So, the waste doesn't tend to leach; it tends to accumulate. There's some conditions where waste will actually accumulate and not leach.

And, this shows an example where we tried to calculate that. So, years ago, Peter Lichter and I developed the semi-analytical solution to look at this case. And, as part of the solution, there's not time to present the whole thing, there is a dimensionless group that is the ratio of the potential for vapor diffusion to liquid advection. We just called that alpha, plotted it up over here. When alpha is high, the flow is towards the heat source, and you wouldn't have the release.

Now, here's an example calculation. This assumes property of sand. We calculate it as a function of temperature, and the log of the moisture potential. This right here would be about two and a half meters of tension. So, it's not all that dry. And, when alpha is greater than 100, you'd say the waste is protected, wouldn't leach, when it's less, then you'd expect to see some leaching, by diffusion, for example. And, so, this region over here would be subject to release. But, out here, this whole region, you would not predict any release. For example, out of the crushed tuff below the waste container.

And, so, when we look at things like this, one might say that perhaps we should take more credit for the situation after a container fails.

So, here are conclusions. One is that the engineered barrier system chemistry is more complex than typically has been assumed. Nitrate sometimes can be separated from chloride, yet we really can't assume that they're always together, and that nitrate will protect. Changes in design might make it less important, lower temperatures, which the Board has recommended. But, some high temperatures will occur even in a cold repository unless you can guarantee the roof won't collapse.

Microenvironments. Sometimes people think they disappear immediately, but they don't. They persist for a very, very long time, albeit they're more subtle. And when you start looking at convection in the repository and all this air flow in the repository, then it's very, very important. And, we're also saying that perhaps we could take a little more credit, that you don't have to rely on the Alloy-22 quite so much.

That's it. I just like to end on a pretty picture.

BULLEN: Thank you, Dr. Walton. Questions from the Board? Actually, I'll go ahead and start it off, because I'd like to go back to Slide 12, if you could. I was very intrigued by these types of presentations where they showed a separation between the chloride and the nitrate and the carbonate, for example. And, I guess I was just wondering a little bit with respect to the dimensions on the bottom graph on the right where you talked about, is that again just water activity, or just water flow source?

WALTON: No, what it is is that the way you do this mathematically is you do a series of mixing cells, and you evaporate a certain fraction of the water, and then you deposit the precipitants. And, so, what this really is mathematically is a record of the deposition of the precipitants that are assumed to rehydrate. So, mathematically, this is the record, if you do all this evaporate, say, 10 per cent of the water, this is the record of the aqueous phase, this is the record of the solid phase, is what would be left behind as the water is moving over it.

BULLEN: And, so, with advection, you actually get that separation, and without advection, you'd end up with a single cell method on the left?

WALTON: Right, exactly right. Without advection, you would wind up with this right here. With advection, these are just different locations. So, it's not relative humidity, it's different locations. Now, you could put relative humidity on there as another way of plotting this, because the stuff out here hydrates at much lower relative humidity. This is the concentrate stuff. But, nonetheless, it will hydrate and keep the same concentration. So, not the same concentration, the same composition. You know, it would be sodium chloride, and it would stay sodium chloride.

BULLEN: Thank you. Latanision, and then Cerling.

LATANISION: Latanision, Board.

I, too, am intrigued by this representation, and your comment is that nitrate will sometimes be separated from chloride. Now, it is--it has been shown that in concentrated brine solutions, nitrates can perform to some extent as an inhibitor. And, so, it would seem to me that it would be of merit to turn that around a bit and look at the issue of how can we ensure that nitrates would, in fact, coinhabit particular geometry when chlorides are present? Is there some way of tailoring this so that you could ensure the presence of nitrates when chlorides are also present?

WALTON: That's a really good question. And, frankly, I've never thought about that direction. You know, it's like could you design it, could you look at those? For example, you could look at the separation factor graphs I showed and put it so you'd predict it wouldn't separate.

LATANISION: That's exactly right.

WALTON: So, you might take that direction. It's a good suggestion. But, I just hadn't thought about it enough that I could pull something out and tell you that we could do it.

LATANISION: Thank you.

BULLEN: Thure Cerling?

CERLING: Cerling, Board.

Two questions about the chemistry of these two things. One, on both of those that you've shown there, for instance, could you describe what happens to pH in your model as you do the single cell versus infinite cell simulations?

WALTON: Yeah, I could tell you what happens. As I said before, this is a very simple model, and all we do is fix the positive pressure of CO2, and write the equations that way. And, so, we don't calculate a pH in here.

CERLING: Okay. And, then, second, in your infinite cell and trying to keep track of the fractional compositions of things, it seems like in your single cells, there's really very little contribution of sulfate and carbonate to the final solution, whereas in the infinite cell, there sub-equal, almost, to chloride. Could you comment on that?

WALTON: Yeah, I could comment on that. I should have explained it a little better. But, it's really a function of the way we plotted it, and it's hard to figure out a good way to present this material. So, what's happened here is that until the sulfates and carbonates are gone, you don't affect the activity of water. And, so, see, this kind of goes up like this? So, that's all back here. But, if we look at the number of cells that were in the model that evaporated, it tends to spread out this way. So, this is kind of a model, this is kind of plotted as model steps over here, and this is plotted as activity of water. If we plotted this in model steps, they may look the same. So, it's an artifact of the way we chose to plot it.

BULLEN: Richard Parizek?

PARIZEK: Parizek, Board.

I'm still trying to get the orientation and whether we're looking at in the matrix of the rock or in the fractures, you have a neat little fracture picture showing separations in a manner that could occur in a joint. Then you have a figure toward the end that shows it on the waste package surface. So, these processes can be working in any different number of ways?

WALTON: Yeah, but the argument is is that there are almost an infinite variety of geometries where these processes could be happening. Another case would be if you have some rugosities coming down from the ceiling, and the water is coming in there by capillary action and it evaporates as it comes out there. So, you can dream up all sorts of situations where this could occur. We just showed you two examples, one was the fracture, and one was drip down the waste package surface.

PARIZEK: So, is there a plot showing change with time in different locations? In other words, I can't tell on this one whether I'm looking at--where does time come into play?

WALTON: I know it's difficult to explain. Let's go back.

PARIZEK: Before we leave, there's also the spike on one, where you said there's a lot of other things going on there. I'd be interested in what other chemistries are going on.

WALTON: Yeah, what happens is is if you--the activity of water doesn't really change much until you get out beyond where calcium carbonate precipitated and where sulfates, you know, calcium sulfates precipitated. So, all that action, because the way we decided to plot it, is stuck right in there. And, maybe, you know, maybe we should plot it a different way, but people tend to be most interested in the concentrate, the right-hand ends of here. So, we chose to plot it this way.

PARIZEK: So, you're going to help us with time?

WALTON: Well, what happens with time is that presumably relative humidity of the repository would evolve with time. So, if we go back a couple slides there, this one right here, this is my best to explain it, because it really is quite confusing. The calculations are quite simple. How you explain them is quite difficult, at least for me.

Here's the single cell mixing tank, and we have time/relative humidity. So, presumably with time, the relative humidity won't come back up again. So, we have some kind of case where it dries out on the rock. Then, everything is quiet in the repository because the relative humidities are so low. Relative humidity hits the deliquescence point here. Now, the mixed salts start to deliquesce. The calcium chloride, sodium chloride, sodium nitrate is in the solution. Relative humidity keeps rising, and that same salt becomes more dilute and more of the original constituents come into the solution.

Here's the more complicated one. Now, we're moving in space, so we're still showing early on in time, it's moving along the rock, and evaporating as it moves. One example is it goes around the drift, for example, capillary diversion around the drift, is moving around the drift this could be happening. Or, it could be in a drip of water, and here's the middle of the drip, and there's the edge. It's starting to evaporate. You can go back to that sidewalk example.

Now, the materials are deposited, the low solubility ones, then sequentially greater solubility of different physical locations. So, these are locations now. Now, time axis goes here. Again, it's time/relative humidity. It's challenging to explain it. Time/relative humidity, and so relative humidity is rising. The concentrate salts at this physical location are now deliquescing. The concentrated salts are deliquescing early on, because relative humidity is earlier in time, and then they get more and more dilute because relative humidity rises. Then, the less concentrated salts, the stuff that was less soluble, deliquesces later on in time.

PARIZEK: Parizek, again, Board.

It's been said that there won't be that much water displaced by the dry-out, therefore, you won't have much mineral matter accumulation and, therefore, chemistry is sort of benign. I guess your model can allow for the chemistry to get pretty potent.

WALTON: It allows for the chemistry to get potent, but we're not explicitly modeling the total mass. So, we're saying that this process, if you had the water evaporating, can separate the fluoride and the chloride and the nitrate from each other, but it doesn't really say what the total mass is.

BULLEN: Last question for Priscilla Nelson.

NELSON: Nelson, Board.

Since we asked this of everyone, I have to ask it of you. Can you validate this? Can you propose experiments that would actually validate the process that you're suggesting here?

WALTON: Sure, I think you could do a number of experiments, and they'd be great to do. You could go in a hot room, and put some rock in, and set up a flow system, then measure the chemistry when it evaporates. In the same hot room, you could drip on a surface, and then look at the chemistry, you know, you could set a drip rate, and look at the chemistry around that drip.

NELSON: Do you have any plans to do any of those?

WALTON: Not at this point in time. But, that's just basically a funding reality, not in terms of what we want.

NELSON: Okay.

BULLEN: John, thank you very much. And we'll give you a little intermission between talks. I would like to note to the Staff that this is absolutely the shortest session I've ever been asked to be the moderator on, and I guess maybe that's an indication of I've been on the Board way too long.

We have a 15 minute break, and, so, I'd like to reconvene at 3:05, and we'll have John back on for the second part of his talk.

(Whereupon, a brief recess was taken.)

LATANISION: All right, John Walton will continue his presentation, and this discussion will be on the subject of Nye County Ventilation Studies. John?

WALTON: The material I'm going to show in this part of the presentation is primarily done by George Danko, University of Nevada, Reno and his graduate students.

I want to show you a number of things. I want to explain the natural draft ventilation concept. Some members of the Board have seen this presented. Others maybe not. I'm not certain. I want to talk about verification, the MULTIFLUX computer code. That's the computer code that George has used for these simulations. I want to check out to make sure it gives proper answers. We did a little sensitivity study with ventilation, and we also did a postclosure natural draft ventilation study. I'm going to spend the most time on that, because I think that's probably the most interesting part for you, a lot of aspects to that.

What do we mean by ventilation? Well, there's preclosure ventilation where we run the fans, and there's postclosure ventilation where there's natural air circulation, and there will be natural air circulation in the mountain. This mountain breathes. It's fairly permeable. And, so, infiltration will occur. However, we could also enhance the natural breathing of the mountain if we wanted to. Perhaps that would improve performance. There's a lot of ways you could enhance it, but if you do that--well, even if you don't do it, you're going to get a permanent flow driven by waste heat buoyancy. You just get more if you enhance it.

And, if you combine this with the more flexible preclosure ventilation, you don't just say it's 50 years or 100 years, but you're pretty open minded about it, then you can do quite a lot, we believe, for the performance of the repository.

A number of potential advantages. You could have a small repository footprint, that is, if you ventilate and pull the heat out, you can put the packages closer together.

If you do that, you lower your costs. That's a nice thing to have. You can lower temperatures. That might lower corrosion. You get it dryer, you have less condensation, because condensation is a big issue in the repository. And, maybe you'll improve the drift shadow effect if you dry out the drifts.

MULTIFLUX computer code. That's a complex code developed by George Danko. You take the Lawrence Livermore code, NUFT, to simulate heat and moisture in the rock. You combine it with a computational fluid dynamics module that simulates the airways. George has got a complicated system that he could spend a couple hours explaining how he does that. But, the modules are coupled on the rock-air interface, and every time step, the fluxes, moisture and heat are balanced, and temperature and vapor pressure are equalized at every time step.

We tried to do some verification of the code, compared it against an analytical solution, basically took an analytical solution for air flow down a drift. Boundary functions are an arbitrary function of time, temperature in the drift. There's a solution for that in Carslaw and Jaeger. Took that, and also integrated that solution again to really give us a triple integral, and tried to set all the parameters to maximize what happened, so we can compare the model versus the analytical solution. And, I put the results in the backup slides, because the talk was a little bit long.

But, the bottom line is there's excellent agreement. There's just excellent agreement, and although this exercise only tested the heat part of the model, in fact, the moisture is treated the same way in the model. And, so, it gives us some confidence that the moisture is also correct.

We did a sensitivity study. We wanted to know what factors are most important to ventilation. We set a base case. Then, we modified the ventilation rate, thermal conductivity, heat transfer coefficient, heat capacity, tried to see what was most important. I'm going to breeze through it pretty quickly, but if you're interested, George has documented this in the Nye County report that you're welcome to have.

Some of the conclusions. Thermal loading didn't seem to change sensitivity very much. Ventilation rate is important. Then, on the ventilation rate, different parameters are more important. Thermal conductivity, thermal diffusivity are important at low flow rates. And, heat transfer coefficient, not surprisingly, is important at high flow rates.

Thermal conductivity is pretty important, and there's quite a bit of uncertainty in the lithophysal regions.

Now, we're going to jump over to the simulations that George is just now completing. This is hot off the silicon, I guess you'd call it. What we tried to do was simulate the current DOE hot repository design. So, this is not a new design we're showing you. We're doing a best estimate of the DOE current design.

Now, given that we're not privy to the waste design cliques, and we just saw a new one this morning, but nonetheless, this should be pretty close. Now, the natural ventilation in the repository, if we don't design extra ventilation, will be complicated. Flow can come in in a variety of fast flow pathways, and go out other ones. We had to start somewhere. So, what we did was a U-tube simulation. So, the U-tube is we have the Solitario Canyon Fault, and we assume that the air comes down that tube. It's heated up, and gets moisture, and both the heat and the moisture tend to increase the buoyancy of the air, because water has a lower molecular weight than air. So, you set up a flow circulation.

We balance the flow circulation based on USGS published permeabilities in the fault zones. That's called our balance case. And, we showed the results. Now, this all follows 50 years of forced ventilation. So, 50 years of forced ventilation, and the rest of it is natural draft ventilation.

Here's the repository that we had before today, and now this is Panel 1, I guess. This was Panel 5 before. But, here's where we simulate. You simulate a single drift right there, across Panel 5. Air is coming down this fault zone, going up that fault zone, into that particular drift.

This shows a little more detail. We've got a characteristic area that's bounded on either side by no flux boundaries across here for the drifts. And, the air comes down there, goes through the drift, up there, you get a buoyancy effect, so we calculate--you have to get a rate, because the buoyancy, of course, depends on what's in the drift and what's in the drift depends on the flow rate. So, it aerates around, and the simulations we have today are what George characterizes as approximate. He's going to have more accurate ones coming out pretty quick.

Here are the flow rates. The red one here is called balanced. That is the current best estimate of what we'll actually have from that particular drift. It's not enhanced with anything. We have from that base case, then George took some lower flow rates and a little bit higher flow rates. You could look at these as uncertainty, or you could look at it as this is what will probably happen somewhere else in the repository that's farther away from the faults.

The highest flow rate up here probably would not happen natural. This could be if you enhanced the natural breathing in the mountain, which many people have suggested, included Nye County, that we should do that.

The results. If this is unclear, then you can stop me because I'm going to try to tell you what you need. This is your 60 in higher years. The fans were on for 50 years. So, this is ten years after the fans were shut off. The air flow goes along the drift. The drift is 710 meters long, and the air flow is moving this way. Temperature, relative humidity, condensate. Temperature, temperature to start with increases along the drift. What are all those wiggles right there? Well, as you saw earlier today, there are different waste packages, and they have different thermal loads and different histories. And, so, those wiggles reflect the influence of different waste packages as we move along the drift.

Now, as we move out in time, we see the temperature takes a more parabolic shape. And, so, the first question would be, well, this kind of makes sense. You go along the drift, the waste packages get hotter and hotter and hotter and hotter. So, why is it cooling at the far end of the drift? And, the answer is is that there's an edge effect. If you have the drift through here, you have a big bunch of rock over here that's unheated. At the entrance, you have a big bunch of rock that's unheated. You start looking at three dimensional effects there, and you get cooling at the end of the drift. So, we get this parabolic shape, and it declines with time, at year 5000, which makes sense.

Come down to relative humidity. Early on, the relative humidities are pretty low, but they change depending on which waste package you're over. Now, we move out in time, and at the end of the drift, we're getting high relative humidity, because we had this cooling down here, and to get condensation, of course, all you need to do is be cooler than some other part of the repository. You don't have to be the coldest part. Pick something that's warm, you get condensation. So, relative humidity keeps going up, and then at 5000 years, it's all close to 100 per cent.

Now, let's look at the bottom here. This is condensate generation, and the units are kilograms per second times 10^{-6} per waste package. You have to put this into something understandable. The first approximation, 100 right here is about three cubic meters per year. That's a lot. So, we're not talking about trivial amounts. So, we look in time here, no condensation. We move out to year 750, and we're seeing condensation. Now, the location here is the waste package, and this is the low infiltration rate. Low infiltration rate, and this is condensation on the waste package, not the drift wall.

We move out to year 1500, we see a little more condensation, at least more widely spread. Year 5000, it pretty well goes away.

Let's look at the next slide. Now, this is all the same, except we made one change. Still waste package, still low air flow. But, now he's using an equivalent porous media emulation. And, the difference here is earlier one, it said convective up there. So, the convective one, what happens is the air rises over the waste package, and cools along the wall, and comes back. And, so, what you get is this double spiral of air as it moves down the drift.

Now, we've switched over to equivalent porous media with invection dispersion type equation. And, so, we don't have explicit convection in there. And, when we do that, the temperatures are the same, if you flip back and forth. The relative humidities are pretty much the same. But, we failed to predict condensate when, in fact, condensate would occur.

Okay, this is the same thing. Now, we're back to the convective model in the drift, and this is the drift wall location. So, all we've done is shifted over the drift wall location, and everything looks pretty similar, except we get even more condensation. Now, there's about three cubic meters a year.

This is what's called the balanced infiltration rate. This is the current best estimate of the actual repository design. This is not enhanced or anything at all.

We see that with this one, the temperatures haven't changed at this higher air flow. Pretty much the same. Relative humidity looks about the same. There's some slight change there, maybe a little more depressed to start with. And, you see now we get condensation here, here, and we get condensation even at 5000 years predicted.

This is the balanced simulation, waste package location, and now we're doing this diffusive equivalent porous media model in the drift. So, everything else looks the same. These temperatures and relative humidities look fine, but we failed to predict condensation when we should be predicting it.

This is the balanced infiltration at the drift wall. Not much change, except there is a lot of condensation in the drift wall.

Here, the nomenclature is kind of funny, the medium is actually higher than the balanced. So, we've--the air flow just a little bit here, and when we do that, the temperatures haven't changed much. The relative humidities are starting to come down, though. See how these are coming down? You can see some effect on temperature if you look really hard. And, we see that we get less condensation. Most of it's in condensation.

Now, this is the high infiltration rate. Waste package location, convective model. What happens now is we look at the temperature history, we get this nice regular increase along the drift, and we see less coolant at the far end. That is, there's enough flow now that we're really starting to see the ventilation makes a difference. Now, this is the high flow rate that you'd only get if you added rubble filled drifts, or some way to enhance the natural breathing of the mountain. And, the relative humidities, they have come down quite a bit, and the condensation has gone away.

Relative humidity and condensate formation. Condensation is predicted on downstream drift wall and the waste packages over long time periods. If you have high enough flow rates, such as you'd get with enhanced natural ventilation, it will go away. Condensation tends to decrease with decreasing maximum temperatures. Now, the obvious question is does it go away if we change to a cold repository design? And, the honest answer is we don't know yet. There's some evidence that it might be reduced, but George has not simulated that yet, and we'd like to.

The refined convective air flow pattern is required to see the correct condensate formation. Now, these results, George calls approximate, and the next iteration of the model should give more accurate prediction to the condensation, and the word is that they're going to be higher from what you see here, not lower.

And, in Nye County we view this as an engineering design problem. We're not trying here to say the mountain is bad or some fatal fault with the mountain. It's just a design challenge that we can respond to.

Summary. Natural draft ventilation occurs with and without enhancement. It's going to be important. You can't just ignore it. Design changes are going to be needed if you want to eliminate condensation in the system, unless we think we can live with that, and there's pretty high levels of condensation.

Active and passive ventilation, that is, can be optimized to lower temperatures and maybe get rid of this condensation. We could run the fans longer and faster. We could enhance the natural breathing. We can change the thermal loading. There's a lot of things we can do as engineers to design this system so we don't tend to get this condensation.

Future activities. We have a lot of ideas we'd like to do, much bigger than our time and resources. But, how do you eliminate condensation? What happens when you get some partial roof collapse. That's a real unknown that's thrown into all the PA calculations. If the roof caves in, you don't know what the material properties are anymore. So, how do you know what the performance is?

Cold repository. Let's--cold repository and see what happens. Barometric pressure pumping. There are all sorts of things that you could look at, but what I want to emphasize here is I'm open to suggestions. So, if the Board has some particular idea that you think we should pursue, we're all ears, and we'll listen to you.

So, if we could talk to these rocks and they could talk to us, they might tell us a lot of things about what might happen, and we've tried to tell you some things that we think are important. We hope they're useful to you, and we want to thank the Board for giving us this opportunity to talk to you.

LATANISION: Thank you very much. Questions? David?

DUQUETTE: Duquette, Board.

Could we go back to Slide 12, please? The temperature that you're reporting there is the temperature where? That's not on the waste package wall?

WALTON: That is on this wall, the surface of the waste package.

DUQUETTE: I think those temperatures are a lot lower than what are to be expected on the waste package with the current design.

BULLEN: Different calculation.

DUQUETTE: What would happen if you increased that temperature?

WALTON: On the waste package?

DUQUETTE: Yes.

WALTON: I don't know. George, do you want to try to answer that? We haven't run it.

DANKO: Yes, these are balanced temperatures, and these correspond to 56 MTU per acre load, end to end emplacement at 10 centimeters between waste packages, so it's fairly consistent with the baseline solution, the license application solution. And, we just cannot increase the temperature. It comes out of the models. So, they input--that's what we are expecting.

DUQUETTE: Thank you.

BULLEN: Bullen, Board.

Could we go to Slide 7? The question that I have basically is that you mentioned that the thermal loading does not change the sensitivities. Could you expand upon that a little bit? If I loaded it to 56 metric tons per acre, which is what George just mentioned, versus, say, 80 metric tons, or I want 30 metric tons, is that the implication, that there's no sensitivity?

WALTON: The implication is is the parameters we studied here, which were thermal conductivity, thermal diffusivity, heat transfer coefficient, flow rate, the sensitivities of those don't change. That makes sense, because heat conduction is a linear process, is what it amounts to.

BULLEN: And, then, Bullen. The last question I have, since I'm a little out of my league here, on Figure 3, you mentioned that the potential advantages of ventilation would be to improve the drift shadow effect. Do we have any experimental verification that the drift shadow effect actually works?

WALTON: I haven't seen it if we do.

BULLEN: Okay. I was just curious, because we've seen presentations by Dr. Bodvarsson from LBNL, and I guess what I was interested in is if maybe there were independent verification of the fact that you went out and look at a lithophysae, or whatever, and saw full pass it, and said yeah, indeed it's dryer beneath it than it is above it, those kinds of things.

WALTON: No. He predicts it from theory. You know, what we're just saying is the same theory predicts if you dry out the drift, it's going to work even better.

BULLEN: Okay, thank you.

LATANISION: Richard?

PARIZEK: Parizek, Board.

On Page 10, do you make a connection between the canyon fault and that emplacement drift, or is that through rock?

WALTON: This is assumed to be a natural system. This connection is presumed to occur through the rock. In other words, there's been no mechanical enhancement here. Now, you might question those assumptions, but the permeability is supposed to go here, through the actual system as built.

PARIZEK: And, do you have adequate information on, say, permeability to know that the model is being fed the right data, the air permeability data they have--

WALTON: Right. Gary LeCain from USGS has done a lot of estimates of the air permeability of the mountain at different fault zones. And, what we did was look at his published reports, pull out some of the permeability numbers from that, and push it into this.

PARIZEK: That's also then true of the air on the other end. That's going up through the fault zone again, is the fault permeability in the Ghost Dance?

WALTON: Right. What we did is a look at the published permeabilities for both of these, and then that's what we plugged in.

PARIZEK: The whole thing, to say you're going to engineer it, you could enhance it even more if you had more open connections, except protected on the extreme ends.

WALTON: Right. There are a variety of ways you could enhance the natural ventilation. And, I think there are a number of proponents to this that have come up with different ways of doing it. And, so, what we've tried to do today is not really try to get into design and say how do we do that, we're just saying here's what's going to happen if you don't do anything. If you do ventilate, it looks like it will help.

PARIZEK: Thank you. You don't mention any downside aspects of this thought process by either enhancing or not enhancing it. Do you have any downside consequences?

WALTON: Well, I think--I've always felt that the potential downside of enhanced ventilation is that it's not going to ventilate forever and ever. Okay? Eventually, if you have this system and it cools off, you're going to switch the system, let's just say if it went like this, and it went straight out this way, you're going to switch over to the system eventually where you go up in the winter, and down in the summer, as the rock versus the air temperature. So, I think if you take it out to time equals infinity, any kind of enhanced ventilation might have a potential to bring moisture in.

PARIZEK: Which you haven't worried about that part of it?

WALTON: Well, we're concerned with it, but the problem is it comes out there way out like probably 100,000 years, or something. It's hard to simulate that far out. So, it is a concern. It's one of the issues we've raised, but we haven't answered it.

PARIZEK: One other statement you made several times was why does the condensation prediction fail. It meant that you didn't get condensation, or you failed to predict it?

WALTON: Right. The point is is that if you use the model that doesn't explicitly have convection in the drift, those models tend to under predict condensation. The condensation would be occurring, but your model would say there's no condensation. So, if you don't use the correct model, you'll get the wrong answer. That was the point.

LATANISION: David, Staff?

DIODATO: Diodato, Staff.

First, Dr. Walton, I appreciate and commend you for this work, and I think Nye County and Professor Danko are also to be commended for pursuing a very interesting line of investigation.

A couple questions. First, are you familiar with the occurrence of observations of moisture behind the bulkhead, in the ECRB? So, then the question would be might this model be used to investigate the controls on the occurrence of that moisture? I mean, is that something you've been thinking about?

WALTON: Well, we haven't really discussed it, but I believe it could be. Do you agree with that, George?

DANKO: Yes.

DIODATO: So, then the second part of it would be I did read through the report, and I was looking at--I appreciate your efforts to do the model testing to make sure you can build confidence in the model. So, I was looking at the model tests, and you have slide 28, and it's really in the backups, and the print is very small, but the thing I remember about it is that none of the test curves ever went above boiling. So, my question is do you have some tests that do go above boiling so you can build confidence in the ability of the model to handle, you know, phase change like that.

WALTON: Well, Nye County has not done such tests. I don't know if George has done some other tests. Now, each of these modules he uses, for example, NUFT has been independently tested at high temperatures. So, I think the real question is the coupler test. Do you want to answer that, George?

DANKO: Thank you for the question, and me to explain that. The modeling of the heat and the moisture, transport within the rock, the rock mass, around the drift, is done by NUFT, which is a qualified code. So, we do not have to prove that that is modeled correctly. What we needed to see is that we can handle, we can couple the in drift conditions to the rock conditions. MULTIFLUX is a universal coupler. Now, within the drift, there is no evaporation, because the moisture flux comes in vapor form. So, if I may answer your question, even these tests, which were somewhere around the 90, 95 degree or some of them, if you see the curves, went up to 110 degrees C on the wall. That's plenty of tests for this code, because if there is evaporation in the rock, and a face change, that's going to be handled by NUFT correctly.

DIODATO: So, the maximum--the test is at 110, is just not shown here?

DANKO: Well, for the tests, right. But, during the current rounds, of course, we go up somewhat higher, 150 degrees C. The coupler doesn't have any problem of handling this situation. There is a correction on the wall, so there is an active interface between the rock and the--during condensation. This condensation is a--on the under drift, and then in the waste package, that could use some more tests, but we see that actually from the code, the balancing of moisture, and heat masses, and the balance is reported, and the balance is one watt over a waste package.

DIODATO: I understand you used the polynomial fitting function to couple the things, and then the iterative process. But, I was just wondering if there is liquid water, and then it boils, you don't have that in the drift. You don't ever have that liquid water boiling. You have condensation occurring; right?

DANKO: Right.

DIODATO: And, then evaporation.

DANKO: There is no boiling because it's impossible to condense and boil at the same time. So, we spent some time on this trying to see if we may have room for error in that sense. We only see condensates, and then we assume that the condensates gracefully leaves the system by imbibing into the rock. We don't see any factor flowing the water from a cooler temperature surface into a higher temperature surface, which case, it would have to kick in the evaporation. But, it's possible, but we don't see that occurring.

DIODATO: Thank you.

LATANISION: John?

PYE: Pye, Staff.

Conceptual question. When you put heat into the rock, which way does the moisture go, the moisture in the matrix, does it move away from the drift, or into the drift?

WALTON: I'd argue it depends on what you do, but I believe this model showed most of it went into the drift. Did it not, George?

PYE: Okay, that was a single drift. The feasibility, the viability of using natural ventilation, it would essentially have to emulate what goes on in the network of tunnels, as it does in forced ventilation. So, it's a more complex, it's a network problem, not just a single drift problem. So, again, I don't think the analysis has touched on that. But, under those circumstances where we're looking at a network, that clearly is going to be a cold trap in the repository network as a whole. So, other conditions could arise. You could, in fact, see, as this network breaks down over time, let me use the term carefully, backwashing of cold moist air back into the drifts, as this system starts to stagnate and break down. Again, would this model be capable of analyzing those types of conditions?

WALTON: I believe the answer would be yes, it can. I mean, that's difficult to analyze if I followed you correctly. But, I believe, don't you agree, George?

DANKO: Thank you very much, John.

The effect of the network, the network effect during postclosure is not nearly as critical as during preclosure, because the irresistance during preclosure is within the emplacement drift. Right? So, you need to correctly model the resistance of that annulus, the flow resistance within the open cross-section between the waste packages and the wall. But, during postclosure, it is just infiltrating. This velocity is zero point zero, zero, one meter per second. You can't see that velocity. There is no irresistance whatsoever. It can go through any small hole, even if the drift collapses, it will be always air flow, and then it's completely--beside the resistance of the total system, which is through the natural permeability and the fracture system. So, in other words, this would be controlled by the mountain, and not by the drift network. So, we can simplify even with the model, and then just ignore the resistance of the drift, even if it's partially backfilled or collapsed.

PYE: How much more complex does drift degradation make to that? Degradation, does it make that picture much more complex?

DANKO: Well, later on, not during probably this few thousand year time period. But, because even a drift collapses, it opens up more cross-sections. So, if it's not backfilled, it will never be backfilled. So, we did some studies on this, and convinced ourselves at least for the time being for a few thousand years, 10,000 years simulation, we can handle with some resistance increase, which we put in the model as an anticipated resistance increase, but it doesn't seem to be sensitive for that time period.

PYE: Thank you.

NELSON: We saw a stainless steel membrane on the tunnel walls today, and also the possibility of a drip shield. Will the stainless steel membrane on the walls change the temperature distributions, and what's happening in the humidity, and can your model provide insight as to what might happen, say, under a drip shield?

DANKO: Preclosure or postclosure? Your question is during postclosure, I believe?

NELSON: I think it's probably both.

DANKO: During preclosure, it would probably be more of a change, because of the mesh, because the radiation will be changing somewhat, and I believe it will be plus and minus. But, it will probably not be a dramatic difference. I don't think it will dramatically change the temperature, and then it won't even affect the moisture transport, because it's perforated. But, during postclosure, it will be probably collapsed, and then it will be--so, I don't think it makes any difference.

NELSON: And, about the drip shield?

DANKO: The drip shield is a huge difference. I think we haven't been able to ground that because it's a fair amount of earth which is in the pipeline still. But, I think the drip shield will not prevent the condensates, and then I think see condensates under the drip shield. And, then, it will be just very controversial that you have the drip shield, which is supposed to prevent containers from drippage, but you are going to have--as a mist, as a spraying of water, making it wet all the time, and then you have these expensive drip shields over it.

NELSON: Nelson, Board.

Do you plan on doing that analysis?

DANKO: Yes.

LATANISION: Latanision, Board.

I'm just wondering if anyone from the project could respond to that last comment? The likelihood of condensation under the drip shield. And, is there a sort of community view on that from the project point of view? No, I'll say it for you. Claudia's comment was that it appears there's no one here in the audience right at the moment who could respond to that. But, we'll get back to you. Thank you. Actually, I'd appreciate that. Thanks.

Leon?

REITER: Leon Reiter, Staff.

Could you turn onto Slide 9, please? What's happening north of the north ramp. You show the Ghost Fault not existing there. Where is the exit point? Is that the Bow Ridge? And, isn't the Bow Ridge at a lower elevation than the Ghost Dance?

WALTON: Well, I don't know the answer to that. Do you know the answer, George? This is just a picture taken off of something.

DANKO: We did that between the Solitario Canyon, that central drift, which is mocked up in this, and then exited through that area of the Ghost Dance Fault.

WALTON: I think he's just asking a general question about what happens--

REITER: What happens up north?

DANKO: It will be all different in different manners, and then what we did, we just picked up the simplest possible part of the repository, which we can study with our limited resources. But, it will be different in different places.

REITER: And, the Bow Ridge, if I remember correctly, exits at a lower elevation than the Ghost Dance, and that could have an impact on the ventilation also.

DANKO: So, if we try to bring the good news here today, was that if we have it around that area, we might have enough with very little bit of engineering in that Panel 5, which is going to be Panel 2, as we learned today, so, it's a main panel. It's an important area of the repository. And, then, in that area, there might be a chance to increase that flow, although we didn't see enough air flow, air infiltration, by the natural system, it was far from being enough to control the humidity. And, then, once you control the humidity, you don't--you can put the drip shields, and there will not be condensation. But, if you leave the system alone, there will be condensation, most likely, and most likely on those other areas where you are farther from the fault system, you will see more condensates. So, in other words, this is a more optimistic scenario which John is presenting today than what you are expecting in other places.

LATANISION: Thank you very much, John and George, both for the conversation, and we will now move onto the final presentation of the afternoon.

Bob Budnitz is going to give us an update on OCRWM's science and technology program. Bob is on the Staff of the Lawrence Livermore National Lab, and he is working at the Department of Energy in Washington in leading the new advanced science and technology development program for the project. He has been an active consultant for over 20 years, with concentration on nuclear power plant safety, and the safety of radioactive waste disposal. He has served as the Director of Research at the Nuclear Regulatory Commission and Associate Director for Energy and Environment at LBL.

Welcome. Good to see you again.

BUDNITZ: The title of this talk is Update. I gave a talk in May. It was the first time I appeared before the Board. Now, this is sort of eight months later. This is an update on the science and technology program, and I'm going to try to give you a picture of the current status, where we've come to at this point, and how we got here, and what our plans are for the future.

These are the rigid objectives of the program. We've written the same thing down. We wrote the same thing down in May, and I'll just go over it with you, because these specific objectives are our point of departure.

We have two different, but very much related, objectives. And, the first is to improve existing and develop new technologies for the system, to either achieve savings or efficiencies. And, I'm going to go into that in the rest of the talk. And, the second is increase understanding of repository performance. But, as I'm about to tell you, those things are very much related, because often through increased understanding, one can implement different technologies that you couldn't do without the understanding.

And, I can't remember, you can look at the transcript, whether I gave this analogy before when I was here. But, for half of you that have heard it, sorry, and the other half will have to go through with me again. I think about this in my mind with the analogy of commercial aircraft. I was in college, or I once flew to Florida, it was in the spring of '59, on a DC-6B, and I flew back on a brand new plane, a 707. And, I remember, it was a week later, the difference was startling, and everybody that lived through that era knows what that difference is. The new jets, brand new, 707, it's 1959, were so much better. They were more efficient, they were better for the passengers, they were safer, they were cheaper. Everything about them was better. They were the best thing known at the time. In fact, they were so much safer than the 6B that I flew south with, you know, the record showed that in the first two years.

Well, I flew out here this morning in a 777, a 1994 machine, 25 years later than the 707--35 years later. Just 35 years later. And, you know, if you don't think about it, just walk on the plane, it looks the same. You walk on and there's a cockpit, and you sit down, and there's a galley, and probably a lot of people don't think about this. But, you know, that plane, there isn't a thing in that plane that's a hold-over from the 707 technically. Of course, there are computers, control systems and radar, but just everything. I mean, the galleys are safer, the seats are fireproof. Well, you know, that plane cost one-third less to run. You know it's faster, and you know it's a hundred times safer, you know, per, however you do it, we all know that, and we take it for granted. But, the 707 was the best we had at the time.

And, by the way, I learned the other day that it was designed by hand, with just a little help from computers. Because you remember 1959, I was just learning computer programming in college, and we had the 7090, it was a tube machine, and it had 50K of memory, or maybe it was 64. what could you do with that? Just a little stuff, you know, a few matrix inversions, and stuff. So, it was mostly designed by hand.

Well, I'm not arguing that we're in that stage now at Yucca Mountain. Of course we're not. But, we're putting together a license application now that describes exactly what the technology is going to look like when we proceed in 2010. It says what the drifts are going to be and what the inverts are going to look like and what robots we're going to use to retrieve things and what sensors there are and what the welding is going to be, and so on. And, it tells you that that's what we're going to do in 2010 with that first drift in the first emplacement. And, it also says that in 2034, 35 years from now, using exactly the same technologies, the license application says, what else could it say. Do you believe that the last drift in 2034 is going to use the same technology as we've designed today? I don't, because we're not flying 707s.

Now, how do you get from here to there? Well, what Boeing did, and by the way, Douglas and the military, was incremental things and a few break-throughs. A few big break-throughs, but mostly incremental things, little things that altogether added up to this huge improvement in performance and safety and operations and efficiency, and all these savings, efficiencies, and understanding. And, understanding led to savings and efficiencies in performance for the airplane, as it will for us.

Well, the way you do it is you initiate a program that institutionalizes within OCRWM a method so that when we get to 2020 and 2030, we have these technologies, and we can implement them and we can deploy them and we can use them and we will improve our understanding. And, that's what science and technology is about. That's my way of explaining it in lay terms what these objectives mean. And, I just feel it in my bones, but if you ask me to predict what these things will be, well, I can't tell you exactly. None of this stuff is proven. If it was proven, we'd have it in there.

The philosophy is intrinsically to take the longer view. What I mean by longer view is three years, five years, ten years, or even longer. It's explicitly distinct from the mainline activities of OCRWM, and the whole next slide talks about that, so I'll skip it here. And, the scope is very broad. We're here to support all of OCRWM's activities, although in the first instance, we're working hardest on the repository and the 10,000 year performance and the design.

Now, we need to resist, and S&T should resist the tendency to get tied up with shorter-term issues. There's always that tendency. I was the Director of Research at NRC in the Seventies, when I was a kid, and I can tell you that it was always the tendency to go to the research people at NRC and ask them to work on six month problems. And, of course, you've got to help out. People do that. But, you've got to resist the tendency, otherwise, it will be 90 per cent that stuff, and it just isn't right. This is set here to do something different.

And, of course, this year and next year, our goal is to institutionalize the science and technology objectives so that it's an enduring activity. So, it's in the budget in

2007, it's in the budget in 2017, and it's in the budget in 2027, just to give an example. It's got to be an enduring activity, otherwise, we won't get to that future time and have those technologies and have that understanding and make the improvements that I believe are sort of, without knowing what they are, for sure to evolve.

Now, the next slide then talks about the relationship to the rest of the ongoing work in OCRWM. And, of course, as you've been seeing for the last 15 years, there's a huge amount of technical work in all sorts of technical areas within the office. It's varied, it's very advanced, and so on. But, we have developed a clear distinction between the scope of the S&T program and the scope of the main project technical work, which is not only now the license application, but before, it was of course site characterization, and now it's the license application, and we're developing a performance confirmation plan, and we're going to do testing and evaluation, all sorts of technical work that's going to go on, and continuing analysis.

Our projects are characterized by longer-term work. The outcomes are less assured, that is, it's a gamble. If we're doing something the project absolutely needs, we shouldn't be doing it. The project should be doing it. Our stuff will come along, we hope, and a lot of it will work, and some of it won't. It's in the nature of research. It's the nature of long-term inquiry of this kind, and development. It not always works. So, it's less assured in terms of the probability of success.

And, crucially, the work is not needed to support the license application, or the rest of the work, not only OCRWM's work, but its interactions with the NRC. Our program is designed so that work like that is in the main project, which is, of course, you know, 90-some per cent of everything, not in our thing. Our stuff is designed to be of a different character, of the kind that I mentioned. And, of course, the aim is ultimately that when improvements in design or operations or understanding come around, ultimately, it will become part of the baseline if it's successful. That's the idea. We won't be, in 2030, using 2002 technology.

Now, the approach is that this is the first real year, just to be clear. Last year, we didn't have a specific budget that we had gone through the whole process, and everything. But, last year, Margaret Chu initiated our program late in the year, it was in the summer, and we started out with what turned out to be $1.7 million, a few initial projects, and they're on the next slide, which please don't go to yet. We started a few things, and all of those were just short things, or a couple cases, started a longer thing, a few months work.

But, this year, we're serious. We have a major science and technology program. The President's budget request was $25 million. We got started because of, you know how it is with a continuing resolution, we really didn't get started until about the first of the year. That's sort of a quarter of the year gone, because of the way things work. So, we may not use the whole $25 million this year, and if we don't, it will be perhaps around 20. But, the budget that we started with is $25 million, and we expect--we don't know what's going to happen of course next year because the President's budget process is still in process, and of course the Congress has to appropriate it, you know, nine months later. But, our notion is that a program about this size, or hopefully we expect to grow a little bit over the years, is the size of the long-term effort.

Now, I'll say more about this in a couple slides later. We're planning a public solicitation, a request for proposals, and that's part of our approach. Of course, we're also working with the DOE laboratories and the U.S. Geological Survey, and so on, too. And, crucially, we're seeking and encouraging international collaborations, because we don't think that the United States of America has a lock on all the new technologies that we'd like to use in Yucca Mountain, or on all the new methods of understanding and analysis that we'd like to use at Yucca Mountain. And, certainly where there is a bright idea overseas, anywhere, outside of our borders, we're going to try to take advantage of that through collaborations. Our solicitation will be open to such international, foreign bidders, and the like.

Now, we started a few projects in 2003, and I won't go over them, because if I did, it would be the whole 30 minutes, but I'm just going to give you a flavor with a couple of them, just as examples of the sort of idea that has motivated us in starting this work. And, by the way, three or four of these were scoping studies that were six months duration, that are then being used to plan a longer term project in that area. And example is a scoping study about advanced work at Pena Blanca. And, another example is a scoping study about what we might get from analogues at the Nevada Test Site. But, I'm just going to give you a flavor by talking about the first two on the list, as an example.

The first project which we initiated, DOD-DARPA, DARPA is the Defense Advanced Research Projects Agency, in the Department of Defense. It's there long-term, R&D, and development agency. We initiated a project with DARPA last summer, which is three years in duration--we're just part-way through it now--to see if we can develop an advanced protective coating, an amorphous metal coating, that if it's successful, we may be able to deploy on the waste packages that would help us have even higher confidence on the question of corrosion. We're not sure whether it will work out. It's just something that we're starting. But, the idea is--well, I don't have to tell you that in the military, one of the services runs around in salt water, and they have real corrosion problems. You can probably figure out which one that is. They have real corrosion problems. And, that motivates them to work in ways to develop materials that are less susceptible to corrosion, and they have advanced contractors, and universities working together to help them develop these technologies, and we're working with them to see if we can adapt that to our waste package welds.

Now, there's some very important technical questions about whether such an amorphous metal coating can adhere, whether it will last, you know, the thousands of years that you need, whether it can actually be put on and applied reliably, and so on. And, all that is being addressed in the project in collaboration with--by the way, it's co-funded with DARPA, half and half.

A second one, just as an example--and, by the way, if it works, great. We'll then consider proposing to deploy it. But, whether or not it works, we don't know. The second one has to do with an advanced welding method for waste packages, and that's electron beam welding. The tungsten welding technique, which is in the baseline design for our waste packages, has been proven. It's been demonstrated, widely used, we know it will work. We have great confidence in it. But, it's tedious. It takes a long time. It's expensive. And, it has a fairly large heat affected zone. And, electron beam welding, which is an advanced welding technique, which has been demonstrated in some applications, but not on our alloy, shows the promise of perhaps being able to make the through-put of our welding setup much more rapid. It can be done in one pass, and occasionally a second one, more easily inspected. Of course, it has a narrower heat affected zone.

Now, whether we can--and this project, which we initiated just, again, in the summer, it headed at Lawrence Livermore, but there's a collaboration team at Oak Ridge, and some other small companies, and the like, shows the promise perhaps that if we can develop it, we may be able to deploy this and save ourselves quite a bit of money, and perhaps have better performance in the weld. We don't need better performance to get a license, but we'd sure like to save the money. And, I'll just give you an example of what money there is to save.

The waste packages today in fabrication cost about a half a million dollars each. I'm not going to give you the second decimal point, but it's in that range. And there are 11,000 of them, and that arithmetic is quickly $5 1/2 million. If you can save 1 per cent of that, it's real money. If you save 10 per cent, it's real money. So, the possibility of saving a good deal of money in a fabrication that then has at least as good performance is something that shows promise that we're pursuing. And, those are just two examples on this. These are the things we started. But, of course, both of those are a couple years or three away, and perhaps even after then, it's longer away.

Now, in 2004, I said we're just starting, this is our first real year of the program, with perhaps $20 million is what we'll end up with, we have two different funding processes, and I won't go into this in much detail, but we can deal with the DOE laboratories and the U.S. Geological Survey directly. We can direct funding to them based on their special capabilities. That's the nature of DOE being-- we're DOE and they're DOE.

But, with the private sectors, universities, private firms, institutes, and so on, well, they can work in collaboration with the laboratories, but if they want to work with us directly, it has to be through a public open competitive solicitation process. And, we're in the process of preparing our first of what we expect a series of RFPs, just now, coming along soon. Because it's in the process, I can't tell you much about that. It's something you can't do for fairness. But, our expectation is we're going to use these two processes together over the years. The private sector process, and when we deal with the laboratories and the survey, with its special relationship, we're going to deal with them directly.

Now, this year, this is our first real year, using the advice and review of a panel of experts that we call the Science and Technology Review Panel, who Margaret Chu appointed more than a year ago to help us in advice and review on what we're doing. We identified five major what we call program thrust areas for this year, or really the next few years. Now, surely these are going to change over the years. I can't imagine that five years from now, it will be just this list, because things will evolve as needs evolve and technology evolves. But, here they are, advances in materials, natural systems, robotics and sensors, drift engineering, and source term work. And, the source term is the code for the phenomenon that take place inside the waste package after water were to get inside it. And, the phenomenon that there's chemistry and various phenomenon inside the waste packages, then we don't--it's something that then leaves the waste packages and continues on to the natural system.

I can't touch on all of these, but I'm going to give you just a flavor for what we're thinking about in advanced materials, the natural systems and robotics, and the others you can ask if you wish, because there isn't time to talk about it all, but I'll just give you a flavor.

The next slide is just a flavor for our advanced materials program that we're putting together. The first one I talked about, the surface amorphous metal coatings, the DARPA project. Welding technologies, besides an advanced electron beam welding project that we already started, we're exploring other--there are several other advanced welding technologies that we might decide to support. And, so, just now, we're supporting a scoping study of these other methods by a prominent welding expert, John Liepold, from Ohio State, who's going to be advising us about what the community thinks could be other promising advanced welding methods.

Advanced corrosion science, we have a long-term, five or longer year, a long-term corrosion science research program that we're putting together and using the advice of Professor Joe Payer of Case Western Reserve, who, by the way, is in the room just watching today, and as we put that together, we expect that that's going to be an important piece of our long-term S&T program. The basic notion there is to have a much more extensive and science based understanding of corrosion science, not just that we have, but that anybody has. There are things that we confront that nobody in the corrosion community has ever confronted before. So, it's advanced science that ultimately--that we're supporting--but ultimately could lead to a better understanding, for example, of stifling an arrest phenomena once a localized corrosion point might start, and other such things. And, I could give you more of that, if you wish.

Getters. Getter is the description of a chemical that might absorb a radionuclide so that it doesn't go through it. I mean, a physical getter would be a sponge, and you put a drop of water on it. But, these are chemical getters, and we're exploring a whole set of possible getters with a scoping study, which I can get into if you ask me, but I don't want to go into it in detail.

Advanced materials in the drifts. Just to give an example, and this second one, too, there's no concrete in the drifts, as I'm sure you know. And, the reason for that is, in part, because concrete changes pH and that's something that we judge not to be something we wanted. But, it's possible that we could develop advanced materials in the drifts that didn't have that. And, if that's true, maybe they would be less expensive and stronger and easier to put in and more maintainable and last longer. We're just not sure. A whole set of advanced things that we want to look at.

Other advanced materials in the drift have to do with the way of holding the drifts up. There is no, whatever the word grout is, there's no grout, because that has the same problem. We're holding the drifts up, and our--designed it a different way. And advanced materials for those drifts is another possible avenue of exploration that we're just contemplating getting started on.

I'm just trying to give you a flavor here of the sort of things that we're doing. In the natural systems area, we've already initiated work in unsaturated zone phenomena, and also in saturated zone phenomena, which are on the next two slides. We're contemplating a major coordinated effort in colloids, colloid studies. We're contemplating the major project to understand seismic hazard better, which would be if we put it together, sort of a five year effort to advance the state of the art in seismic hazard. And, we're contemplating some work to pursue what we learned in the scoping study about possible insights at Pena Blanca, and also possible insights from the Nevada Test Site.

In the unsaturated zone, we've already begun here, we just put out some significant funding. Fracture/matrix interaction, understanding where we want to improve our understanding of the phenomenon, actually of the physics and the chemistry. Field and laboratory studies and theoretical work. We're going to put on our workshop for specialists to see if we can learn some more. Drift shadow studies where although the current TSPA takes some credit for this, it's no where near as detailed an understanding as we'd like to have.

And, then, we're going to look at some off-site analogues. We're going to look at the lithophysae in our formation. And, we're going to do some scaled laboratory work, all of which I'm going rather rapidly through. And, this is just a flavor for our program.

In the saturated zone, two major areas. One is transport studies. Better integration of the site and the regional flow models is something that the saturated zone people have been calling on, and we're going to do that because we believe that that should then enable us to have a stronger framework for understanding a better model of the saturated zone, and some Carbon-14 ground water analyses.

Hydrological parameters. We're supporting--we're just starting to support some lab sorption reversibility studies. A natural-gradient tracer test, and we're planning for a long-term pumping test in the volcanics. Of course, we can't do that test because probably everybody in this room knows that we don't have a permit to do it. But, we're planning for it, because we hope and expect that some day, we'll get that permit, and then we can proceed with improvement in our understanding of volcanics.

Advanced Robotics. I'm just going very quickly here. Now, robotics is an area which is among the most rapidly moving technological areas on the planet. If you just go to robotics meetings or read their literature, every year, every two or three years, revolutionary things are taking place with all sorts of different phenomenon having to do with control systems, and artificial intelligence methods, manipulators, and all sorts of mobile systems and the like. And, we're supporting a robotics technology scoping study at Oak Ridge that's going to help us try to figure out where those advances are right for us to begin supporting something, or maybe several things, probably, in the next few years.

Secondly, the Department of Energy's NNSA, that's the National Nuclear Security Administration, which is the old Defense Programs part of DOE, has a university research program in robotics, five universities, for developing advanced robotics technologies for them, and we're talking seriously with them about a collaboration in which those five universities would also work with us to do things that would advance our technology in manipulators, control systems, high radiation environments, which is a real problem. You know, a whole lot of things you'd like to do, you can't do because you can't put the organics in that drift. They just won't stand the radiation over ten years, never minding 50. And mobile systems for retrieval and for monitoring and the like. All those things are things that we're contemplating doing, and I expect that if you have me here in six months, I could tell you that by then, we will have started them, at least most of them.

Finally, and this is almost my last slide. The Department of Energy itself, I don't have to tell you this--maybe I do--the Department of Energy itself is the residuum, the holder of a national trust in science and technology in many areas, that is very special advanced, in some cases, the word unique, which you should never ever use unless you mean it, is correct. Some of the stuff they have is unique in the world, both in their laboratories and in the university work that they support. Some of this is in the Office of Science, in fact a good deal of it is. But, of course, it's in many other offices, too.

We've begun exploring serious collaborations with the Office of Science. Now, the Office of Science, by the way, if you don't know who they are, they have $3.3 billion. Of course, almost $2 billion of that runs large facilities like the accelerators, the lab, and the reactors, and light sources, and the like. And, the rest of it is research and development in the national laboratories and in universities and in the private companies.

And, the goal here is to identify areas where DOE's Office of Science and we can work together on joint projects, or we can use common capabilities. For example, they may have an electron microscope that we can use to advance mutual objectives, which are they want to advance knowledge and understanding, and, of course, you know what our objectives are.

The first thing we did in this area was a very successful corrosion workshop in July, a half a year ago, in which we brought together about 15 or so experts in corrosion that the Office of Science had been supporting, many of them for a long, long time, and a half a dozen of our people, and we explained to them our problems and out issues and our questions, and where we'd like to go in five years. And, through that, came to a common understanding. There's actually a paper that's the result of this that's been written. Joe Payer wrote it, together with John Scully from the University of Virginia, who was the co-chair of this, Joe and he were the co-chairs of this, which is available. And, out of it has emerged a very strong possibility of some wonderful collaboration with some of their people, some of their experts, and some of their facilities, and some of their laboratories.

We're planning an unsaturated zone phenomenon workshop--actually, it's not a workshop, just a meeting, with their experts along these same lines in the spring. These are with people in the EM Science Program in DOE who have done a lot of work in the unsaturated zone that we think we could tap into, and we're discussing a getter meeting sometime soon, too. And, in each of these areas, the idea is to find experts. We haven't thought at all about Yucca Mountain, haven't thought at all about, sometimes, our phenomenon, but who have developed models, or data, or methods, or just different ways of thinking about things that we can tap into and improve our understanding of our models, and in some cases, our technology.

We're going to try to take advantage of this wherever we can. We have the endorsement at the top from their director and our director, and that's certainly been a very important imprimatur to get going here, and we expect this is going to be a major element of our long-term success, because they have such marvelous technology, both in the laboratories and in the universities.

Now, just to summarize, and I think I'm at the end of my half hour. When we started this, it was before I got here, I came in November, and it started a half a year before with Steve Brocoum in a task force that you learned about a year ago, the idea was that surely many, many opportunities existed, advanced technologies, advanced methods of analysis, and so on. And, in the last year, we have absolutely for sure confirmed the original vision.

Now, more technologies, there's more advanced possibilities, there's more out there that we could possibly support. And, legitimately and without any feeling that we're dipping into the lower end of the stuff that we know about, this high end stuff, it's just much more. It's amazing, and I'm just thrilled to know that there's so much possibility for advances that by the way, it's going to take three or five or ten years sometimes to develop, but which in the end, taken together, it's going to make a difference in the way this whole art system works and operates and is understood.

Now, the first real year, the 2004 program, is pursuing many of these opportunities already, and I went through some of them, but I didn't cover, by any mean, all of them, even some major areas I didn't talk about here. And, right now, we're in the process of developing other opportunities so that we can put them in place and make a broader, more comprehensive program in the future.

And, one of the things you'll notice here is that we haven't done anything here about science and technology for transportation. We figure that that's something we may do next year or the year after or the year after, because, of course, we don't even have a baseline transportation technology system yet put in place, although we expect that that will be there in a year.

And, we also have done very little here on advanced technologies for the surface facilities, or the emplacement technologies, although we have the robotics program. That's the one exception to that. But, I expect that in a year or two or three years from now, we're going to have important work supporting their advances, too, because surely, I just feel it in my bones. The opportunities are there. We've got to find them. By the way, the nice thing about this is you put a flag up saying you've got money, they find you. Isn't that nice. And they do, and they send stuff in, and it's wonderful. But not always.

We have to find them, and then we have to put them together, we have to make a program out of, you know, disparate things. We have to convince people to do our stuff rather than something else, which takes money and motivation and making them feel that it's important. And, by the way, motivation is as important for people's devoting the next two or three years, or five, of their life as the money. People have to feel it's important, and we've worked hard to try to give them that feeling. And, I believe that you're going to find that three years or five years from now, this is going to be an established program, that by then, we'll have developed a whole lot of neat stuff that you can already describe and look back on, we're just now in the formation stage of it. And, then, it will be for sure an institutionalized part of the Office in perpetuity.

Thanks.

LATANISION: Thank you, Bob.

Priscilla, Dave, Mark?

NELSON: Nelson, Board.

Well, we've been strong supporters of this effort for a long time.

BUDNITZ: For which we thank you.

NELSON: We're very happy. I've got a question, which I'm sure you have a very good answer for, so I'll ask it because I think it's an important question.

On Slide Number 2, there's two parts to this. One is increasing the understanding, doesn't always decrease the uncertainty.

BUDNITZ: The chips fall where they may.

NELSON: Yes, and you've got if those two up above are drivers, which have to do with the potential for saving said efficiency in the thinking, I'm wondering where safety is in this.

BUDNITZ: I'm glad you asked that. Actually, several months ago, we went over and briefed your staff, and Leo Reiter asked me that three different times within the hour.

NELSON: And, that was unprompted.

BUDNITZ: That's okay. It's not an explicit objective, because we don't feel we need to improve the safety, but we do need to improve our understanding of the system. Okay? Now, that's a--I have to say that carefully, and I thought I did. But, of course, much of what we will learn will result in that. I can't predict. How does one know? And, maybe something that we'll learn will tell us that we didn't understand something that is actually not what we think. Okay? But, it's not an explicit objective.

NELSON: You were very careful about a statement you made during your presentation, not about safety, but perhaps about efficiency, or savings, is that--or the level of understanding is sufficient, but it can always be improved. I just suspect that there's a way of saying that someone explicitly, because if these become the drivers, the savings and efficiencies, then new technologies that may not address either of those, but may actually address some safety opportunities might not end up being prioritized.

BUDNITZ: I understand that. But, of course, we have to decide, in part, whether we think it's safe enough. And, by the way, we don't get to decide that. We get to decide what we think, and we can submit it, and then our regulator gets to review it.

Now, once it's safe enough, and that's, by the way, a philosophy that goes all the way back to reactors, many years ago, once it's safe enough, then you improve safety only when it is also cost beneficial, rather than by itself.

NELSON: Maybe that's the angle to do it in.

BUDNITZ: I think that's the right logic, isn't it?

NELSON: Well, I'd still for proof of objectives, I'd still just suggest that you continue to think about that, because I think there needs to be something about safety in that.

BUDNITZ: I understand your point.

NELSON: We can figure this out. Now, on Slide 4, you make a clear distinction between the scope of the S&T and the PC, for example. And, I can see how you're doing it for the LA, but we've always had a question about the whole idea of PC, testing and evaluation. It really represents an opportunity for S&T and for the feedback from what's being observed in PC into S&T, and what's being found out from S&T to modify PC.

BUDNITZ: Yes, ma'am.

NELSON: So, that interface, by saying a clear distinction, it sort of put me off, and made me wonder where that sense was.

BUDNITZ: Well, first, I want to tell you that you asked us this--whether or not you asked this--in a letter that perhaps the last letter, but one, maybe two letters ago, we answered that very question explicitly, and I wish I had the letter in front of me, but I can sort of paraphrase it for you, because I was involved in helping draft the answer.

The performance confirmation program is what it is. They have technology needs. For example, they know how to do a certain thing, but it's expensive, or it's clumsy, or it's difficult, and they would ask us to develop, or work on developing something that's less expensive or less clumsy or more efficient or more sensitive, or the like. So, our role would be to support them by building advanced technologies they can use to make the measurements, or whatever they do. That's role number one.

But, role number two is we have to watch them over the years as they're making their measurements. And, the knowledge they develop in making their measurements becomes a piece or would feed into what we could then assemble or make into a coherent advanced understanding, and proving an understanding. Okay?

So, at first, our role with them is advanced technology development to support their technology needs. I don't use the word needs, because the program--needs isn't right. If they need it, they've got to do it, and they actually will. It's a desire to improve. And, later on, we're going to learn from them, and it could easily be that we would have an advanced understanding of the project that relied on measurements that PC was making as a piece of, not only, but perhaps maybe even centrally, depending on what it is, a piece of what that project was. That's how I see the long-term relationship between performance confirmation--and testing and evaluation program is broader than PC is, you know. But, it's sort of an integrated set of things, which has a relationship to us that I just described.

NELSON: So, Nelson, Board.

I still come back to the statement there. The idea of making a clear distinction without making the clear interrelationship put me off. Okay?

BUDNITZ: Oh, I should talk about that. I think I can explain something that's very important. We could not do this without direct, continuing interaction with the staff in each of those areas. So, that, for example, we wouldn't be embarking to develop an advanced robot without interacting with the people in the PC program, or wherever it happens to be, to ascertain that's the robot that they could use or need, and to ascertain how much improvement would be important rather than not so important. So, that interaction has to take place all the time, and it does. We're on the phone and we're out here all the time, and we're constantly interacting with them. Otherwise, this--so, the separation has to do with the programmatic separation, but none of it has to do with the flow of information.

NELSON: Right. So, I mean, as someone who--that first statement just honestly put me off.

BUDNITZ: Yeah, thank you.

NELSON: But, I don't question the sense of your commitment to make this work.

BUDNITZ: But, there's something very important that was on the previous slide, which is we've got to stay away from the short-term trap. That's a trap. Okay?

LATANISION: Dave Duquette?

DUQUETTE: I applaud your enthusiasm. A couple of things, though. I really like the concept of the corrosion workshop that you had. I don't think the Board was invited, but that's neither here nor there. You might want to do it for some of the other areas before kicking them off as well, because you've also instituted a program in EB welding, and several members of the Board and Staff were privileged to watch EB welding of I think it was about a 25 millimeter chunk of nickel alloy in England a short time ago. So, the technology is already there, and I wouldn't want you to reinvent some of the same technology. So, I applaud the idea of getting together some people beforehand to define what really is out there and what's not.

I also wonder if you had considered setting aside a piece of money for what I'll call unsolicited type things, and by unsolicited, I don't mean that you're not soliciting proposals, but things that come in out of the blue. For example, you defined certain areas that you want to cover. There are going to be some individuals who will have some knowledge of what's happening at the repository and things that are connected to it that may have some ideas that you just hadn't thought of.

BUDNITZ: Of course, our job is to be on the lookout for those.

DUQUETTE: Well, but if you don't ask for them, no one's ever going to respond to them. There ought to be a scope somewhere in the way you're setting up your program very much like Basic Energy Sciences does, where someone submits a white paper proposing to do something, and you decide, gee, that might be something we might want to do instead of pigeon holing all of the things that you do.

BUDNITZ: Yeah, that's a very fair comment. In fact, it occurs to me that if we had a mechanism for publicizing the fact that we're interested in, let's say, advanced robotic manipulators, that somebody in Madagascar that had one might know about it that wouldn't otherwise. I used Madagascar, it seems kind of far from here, because, by the way, if you drilled through from Las Vegas, that's where you'd come out. And, when I say that, that's far, all right? But, there might be somebody anywhere on the globe, as I said, who had-- they need to know about us, otherwise, we can't make the connection. So, that's fair.

In the corrosion area, for example, Joe Payer and Scully are just about to submit this corrosion workshop paper to a referee journal, where it will be then in the referee literature, and will probably be available to anybody. And, I think that's a really sensible approach so that people can read it, and if they say, gee, number three, they don't agree with, or they have an idea, they can find it that way. I think that's excellent. We've got to find a better way to do more of that.

LATANISION: Joe? Joe Payer, Case Western Reserve, who is one of the co-chairs of that workshop.

PAYER: Yeah, Joe Payer, and also I'm assigned to the Technology Panel. That workshop, just to clarify, your quick remark, a Board member or two were invited to participate in the workshop, but it was a closed workshop within the group. It was not open to the public, to participants, and it was the Board's decision that that would not be the right place then to have a Board member. So, we would have benefitted from some of the Board members participation, but it was just this trying to keep the lines of communication clear, and so forth.

The other clarification is TWI is a participant in the Low Energy Electron Beam program that's being--Frank Wong of Livermore is project manager on that, but TWI is a partner in that, and they have welded up some of the Alloy-22, and things of that sort.

BUDNITZ: TWI is the British--

PAYER: And, that's the British folks. I think that's the folks you visited. So, that is a good thing.

LATANISION: Thanks, Joe. Mark?

ABKOWITZ: Abkowitz, Board.

I certainly want to add the applause for getting this program off the ground at a fairly robust level. I did want to pick up on the points that both Priscilla and Dave have made, because I agree strongly with each of them.

I think the absence of safety and security on that Slide Number 2 is quite conspicuous, and I would echo Priscilla's comments that you seriously rethink how you want to publish that information, because I could take the counter-argument and say that we should improve existing and develop new technologies to enhance safety and security, and oh, by the way, savings and efficiencies are a by product of that in most cases. So, you're really at the same place.

And, to make the comment that safe enough is being determined by other people, I think there's two different types of safe enough. There's the technical one, and there's the court of public opinion. And, if you want to engender public confidence in the science and technology program, it would make sense to make sure that those are explicitly identified. There's no need to comment, if you don't wish to.

I did want to move on to Dr. Duquette's comments about other things that could be identified as part of the program. In the area of transportation, which you did allude to as somewhere down the road, there's a number of very important issues that are coming up that I don't think it's, you know, it's too soon to start thinking about, because a lot of the intelligent transportation world is beginning to think about them. These technologies fall into a lot of categories. Some of them have to do with tracking, some of them have to do with surveillance and detection, others have to do with tampering, electronic seals, and that nature. And, given the aggressive transportation schedule that we've been--that has been suggested, I don't think it's too soon to look into those things.

Similarly, in the communication area, DOE is going to have a humongous interoperability question to deal with, and I think science and technology is the appropriate place for that. So, my general suggestion is, beyond those two subject areas, is maybe to broaden your advisory group, or to have other mechanisms for making sure that all kinds of different ideas are vented properly.

BUDNITZ: I accept that suggestion directly. Just to give you back your example, we needn't wait for the actual transportation scheme to be put in place as the baseline to recognize that perhaps a multi-year operations research effort could produce something that would be far advanced, something that obviously you couldn't deploy now, and that we could make available three to five years hence. And, I agree with that.

By the way, in transportation, the areas that we have contemplated are some work on burnoff credit, which if we could develop, could make more efficient and more effective the whole problem of transporting spent burned fuel. And, the other area we've thought about, but haven't done anything about yet, is the possibility that perhaps a very advanced waste transportation cask, either road or rail, could be available, say, ten years hence that could be much more demonstrably efficient, effective and secure, and so on. We haven't done anything there yet, but those two at least we're thinking about, and the other we haven't yet.

LATANISION: David?

DIODATO: Yes, Diodato, Staff.

Again, congratulations on getting your program off the ground here. You've used the airplane metaphor more than once with us, and it's an interesting and thought provoking one, because you're making an argument that seems, on the face of it, quite reasonable, that the last drift won't be the same as the first, the last technologies won't be the same as the first. Airplanes are an interesting subject.

Recently, I just read this morning, in fact, about Japan Airlines grounding their fleet of MD-80s because the pilot in one of the planes heard his Pratt and Whitney jet engine making a funny noise, and then they tore it apart and they found out that one of the fan blades in the turbine is cracked. And, so, they said--they made a safety determination in that case until we understand why that happened, what the controls are and how frequently it occurs, then we have to ground this whole fleet. And, so, that was kind of a safety rubric that they used to make that decision.

So, what I wonder, and I rhetorically ask myself, is who are the pilots in this program, the DOE OCRWM system? Is it the performance confirmation people? It could be S&T people. Could it be the people in testing and evaluation? I'm not clear on that.

BUDNITZ: Well, I think what you just said is very profound, and I can give you an answer based on a previous slide. I was the director of research at NRC in the late Seventies. Now, the Office of Research had a mission similar to this for NRC. If a problem occurred at a power reactor, and I remember in 1978 or '79, they had the pressurized thermal shock event at Rancho Seco, which is in California, the operating office had to make the determination whether that required them to shut all the plants, or some of them, or what, or derate them, or what. And, sometimes they didn't have enough information and they called on research people to help them, and establish a three month really rushed effort, of course, you've got to do that.

But, what came out of it was a determination that they made some changes to the temperature of the water, and based on some analysis that was done, they concluded the plants could run for at least five years, and perhaps ten before they were in real trouble, during which time the Office of Research initiated a ten year program to get on top of it. That could happen here.

The determination that something short-term is important, it has to be done, it's going to be made by the regulator. Remember, Rancho Seco was run by a utility, which is the analogue of DOE, you know, the operating entity, but the regulator made that decision about what to do. And, then, that was implemented. Of course, everybody was working together. It was a serious problem at the time. And, the industry did work at EPRI, and we did work at NRC, and seven or eight years later, they were on top of it.

Now, it could have come out that it was so serious that all the PWRs had to shut down. It wasn't, but it could have been, because they didn't know until they knew. So, without arguing about who the cop is on the other side, and surely it's NRC, they're the regulator, and surely on our side, it's our operating people, the people who are taking data, the people who are going to be the first people to see the data, and say my, we've got to report that.

But, our role is different. Our role then would be to put in place a long-term program, because these things, unless you could do it in six months, but, it's a long-term program for us to understand something better that needs understanding, but are merged through experience. It's not experience yet, we're not running anything, or better, it's not quite, you know, we've taken data, of course, on the side, and those data taken on the side are leading to some of the other work that we are doing, of course. And that's also true in our engineering systems, too.

So, I think over the long haul, there's going to be an interplay between--we're imagine we're operating and they're putting waste, you know, in the drifts, and they're handling stuff and they're transporting stuff, and something happens, and there's some technological failure that was identified, maybe the sensors don't work as reliably as people had hoped. I don't know. Well, somebody is going to have to decide what to do, and in the end, science and technology may be the right office to undertake the long-term work, and it's going to be a case by case. But, I can just see that there will always be sort of a case by case determination. Maybe not.

DIODATO: Okay, thanks. And I have one more easier kind of follow-up question.

BUDNITZ: Well, that was pretty easy.

DIODATO: I actually didn't expect you to answer it. But, the other part was the Pena Blanca natural analogue study. Can you tell us a little bit about what you're doing with that and where that's going and what the status of it is, and how excited you are about it, because you're excited about a lot of this?

BUDNITZ: Yeah, I'm excited. And, of course, the background here is there was a site visit by several of your Board and Staff a half a year ago, or so, and a few of our people. Mark Peters in the back was on that, maybe I'll ask him to answer it, if I don't get in enough detail.

We did a scoping study about what we might usefully do that was documented. You can get a copy. Everybody can. That was pulled together in the last six months, and we're just now in the process of putting together what we think will be a several year, several million dollar research effort at Pena Blanca that if we decide to do it, and we haven't decided that yet, and if it then is successful, will rethink, possibly demonstrate that our models used at Yucca Mountain can also be used there to predict and understand what happened there.

For those of you that don't know, Pena Blanca is a natural uranium formation just south of the Mexican border in Chihuahua State of Mexico, which is a very nice analogy to many of the characteristics of our formation, because it's in bedded tuff, and it's natural uranium, and it has, of course, the uranium series of the decay daughters and the like. And, we haven't put it together yet, but it's probably pretty soon. My guess is within the next three months, we may have a program put together. But, perhaps we won't. The decision process is cumbersome because it's a lot of money, it takes a lot of time.

Mark, is there anything else I need to add to that?

DIODATO: Well, that sounds really interesting. I hope you'll keep us apprised of the progress.

BUDNITZ: Well, if you want to be apprised in detail, we can brief you in detail about any of these. By the way, you or your Staff, if you ask us in detail about any of these, we're here to be information for you on detail. You just have to ask us.

LATANISION: Any follow-up questions? If not, Bob, thank you very much for joining us today.

We now enter the public comment session of the afternoon program. And, we have five speakers who have signed onto the register, the first of whom is Sally Devlin. And, Sally, I'd like to invite you to come forward.

DEVLIN: Good afternoon, one and all. And, thank you all for staying so late and staying awake. And, again, welcome to Nevada. I hope next year, we'll be seeing you in Pahrump.

But, I'm really here for two reasons. The first thing, I didn't realize how old I was when I talked about the basaltic magma stromboli, and referred to it as an Ingrid Bergman. And, for you kids, that was when Ingrid Bergman was making a film in the island with the stromboli volcano, and she fell in love with her director, Rossalini, knocked her up, she had twin girls and that's the story. So, of course, that's how I remember names with incidents. So, now, you know what an Ingrid Bergman is, and I had to clarify that.

The second thing, and as I say, this gentleman who just spoke was very impressive. My business career for 40 years was in sales, and I would hire him in a minute, and he is very good. I've been retired for over 23 years, but, anyway, he's hired. And the reason is if I didn't know any better, I would say that I believed him. Well, you know I don't, and the reason that I don't is I still haven't heard things namely about Abe and I, how long we're going to have to sit on top of both Yucca Mountains, and I hope you heard the term both, because the amount of waste, playing gin rummy. Has there been anything done on that? I didn't think so.

Okay, the other thing is, and, of course, we have to always be very positive, and that is of our 50 states in our Union, does everybody know who is worse in education and health care, who is number 50? Okay, you know who is number 49? That's Nevada. We are number 49 for the worst education and for no health care. And, the reason that I'm saying this to you is I know we all know that--and everybody is throwing money at education. But, the most important thing is we're talking many years from now, be it 12 years, or what have you, and you're going to have to employ the contractors and BSC and all the rest of them, including the Board, who has just five years and changes, and so on, and has to be around until Yucca Mountain opens. I read all the information on you guys. So, it's going to be very interesting in many years.

Now, who is going to be around that is educated to do these jobs? I know the contractors in Nye County, and of course they hire, like Wal-Mart, and that's all I need as an analogy for you. So, I'm just saying it is a very scary proposition, and I think one that should be looked into.

The other thing regarding health care and asking you all, and I say that because I'm very serious about this $25 million, for a research hospital in Pahrump. And, I did my homework, I actually spent 50 minutes on it, and when you realize that the test site is 1,730 square miles, Yucca Mountain is just 25 square miles, and that Pahrump is the first responder, because we're only 30 miles from it, and I'm talking about the 510 entrance, and it is over 60 miles to Las Vegas. So, I am saying to you you cannot afford to build a medical facility that can handle accidents, be they just plain ordinary accidents with trucks or whatever, or whether they were accidents with radionuclides and other awful stuff, so that I really want to impress upon you where this hospital should go, and why it should go there, and it should be done yesterday. The land is available, and we will be more than happy to work with you because our town board will welcome you with open arms. And, we have no health department in all of Nye County because the other rural areas don't want it. Only Pahrump wants it.

So, you see, we have a civilized area and uncivilized area. And, in the other rural counties, they are totally uncivilized, and I'm talking about Esmeralda, Mineral, Lincoln, and so on, because they don't have any people. And, that is what is about the truth. They are deficit counties, and so on and so forth. So, it is a very unique situation.

I will be going before the legislature. Since 1919, they have never realigned counties. The State has twice put in my broadband bill, and the funding is there. They don't even know what we're talking about. On emergency services, nobody is on the same frequencies. So, we have major serious, and I mean safety elements here that should be addressed, and I'm so glad that you brought it up, because I try and make you understand we have nothing. And, when I say nothing, I mean nothing. You cannot get sick in Pahrump after 5 o'clock Friday, until 7 o'clock Monday. So, remember that when you go through.

The other thing is, and that is on my bugs, and that is I'm asking Robert if the getting are my bugs that might possibly be doing things to your canisters, and what have you. Because microbic invasion now includes algae and fungi, and we all know there's algae and fungi in the current mine, and we all know that the drip shields and all the equipment is rusting, rotting and whatever equipment does. So, we have a problem there. Can you answer that, Robert? Is he here? Or somebody from the Staff answer the question.

The only other thing I have to say, and that is he mentioned the papers, I'd like papers on corrosion and on the getting, because I don't think getting is a good name. I think Sally's bugs is much better. Right?

The other thing is we're talking about the transportation. Tomorrow, we have a lot to say on that, and that's my field. But, again, I really want to say thank you all for being here, because I know at every one of these meetings, interesting explanations, interesting dialogue, and so on, occurs. And, I really want to thank you for sending me the information. I never learned the word deliquescence before. I had to look it up. Now, it's a member of the family. I never knew stromboli, I didn't know Ingrid Bergman, and I keep growing thanks to you. And, I hope I will grow and we will all grow together for many years.

But, remember, since Nevada is the bottom of the barrel, not quite the bottom, but number 49, we are going to have major problems here, as well as everywhere else in the country, with what we're talking about, the future. And, I might not be here, because I'll be 75, but you all will be, and I feel very strongly that this will be affecting the entire world.

And, if you talk about the Ingrid Bergman only going to the world and through the repository and only to Amargosa, not Beatty, Death Valley or Pahrump, I think it's wonderful, and I really feel, and I'm going to say my usual appeal, that Yucca Mountain is on the test site, and you look at that FACO agreement, and you look at those 400 pages of the bombing and all the rest of it, as far as I am concerned, from my studies, and I'll like to be disputed, that those colloids are going to go to Yucca Mountain and say how do you do.

And, with that, how do you do, tomorrow. Thank you.

LATANISION: Sally, thank you very much. I want to tell you we're always happy to hear your perspective. Thank you for being here today. I should let everyone know that Sally has been promising us cookies. You heard that this morning. Well, she delivered in part, these are dates, which are something we'll share with everyone in the room after we finish. How's that.

All right, let's ask Grant Hudlow to come forward.

HUDLOW: I'd like to thank you for something very special that you're doing. You're implementing quality circles with these talks and with your communication with other groups, and so forth. And, of course, this is mandated by the federal law under Results Management, and I'm sure there are a lot of people in the room that don't know what a quality circle is, and I'm not going to take the time to tell you that. You can look it up. It's extremely important, and one of the reasons that this group works so well.

I had a couple of questions on the transmutation, and I wanted to answer those. The transmutation that they successfully demonstrated just the other day does not use an accelerator. That cuts the cost back to the normal utility implementation, which is three-quarters to a dollar a watt, something like that. So, there's no additional cost to do this.

The other thing is that in the transmutation systems, the reports that have been written, they need a separation system. And, the older separation systems that the DOE uses are extremely extensive. We have new systems that have been discovered about five years ago, and they're implemented world wide in the chemical and pharmaceutical industry already. They're that good. Their membranes at less than five pounds of pressure. You get a 90 per cent separation for pass, you put two membranes, one that takes the stuff that you want, and one that takes the stuff that you don't want, and when you get through, you have the same concentration you started with, so you'll just be cycling to extinction. And, you get 90 per cent per pass, so if you want five nines--and they just crank it up and it runs automatically.

The DOE and the nuclear industry have not kept up. They're not even aware at all of these systems. And, so, I would like you to find somebody that can give you a talk on that. It should be implemented, not only in the Yucca Mountain, but in the--through the NRC into the nuclear plants themselves. It would save everybody a lot of aggravation, sickness and death from the materials that are spewed out by those clamps now.

Thank you again.

LATANISION: Grant, thank you very much. Steve Frishman, please?

FRISHMAN: I'm Steve Frishman of the State of Nevada.

Listening to Bob Budnitz got me thinking that I needed to say something. First of all, I think it was notable that the use of the airplane analogy got questioned, and properly questioned about who is the pilot in the analogy. And, Bob didn't answer who's the pilot. He answered who's the cop. And, I think just for your thinking, you should go back and review who the pilot should be, and why we didn't get an answer about who the pilot is.

Now, another thing that is going to be somewhat controversial, but I think you need to know about it, and I'll tell you the full story, in all fairness, and that's that I've got a notice here for a meeting that was scheduled for tomorrow, and then postponed, and I'll just read you some of the pertinent parts of it. "A new National Academy Committee examining science and technology for physical security at Yucca Mountain has been established. The study will review the Department of Energy's plans for physical security for the Yucca Mountain repository, and provide recommendations on how the use of science and technology to improve them, including applying improved risk assessment methodologies, to enhance capabilities to understand and respond to a range of potential threats, adopting science and technology current used for physical security at other facilities, adapting existing technologies that are not currently used for security to deter, defeat, delay and mitigate attacks, pursuing opportunities for research and development of new technologies."

I think it's important to get to this, but I have to tell you first that I just went and asked Bob Budnitz why he didn't tell you about this, because he certainly had every opportunity with Priscilla's question about the need to include safety and security. We also this morning heard one of this, I can't tell you or I'll have to cure you, in terms of security against intentional acts at the surface facility. And, so, I went and asked Bob why he didn't mention this to you, and his answer was, "It's not our project." So, I told him, well, I have a duty to read at least public information to this Board, and if it's not his, he needs to deny it.

So, I just wanted to let you know that that information is out there. I can't quite understand how the National Academy could have gotten it wrong, because as I understand it, this Panel started last October. Their first meeting was supposed to be tomorrow, but postponed. I believe it's in the amount of something a little over $800,000. It's to be--the work is to be completed and a classified report that coincides almost identically to the date of license application, and an unclassified report to follow about five months after that.

So, that's all I know for now, and I think if it's not Bob's project, he'd better tell you that.

LATANISION: Steve, thanks for being here today. Go ahead, Bob, sure.

BUDNITZ: Robert Budnitz.

That project was initiated by a decision by our Director, Margaret Chu, and it's supported out of her office, but it's not out of our office, that's technology's, is why I didn't mention it. But, it's just along the lines of the sort of thing that is a scoping study that if they weren't doing it, we might have found some other way to figure out how to do that. But, they are doing it, and we're thrilled that they are doing it.

LATANISION: Thank you. Dr. Paz, Jacob Paz? Welcome back. It's good to see you again.

PAZ: I will make it very short. First of all, I'd like to commend the person who gave about science and technology, and I'd like to make two comments. Don't go out. First of all, how much would be added to the cost of the technology, such as surface metal coating on--to potential, if the repository would be approved. And, second, is how unsolicited or solicited grants are going to be peer reviewed? I don't want them on a personal level, but to ensure that a peer review should be outside DOE, and the laboratory, or who have any connections, so you can get an adequate, an unbiased scientific peer review, which can increase the confidence, because I don't have at this point, a very low confidence in the proposal, which I submitted, which was contrary to the scientific literature.

Thank you.

LATANISION: Thank you very much. Bob?

BUDNITZ: Bob Budnitz.

On the second point, the RFP process is going to--embedded an external, independent peer review, along the same lines as the Office of Science used, using the Panels of outside experts who are not associated, either with any of the proposals, or the institutions that have made those proposals, to do an independent peer review of the technical merits, which then becomes the technical part of the review.

Of course, besides the technical part of the review, we also have to do a programmatic review to make sure that the work, you know, actually will help OCRWM. But, I think that the intent there from the start, and I've done this absolutely as openly as we can, was to make sure that the peer review of the proposals was credible and independent, along the same lines as the Office of Science of DOE, or of NSF.

Now, your first question had to do with potential costs of some of the things that we are developing. We don't know. We won't know until they've come in. Obviously, we've done enough thinking about them to believe that there's a very large potential benefit. We wouldn't have supported them without having done that preliminary thinking. But, until the work is done--until it's further along, we're not going to have as good a feeling for that as we'd like. It's just the nature of an engineering development effort.

LATANISION: Thanks, Bob. And, let me call forward Marty Mifflin, please.

MIFFLIN: I have a brief technical comment that came to mind as I listened to the presentation on the postclosure ventilation simulation. One of the things that impressed me that was the assumption that there was a unified circulation system in the mountain, with the cold air coming in in Solitario Canyon, and ventilating out the Ghost Dance Fault. And, I realize that that was a starting point for the kind of like scoping model, but it pointed out to me that because that assumption had to be made to get someplace with this approach, that it reminded me of the studies that were urged back in about 1991 or '92 for getting a better handle on the, what we called at that time, the pneumatic continuity at a repository scale.

And, the issue came up and became quite critical, because the ESF was about ready to penetrate the bedded tuff, and at that point, the degree of confining, whatever degree of confining, in terms of pneumatic circulation, was about to be disrupted. Well, the decision was made by the DOE program to go ahead with penetrating that, and getting the database didn't matter.

About that same time, and I forget what year it was, the State of Nevada supported a thermal imaging project, which I was the project manager, and we took the thermal scanners air borne, and flew around during a storm front that came through so we could see where the hot air was coming out, and the hot air was coming out in a large number of spots, at least in terms of thermal imaging, including Solitario Canyon.

So, the question is what is the natural--this was before the ESF penetrated the bedded tuff. So, the real question is is what is the natural circulation pattern, and whether or not it can be overwhelmed by a ventilation type of program. We attempted to have funding for further study, and we did a little bit of study on the ground, and some of these in recognizance basis, some of these hot spots were indeed zones where warm air came out based on moss around the fractures, and so forth. So, there was evidence that it was not just some type of a thermal anomaly.

So, the real question I'd like to point out to the Board is that the pneumatic continuity that exists, either on a very detailed scale, or a repository scale, is not well established, and that that will cause some uncertainty at least in approaching this idea of dry-out scenarios, unless it's all artificially done with ventilation shafts, and so forth.

Thank you.

LATANISION: Thank you. I appreciate your comments.

We have reached the point of adjournment. I would like to thank all the presenters today, including, of course, the public presenters for joining us. We will meet again tomorrow morning with the Panel on Transportation, beginning at 8 o'clock in this room.

Thank you very much for being here today.

(5:00 p.m. - The meeting was adjourned.)