UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

WINTER BOARD MEETING

February 9, 2005

Alexis Park Resort
Room Parthenon 2
375 E. Harmon Avenue
Las Vegas, Nevada 89109

NWTRB BOARD MEMBERS PRESENT

Dr. Mark Abkowitz
Dr. William Howard Arnold
Dr. Daryle H. Busch
Dr. David Duquette
Dr. B. John Garrick, Chair, NWTRB
Dr. George M. Hornberger
Dr. Andrew Kadak
Dr. Ronald Latanision
Dr. Ali Mosleh
Dr. Henry Petroski

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Dr. Carlos A.W. Di Bella
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I N D E X

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P R O C E E D I N G S

8:00 a.m.

GARRICK: Good morning, and welcome to our meeting. My name is John Garrick. I'm Chairman of the Nuclear Waste Technical Review Board. As most of you know, our meeting will continue tomorrow in Caliente, where we will review plans for transportation of spent nuclear fuel, including plans for developing a branch rail line from Caliente to the Yucca Mountain site.

The Board periodically meets in smaller communities near the Yucca Mountain project to provide an opportunity for those most directly affected by the repository to attend our meetings and express their views. Tomorrow, we look forward to hearing from the local governments and citizens of Caliente and the surrounding areas.

Let me begin today's meeting by introducing the Board members, something we do at each of our meetings, and then I will briefly summarize the agenda. As usual, let me remind you that all of the Board members are part-timers, and we all have other activities which we have responsibilities for. In my case, I am a consultant on the application of the risk sciences to technical systems in space, defense, chemical, marine, and nuclear fields. I served for ten years on the Advisory Committee on Nuclear Waste. My areas of expertise include risk assessment and nuclear engineering, and I was the founder of the firm PLG, Inc., from which I retired as President, Chairman, and Chief Executive Officer in 1997.

Now, as I introduce the other Board members, I would ask the Board member to raise their hand so that they can be recognized. Mark Abkowitz. Mark is Professor of Civil Engineering and Management Technology at Vanderbilt University in Nashville, Tennessee, and is Director of the Vanderbilt Center for Environmental Management Sciences. Dr. Abkowitz has served on several national and international committees, including Chairman of the National Academy of Sciences Transportation Research Board Committee on Hazardous Materials Transport, and as a member of the National Research Council Committee on Disposal of Transuranic Waste at the Waste Isolation Pilot Plant. His expertise is in the area of transportation and risk. Dr. Abkowitz chairs the Board's Panel on the Waste Management System.

Howard Arnold. Howard is a consultant with 40 years of experience in the nuclear industry. During that period, he served in senior management positions, including vice-president of Westinghouse Hanford Company, where he was responsible for engineering, development, and project management. Before his retirement in 1996, he was president of the Louisiana Energy Services, an industrial partnership formed to build the first privately owned uranium enrichment facility in the United States. From 2001 to 2002, he served as Chairman of a National Academy Committee that assessed the scientific basis for disposal of special nuclear materials.

Daryle Busch. Daryle is the Roy A. Roberts Distinguished Professor of Chemistry at the University of Kansas in Lawrence. He also was deputy director of the National Science Foundation Engineering and Research Center at the University of Kansas, having the title of "Center for Environmentally Beneficial Catalysts." His research is presently focused on homogeneous catalysis, bioinorganic chemistry, and orderly molecular entanglements. Daryle is a recent Chair of the Chemistry Section of the American Association for the Advancement of Science.

Thure Cerling is doing field work in Africa and, therefore, is not with us today. We'd like to introduce him anyhow. Thure is a Distinguished Professor of Geology and Geophysics and a Distinguished Professor of Biology at the University of Utah, Salt Lake City. Dr. Cerling was elected to membership in the National Academy of Sciences in 2001. He is a fellow of the American Association for the Advancement of Science and the Geological Society of America. He has been a visiting professor at Scripps Institution of

Oceanography, Yale University, the University of Lausanne in Switzerland, and the California Institute of Technology. Thure is a geochemist, with particular expertise in applying geochemistry to a wide range of geological, climatological, and anthropological studies.

David Duquette. David is Department Head and Professor of Materials Engineering at Rensselaer Polytechnic Institute in Troy, New York. His expertise is in physical, chemical, and mechanical properties of metals and alloys, with special emphasis on environmental interactions. His current research interests include the physical, chemical, and mechanical properties of metals and alloys, with specific reference to studies of cyclic deformation behavior as affected by environment and temperatures, basic corrosion studies, and stress-corrosion cracking.

George Hornberger. George is the Ernest H. Ern Professor of Environmental Sciences and Associate Dean for Sciences at the University of Virginia. His research interests include catchment hydrology, hydrochemistry, and the transportation of colloids in geologicaL media. He has served as Chair of a number of committees, including the National Research Council's Board on Earth Sciences and Technology, the Commission on Geosciences, Environment and Resources, and the Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste. Dr. Hornberger Chairs the

Board's Panel on the Natural System.

Andrew Kadak. Andy is Professor of the Practice in the Nuclear Engineering Department of Massachusetts Institute of Technology. His research interests include the development of advanced reactors, space nuclear power systems, improved technology-neutral licensing standards for advanced reactors, and operations and management issues of existing nuclear power plants. Andy was President of the American Nuclear Society for the year 1999-2000.

Ron Latanision. Ron recently retired from his position as Professor at MIT to pursue a senior position with an engineering and scientific consulting firm known as Exponent. Ron retains a position as Emeritus Professor at MIT. His areas of expertise include materials processing and corrosion of metals and other materials in different aqueous environments. He chairs the Board's Panel on the Engineered System.

Ali Mosleh. Ali is Professor and Director of the Reliability Engineering Program in the Mechanical Engineering Department at the University of Maryland. He has performed risk and safety assessments, reliability analyses, and decision analyses for the nuclear, chemical and aerospace industries. He serves as Chairman of the Engineering Division of the International Society for Risk Assessment and Management, and is Director of the X-Ware Systems Reliability

Laboratory, focusing on the reliability of integrated hardware-software-human systems. Dr. Mosleh chairs the Board's Panel on Repository System Performance and Integration.

Henry Petroski. Henry is the Alexander S. Vesic Professor of Civil Engineering and Professor of History at Duke University. His current interests are in the areas of failure analysis and design theory. Ongoing projects include the use of case histories to understand the role of human error and failure in engineering design, as well as models for inventions and evolution in engineering design. Professor Petroski is the author of several books. One that I refer to often is "To Engineer is Human: The Role of Failure in Successful Design."

Now, today's agenda consists primarily of presentations by invited speakers, with a short period of time designated for questions and discussion after each presentation. At the end of the day, we have scheduled a period of comments by members of the audience. If you would like to comment at that time, please enter your name on the sign-up sheet at the table near the entrance to the room.

Alternatively, you may submit written comments at any time during the day, and we will try to present them to the speakers or otherwise work them in as time permits. Please give any written comments to our support staff, Linda

Coultry and Alvina Hayes, at the sign-in table. They will collect the comments and give them to us at the front table.

Today's agenda includes a variety of topics, beginning with an overview of the Department of Energy's Civilian Radioactive Waste Management program and, specifically, the Yucca Mountain project. The second presentation will discuss integration of the waste management system, which extends from waste acceptance at nuclear power plants or other points of origin, through transportation to Yucca Mountain, and eventually to emplacement underground in a repository. Integration of this system has been a subject of keen interest by this Board, and we especially look forward to this presentation. Our third presentation will address another area of integration, that of total system performance assessment and repository design.

After lunch, we will begin our afternoon session with a presentation on the Yucca Mountain project's thermal management strategy. We will then hear two update presentations: the first on the DOE's Science and Technology program, which will conduct a long-term program of scientific and engineering studies to support the repository, and the second on science and modeling.

The final presentation of the day will describe the DOE's performance confirmation plan, which will consist of scientific studies aimed at confirming that long-term repository performance will be as predicted by mathematical modeling. The last, and in some ways the most important, item on our agenda is a period for public comments. We encourage anyone in the audience to address the Board about any subject on today's agenda or on any other subject related to the Yucca Mountain project that you think should be brought to the Board's attention.

At the beginning of each meeting, the Chairman reads the following statement for the record, so that everybody is clear about the conduct of our meeting, and what you're hearing, and the significance of what you're hearing.

Board meetings are spontaneous by design. Those of you who have attended Board meetings before know that the Board members speak frankly, and openly voice their personal opinions. But, I want to stress that when the Board members speak extemporaneously, they are speaking on their own behalf, not on behalf of the Board. When a Board position is articulated, we will let you know. Board positions are stated in Board letters and reports, and as most of you know, can be accessed from the Board's website at www.nwtrb.gov.

Now, finally, I'll ask all of you to please take a few seconds to confirm that your cell phones and pagers are off, or switched to the silent mode.

Now, let me introduce the speakers. Margaret Chu and John Arthur will jointly make our first presentation, an update on progress in the overall program and the Yucca Mountain project. Margaret is Direct of the DOE's Office of Civilian Radioactive Waste Management, with overall responsibility for the program, including transportation and the Yucca Mountain project. John Arthur is Deputy Director of the Office of Civilian Radioactive Waste Management, and leads the Office of Repository Development.

Chris Kouts, Richard Craun, and Gary Lanthrum will jointly make our next presentation on integration of the waste management system. Chris has served in various management and technical positions in the Office of Civilian Radioactive Waste Management, known as OCRWM, at the U.S. Department of Energy. In those positions, he has been responsible for overall program policy-related activities, including the transportation of program strategy and contingency plans.

Ric Craun is the acting director of the Office of Project Management and Engineering within the DOE's Office of Repository Development. Prior to joining the Yucca Mountain project, he worked for four years in the Rocky Flats office as the Director of the Engineering and Construction Division. Ric also has 15 years of experience in the commercial nuclear industry.

Gary Lanthrum is currently the Director of the Office of National Transportation Program. Gary was formerly the Director of the Environmental Management National Transportation Program in Albuquerque. In this capacity, he was responsible for managing EM's field transportation programs. These included nuclear materials packaging, research, shipping and certification, the operation of the TRANSCOM system for Waste Isolation Pilot Plant shipping, managing the Automated Transportation Management System for tracking all of DOE's nuclear and non-nuclear shipments, and running EM National Transportation Program's national stakeholder outreach program.

William Boyle and Kirk Lachman, they will jointly discuss integration of performance assessment and repository design. Bill Boyle is the Senior Advisor for Regulatory Policy for the Office of the Assistant Manager for Licensing at the Yucca Mountain project. In this capacity, he is responsible for developing and implementing regulatory policy. Previously, he was a geotechnical engineer in the Nuclear Regulatory Commission's Division of High-Level Waste.

Kirk Lachman is the DOE Design Lead for Subsurface Design, Waste Package Design, and Engineered Barrier System Design in the Repository Engineering and Design Division at Yucca Mountain. Prior to joining the Yucca Mountain project, Kirk was the Lead for the DOE Nevada Operations Office National Crisis Response Assets where he led teams of specialists on nuclear emergency response operations.

Paul Harrington. Paul will update us on the Yucca Mountain project's thermal management strategy. Paul has been with the U.S. Department of Energy for over twelve years. Currently, he is the systems engineering lead for the Director of the Office of License Application and Strategy at the Yucca Mountain project. Paul leads the effort within that office to develop engineering processes and products.

Mark Peters. Mark has spoken to the Board many times, and today, he will tell us about the Department of Energy's Science and Technology program. Mark recently completed a detail to DOE Headquarters in support of the Director of OCRWM. His responsibilities were to work with DOE to plan and implement a long-term science and technology program to enhance confidence in the Yucca Mountain repository system, and bring efficiencies to the repository system, such as cost reduction. He also provided support on technical matters related to the Yucca Mountain project. Mark is currently Director for Program Development at Argonne National Laboratory, where his responsibilities include continuing to work with the DOE to plan and implement the science and technology program.

Robert Andrews. Bob will tell us about efforts to develop more realistic models for projecting repository performance. He is Manager, Postclosure Safety, for Bechtel SAIC Company. He manages and coordinates the technical investigations of the BSC team, including the national laboratories, in support of science and performance assessment products for the License Application.

Deborah Barr. Debbie will make the final presentation for today, describing the Performance Confirmation Plan for a Yucca Mountain repository. Debbie has been supporting the Department of Energy, and currently manages various aspect of the science program on the Yucca Mountain project, including the thermal testing and performance confirmation. She has a BS in Geology from UCLA, and an MS from BYU, a couple schools I know something about. She joined the project in 1995 as a member of the Underground Mapping System with the U.S. Bureau of Reclamation. In 1998, she joined DOE as a technical lead, and is now responsible for Performance Confirmation, Coupled Processes, and the Engineered Barrier System.

A long and lengthy introduction, and I appreciate your patience. But, now, we'll get into the real stuff, and I'll invite Margaret Chu to come and start the presentations.

CHU: Good morning. And, happy Chinese New Year, in case you didn't know. According to Chinese custom and horoscope, what you do the first day of the New Year is indicative of what's important to you. So, I think it's very appropriate what we're doing here.

But, first, I would like to begin by noting that the Department of Energy has a new Secretary, Dr. Sam Bodman, a former Deputy Secretary of Treasury and previously, Deputy Secretary of the Commerce. Was also formerly an Associate Professor of Chemical Engineering at the MIT. And, of course, he also has some very successful private experience.

Dr. Bodman was confirmed in the Senate on January 31st. Although he has been very busy in the first week or two as the Secretary of Energy, he has taken an active interest in the information that he received from our office on the repository program. And, our office really looks forward to working with him.

I'm personally especially excited about his technical background, and I believe Dr. Bodman will be very helpful to our program.

Now, let me turn to some of the key issues our program is currently facing. You may remember that our Management and Operating contractor, BSC, delivered the first draft of the license application in July of 2004, and we reviewed the draft intensively, and made many comments and which were incorporated into our second draft, which was delivered to us in November of 2004.

Shortly after that, we announced that we will be revising our original goal of submitting the license application in December of 2004. That's because several events and circumstances necessitated this change in schedule.

First, last July, the Court of Appeals, you know, issued a decision invalidating the compliance period, that's the 10,000 year period, in EPA's Yucca Mountain Radiation Standard. And, in the second consideration, and, in fact, in our time table, was a decision of the Nuclear Regulatory Commission's Prelicensing Application Presiding Officer Board, we call that the PAPO Board, to strike our Department's certification from June of 2004 of the availability of the documents through the Licensing Support Network, that's the electronic web-based data base, millions of documents.

So, since then, we have been reviewing and processing additional documents in responding to the Board's direction on the License Support Network. As you know, the significance of that certification was that LSN must be certified six months in advance of license application submittal. We anticipated we'll be ready to certify again somewhere in the middle of this year, in mid year, 2005.

Now, while these activities are ongoing, and we're performing additional work to our draft license application, and largely to enhance and refine the technical work, we believe we have a draft license application that after thorough cross-referencing, we believe that it complies with the current requirements of 10 CFR 63, and the guidance in the Yucca Mountain Review Plan.

One of the refinements that we're making is to enhance some of our analysis by developing more realistic models, input and technical basis. For example, we are factoring in in the latest dosimetry signs from ICRP 72. That's the latest, those conversion factors.

Similarly, we are refining some of the seismic analysis, deliquescence and Neptunium solubilities, these are examples, and John Arthur will provide more detailed information on our ongoing license application work. Also, I believe, one of the presentations will talk more in this topic.

Now, our draft license application provides the safety analysis from the preclosure period through 10,000 years after permanent closure. It is clear that any proposed EPA rule will include a radiation standard for a period beyond 10,000 years. That was the Board's decision. So, now, we are also using this time to ensure that we will be ready to perform analysis over extended time period beyond 10,000 years. And, we do not anticipate significant scheduled delays for the license application, and we are working very hard to complete a high quality license application this calendar year, and we're committed to submitting as soon as possible after we complete it. Of course, some of the things are not totally up to me.

However, the timing of the overall program goal of achieving an operational repository is depending on multiple factors. They require attention from various parties, of course, including the revision of the EPA standard, and probably more importantly, the availability of adequate and assured funding over the long-term. Building a repository is a capital project. It takes a lot of money, and there's no way you can save a whole bunch out of the capital funding. Eventually, we do need that funding to build and operate.

So, until these factors are in place, it will be very difficult to specify a specific date when the repository will open. I know I made some offhand comments a couple days ago in the budget role-out, and then it got all over the newspaper, but I do want to say it will be difficult to specify a date with confidence because it's so budget-dependent.

Since we're talking about budgets, let me summarize what's going on with our budget request for fiscal year 2006. The request from our office includes $651 million versus this year, it's $572 million. Of the total $651 million request, we are requesting $427 million for the Yucca Mountain repository activities, which is very similar to this year's figure, slightly more. And, approximately $85 million for transportation activities, which is I believe like $50 million dollars more than this year. Gary, am I right?

Yeah. And, approximately $139 million for program management, program integration, and program direction activities.

Within this program management, integration and program direction budget, it also includes a $25 million budget request for the science and technology program, versus this year's $19 million.

Now, between now and the end of fiscal year 2006, our objectives are to move ahead with licensing, submitting a high quality license application to the NRC, and providing--this is a very important part--providing timely responses to information requests during NRC's technical review, because we know there's going to be a very rigorous review.

We also plan to continue the design of critical repository facilities and engineered barriers, and ramp up repository readiness through safety upgrades of site infrastructure. We'll also move ahead with the development of National Transportation System infrastructure. We anticipate that within fiscal year 2006, we will complete and issue the Environmental Impact Statement, and a record of decision for the alignment of the Nevada Rail Line.

We also plan to initiate the award of a design/build contract for the Nevada Rail Line. I'm really talking about if the budget request activities for '06. And, also award a contract for prototypes of the rail cars. And, we will continue working on the design and certification of transportation casks. Of course, we'll also continue to work very closely with the stakeholders and industry to advance our whole transportation program.

And, then, finally, in '06, we will continue our efforts in getting ready for waste acceptance in the most efficient and economic manner. This area includes continuing to pursue the science and technology activities, integration of repository designs, operation and transportation, to optimize the whole disposal system. And, finally, prepare for waste acceptance by assuring institutional readiness for both the commercial and defense waste across the complex.

Now, in closing, I would like to observe that our presentations at this meeting touch on a variety of technical topics in which the Board has expressed interest. There's some we have been discussing for some time, like thermal management, performance confirmation, and performance assessment, that are fundamental to a successful repository licensing. Other issues, such as integration of the repository activities, waste acceptance and transportation, and forward looking activities, like the science and technology program, have emerged more recently as the program has moved further and further past the site characterization phase, and begun to look at technical activities in upcoming phases of our program.

In all of these areas, the prospectus and expertise of the Board, all of you are very valuable, very much appreciated by all of us. Thank you. And, then, I think John Arthur will follow. I'll be willing to take questions.

GARRICK: All right. Questions from the Board? Yes, Mark?

ABKOWITZ: Abkowitz, Board. Hi, Margaret.

CHU: Hi.

ABKOWITZ: Happy New Year.

CHU: Happy New Year.

ABKOWITZ: I just want to make sure I have a clear understanding of the chronology of license applications and EPA standards, and so forth. Is there any scenario whatsoever where DOE would submit the license application in advance of the EPA's standard having been formally issued?

CHU: I'll tell you what, I don't know, and I can't speculate whether we will be able to do that under that scenario or not. The timeline for EPA revision, we have been told that they're hoping, EPA hopes to issue a proposed rule sometime maybe this year. And, what we're doing is we are trying to get ready for this longer term calculation, which is really an extension of current technical basis to a longer term analysis.

So, we will get ready and keep doing that, and then I'm hoping when the proposed rule comes out, we'll have a good feel, like what are the potential requirements, you know, and so on. And, then, we will keep working within the new information box we got.

And, then, the question is really when the final rule will be out, and then, it's really, then this is another agency, so it's a little bit hard for me to speculate, and then, you know, you want to manage your program of this size. What we are doing is I call it control the controllables, and try to manage our internal thing, walking down into a direction, collecting as much information as we can, based on that proposed rule, and we'll try to complete a license application that includes the new requirement by the end of the year.

Whether EPA will have a final rule or not, whether--I really can't speculate the specific date. And, that remains to be seen.

ABKOWITZ: Abkowitz, Board.

If I might followup? It seems to me that to some extent, this is a cart and horse issue, and a tremendous amount of work it appeared would be necessary on the part of DOE, even once the draft standard has come out, to deal with two issues. One is revisiting the FEPS, I think I've got the right acronym, where a number of scenarios were ruled out because they were considered probabilistically too low over a 10,000 year period. And, not knowing what the new standard might be, means opening that box back up.

And, then, in addition, those that make it through that screen, are carrying the TSPA forward past a 10,000, 20,000 year period as well. Can you just comment in general the contingency efforts that are going on to get prepared for those types of things?

CHU: You know, we have people, they have worked on FEPS and all these things, for years and years, and they are looking at it, and I really can't speculate right now what may happen or may not happen. I will have to wait and see.

GARRICK: We'll take a couple more questions. Dave?

DUQUETTE: Duquette. Margaret, I noticed in your budget, you've got a significant increase, percentage-wise at least, in the science and technology program. Perhaps John Arthur is going to review that with us, but would you share with us at some point exactly how you intend to expand that and into what areas?

CHU: Well, I think Mark Peters is going to talk about science and technology. He can probably--this year, we have $19 million. And, next year, we're hoping to get $25 million. We have four focus areas. I think there will be some--it will be mostly continuation, probably there will be a couple new, new initiatives. That's my guess.

GARRICK: One more question. Ron?

LATANISION: Latanision, Board.

Margaret, you mentioned as a companion issue to the compliance standard, the LSN, is that now fully functional, or if not, what is the timeline for implementation?

CHU: John Arthur is going to--yeah, he's going to give you a little bit more detail on that. I think we have a good plan right now.

GARRICK: Okay, thank you very much.

CHU: Thank you.

ARTHUR: Okay, good morning, and welcome to Las Vegas. I look forward to visiting with you here and entertaining some questions. I'll try to provide some additional information on LSN and some of the other areas.

Now, the purpose of our remarks today are, first of all, to discuss a little bit more detail on DOE's preparations of the license application, give you a little bit of a project update, and then, really set the stage a little bit more on the relationship between a license application, or technical design, and there, to assign some technology on some of the other programs.

I might start by saying that we did receive your letter of November 30th. We are currently working on a response we hope to have out shortly. And, a lot of today's presentations will amplify hopefully on some of the issues and the areas of questions you raised in your letter.

Let me start, first of all, and I'll get to some exhibits a little bit later. License application schedule. First of all, in the November 23, 2004 meeting with the Nuclear Regulatory Commission, the Department of Energy announced that while we made significant progress in completing and documenting a technical basis for our license application, we were not going to submit at that time. And, there was a number of factors. Obviously, the court ruling on the EPA's standard, the rejection of the LSN certification, but also based on a senior management, and some of our managers did the license, and we're very proud of the product that was there, but some further enhancements that we're going to do over this remaining time this year.

I might state that the science and design work that are in the license application that we have today are very technically sound, are adequate for its intended purpose, and meets all quality assurance requirements. This work supports a very robust safety analysis for not only the preclosure operational period, but also through the 10,000 year plus time frame.

Also, additional work remains mainly in the areas of making sure there's transparencies. I'm going to talk a little bit later the supporting products to a license. It's to make sure that when you pull down on the various analyses and model report, the conclusions could be drawn, and everything is very tight in that area.

Additionally, as we talked about, the Court of Appeals made a decision to vacate the EPA standard to the extent that it does not incorporate a post-10,000 year compliance period. Obviously, this limits our ability, as Mark had asked the question, and we will look forward to a draft standard that hopefully is issued this summer, making the necessary corrections for that. But, also, at the same time, we are doing internal evaluations right now.

It's important to remember that when the regulatory period is 10,000 years or much longer, much of the repository site stays the same. The scientific work that describes Yucca Mountain, and analysis of the performance of natural engineering barriers is still very valid.

DOE does not currently foresee significant changes to the analytical basis for evaluating safety in the 10,000 years after closure, nor should analysis of a much longer term performance necessitate significant changes to a lot of our scientific and technical basis. And, internal, we have looked. There are chapters of license, as you mentioned, the features, events and processes, we are looking at those, you know, for applicability for other periods. So, we are doing a lot of internal review right now.

Let me now just take you a little bit from where we were in December, to the kind of work that we're actually doing over this time. And, a lot of this work will actually culminate probably about May, June time frame, and then all the integration will occur at that time.

First of all, the postclosure enhancements. As we mentioned, we did the management review. We identified selected areas of our postclosure safety analysis where we would like to develop and continue scientific updates, some of the scientific technical basis versus bounding type parameters. Some of the kind of areas that we are actually evaluating right now is revising the treatment of analysis in the seismic, a package to package damage to waste packages, dissolved neptunium concentrations, and also modeling a waste package damaged by a pigneous intrusion. That's three areas right now that we are enhancing over this time delay that we have.

Also, after we develop the features, events and processes in models that are ascribed, we will then rerun the TSPA, the Total System Performance Assessment, Validation and Compliance Analysis, and complete the remaining reports.

A little bit also at the same time that's, you know, the postclosure areas, I'll talk a little bit about preclosure. Some of our folks are going to get into a little bit more detail later. But, some of the enhancements we're doing over this remaining five, six month time frame to the preclosure safety analysis are further developing some of the fire protection designs, including selection, detection and suppression methods for each waste handling area. And, I'm very pleased today on the walls here, and I'm sure some of our managers will be referencing them later, we have some of the current design drawings of some of the facilities. But, you just don't put your engineering team in a room and start design. We're actually doing concept of operation, so overlaying that in time, so you've built facilities that actually operate and meet the necessary safety requirements.

We are also expanding the discussion of the site specific aging cask in the operational considerations, with expected doses adjacent to the individual cask. Paul Harrington is going to talk a little bit later about our management of our thermal operating strategy, both above ground and below ground. We're developing all the event trees as suitable for performance, sensitivity and uncertainty analysis. So, a lot of work going on parallel in the design and preclosure areas.

Also, below the license, is shown in this figure, if you go down, I've shown this before and nothing has really changed, but the top of the triangle, the area, that's really the license application, you know, plus or minus 100 pages if we complete that, but it's about 5,600 pages of documentation of all the chapters that are required to be responsive to 10 CFR 63, and the NRC's Yucca Mountain Review Plan.

But, you go down below that, and there's a lot of specific plans, such as material control and accounting, emergency management, physical protection. And, then, as you go down much, much more documentation, stringent configuration control. If you look at the third level down, principal supporting inputs, analysis and model reports, that's postclosure, 89 of those.

And, then, most of the other areas, the next three, the system description documents, 26; facility description documents, 8; and preclosure safety analysis, 23. That's all the supporting documentation for the operational period and the preclosure. And, then, Yucca Mountain site description.

As you go down below the next level, you're looking at thousands of supporting data packages, calculations, and other areas. So, again, it's real important, and that's the stringent configuration control, traceability and transparency of all those products.

Additionally, the work we're doing at this time is improving the readability and ease by which NRC and other reviewers will look at the license to draw various conclusions to make it as user friendly as possible.

A little bit about the documentation. As you're well aware, in all of these areas, we follow stringent quality assurance and quality control processes. In the area regarding postclosure analysis, analysis and model reports, out of the 89, about ten of those will go through further revisions over the next five to six months, based on some of the revisions in the postclosure areas I talked about.

We have done a lot of reviews over the last two years, and I'll later, in my summary remarks, talk about where we were and where we are right now. But, if you look at the KTI agreements, I'll talk about in a few minutes, the results of a Regulatory Integration Team that we actually centralized our production of some of the model reports. Many of the model validation reviews, the completion of validation of data packages, software packages, and also soon to be closed, a major corrective actional models that we've had open for three years, I have high confidence in three weeks, that will be closed out.

We have significant confidence, increased confidence in the quality and robustness of the supporting work products. We also continue to work, through a corrective action program, other remaining issues.

In the preclosure area, a lot has happened over the last year. If you recall, it was probably a little over a year, a year and two months ago, we directed and worked with our contractor, Bechtel SAIC, to go with a new phasing on our operations. At one time, we were going with a big, large, one dry transfer facility, but we actually added in a phased approach now with a fuel handling facility first, followed by a canister handling facility. With that, it required a lot of architecture changes, and we planned a lot of catch-up over the last year to get to the same level, rigor and safety analysis. So, that's an area additionally we're enhancing over this next six months.

As far as the summary on just the license application, we are making good progress. We are doing a lot of analysis to react to, again, what we're looking for, to seeing what EPA comes out with, hopefully a summer or spring time frame, and our readiness to have an LA complete this year.

Now, let me just side step for a second from the license application. Additionally, when that does go in, there's three other key documents that need to go in to support that that sometime aren't discussed. First of all, the final Environmental Impact Statement that was issued several years ago with the Commission, NRC's Commission's Comments on the final impact statement that were sent from the Chairman of the NRC to our Secretary of Energy back in 2002. That's the first one.

The second one is the quality assurance requirements document. We're now up to what's called Revision 17. We have meetings with NRC to receive the final comments, and we hope to have that completed and issued probably in the next month or so. We're in, I believe, the final comment resolution right now.

The third area is from the Navy Classified Technical Support document that will be transmitted under separate cover, consistent with Department of Defense and NRC provisions for the use of this information. So, those three key areas go in parallel to the license application.

Let me talk now about another area that I think is a lot of progress, and a lot of times, there's different interpretations about what these mean, but let me tell you my perspective. Four years ago, or so, NRC and the Department of Energy had agreed to initiate what was called Key Technical Issues to try to get staff and management review of Key Technical Areas well in advance of a license application. These areas were broken into about a dozen technical areas, which I have the keys down below for the acronyms, and agreed to about 293 what I'd call sub-agreements, and they were called Key Technical Issues.

As I reported out last meeting, as of August of last year, we had fully submitted all 293 of these agreements to NRC. NRC has done a very good job over the last four or six months. They've put a lot of effort in. We've gotten a lot of comments back from them. And, also, right now, we're at 187, about 65 per cent of those agreements are fully complete, as determined by NRC. I really believe that over the next three to four months, there's still agreements coming in, we'll probably get to the 75, if not 80 per cent, before too long, completion level. We're really focusing on those ones that NRC and DOE determine to be high risk, to try to get those technical bases understood. Again, when NRC does complete these reviews, they are very careful, this doesn't mean concurrence with the license application, but I believe it shows a general review and understanding of the technical foundation of a lot of the postclosure areas of the license application.

A couple other areas let me talk about, license support network. A lot of work, as I said before, it was a major setback to I and others in the program when the NRC Board denied that certification. We spent months actually looking at the guidance they sent back to us, as well as our internal analysis. We reset our requirements, but it is a phenomenal undertaking, I've said this before, to do all the processing and quality control. I have a new manager over that program, Carey Grooms, who's actually spending three weeks back in Virginia where we do the processing to oversee the management and the quality control of the records, and I do believe that we'll have that completed mid-summer time frame this year.

While I don't predict an absolute date, there's probably plus or minus three weeks accuracy on any data I would project, just because you don't know until you process, determine the amount of documents that are relevant, what the final collection is and, therefore, the final schedule date. But, I believe the requirements that we are implementing in our quality control program will result in a very adequate collection that will support a certification.

We did issue a letter to the NRC back on January 11th, and what they have to do, what the NRC has to do, is ensure, because we send electronically all these documents, they go through a crawling to put those on the NRC website. At that time, we estimated when we finally certify, we'll have a collection of between 3 to 4 million documents, and between 26 million to 34 million pages. So, it's a very voluminous electronic effort that we go through here.

I want to go to the next set of exhibits, if I can. One area I reported out last year, I believe it was one of the meetings back in the Washington area, we take very seriously, it's not just a license. You know, we have 2,500 people in this program, scientific, engineering, management, multiple disciplines, and as you're well aware in this business, you have to have a culture that's conducive with an NRC licensee.

We had an independent firm, International Survey Research, do a survey, and, you know, that survey was set up and done in the October time frame. You look at where this program was back in October last year, it was in the, at least here in the state, a major presidential debate, various positions about what would be the future of this program. We did not know at the time whether we'd have a budget of $131 million or $880 million. Our program was facing major cutbacks and subcontracts, as well as employees. So, I can say there was a pretty significant cloud over the climate of our project at that time, and uncertainty in the future.

With that, the participation of our employees, out of those 2,500 people, was 65 per cent participation that showed our employees took the time to give us responses. We surveyed similar--we had some changes from the last year we did that, because we wanted to now be able to benchmark back to some of the nuclear utility data, so we used some of the NEI questions, and what other utilities in industry do, so in time, that could be benchmarked and systematically, to where other utilities are.

We also, the firm gave us a comparison with other U.S. national firms, Fortune 500, other manufacturing industry in the U.S., as well as other U.S. government R&T norms, NASSA type laboratories, or laboratories that support the U.S. Federal Complex. And, analysis and results are underway.

The summary shows, and I'll just show the next exhibit, this is the amount favorable in that area, starting with safety conscious work environment culture. 84 per cent of the employees have favorable responses in that area. The lowest area was a 69 per cent, the value of awards and recognition, which we benchmark very similar to a lot of other areas in that. But, you can see what the strengths are. Our goal, I and my management committee, is to look at that and continue to try to improve. There are some areas that we did observe some other opportunities for improvement.

One, we did have about a 3 percentage point decline in confidence on concerns program as related to our safety conscious work environment. So, the number you see up there at 84, was about 87 last year. It had about a three point setback. But, overall, considering where we were in the program at that time, these are very favorable responses.

Let me show you now how this compares to other major companies. If you look at the numbers and the color, it means statistically significant as determined by the independent consultants. These areas were comparable to other benchmarks, for instance, like Ford, other manufacturers the U.S. had, and it shows you our project's percentage as compared to that. So, in the areas of openness and communication, our employees had a 17 per cent, which is statistically more significantly favorable than what you'd have had in the other private industry in America.

So, we're not by any means claiming any victory with this. We know there's areas that we still need to continue to improve, and we're going to do that. But, I can tell you I'm very proud of our employees in this program. We see an active improvement. One of the biggest significant improvements was corrective action program, which is the heart of effective NRC operations. We moved up 10 percentage points, which is a very significant advance from last year, showing that the employees have more confidence in that program. We still have a ways to go, but we're moving in the right direction.

Let me talk now about a few other areas, and I'll come back to remaining slides, a couple other things in the project I thought you'd be interested in. Waste package prototype. We have a prototype currently under development. The goal is to have that delivered in September of this year. After that time, we want to move that up to Idaho to demonstrate our first welding technology. We know that it's very important not just to have a waste package prototype, or a license application with design specifications, but be able to demonstrate that you can actually implement that.

Underground access. In the last meeting we were here, I apologized that we could get you just in to about Alcove 2, I believe. We now have done a lot of enhancements in our underground. We're continuing that over the next year, where one day a month, possibly two days, we open it up for access down deeper into the underground. So, I welcome at any time further visits where we can get you deep to the underground to the site. What we're really trying to do, and the reason for that is we had a number of electrical, other upgrades that we're trying to do, ventilation system down there, to make sure that we maintain access to our scientists and that, at least have that buffer between now and when we get into construction.

Okay, let me go into summary then. First of all, we've talked enough about the remaining talks, I just wanted to talk for a second about the relationship, and this is just my figure I and some of my staff developed. But, if you look in the middle, the license application, driven by 10 CFR, Part 63. With that, the five major areas in the license application, all of our design, operations, preclosure, postclosure safety analysis, as well as our technical specifications and design basis.

Also, regulatory driven is the performance confirmation program that Deborah Barr is going to talk about a little later today. With that, I give you the purpose of that program, and also some examples. But, I want to let you know, and I hope this comes clear in our presentations today, if you look at the right, science and technology, the mission is to continue to invest money, and we've done a great job, and I think Mark has a very promising talk to give you today, about making sure we look to the future, better metallurgy, advanced welding, advanced tunneling.

As new information comes out, we will have a close interface with the license. If we hear something that's better or helps enhance safety, or other areas, we will go through the necessary revisions at the right time. But, there will be a close connection, there is a close connection between those programs.

If you go over to the left, Chris Kouts is going to talk a little bit later. We have a program with current life cycle costs of $62 billion, we take very seriously trying to optimize, especially when you look about 10 per cent of that being a titanium drip shield. So, we have a program right now, and Chris will talk about, to do integration and optimization amongst the front end of the waste generators, out to transportation, into the repository, to make sure we have the right level of optimization and other key areas, and life cycle cost reductions.

At the bottom, is a conglomeration of other programs that we have that we have interface and monitors, such as Nye County's drilling program, some of the large scale heater programs, and other areas. And, my point here is that in the license right now, we believe we have an adequate design and other areas that we're moving ahead with, at the same time as new advances come in in time, we will interface them in through as appropriate to that design, and make changes if required.

With that, let me summarize by just saying that sometimes when you read or hear in papers that it seems like it's maybe a doom or gloom on this program, that it's a major setback. But, I just want to let you know today, I believe Yucca Mountain project is moving very well right now. I know we have some uncertainties with EPA standard, but there's a lot of good work going on, and we have confidence that we can complete the license application this year, again, with the caveat we'll wait to see what EPA comes out with hopefully this summer.

At the same time, I believe many of our metrics, if you look back at where we were on our Enunciator Panel a year ago, of many things that were red, have now moved up to yellow or green. So, the improvements are moving in the right direction. With that, I think we have a critical self-assessment program to savor those issues. Many of those now are identified internal to the line, versus QA. So, the ratios are moving in the right direction.

And, lastly, as Margaret said, the funding is a challenge. While $571 million for this year, and the President's budget, I believe, of $651 for next year, the challenge we have in time is to transition staff up with the right engineering. Right now, I am probably deferring some work on some of those facilities. In time, we're going to have to play a catch up. We do need critical dollars in the out years to support engineering to move some of these facilities as we advance through licensing.

So, let me stop there, and just say I look forward to the meeting, and entertain any questions.

GARRICK: Andy?

KADAK: Kadak. I'm curious, I've seen studies, Total System Performance Assessment studies that go out to a million years. And, with uncertainties in these horsetail plots, why is it now that there's a big flurry about trying to address a 10,000 year limit, when apparently the analysis has been done out to a million?

ARTHUR: Well, I mean, we did a million year analysis in our Final EIS back two years ago that I believe showed less than 150 millirems. But, what I'm really saying is the rigor of the whole quality assurance program we based on, the rigor is based on that 10,000 years. And, so, we have run plots, and Bob Andrews could probably talk better than I as to what we've done through the years.

KADAK: And, I'm just trying to figure out what would change in the modeling in terms of rigor that you did to 10,000, or say 20,000, that would be different in the, say, longer time period? I don't understand how your model would change.

ARTHUR: If I can, I'll have Bob go with that later. But, I guess from my perspective is when you look at where we are right now, 10,000, I believe our scientific community of engineers can stand by, is what I was trying to tell you earlier, the products will be developed against a 10,000 year standard. When you go out and try to make projections on climate and other areas at much greater time frames, you know, I guess I'd say the confidence levels, your error bands go up significantly. So, you propagate a lot of errors at that time. But, I would let Bob answer that additionally from his perspective. He's closer to the details than I.

GARRICK: Mark?

ABKOWITZ: Abkowitz, Board.

John, I just wanted to go over the slide that's up here at the moment. I was struck by the missions of system engineering and science and technology. System engineering seems to be the focus as to ensure maximum program efficiency, and science and technology is to reduce the costs and schedule for the OCRWM mission. I was just curious why the word safety and security were not in either of those two mission objectives.

ARTHUR: I mean safety and secure our goals, I've got to go back, because I want to ask Mark when I look at that, I think we pulled these out of respective plans, but I mean, when you look at that, Mark, I mean, safety and security is a foundation of everything we're doing here. We're not going to sacrifice safety or security commitments for any of those programs. We're going to maintain our commitments, you know, to ensure those. But, I believe you can see in areas, in some of the science and technology, and Mark Peters will talk later, we're not just looking at technical areas like welding. There's other optimizations we're looking at, future natural systems, and other areas.

ABKOWITZ: Abkowitz, Board.

If that's the case, and I'm not questioning it, I think it would be important to make that part of your explicit mission on slides like this.

ARTHUR: That's a good point. Thank you.

GARRICK: Henry?

PETROSKI: Petroski. Did I hear you correctly to say that the titanium drip shield was 10 per cent of the budget?

ARTHUR: I'd have to look. I mean, I think our projections right now are about $6 billion our of a $62 billion. That's just short of 10 per cent. Is that correct?

KOUTS: That's correct, approximately 10 per cent.

ARTHUR: Yeah, the answer is that is correct. I'll just--but, it is a little short of 10 per cent of the life cycle costs. And, let me add on something there. I mean, that is part of our compliance strategy right now, the emplacement, but I have high confidence. Let me just tell you some of the other things, and maybe not formally our science and technology program, but we have very close interface with DARPA, you know, Defense Integrative Research and Development, for future production costs of titanium. I have high confidence in time the production and development costs of titanium will go down.

Also, I was over in France two weeks ago and had an opportunity to run through the whole French nuclear cycle. One of most promising parts of that trip was going into one of the metallurgy shops, and actually saw them welding titanium and actually producing some of the areas. So, I have confidence in time we can bring that down, and that's the kind of things we're going to continue to try to do. But, again, we don't want to sacrifice anything in our safety or security to do that.

GARRICK: Garrick. I want to comment a little bit about the agreements. I'm impressed with the progress that was made in the last year, because if you looked at this situation a year ago, you would not have been able to forecast this level of processing.

The question I have, John, is has DOE done an analysis of the agreements in terms of the impact of the EPA standard? In other words, how many of these agreement responses have been voided by the remanding of the 10,000 year compliance?

ARTHUR: I don't have--I don't believe we've done an analysis to say which of these are void or not, because, I mean, we're building on top of 10,000 whatever we do in the future. But, I don't have an answer for you on that.

GARRICK: It would be kind of interesting to know just what the impact is going to be in terms of reaching any kind of conclusion about how much progress has really been made.

ARTHUR: Yeah. I guess from my standpoint, I'd have to have NRC speak from their perspective. I believe that whatever you do for longer term peak dose calculations, you're going to build on 10,000 years, not do it in lieu of that. And, there's been a lot of review of a lot of these systems. As I mentioned earlier, features, events and processes, and other key areas, we will look on applicability of those over longer terms. So, we have not done that yet, but it's a very valid question.

GARRICK: The other thing about this, of course, that's kind of important is that some of the incomplete agreements are in some of the real big hitters. For example, the near field environment issues, the TSPA issues, the thermal effects, and the container life and source term. This has a tremendous amount of meat in those issues relative to completion. So, I don't know if you've done an analysis in terms of looking at this from a different perspective, mainly scope rather than just number.

ARTHUR: If I can on that, John, the main area that I hope I mentioned earlier is we had looked--NRC had done an assessment before, what they perceive as high risk, and what we're trying to do, we have requested their review and feedback on those first, and I'm not saying we have all the responses yet, I mean, there's still even approvals and other things still coming in, but I believe I just saw four last night I was trying to catch up with at home. So, there's still feedback coming in. Some of those areas will definitely go up here soon. But, we are trying to focus on the higher priorities, higher risk, as far as the overall system.

GARRICK: It would seem that this issue of the EPA standard would suddenly become a major input to establishing priorities.

ARTHUR: Yes.

GARRICK: Okay, other questions? Andy?

KADAK: Just a quick followup. Kadak.

Have you looked at all at these FEPs to see how many are really critical, if the time period were extended?

ARTHUR: We've done some preliminary analysis, and I think what I'll do is when Bob gets up, because that will come through Bob Andrews' group, and I don't mean to keep pointing to him, but he's closer to the mechanics of what we've done. We did some initial evaluation features of value, events and process, of what would be applicable longer time frames, but it's very preliminary. You've got to go back to get the scientists to say the same rigor that you put at 10,000, you go out to a million, you know, there's a--

GARRICK: Okay. Any other questions?

(No response.)

GARRICK: Okay, thank you very much. That keeps us right on schedule.

I guess Chris Kouts is the next person.

KOUTS: Dr. Garrick, distinguished members of the Board, it's a pleasure to be able to be in front of you today to talk about systems integration. Certainly from Dr. Garrick's comments, you're excited about the opportunity to talk about systems integration, and then I'm excited about the opportunity to talk about it also.

As was introduced previously, my colleagues, who are seated at the table over here, Richard Craun, who heads our design effort at Yucca Mountain, and Gary Lanthrum, who heads our transportation program, are here. I'm going to be basically giving the presentation, but Gary and Rich are here to answer questions that cut across functional lines of our program. I deal with waste acceptance and systems integration, and obviously they have the other areas of the major component areas of the program.

I'll just give you a quick overview of what I'm going to talk about. I'll talk about our concept of systems integration, what integration activities we've had underway in the past, and are currently underway, some of the tools that we use to do that, a little bit about our total system model, and where that is its development, and, of course, summary.

I'd like to start with a quote from the International Council on Systems Engineering, which I think it's always useful to focus people on what system integration and engineering activities are. That council believes, as we believe, that it's an interdisciplinary approach and a means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and systems validation while considering the complete problem.

This is more or less a standard industry approach, and the approach that the program has taken over the past ten to fifteen years. And, I'll talk a little bit, as I go through the talk, about the evolution this program has gone through as we've developed our facilities and further understood the technologies, the requirements of our regulation, the regulations that have come out over the years, and basically tried to focus that into a solution, which we think is a good solution.

Going to the next page, our solution for how we will accept, transport, and dispose of these materials are grounded in a variety of requirements that flow down from federal regulations, and the standard contracts that we have with utilities. From a waste acceptance standpoint, we have to be very mindful of our relationship with the utilities, which the congress basically directed us to enter into contracts with after the inception of the program and enabling legislation.

That also, the transportation component, Gary has to deal with 10 CFR Part 71, Part 73, NRC regulations and DOT regulations associated with the transport of radioactive materials. Rick needs to deal with basically the licensing the facility under 10 CFR Part 63.

I think it's important to digress for a moment and talk a little bit about where the program has been in the past, and how we evolved to where we are now. If you go back ten or fifteen years, and let's take an example of our surface facilities, we basically had very large surface facilities that were, many cases, had very large pools. We were trying to build a very large facility that would take many years to build. As the program evolved, and from a policy perspective, we understood that we weren't going to get the kind of money we needed to build those facilities, we had to go to a different approach, and that approach is to deal with smaller facilities that deal with more specialized components of the program, or of the waste that we have to deal with. And, that's more or less how we've evolved to the design that we have today.

I mentioned a little bit about the types of cross-cutting issues we have, and as anyone who's followed this program over the years, understands that it's somewhat of a dynamic environment. We're being, right now, trying to deal with changes in the regulatory structures associated with a change in the Environment Protection Agency standards. We are learning more about what the industry capabilities are at reactor sites and what their capabilities are there. And, that trickles through Gary's acquisition of casks and his ability to transport them, and also Rick's ability to deal with those materials as we move them to a repository, assuming we have a licensed facility.

Our former Undersecretary, I'd like to quote him for a moment, Bob Card, who we spent a lot of time in front of over the past several years, Margaret and John and I, we had very interesting discussions with Bob, but his vision of how this system would operate--

CHU: I saw him the other day. He's saying he misses you.

KOUTS: Thank you. We all miss Bob very much, too. He certainly made my life interesting. But, Bob felt very strongly that what we were going to end up doing on day one of the operation of the repository was going to change in year twenty and year thirty, and we're going to have to evolve, we're going to have to grow, we're going to have to use new technologies as they become available.

So, when we talk about systems integration, I think we have to be open as a program to changes in our environment, and anyone who has lived in this program for, or who's been around for a while, and I've been in this program for twenty years, there have been many changes, and the program has had to adapt to them. And, that's the key, I think, in many cases to systems integration. We have to remain flexible and we have to study what our current system is. We have to understand it, and by understanding its capabilities, we can look at alternatives and see better ways to implement it.

In that regard also, I think Dr. Chu, in her reign as our director, has instituted a new program, Science and Technology, which basically is going to look at ways that we can improve the performance of our system, and that improved performance can have all kinds of benefits, including reduced dose to our workers, and also basically reduce costs for the overall program.

We can go to the next slide, please. The systems analysis and integration, as my office deals with it, basically cuts across three components of the program, waste acceptance, transportation and repository. And, I would want to emphasize here that I don't direct Gary, I don't direct Rick. We have to work collegiately across the lines of the program, and make sure that we're all marching to the same tune. We're all implementing the same requirements. We're working on our interfaces to make sure that when we're ready to move materials, that those interfaces will work with us and make sure that we'll do it effectively and efficiently.

When I took this job about a year and a half ago, one of the first things I did was sit down with members of the aerospace industry and the defense industry, and to find out a little bit about how they do integration. And, I think the message that these executives gave me was it's not so much the resources that you apply to it, but it's the constant communication you have across all the elements, it's making sure that the right people are talking to the right people. And, it's not just Gary and I talking or Rick and I talking. It's our staffs talking, and it's our contractors talking across the lines, that as problems and as issues arise, we work through those issues and make sure that the solution that we're defining is a good one, and is a workable one.

Let's go to the next slide, please. I'll talk a little bit about requirements. This is one area of the program we don't spend a lot of time talking in public about, but nonetheless, we have a hierarchy of requirements documents. The upper tier requirement document is what we call the CRD, or the Civilian Radioactive Waste Management System Requirements Document. That's owned by the director, and from those requirements, flow down to basically the requirements to the other components of the program, to Yucca Mountain, to the waste acceptance component, and to the transportation component.

And, from there, from those requirements documents, we define interfaces, and right now, we're working through the development of those interfaces to make sure that, again, the system will work when it's put together.

We can go to the next slide, please. One example of some activities that have occurred recently is we regularly do updates on the waste stream characteristics, primarily in the commercial area, where we go to utilities and we try to find out through a standard form that we go out to the industry with, which we call the RW859 form, which is an OMB form, where we get perspectives on what their status of their spent fuel is, the types of spent fuel projections that they have in the future, what the characteristics of that waste stream will be.

And, that flows across essentially transportation and repository components. So, that's one of the areas that we feel is very important that we fully understand what the industry is doing, and how they're evolving and changing, because obviously, over the years, they've gone to higher burnup fuel, and in many cases, the design of the fuel that we're going to have to emplace in the repository haven't even been created yet. So, we have to stay open and understand how the environment is changing around us.

We can go to the next slide. One of our former directors, Dr. Daniel Dreyfus, used to say that visual aids are the crutch for the inarticulate. And, what I hope this relates to you is the fact that the flow-down that we try to have in the program starts with our systems requirements documents. From there, we work toward facility capability studies, from the standpoint of the utilities, then Gary does his analyses, which indicate what capabilities his cask system will have, and from there, of course, Rick has to do his understanding and develop his designs for the repository.

Now, the overlaps of those three activities basically force us to make sure that we document in interface controls exactly how the system is going to go together. And, I mentioned that earlier, but I did want to emphasize it with this slide.

We can go to the next slide, please. Another thing that we've done recently is actually go out to the reactor sites, not go out physically, but work with the industry to try to get an update as to what the physical capabilities are at reactor sites today. About ten years ago, I think our perspective was that we were going to have a very large rail cask and a truck cask, and that would service the entire system.

When we went out and went through our queries with the industry, we discovered that many of them hadn't upgraded their cranes. Many of them don't intend to. And, as a result, I think this informed Gary's cask acquisition activities to the extent that now we're understanding we need an intermediate rail cask, something along about a 70 to 100 ton cask that will service these other facilities.

So, we're trying to learn and get information to our designers, to our system designers, so that what we're designing is the best system that we can implement. That, of course, flows down to Rick's design at the repository.

Next slide, please. Over the past, we've used a variety of tools in order to understand how the system will operate. Classic examples are TSPA and the assumptions that go into that. Those assumptions have informed basically the other components of the program as to what the repository physically needs in order to meet its recipe, if you will, for the waste package from a heat perspective and radionuclide perspective. We've also had preclosure safety analysis models and value engineering activities that are going on.

But, what I want to talk to you next about is something that I'm kind of excited about. We can go to the next slide. Over the past year have undertaken the development of a total systems model, and that model is intended to bring a coupling of all three components of the program from a waste acceptance, transportation and repository component, and it allows us to analyze the synergisms between those three elements, such that when, if the repository is having an issue, is there something that we can do back along through the transportation and its reactor side to make the repository operate more effectively and more efficiently.

And, we're hopeful that as we develop this tool, that it will give us a capability to evaluate our baseline performance, to look at alternatives, to hopefully come up with some system solutions that will be more effective and efficient, and will also be able to analyze, program or policy changes and impacts.

Go to the next slide. This is more or less again an inarticulate graphic that's attempting to say what I just said earlier, basically that the requirements and inputs from waste acceptance, transportation and repository would flow into the model, and hopefully we'll get a synergism and an understanding of how the different components impact each other.

If we could go to the next slide? It's a little bit more about the model. It uses a commercial off the shelf software called SimCAD. SimCAD has been used by a variety of other organizations. The United States Air Force uses it for logistics management. Yamaha Motors uses it for parts management. Owens Corning uses it for manufacturing processes management. And, it's also been used actually to evaluate hospital emergency room operations, and how to make those flow more effectively and more efficiently.

So, if you look at all the fuel coming through the system, it can track up to right now about 275,000 objects, which means each of the individual fuel assemblies through the system. It can get us a variety of data outputs that can help us understand how each of those went through and were handled by the system, and what occurred at the repository with them, whether or not they had to be stored, and we can look at time periods throughout.

Now, it's PC based. It's a typical Pentium III or Pentium IV, will take about 23, 24 hours to run it. There are faster machines that ill hopefully get you an answer in about eight hours, or so. But, we're looking to, I think, get a lot of information out of this model, and hopefully, will help us understand the system as we begin to deploy it.

Next slide, please? I've covered most of this in my earlier remarks. Alternative scenarios against the program baseline, certainly we want to look at. It will allow us to challenge our existing designs and operating concepts, and try to improve upon them. And, hopefully, it will provide some insights into areas requiring attention for improvement and optimization.

I won't go into this in any great detail. I mentioned its capability to generate a great deal of output. It still isn't where we want it yet. One of the things we want to make sure that's inputted to it is a dose, and make sure we can evaluate the dose at reactor sites through the transportation system, and at the repository, and look at alternatives to that, so we can reduce it across the board.

The other thing is that we'd like to get an update of costs, operating costs of the system, but we won't have that information until Rick's further along with his designs, and will be able to get some more information on that.

Some sample results from some general runs, just to give you a sense of some of the output that we have. This is a sample case. It's not a baseline case. But, it gives you, or what this can convey to you is the amount of bare fuel shipments, truck shipments, and potential DPC shipments into the system over the years of operation. I should say that DPCs are right now an issue of litigation with the utilities. But, assuming there was a DPC available, these are the amounts that could be brought into the system. And, this is for the 63,000 ton case. There were no DOE shipments in here to deal with DOE materials either from EM or from the Navy.

SPEAKER: DPC is what?

KOUTS: Dual purpose casks, or dual purpose canisters, if you will, from reactor sites.

Another example, on the next slide, we're working with Gary on this, and Gary has his own models to develop his needs for his cask acquisition, but this gives a sense of, based on the ordering that we have within the standard contracts, the amount of BWR large casks that we might need in any one year, and the first ten years of operation. And, what we find here is that based on what we've seen, just from this general case, that Gary may need no more than 17 of those casks in order to operate the system effectively in the future.

Of course, there are a lot of assumptions that went into this, and you have to look at maintenance issues, and so forth. But, these are the types of outputs that the model can give us, that can inform us, can help gary and also can help Rick on the repository side.

Our future activities, I think I mentioned earlier we need to, I think, get the model in a shape that will have all the capabilities that we want, and then we'll have opportunities to learn and understand. We're still in the validation phase. We want to make sure that the model is giving us answers that we can believe, and at that point, I think we can probably sit down with the Board and show some of the results associated with those analyses.

In summary, I want to reiterate that we feel we've developed a workable integrated solution. The repository solution will be contained in the license application. We are continuing to integrate across all our functional elements, and will continue to do that well into the future. And, as we move forward, we hope to have more refined systems, tools that will allow us to understand and optimize the system as we go forward.

And, with that, we'll be happy to answer any questions.

GARRICK: Thanks. Howard?

ARNOLD: Arnold. Do you have a specific plan, at least a straw man plan, for each of the reactor sites, or are you still dealing with them in broad categories?

KOUTS: We have specific information on all the sites, and our understanding of each of the sites is based on its individual capabilities, if that's what your question was.

ARNOLD: Yeah, I guess I was going one step further to the word plan as opposed to you having information.

KOUTS: We do have a planning process in terms of the acceptance of the fuel from the reactors, and that's laid out in our standard contract, if that's what you're referring to. And, that would be specific information that we would request from the reactors, or from the contract holders about each of their reactors, which has to do with the fuel types and the facilities that we would be moving the fuel from in any specific year.

HOWARD: And, you know you can handle them all?

KOUTS: Well, the system is designed to handle it all. We have to be capable of doing that, and that's what I mentioned earlier when we go through the analysis of the waste stream characteristics, we have to make sure that our facilities are fully capable of handling all the different fuel types that will come into the system. And, maybe Rick would like to comment about that.

CRAUN: Yes, I can. From the repository perspective, the surface facilities are designed to accommodate all of the different fuel types from the commercial reactors. So, we have that based in our design inputs to our facility. So, that is part of our requirements for our analysis. That's also included in our preclosure safety analysis, so we look at, in our accident sequences, we look at the different casks that may be involved, the different fuel assemblies that may be involved. So, that is included in our design.

ARNOLD: Okay, I was starting from the point of what's happening at the reactor site. But, you can handle it there, too?

KOUTS: The way the relationship with the utilities is set up, is that the utilities, we will provide casks to the utilities, which they will load, and then we will take possession of the materials at the reactor gate. So, any activities within the site itself are the responsibility of the reactors themselves, if that helps you with your comment.

GARRICK: Andy?

KADAK: Could you just, in terms of this integration function, could you just explain what your current vision is for getting fuel from the reactors to wherever it's going to go, and what kinds. How many times are you going to handle this fuel before it ends up in the repository? Could someone explain that?

KOUTS: Well, I'll art from the front end, and then Rick can take it from the back end. And, Gary, if you want to jump in in the middle, you can certainly address that.

LANTHRUM: I would be more than happy to do that.

KOUTS: Right now, our system is based on the standard contract, which requires the handling of bare fuel, since that is the only acceptable waste form currently under the contract.

KADAK: So, canisters prepackaged, sealed, are not accepted ideally right now?

KOUTS: That's an issue that's the subject of litigation today, and I really would care not to comment about it. The Department has said in the past that we will look at that issue, and address that with other issues associated with the contract in the future. But, it is the subject of current litigation.

So, let's take the current case, which is basically the bare fuel at reactors. The bare fuel, as I mentioned earlier, Gary's program, Gary's system, will be providing a cask to the utilities. The utilities will then load that cask, get it road ready, and then we will take possession of it, either a truck or a rail cask, at the reactor gate. And, Gary?

LANTHRUM: Lanthrum, DOE. From the gate at the reactor, the transportation system, we will be working with all of our stakeholders, the states, the industry, and the tribes whose lands we pass through, on revisions to the DOE transportation protocols, which in a very broad sense, looks at what our requirements are on how the transportation system is going to work. In a more detailed sense, there will be campaign plans for each of the reactors that we're visiting to make sure that the individual notifications and all the specific details for a particular shipping campaign are identified, and all the necessary parties are informed. The transport will then be conducted in accordance with those plans. We get to the repository, and hand over the casks to Rick.

CRAUN: Craun, DOE. Basically, we will receive it in a transportation cask, receipt return facility. A cask will be offloaded from its National Transportation conveyance system, would be put onto a site specific rail transport cart system that would take it to any of our nuclear facilities.

From that point, a specific facility would be designated to handle that material. For example, if we're handling, let's say, bare fuel assemblies, or individual fuel assemblies, coming into the fuel handling facility, which will be our first facility where that will become operational. It can be handled up to four times, or as few as one time. If it goes directly into a waste package, it would be picked up out of the transportation cask, placed into a waste package. Once the waste package is loaded, it would then be sealed and taken down underground.

KADAK: Excuse me. Is that wet or dry handling?

CRAUN: That would be dry. The surface facilities are predominantly, the fuel handling facility, the canister handling facility and the dry transfer facility one and two are all dry. They do have some wet remediation. The dry transfer facility one and two do have a wet remediation capability, but the preponderance of the throughput is anticipated to be in a dry mode.

As I said earlier, it would be as few as one handling. If in fact you went from a transportation cask or conveyance system to a waste package, that would be one handling. You can have, and our preclosure safety analysis includes up to four individual handlings of a specific fuel element. That would go from receipt, we would take it out of the transportation cask, and put it into a staging rack in the facility. You may then pick that from that staging rack and put it into an aging cask that would go out onto the aging pad, bring that back in from the aging facility, into one of our surface handling facilities, pick back out of the aging cask, and then place into a waste package.

So, our preclosure safety analysis can accommodate up to four. We do not anticipate that all of the fuel would go to our aging facility. It would only be selected elements that would have to go there. So, that's both from a cask perspective. Once the cask is offloaded, it's returned back through our site cart system. It's brought back to the transportation cask receipt and return facility, and then placed back onto a national conveyance rail system, and then returned into that system, back to Gary.

LANTHRUM: And, once I get the cask back again, then cycle repeats more than once.

KADAK: You're looking at potentially over a million fuel handlings.

CRAUN: We have, right now, the preclosure safety analysis is based on approximately a quarter of a million assemblies of fuel that can be handled up to four times. That is in the preclosure safety analysis. The throughput calculations that we are running for our facilities include fewer handlings than that, but the safety envelope, if you'd allow me to use that term, that will be in our licensing basis, would be up to four handlings, or up to a million lifts of assemblies.

GARRICK: Okay, we've got Ali, Mark and David. Ali, go ahead.

MOSLEH: Is it correct to characterize this as basically a process model simulation? It looks at the process, not the details the design of the individual structures?

KOUTS: Correct.

MOSLEH: And, it's my understanding that currently, it's the alternative scenarios of basically, it's deviations from the, you know, basic scenario, and you want one scenario at the time, and it will take 24 hours, or so, to run?

KOUTS: Well, in many cases, you don't have to run the scenario to the end. If you're looking at how you're trying to start up the system and do efficient ways of doing that, you can run it for shorter periods of time, and stop the model, and then change assumptions. Basically, the driver of the model is moving the fuel from the utilities. That's the driver. In other words, you need to move it, according to our baseline and our baseline needs. That triggers other events within the model that basically, we need transportation casks and rolling stock, et cetera, conveyances for the trucks, et cetera, in order to move it through.

And, I didn't include any slides here, but the advantage of the model is visually, you can watch it, the analysts can watch it, look at choke points, and identify areas that perhaps need to be looked at or adjusted, allows us to revisit assumptions associated with aspects of it.

MOSLEH: And, in such exercises, do you have an ability to look at multiple factors or parameters, or is this kind of a single factor or single parameter?

KOUTS: There's a logic. We've written some algorithms for decisions to be made within the model itself. And, if you run the model, exactly the same scenario, the initial state, you will not get exactly the same answer on the other end. Basically, because of the internal logic of the model and the interim decisions that it makes. So, there's a stochastic aspect of it, such that if you run it on one case, you may get a slightly different answer, but it will be within a reasonable range of outputs.

MOSLEH: Did you plan at some point to kind of tie that to kind of a failure scenario, so to speak, from a safety, or just process failure?

KOUTS: We can look at, say, aspects in the system. If there are certain components of the system where there's issues, and how the system would react to it, we can certainly do that. We have the capability to do that. For instance, if the waste handling building, one of the building is having issues and can't operate, then we can look at how the system would be affected by that, how the repository would react to it, and how that would ripple back through to where our waste acceptance would be.

And, it also allows us, one of the things that Rick, I think, very artfully went through, the many different lifts and the many different possibilities that may occur, my sense is that with the utilities, we'll be working with them and trying to make this system work as effectively and efficiently, and to the extent that we can get Rick what he needs in his initial facilities to avoid storage, I think we will work very hard to do that. And, I think certainly as a member of the Board here, who was a member of a utility, but I think the utilities, when we get operational, will work with us on that. And, my expectation and my sense is that we won't see the million picks, or the million lifts, if you will, we'll see a far reduced number. But, again, we have to work with the utilities and make sure that we can accommodate their needs, and we can also try to make our system work as effectively as possible.

GARRICK: Mark?

ABKOWITZ: Abkowitz, Board. I have two questions. The first one is on Slide Number 10, and it's probably best directed to Gary.

I noticed under the transportation capabilities, the list of the modes that are under consideration. I was just curious if there's been any consideration given to other modes, one being rail to heavy haul. That would be the case of the need for an intermodal transfer in the event that a rail spur is not built, or it's delayed in its construction. And, the other would be exclusively heavy haul.

LANTHRUM: Lanthrum, DOE. In looking at the system, once the decision was made to use mostly rail as our mode of transport, that essentially put additional work at this time on an intermodal facility for heavy haul specifically on the back burner.

It turns out that the cost of building the infrastructure to do heavy haul from an intermodel facility in Nevada to the repository is nearly as expensive as building a railroad. And, so, if we've got challenges with building a railroad, they're primarily financial challenges, we would have the same challenges with trying to build and upgrading the existing road system to handle a heavy haul transport from an intermodel capability to the repository.

So, right now, the decision to use mostly rail has, at least for the time being, precluded any additional work on an intermodal facility, specifically for taking rail casks off of a train, and putting them onto a heavy haul. And, as far as heavy haul the whole way, that challenge is just exacerbated even further. Again, the existing infrastructure on the highways, and what not, is not substantial enough, particularly with the 77 sites we have to ship from, to do heavy haul all the way from the shipper site to the receiver.

ABKOWITZ: Abkowitz, Board. So, then, it's my understanding that at this juncture, the assumption is that there will be a rail spur, and the waste management system cannot perform unless there is a rail spur, based on the input conditions that have been defined at this point.

LANTHRUM: Actually, no, because we've taken as our mode of transport, mostly rail. We've indicated from the very beginning that even under the mostly rail scenario, there will be some truck shipments, and those will be legal weight or over weight truck shipments, but not heavy haul shipments.

ABKOWITZ: Okay. But, then, they need to be represented as modes in the logistics model; correct?

KOUTS: And, they are. That was an oversight here. Basically, we do have truck transport. There are reactors that only are truck capable. And, if you go back to the sample of output I showed you, there were truck shipments on there. That was just left off this slide.

ABKOWITZ: Okay, thank you. The other question that I had with regard to TSM, first of all, personally, I'm very excited about the idea that there is a TSM. I think that's the appropriate way to approach this problem. The natural gymnastics, as you know, are quite complicated.

I'm a little bit curious about the outputs that are coming out of this model right now, because it strikes me, as Ali was referring to, as a process model that's really driven towards logistic solutions. You mentioned in one of your comments about wanting to include dose, and I was just curious as to how extensive at this point are their output metrics that relate to safety, and to what extent are you planning to perhaps expand into that area. And, will there be a time when the types of results that will be coming out of this model will allow us to profile the trade-offs between cost and safety, because I expect that there will be some.

KOUTS: Well, in answer to your question on dose, I think that there's a lot of published information from the reactors about handling and loading casks, et cetera, at reactor sites. And, what we intend to do is to utilize that as inputs into the model. So, I think that will be an important component, as you indicated. Certainly dose across the system, and even though it's not DOE dose, or in other words, DOE employees or contractors won't be incurring it, certainly it will be incurred at reactor sites, and we've got to be sensitive to that also.

And, the issue with cost, I think is also a very good one. Again, we're at a point now where we're still in the design stage with our facilities, and the operational costs are right now estimates, but as we learn more about the facilities, we'll have a better understanding of operational costs, and we'll be able to do those kinds of trade-off analyses that you're suggesting.

ABKOWITZ: Thank you.

GARRICK: David?

DUQUETTE: Duquette. I agree that it looks like a process analysis program, and I think it's a very good one. What I don't see very much about in it, however, is the accident scenarios, and I'm sure they're built into the safety model. But, at some point, I wonder if you could come back to the Board at some future time, and talk about how accident scenarios will factor into this kind of a program, because you've talked about choke points, you've talked about loading capabilities, and so on and so forth. All of those are process oriented, but don't take into account the non-predictable kinds of things, such as accidents that can occur, and what that will do to your model.

KOUTS: Well, as you know, computer modelers are always excited about opportunities to develop new algorithms, and I'm sure we have a very capable individual who developed this out of SAIC Oak Ridge, and I'm sure he will be excited about the opportunity to look at issues such as that.

GARRICK: Andy?

KADAK: Could you go to Slide 7, please? One of the challenges of systems integration is to be sure that the requirements are integrateable. Have you looked at these basic requirements documents to see if there's any conflicts to allow you to do these integrations effectively?

KOUTS: Certainly the parent document, which is the one that I manage for the director of the program, does not have inconsistencies in it. Basically, it's a flow-down of regulatory structure. It's a flow-down of programmatic requirements that have been existing within the program for a very long time.

I can speak about the waste acceptance requirements document, which is a document we use to communicate primarily to EM, Office of Environmental Management, and other components, our Navy component and our NSA component. That, as far as I know, doesn't have inconsistencies. Gary is in the process of developing his document, and Rick, of course, owns the repository document. But, we spent a lot of time with these requirements documents, and our designers have to be faithful to them, so my sense is if there were conflicts, this would surface up and we would know about it.

We've had internal discussions about the requirements, and as usual, people find them, in many cases, challenging to attain, but I don't think inconsistency has been one of the issues that we've really had very much discussion about.

KADAK: But, these are your documents; right?

KOUTS: No, the only document that I have involvement with is--well, the top one is basically the Director's document. The second one, which is the waste acceptance systems requirements document, I own as had waste acceptance. Gary owns the one on the right. Rick owns the one on the left. Now, the interface control documents are ones that I do develop with the help of the other components. So, that's a joint effort to identify those interfaces. So, there's a lot of synergism and discussion about the interface documents.

KADAK: And, you've gone through the process to say that when you're now managing or trying to plan a system, you have no issues relative to the requirements that you perhaps throw a stovepipe in their original development?

LANTHRUM: Can I say something to that?

KADAK: Sure.

LANTHRUM: Lanthrum, DOE. One of the areas that we're working on with the repository, between transportation and surface operations, is the question of moving material from the transportation system, and if it does wind up being put out into an aging facility, how do the transportation requirements translate to the requirements for placing a cask on an aging facility. And, there are separate requirements under 10 CFR 71 for transportation. And, the surface facilities have to live with the requirements of 10 CFR 63.

What we're doing now is we know the individual requirements, we're mapping the capabilities of casks to see if casks designed to 10 CFR 71 will fulfill all the requirements of 10 CFR 63 for placing things on the aging pads. And, so, we're taking a very close look at how you do the integration of requirements in the handoffs between different elements of the system.

GARRICK: Howard?

ARNOLD: Arnold. I'm trying to deal with a confusion in my own mind. Your plan is based on shipping casks which are loaded at the reactor site, and then unloaded at the repository, and then shipped back. I thought I heard, though, that people were still looking at the idea of a once and for all container that is loaded at the reactor site and is the ultimate disposal container. Is that totally dead, that idea?

KOUTS: No, it's not. And, the Department has looked at that in the past, and continues to look at it. I think that, let me address it this way, until we have a licensed waste package, until we have a repository that's licensed, we aren't really sure about what the disposal container, the acceptable disposal container, will be. At that point in time, once we understand that, then I think there may be opportunities for the utilization of a disposal container, assuming that it would be acceptable to the utilities, and assuming that it could be provided, looking at the costs of it, et cetera.

In other words, a canister that would be used and loaded at the reactor sites, brought through the system, perhaps put on the aging pad, or put underground, immediately underground, I think we're still going to look at that issue, we haven't given up on it. Right now, we're looking at a bare fuel system, but we will continue to look at the canister system, and if it proves to be efficacious, if you will, there's no reason why we couldn't go to that at some future point.

ARNOLD: How about DOE's own material?

KOUTS: DOE's own materials right now are baseline, requires that all the vitrified materials and the spent fuel materials to be canistered, as well as the Navy canisters. So, they will be provided to the system in canisters, and they will be handled primarily, and Rick can talk about that if you'd like, in the canister handling facility, where waste packages will be made, but they will be transported in canisters, then those canisters will be removed at the repository and placed in a disposal container. Then, that container will be sealed and put underground.

ARNOLD: But, they wouldn't be opened up bare, dry, at the repository?

CRAUN: Craun, DOE. The canisters that we would receive from the Navy or DOE, will not be opened. They can be handled in the fuel handling facility, the initial facility, or the canister handling facility. That's where the preponderance of them will be handled. And/or in the dry transfer facility. We have a diversity of operational capabilities in each of our facilities. The canister handling facility is the only facility that has a much narrower focus, in that it can only handle canisters. It's never intended to have bare fuel. It keeps the simplification of the safety envelope in the canister handling facility. As a result, it is a little more simple. It's a little simpler in nature, in that you have much fewer lifts than you would anticipate having in a fuel handling or in the dry transfer facility. But, we do not intend to open those canisters up.

GARRICK: Garrick. As you can tell from the Board's questions, we have a great deal of interest in systems optimization, and I realize that most of what you're addressing here is systems integration. But, there is the view that if we can accept the results of the postclosure safety analyses, that perhaps the greatest risk of this whole system, including all three modules that you identify, is the waste acceptance and the transportation and the handling.

And, you've also heard questions about systems optimization with respect to cost and dose. I think that one of the things that occurs, and I would add to that, because of my engineering instincts, that the optimization should also include throughput. But, one of the things I'm very curious about is that if you look at these three major system modules, I don't see a great deal of flexibility for optimization. I would guess most of the systems for the transportation are pretty well, you're constrained considerably. Most of the systems with respect to waste acceptance, the nuclear plant sites are not going to want to do a great deal more than what they have with respect to handling facilities.

Is there any way you can deal with two questions? One is the likelihood that we'll see a real system optimization study with respect to, say, those three parameters, cost, throughput and exposure? And, the other thing is how much margin do you have to work with for optimization? I don't see too much.

KOUTS: Okay, let me try to address some of your comments. I agree with you from the standpoint of the reactors are there. We can't change that, and they exist, and their fuel exists. That's immutable and we have to deal with that. But, I do think in terms of getting the utilities to work with us, to provide us, let's say, fuel that will ease our handling at the repository, I think that's a real opportunity for the program to work with the utilities on that.

I think in terms of optimization analyses, I think there are opportunities there. How we choose to operate the system in terms of the actual, and I'm struggling for words here, but suffice it to say that once we fully understand how our system will operate, more understanding about how the repository will operate, what we need to do in order to reduce dose at the repository to make our lives easier, I think that informed information can help us work with the utilities and get, hopefully, to a point where we can optimize to the greatest extent we can for all parties involved.

GARRICK: One of the most impressive issues associated with nuclear power plants is the progress they've been able to make in dose reduction with respect to procedures for handling, and operating, and maintenance activities, in plant operating and maintenance activities. That's been very, very impressive over the last decade or so. I'm sure Andy can elaborate that specifically. That experience would seem to me to be really important to your system optimization efforts.

KOUTS: I totally agree with you.

CRAUN: Chris, if you don't mind, this is Richard Craun, DOE. We are currently, we've done throughput analyses on all of our surface facilities on the transportation cask received from the facility, the fuel handling facility, et cetera. Along with those throughput studies, we've also done dose assessment calculations to look at the exposure to our workers for each of the individual steps. As we upend the transportation cask in the fuel handling facility, some of those of the impact limiters have to be removed. Those are manual operations. Once the impact limiters are removed and the transportation cask is upended, it's then picked and put into a trolley system that then brings it into the facility itself.

The trollies, six months ago, were designed so that they are manual. We would have our workers actually bolt the cask into the trolley system. The current evolution of the design of the trolley system that's on the drawing boards today is an automated system, and the intent of that was to optimize the throughput, to remove, reduce the number of manual operations that are having to take place. We're doing system studies every year on all three of our major surface facilities to look at throughput, dose, ways in which we can do operations faster, cheaper, and more effectively, with less dose. So, we are making strides now. In fact, some of the enhancements that we will have incorporated in this version of the license application will be addressing those.

GARRICK: How much are the other institutions that are involved here, such as the transportation and the nuclear utilities, how much are they cooperating with you to reach these reductions?

CRAUN: DOE, Craun. I'm sorry to interrupt you. We have routine meetings with the National Transportation to look at how might we position or locate the trunnions on a transportation cask to simplify and ease our picking of that transportation cask in our surface facility. So, we routinely, I believe it was not more than about three weeks ago, time goes very quickly in this program, but about three weeks ago, we had a week long interaction with the National Transportation folks, where they came out to compare how might they be able to help us from a throughput perspective. So, that communication is taking place now, and on a fairly routine basis.

KOUTS: And, I would add that also my staff, who has a lot of experience with the utilities, also participates in those meetings. So, we are talking about these issues, and we are trying to work them out.

I think what you're getting at, Dr. Garrick, if I can take it one step further, I think you're wondering whether or not we have access to information from the utilities to inform our design efforts, and I think the simple answer to that is I think we have just about all the technical information and process information that we need at this point. And, I'll look to Rick and I'll look to Gary, from their perspectives.

GARRICK: I guess the other thing I'm trying to get at, too, is how much margin do you have to implement change? How much is fixed and how much is non-fixed? And, does that non-fixed component of the systems integration really amount to enough to have much of an impact? That's kind of the global question I'm researching for.

LANTHRUM: Lanthrum, DOE. In the transportational world, my background has a fairly significant amount of linear programming and management systems analysis, looking at transportation networks, and how you optimize throughput through a transportation network. And, we're doing a lot of that modeling right now for transportation in a very unconstrained sense.

The output of my attempts to try and optimize as if there were no constraints is a feed to the total systems model that Chris Kouts then runs, and it looks at how that affects the total RW system and whether or not the things that might be beneficial from a purely transportation perspective will work on the overall system. We don't have the answers yet about how many of the optimization opportunities can be realized when you look at the systematic impacts. But, we are providing the fees to help come to those conclusions and find where we can become more efficient.

CRAUN: Craun, DOE. From the surface facilities, or from the repository design perspective, our throughput analysis is fed into this model. So, as we're looking at the throughputs, our handling techniques, we're looking at the times necessary for each of these steps, this is all fed into this total system model.

But, also, from the flexibility, how much latitude do we have, our preclosure safety analysis is set up to bound our operations. So, within that boundary, we have a lot of flexibility, everything from a million assembly lifts, which would be the upper end boundary of the number of assemblies that we would have to lift, to the number of canisters. So, our preclosure safety analysis establishes the boundary to which you need to maintain your operations within that.

If you need to change that, that's still allowed by the Nuclear Regulatory Commission under 6344. We're allowed to go back in and make revisions to our basis for our license application. So, if we find something that needs to be improved, if it's within the analyzed boundary, we can accommodate that fairly quickly. If it requires a revision to our safety analysis basis, we can also accommodate that. So, there is flexibility in how we could optimize in the future, in my mind.

KOUTS: Until we build facilities, I would think we have flexibility. Once we begin to deploy them, then we'll be more constrained. But, we're in the design phase now, and I think there are opportunities to realize what some of these situations are.

GARRICK: Yeah, and I think what we're trying to figure out is just how much initiative you're taking to do that. It's one thing to just make the systems that exist and understand how they interact with each other. It's another thing to really design the system with respect to some performance parameters. And, the opportunity seems to exist to do a lot of the latter.

I wanted to ask the Board Staff if they have any questions or comments on this topic? Okay.

KADAK: I don't want to be, Kadak, I don't want to beat a dead horse here, but according to my understanding, that if you were to use this DPC, dual purpose cask, for pressurized water reactors, you could reduce the number of fuel handlings by a factor of 20, and for boiling water reactors, by about a factor of 60. When I look at this, there's not so much an optimization question, but a safety question.

And, I also understood your comments to say that in the license application to the NRC, will not have this dual purpose cask as one of the means for which to license this repository. Is that correct?

KOUTS: Right now, it's dealing with bare fuel handling. That's correct. With the capability, though, that the facility is designed to have the capability to accept those materials, and we designed that into it.

CRAUN: Craun, DOE. Let me try to respond to that. You mentioned a couple of things. You mentioned a dual purpose canister type system, I believe is what you're wanting to refer to, which would be a dual purpose, which is a Part 71/72 co-licensed canister. We need to make sure that it is compatible with 63 for disposal. At this point in time, the surface facilities are designed, the dry transfer facility specifically, has a design feature to allow us to, if received, to cut those canisters open and offload that fuel assembly by assembly.

So, in this time, a dual purpose 71/72 canister system really helps in the initial receipt, but we have to cut it open and offload it at this point. It's currently not disposable under 63.

KADAK: I guess that's my question, and I think that's what Dr. Garrick was referring to. How much flexibility is built into this that would affect the rationality and the safety of the ultimate system?

CRAUN: Craun, DOE. The canister handling facility is currently designed, can handle any canister system, Navy canister system, DOE system and/or commercial system currently available.

KADAK: And, if you don't open the Navy fuel, why is it that you must open the commercial fuel?

CRAUN: The Navy fuel canister is designed for disposal. But, what you're asking is can we have canisters that are disposable, the Navy canister is disposable, and the DOE canisters are disposable.

KADAK: Well, I guess this gets into the integration question.

KOUTS: And, what I said earlier is that this is something that we are looking at. But, at this point in time, what will be in the license application is as we've described it.

GARRICK: Let's see, I think it was David first, and then Mark.

DUQUETTE: Again, the same dead horse, I think. Duquette. But, I guess my understanding of the license application process would be that you're going to submit a particular kind of set of canisters, transportation as well as burial canisters. Given the way the large systems work, I suspect if NRC accepts that, that will be the end of it, that you will not go back and revisit what Dr. Kadak just called the dual purpose canister, and that only if the NRC says you'd better look at some other alternatives, or rejecting this alternative, will you go back to another canister. So, when you say it's still under consideration, it's only under consideration if the system is not accepted by the license application; isn't that correct?

KOUTS: No, that's not correct. I think that simplistically, once we have an acceptable waste package design, there is no reason why we could not design an internal canister that would have the internals of the waste package, and assuming that could be designed for 71 requirements, if you will, and it could be loaded at reactor sites, there's no reason why that couldn't also be utilized. But, that's something we'd have to analyze. That's something we have to evaluate. And, we're not prepared at this time to say that that's the way we're going to go. But, we will evaluate it, and if it turns out to be the proper way, I think the Department will make a decision at the appropriate time.

DUQUETTE: Duquette. Again, it's probably my incomplete knowledge of how license applications works in a government. Would you then have to go back and reapply for a license if you then change your canister design?

KOUTS: There are--we don't have to get into the NRC licensing process here, but as many of you know, with the licensing of reactors, there are changes all the time that are made to operating reactors licensees. This potentially could be a very minor change, especially since we're using essentially the same internals of the waste package. So, I don't see that as a--when the NRC gives us a license, the expectation is that license will evolve over time, and we will make requests to the NRC for modifications to our license. So, I don't see that as an impediment in any way to go into the system, if we choose to do so.

CRAUN: DOE, Craun. The license application, as we go through time, there will be many changes to the application as we progress. You have to look at it from the standpoint of are you increasing the probability of an accident? Are you increasing the consequences of an accident? Those are introducing a failure mode of an unanalyzed condition. So, those are kind of the fundamental elements that you have to look at.

Once you answer those questions, then you can submit an application to the NRC to either change your license application, or if you haven't introduced those, then those can be considered to be bounded by your existing analysis.

Currently, we have one waste package design, with ten different configurations. So, what we would look at is adding yet another configuration. So, those are kind of the issues that are involved in that. So, it's within a licensing capability to make those changes.

LANTHRUM: And, to add just a little bit more, Lanthrum, DOE, when a waste package design is finally certified and accepted, the transportation casks and transportation capability, the transportation system is not licensed by the NRC, but the transportation casks are. And, to the extent that a disposal cask design could be certified to meet 10 CFR 71 transportation requirements that would be an add-on that would not affect the repository's license.

GARRICK: Mark?

ABKOWITZ: Abkowitz, Board. I've got a slightly different horse to throw into the mix here. All the systems integration discussion that we've had so far today is what I would consider to be kind of in the planning mode. At some point, if it comes to pass and all this is reality, someone is going to have to be the implementing organization. Is it your understanding at this point that DOE would be the implementing organization that would run this waste management system? How would that be done, and the ability for DOE to do that well, is that factored into the uncertainties that are in your logistics model now?

KOUTS: Well, I think there is an expectation in the model that the system will operate. The strategies and the structure of our program as it moves toward the operational phase I think is something of discussion right now within our program, and we're looking at options as to exactly how we should be structured for that next phase, if you will, when we get beyond licensing. And, until I think we're in a position to talk about that, all I would like to convey to you is that we are looking at that issue. We're looking very hard at that issue as to how we should be structured, how the Department will operate this through its contractor structure. That's a very key decision that we need to make in the near future.

GARRICK: Okay. Excellent. Any other questions? No?

All right, I think that completes our morning before break session. I think we're right on schedule to take a 15 minute break. Thank you.

(Whereupon, a brief recess was taken.)

GARRICK: Could everybody take their seats, please, so we can get the next session underway? Thank you.

I think we can go ahead and go.

BOYLE: Good morning. I'm William Boyle. It will be a joint presentation. Kirk Lachman is over there. If it's okay with you, I ask that you not ask questions at the end of my part, but to leave time for Kirk's and then Kirk and I will handle the questions at the end, if that's okay.

GARRICK: We'll honor that.

BOYLE: Okay, thank you. So, thanks for this opportunity, and I think this talk is just turns out it will be a natural follow-on to some of the questions that were posed for the last talk and presentation. And, Kirk and I are here to talk about integration of the Total System Performance Assessment, TSPA, and repository design, and do we talk to each other, and do we look at making things better in terms of the system.

Next slide, please. I'll provide a historical perspective to start, and I'll talk about a specific example, the drip shield, which came out of an exchange at I think it was at the Board meeting in September, and then Kirk will talk about current practice of integration of TSPA, and design.

Next slide? This is just a summary listing of TSPA iterations, and why the changes were made. And, for many of these iterations, going all the way back to the late Eighties, up to the present, many of these iterations in the TSPA had different designs. The design for the viability assessment is different from the design for the site recommendation, which, in turn, is different from the design for the TSPA-LA.

So, what this captures in a summary format is, yes, that there have been many changes in the design and TSPA, and they were commonly done in concert.

Next slide? Here's a cover of perhaps the most recent attempt at this, you know, looking at design and TSPA together for the entire system. This is the cover of the license application design selection report, published in

August 1999. Now, I know none of the current Board members were on the Board in 1999, but many of your staff members were staff members at that time. As I show many of these historic reports, your staff members certainly are aware of them.

This was, I'll describe it if you will, if you took as a given that the repository was at Yucca Mountain, it was a clean sheet of paper that was what should the repository look like? Hot, cold, you know, looked at all sorts of different aspects, and they did a study and decided, well, this is the LA design we should go with. As part of that selection, there were evaluation criteria, safety, construction operations, maintenance, flexibility, cost/schedule, meets regulatory criteria. And, design participated. They were the ones that came up with the design related aspects of the study and TSPA participated as well, and calculated the postclosure response of the various systems.

Next slide? This is an even older report. You can see up there printed September 1991. And, I just wanted to get across that we didn't do this one time. This was, again, a study that looked at the entire repository system, at least the postclosure part. They looked at what turned out to be 34 different options. It was two sets each of 17, and they had different designs and different postclosure responses.

During the study, they also looked at things, you know, cost is always on there, safety is always on there, including aesthetics in this study. So, there's been a history on the project every now and then of looking at, okay, let's start with a clean sheet of paper, given that it's going to be at Yucca Mountain, and see if we can come up with a better approach.

Next slide? Here's yet two more studies that essentially did this. This cover is from the design volume of the Viability Assessment reports. There was another volume related to postclosure performance. This is the oldest document I think I show in my presentation today. This goes all the way back to the site characterization plan. There was a conceptual design report, and there was also an assessment of postclosure performance.

And, what I wanted to get across was, showing you some of these slides, is we have looked at so many different variations, features, options through the years, that commonly, if somebody were to ask a question today, well, what if you did it this way, I can get an in the ballpark answer with respect to postclosure performance simply by calling up Bob Andrews or Dave Savugian and saying, well, what if we changed this to that, and we've looked at so many different options in the past, that we can gain insights if we just look back at the historical work we've done.

Next slide? The reports I have been describing up to this point were generally system-wide, you know, it was the whole repository was being looked at. We also do a lot of what are referred to on this slide as value engineering studies, where a narrower focus is taken. Let's look at something specific, and this is the cover of a report from 2003, you can see, where the ground support methods were examined.

And, again, you can look at the evaluation criteria. TSPA was involved. TSPA, the postclosure performance people are really interested in the ground support for largely the chemical aspect, you know, what do the ground support methods do to water, how does it change the water chemistry. For example, Portland cement concrete very typically will produce high pH waters, and if you know our waste forms, some of the radionuclides, when you look at their solubilities as a function of pH, they're U-shaped diagrams on log log paper. So, they are highly sensitive. They're very soluble, acidic conditions, very acidic and highly soluble at very basic conditions. So, that the chemistry matters, so TSPA is concerned.

And, of course, design wants to, they have interests in the ground support as well, so you can look at the criteria that were used. Safety was also considered. And, so, that's one example.

Next slide? We also looked, we had a value engineering study for the drip shield, and here's the criteria they looked at. And, the conclusion of that study was, well, yeah, the drip shield you have will work, the titanium one, but you might want to consider continuing looking at alternatives and improvements.

Next slide? This was brought up in part in the prior talk, and also in John Arthur's talk. This is an old document. Whenever we make these changes, we can do all the studies we want, but we don't make changes in a haphazard fashion. We have to, I think it was Chris in his talk, he had the slide with the requirements document that he owned, the one that Rick owned, the one that Gary owned. We have requirements documents, so when we make a change, we do it in a structured, controlled fashion, and I like this one because down here, it says changes to this document itself has to be done according to a specific procedure. This historic document, you can see, is from the mid 1990s.

Next slide? All right, I'm getting to lower and lower details. The first figures dealt with, you know, system-wide studies, and then the last two value engineering studies were on more narrowly focused topics. We also use what are called information exchange drawings to allow communication between interested parties. They were introduced after the site recommendation to control data handoffs between TSPA and design. And, actually, any two groups that need to, can you this process. There's the procedure that control it. That procedure is controlled by the head of design and engineering.

Next slide, please? Okay, these two figures, this one and the next one, in the handouts are also available as larger stand alone documents. I had them printed in the larger format to make them more readable. And, they're just two examples, you know, I didn't care which were used. The main point I want to get on this is to show you there's usually a requester and a supplier shown. I can't read them here and I didn't bring my--thank you.

On this one, now you see what happens when you don't wear bifocals. Down here, the requester is Bruce Stanley, and the D&E stands for Design and Engineering. So, Design and Engineering is the requester, and in this case, the supplier is Vron Chipman, who works on the postclosure side of the house, TSPA.

Here, you can see that the checkers are Vron Chipman, TSPA, and Dwayne Kicker, Design and Engineering. And, if you look at the sign-offs, you can see the various organizations involved, Larry Lucas for Design, and Jim Whitcraft essentially representing the postclosure side of the house. So, that shows that there's integration there.

Next slide? On the prior slide, the requester was

Design and Engineering and the supplier was TSPA, and I think on this one, it's the reverse. The requester up here is the TSPA group, engineered barrier systems and natural systems, and the supplier is subsurface design. Again, you can see the integration. Over here, the sign-offs are by Bob Andrews on the bottom line, as the head of Performance Assessment, and Larry Lucas is the head of Design.

So, those were just examples to show that in our day to day work, that there is integration between the two groups.

Next slide? Drip shield example. This one is just largely to provide a simplified presentation of the history of the drip shield, that in the earlier designs, there wasn't a drip shield. Then, that was the initial concept for it. The exact details change through the years. But, we still have a drip shield in. It was largely introduced as part of the studies related to the license application, design, selection.

Next slide? These next couple slides provide the text to go with that history, if you will. The concept of the drip shield emerged from the multi-layered, multi-material waste package concepts considered in LADS. And, in a simplistic way, if you look at the entire engineered barrier system, you can think of the drip shields and the what we call the waste package now, if you want to view a mega waste package, it's titanium, air, Alloy 22, and stainless steel, if you will, you know, it is a multi-material system. Our prior waste packages were multi-material as well, but then the last element was air. But, then we introduced the drip shield.

Based upon long-term performance, the corrosion resistant alloys are favored over less corrosion resistant alloys, and titanium was chosen because the waste package outer barrier was Alloy 22, and it was felt that having two different materials would help in terms of defense in depth, rather than having both the drip shield and the waste package outer barrier being the same.

GARRICK: William, Garrick here. I'm curious about how much this dissimilar material issue was really a factor in the choosing of Alloy 22 for one and titanium, how real is that observation?

BOYLE: Well, I'd have to read the report in detail.

GARRICK: Philosophically, it sounds good to say it, but I have this sense that it may not have had anything to do with the decision making process. But, maybe it does. Because you do make a substantial point of it, and I've not seen evidence to convince me of that.

BOYLE: I can't point you to the page in the report or the actual decision paper, but the end result is the same. I mean, it--

GARRICK: Well, I was just curious. Just suppose those two were reversed.

BOYLE: I'm not a metallurgist, I don't know that we've ever analyzed it. Well, I can answer it in part, that prior to the current waste package, which has the Alloy 22 on the outside, and stainless steel on the inside, we had a two material waste package with the carbon--it was carbon steel on the outside and Alloy 22 on the inside. I'm not a corrosion specialist, but, that arrangement was not as good as this one that was chosen. So, you know, putting titanium on stainless, or something else, you know, people would need to look at it. But, it does matter, switching them around, that much I know.

Next slide? The basic geometry has not changed since '99. This slide goes through some more description. There have been tweeks, changes to it, if you will. I know that stiffeners have been added, and the stiffeners were added for this reason, in case of rocks striking the top of the drip shield.

Next slide? Now, this slide deals with the exchange that took place at the September meeting, which I did not attend, but I looked at the transcript, and it was Professor Latanision essentially said, you know, in summary, for God sakes, the cracks, you know, why are you using the titanium drip shield? It suffers from stress corrosion cracking. And, yes, it does. It can stress corrosion crack, and, however, analyses of that, and I'll get to that in a second on the next slide, essentially, the project's position is is that when it does crack, the cracks tend to be tight, which won't permit advecting water.

And, for the cracks that are there, if water does get in them, as some of the water evaporates, minerals will precipitate, and the cracks become plugged, so in the end, even though the titanium drip shield suffers from stress corrosion cracking, perhaps, it is still able to perform its function, which is to keep dripping advecting water coming out of the rock off the waste package. So, even though it's cracked, it still functions.

KADAK: Has that been FEPed out, so called?

BOYLE: Yes. Right, and this was in this document right here, which if you notice the date is October 2004, which is after the September 2004 Board meeting. It's in Section 637 of this report. You can read the discussion of this consideration, that the cracks are tight, that the cracks tend to plug with filling material and, therefore, we considered it, but it's not in the model, so to speak. It's been FEPed out, to use the term of art of the project. It was considered, but shown to be it's not going to have an effect.

KADAK: Is it a time dependent FEP or a FEP?

BOYLE: I think it's out.

KADAK: Mechanistically out?

BOYLE: Yes, based upon the discussion, Section 637.

Now, I think that's the end of my slides. I believe the next one is Kirk's. I just wanted to reemphasize the point that--John Arthur had it in his slide, the one that had the license application in the center of the diagram with the feeds from systems engineering from the left, and science and technology from the right. We do have a baseline. We're constantly asking ourselves can we do this better or differently. Either TSPA will ask of Design, or Design will ask it of TSPA. But, we do have a baseline, and because of the licensing process, in part, you know, we have to go through a structured process in order to make sure that we make the right decisions. We don't make changes lightly.

So, Kirk?

LACHMAN: Thank you, Bill. Good morning. Thank you for this opportunity to present to you today. I'd like to talk about does this integration happen by chance? Are we just that lucky? Or, do we have a process behind it? And, I can assure you we have a process behind it.

Bill has shown examples of the integration, and I'm going to talk about how that occurs, what the mechanism is behind it, and the fact that it is a formalized process.

As you see on this slide, as recently as April of

2003, we did update our process, and inside BSC, formed the Technical Management Review Board. And, that again to further formalize the integration of the TSPA and the Design, along with licensing, safety and health, other, as you see here, the chief science officer, and DOE are part of those meetings that says observers or active observers. We participate. I particularly remember one meeting that I was participating for eight hours on the same subject. So, we do participate on these meetings.

It's a multi-disciplinary team. It's not done in isolation, and it essentially forces the integration through this formal process. We're not allowed to do the right thing for no apparent reason. We do the right thing because it's formalized in our process.

Next slide, please.

KADAK: Who is the chairman of this board?

LACHMAN: Nancy Williams.

KADAK: Where does she work? Who does she work for?

LACHMAN: She works for BSC.

KADAK: And, her role?

LACHMAN: Her role is she is--there's the TSPA science and licensing side, and the engineering side, both report up to Nancy in their organization.

LACHMAN: What are the functions of this board? It provides the planning guidance. If we're going to do some changes, think about changes, it provides the guidance to the staff. It approves and disapproves, at the appropriate level within BSC the new design concepts. If they trip a threshold for a change control, and things, it does get elevated up to a DOE decision board through our formal change control process within DOE.

Again, it's reiterated in the second sub-bullet there that it approves and disapproves. And, the third one we're talking about, the integration between the TSPA, science, licensing, design, the whole concept is brought across. After a decision by this board is made, it's formalized in a decision document. That document then is used by the designers, it's used by the TSPA folks, depending on where the change is, so they know what the decision is. It's not a guess. It's formalized in the decision document.

Next slide, please. As much as I'd like to, as the Engineering Director, change things, because I like to do things a certain way, I'm not allowed to do that. I can't just decide to make the change without--we cannot make this change without going through this process. The ground support is a perfect example of that. Bill brought up the value engineering study. There are lots of options looked at. Personal preference would be to shotcrete the whole thing, but, you know, that provides me some issues.

So, we work with the science and the TSPA people.

As Bill explained, there's some chemistry issues there. So, we were challenged to come up with something else. That challenge we took and developed the current ground support system, which meets all the needs of the TSPA organization, science organization, as well as the design through the preclosure period.

So, this step that we do to ensure that the changes are controlled gives us that the models are consistent, the design, that is, design, the analyses that backed those models up, are consistent. And, that feeds this integration, and looks like these.

For summary, just to wrap this whole presentation up, Bill went through examples of where integration has been done, how this it's documented. Interface documents that you saw where an engineer would request information from the postclosure or the TSPA folks on a certain instance, and they would get that information, formalized, it's there. Everybody who's using that bit of information is now using the same thermal conductivity of this specific rock, that sort of issue.

So, those are formalized. We do studies to improve the design. It's not a static thing where we don't make changes every day. We do look at things, and look for areas to optimize. These are both managed, though, it's not one group deciding to make a change without the other being involved. Those value engineering study teams were integrated, as well as just like this Technical Management Review Board is integrated, including outside experts on some of those teams.

The point I wanted to make is the design and the TSPA are integrated. They're not off doing their own thing, and then coming together later to decide and see where they meet up. They're integrated throughout the entire process, and it's an ongoing process that's being done in a controlled manner. We have been, and will continue to integrate the design and the Total System Performance Assessment, as well as with the licensing, the science background, the whole bit. We're working through this. And, that concludes my presentation, and if you'd like to ask Bill any questions, I'm sure he'd be happy to answer them.

GARRICK: All right. Okay, we've got Ron, we've got Henry, we've got David, and we've got Ali. Ron, go ahead.

LATANISION: Latanision, Board. Bill, you set me up. I have to ask you some questions now. But, let's just first of all turn to Slide 18. I don't recall seeing this document, so it may be one I haven't--

BOYLE: Right. William Boyle, DOE. That's why I tried to point out the October date. It came out after the exchange you had with Rick Craun and Bob Andrews at the September meeting.

LATANISION: No, I appreciate that. But, I haven't seen it since October either. So, I mean, the fact is I really can't--but, let's go back one to Slide 17. I think that fourth bullet is the key bullet.

BOYLE: Right.

LATANISION: And, you know, from my perspective, I would want to--I had actually hoped that at this meeting, we would have a presentation and a full discussion on a drip shield issue, because it did come up. And, while I appreciate your taking the time and effort to use it as your descriptor here, I really don't think, without a more full discussion, we can--I can make any reasonable judgment on what has evolved. But, I'd love to see that.

BOYLE: You mean, you weren't buying, just based on that?

LATANISION: The other dimension that does not appear on this slide is the fact that this drip shield does, in addition to the materials of construction of the shield, it does sit on feet. And, as I recall, there is a carbon steel/titanium interface somewhere along that line, and the potential for dissimilar metal--

LACHMAN: Lachman, this is Lachman, DOE. It's actually an Alloy 22 plate between the titanium and the carbon steel.

LATANISION: Well, I know, but Alloy 22 is a great conductor, so it really doesn't provide any insulation. You know, electrically speaking, carbon steel is in contact with titanium, and in that scenario, from an electrochemical point of view, the titanium is a cathode, and hydrogen and titanium are not very compatible. So, I have this vision, as I guess I've expressed before, of something like a considerable problem with hydrogen in this case. That's the stress corrosion phenomenon.

BOYLE: Well, I think there's a number of things. I can speak from personal experience, with these meetings, there's usually, just like with the buffets here in Las Vegas, people's eyes are bigger than their stomach. You know, there's always a desire to get more in than can be accomplished in the time, so we focused in this talk on the request on the integration, and did use this as an example. But, the next meeting is in May, certainly you and the staff could read this report, and, you know, could offer up a more full discussion of the drip shield at the May meeting.

LATANISION: Latanision. I would gladly take you up on that one. I would like to proclaim here and now that in May, we have a full discussion of the titanium drip shield issue. How's that?

BOYLE: It works for me.

LATANISION: Okay.

BOYLE: And, I will offer up as well that the checker for that AMR was David Stahl. Dave is in the audience. I'm sure you know David. And, at a break, lunch, whenever, he'd probably be able to go into more detail, at least in conversation.

LATANISION: Fair enough. Thank you.

GARRICK: Okay, David?

DUQUETTE: I had to double beat on you, twice on the same issue, and I realize that this presentation was not a corrosion presentation, nor was it a metallurgical presentation. I would caution you on putting up that kind of a slide to support your position, however, because reading that slide out of context, I'm glad it's not a medical analysis, because it basically says we have cancer, but we're not going to worry about it.

And, the fourth bullet, as Professor Latanision quite correctly states, is the key issue, because at least in that bullet, as it is written, it implies that whoever wrote the bullet, doesn't understand how stress corrosion cracking occurs in titanium.

BOYLE: That may be, but, you know, I'll bring the--no AMR on this project is written by an individual. And, so, not only did the person who wrote it would seemingly not have to understand, all the other reviewers, you know, and you might be right, this isn't my area of expertise, but I can assure you that that fourth bullet captures what is in that AMR. Now, whether the AMR is correct or not, if you have comments on it, I'd like to know. As on any technical topic on the project, you know, if something thinks are you sure, you know, we want to hear about that.

DUQUETTE: Duquette again. I don't want to beat the issue to death, because I would support my colleague in saying that we'd really like to hear a presentation of it, and perhaps even a panel discussion even before the May meeting might make sense, to discuss the issue, because there are several things in this, again, I know this is not a corrosion presentation or a metallurgical presentation, nor do I want to put you on the dais for having to answer in those areas. But, if what you have here is really a problem, it really has to be addressed, and I think fairly quickly, because I think it will affect the license application.

GARRICK: Ali?

MOSLEH: Mosleh, Board. Since this is a presentation on TSPA integration and design, is there a clear-cut shining example of TSPA impacting the design, something that is not ambiguous, flowing the other way?

LACHMAN: Lachman, DOE. Absolutely. There's my ground support example. I would not be using stainless steel rock bolts, stainless steel sheeting for my ground support if I was able to use shotcrete.

BOYLE: I can give you another example. William Boyle, DOE. The configuration at the end of the emplacement drifts was done at the request of the TSPA folks, specifically to have plugs or barriers that they just not be open, because under some scenarios, it's possible to imagine that if a salt flow comes into the repository, if the drifts are all open on the ends, it just the magma snakes throughout and fills up the entire repository. So, we asked Design, is there anything you could put at the end of the drifts that would, you know, if it did intersect one drift, it was limited to one drift, and they accommodated our request.

GARRICK: Henry?

PETROSKI: Petroski. I just have some elementary questions. In all the talk of the example of the drip shield, I don't have a sense of a scale of it. What are its dimensions? How big is it?

BOYLE: Kirk might know the exact answers, but if the emplacement drifts, as I recall, are 5 1/2 meters in diameter, so it's a horseshoe shape that fits inside that, you know, 16, 17 foot diameter tunnel. And, it's pretty much up against, not flush up against the rock, but it's up against or close to the rock boundary?

PETROSKI: So, it's closer to the tunnel than it is to the containers?

BOYLE: Right.

LACHMAN: Lachman, DOE. I think before we say that, I have those dimensions, I just don't have them with me, nor do

I memorize that, sir, so I could get those for you.

PETROSKI: Well, I don't think the drawings I've seen convey that.

BOYLE: Well, I think it's because they're not both circles, you know, depending upon where you're at, like down, I think, near the feet, or closer, the drip shield is closer to the rock, and as you go up and over the waste package, it's further away from the rock, so, it's not a uniform--they're not both--the drift is a circle, but the drip shield is not, so it's somewhat variable.

LACHMAN: Right, and the diameter, this is Lachman, DOE, the diameter of the waste package varies through the ten configurations also, so that that air space between the titanium and the Alloy 22 varies. The drip shields are all the same size. There's one drip shield size.

PETROSKI: Now, in one of the slides for this drip shield historical background, the bullet says, "Based on long-term performance, Alloy 22 and titanium alloys are favored." What does long-term performance mean in that context? Are you projecting long-term performance?

BOYLE: 10,000, 20,000 years was the calculation period. But, you can look at the corrosion rates for, you know, general corrosion rates, setting aside any concern for localized corrosion, and both the Alloy 22 and titanium would probably, in terms of general corrosion, work much longer than even the 10 to 20,000 year period we were looking at, because of the standard at the time, you know, the EPA standard and the NRC regulation for a 10,000 year calculation. But, we extended to 20 just to make sure that something strange didn't happen at year 10,001.

PETROSKI: So, you're extrapolating from basically years to the thousands of years, is effective what you're saying?

BOYLE: Yes, but where possible, we always use analogues if we can. And, like, again, I'm not a metallurgist, but I know that many of these corrosion resistant metals are corrosion resistant because they form oxide films, like in the titanium oxide, or chrome oxide, there are geologic equivalents, you know, minerals. Titanium oxide, it's mined commonly in sedimentary deposits, because the rock that it occurred in has long gone, but the titanium oxide is still around because it is so corrosion resistant.

But, analogues only get you so far, because in the case of the natural oxides, the minerals, it's usually oxide upon oxide upon oxide. You know, there might be, here and there, little specks of bare metal, whereas, our metal structures are different. You know, the substrate is metal, and the oxide film is thin. But, still, there's something to be gained. Geology will tell you that simple oxides are highly corrosion resistant.

GARRICK: Howard?

ARNOLD: Arnold. Let's assume the schedule, as shown on TV last night, you open in 2012, when does the first drip shield go into place?

LACHMAN: Lachman, DOE. The first drip shield would not be emplaced until a decision to close the repository was made and a license to close, a license update and then I'm not sure of the exact regulatory term, was received. So, that was anticipated up to 100 year preclosure period.

ARNOLD: So, we're talking something that happens a long time from now?

LACHMAN: Yes, sir.

ARNOLD: And, there's a lot of opportunity to work on the design of that thing?

LACHMAN: Yes, sir.

ARNOLD: And, even after that, what kind of difficulty would be involved if you decided you had a much better design, or somebody downstream decided that, what kind of difficulty is it to open the repository again and replace the drip shield?

LACHMAN: Once the repository is closed and sealed, it would--we do not anticipate going back inside. If the decision was made as we were emplacing the drip shield before the access mains are backfilled and the seals are put in place, then it would just be simply a reversal of the installation, the drip shield gantry would go in and pick them out one at a time, just like in the same order, or in reverse order as they were placed, last in, first out. It's a remote operation. It's a similar discussion that one would have with the retrieval of the waste, should that decision ever be made.

BOYLE: William Boyle. I'd like to add on to that. From a process point of view, a regulatory process point of view, if the NRC granted us the construction authorization and the license to receive and possess, premised upon our analyses showing that the postclosure performance was okay with titanium drip shields of a certain size and type, we're allowed to change that, but only if we go to the NRC and show them that what we're substituting will work as well or better.

So, there's that process aspect of it. And, we're free to do that, you know, like let's say we make up our minds ten years before the installation of the first drip shield, we've come up with a better way of doing it, we could contact the NRC and say here's the information, and they would take it into consideration.

ARNOLD: Arnold here. Your immediate problem is to have a design that looks good to the regulators?

BOYLE: Yes, if you read the regulation, they--

ARNOLD: 50 years before you actually put them in place?

BOYLE: Right. But, for them to grant, for the NRC to grant the construction authorization, they have to make positive findings with respect to preclosure and postclosure safety.

GARRICK: Mark, and then Andy.

ABKOWITZ: Abkowitz, Board. I'm trying to understand the context of where we are today with where things were a few months ago. My recollection was that there was a TSPA-LA and that the door had kind of been closed on any work that was going on that would improve our knowledge in the TSPA process in supporting the LA, and then, as a result of that, the repository design was pretty much trying to operate in tandem with the TSPA-LA.

Now that the license application is being pushed back some amount of time, have the gates opened up again? What's the environment now for continuing work that was going on before to support TSPA? Are there new studies that can be undertaken now that couldn't be taken because of the anticipation of the license application? And, what's the relationship between that work and the design process?

BOYLE: William Boyle. I'll take the first crack at it. For regulatory purposes, the TSPA and design must be integrated. We're free to do whatever studies on the side that we like. And, if we had submitted last year, the TSPA and the design at that point would have been integrated. But, as you pointed out, we're delayed some, and we knew that, and, so, I wouldn't refer to it as opening the gate. We opened the door a crack, and I think it was John Arthur or Margaret Chu referred to some of the changes this morning, and in the area of neptunium solubility, which really doesn't affect designers in the area of seismic analyses, which possibly does affect the designers, we changed the TSPA, in other areas like that.

So, we, on the TSPA side, we did open the door for some changes. We considered more than we allowed, but we did consider and allowed some changes.

ABKOWITZ: Abkowitz, Board. Is there a new TSPA-LA drop dead date then that's going to govern this process?

BOYLE: Wrong verb tense. There was. It's come and gone. The lead time for getting changes into the TSPA, it's just a complicated calculation, and the TSPA analysts are always pressured to try and do more, but we asked for the inputs to them to come by January 28th.

ARTHUR: If I could add into that? Arthur, Department of Energy. But, when you look at that, one of the areas we really never showed, if you look at internal production, just the process of a license, from the time you make that final run of a TSPA, from the time you ensure the 89 analysis and model reports, all the data, software, and that, to completion of the actual license, is about a four month, three or four month process, through final integration, reviews, and the rest. So, it's a highly configured process.

If, what you're referring to, could we just take another three years, and start back to ground zero, I don't believe that would get us--or my point this morning is we believe we have a technical baseline now, a foundation which we're building a license. But the point that I still, I think, all of us are trying to make today, we recognize the metallurgy we're in, and I would welcome this discussion on titanium, metals and drip shields in one of the meetings.

If, in the future, we find that there's better metallurgy, better materials, better configurations, we need to continue the challenge and optimize that license, and, if so, that amendment can be modified. But, it is a long time, I know, having been in this for two years, I didn't appreciate when I came in, it takes a lot of analysis, sign-offs and configurations. So, from when you get that TSPA final run done, you can add plus four months for license ready to go, if all the rest of the things are good.

ABKOWITZ: Abkowitz, Board. I thought I heard William Boyle say something about January 28th, which has already now come and gone. So, is it fair to assume that we have another closure of the door on TSPA-LA effective January 28th? In which case, issues as significant as the potential one that's been raised by my colleagues pretty much are not factored into the license application whatsoever; is that a fair assessment?

BOYLE: William Boyle. The door can be opened at any time by anybody that brings a concern, that we will look at it, and if it's real, you know, and we have to go back, you know, new information becomes available, or we made a mistake, any number of reasons under the sun, whatever schedules we had at that point, they're no longer valid. But, in terms of just doing day to day business in order to get done at some time, you know, we had a January 28th cutoff.

ARTHUR: One last brief comment. Arthur, DOE. And, it would be good in time to talk through the process, because one of the areas that I was trying to also say this morning, when you look at the '89 analysis and model reports, just assume TSPA as we know it today, that 10,000 years from where we are, it took about, just now from when we start, to now two years to get data, software, and we're real close to all the model validation issues resolved. What we've done is hold about 79 of those under real tight configuration control, which I mentioned this morning, ten are going to continue the change before we do updates to TSPA. So, we're open to other ideas, but you always have to look at configuration trade-off about when the license goes in versus what we learn through other programs for future optimizations. So, I'll be glad to talk more at a break.

ABKOWITZ: Abkowitz, Board. Just one final comment on that. It seems to me that there needs to be some type of risk based decision making going on with this whole interaction. And, if there are areas that are judged to be potentially significant, where the modeling has a sufficient amount of uncertainty associated with it, I think those are areas that need to be prioritized and brought forward into this process.

You know, we've talked many times about taking the time to do it right. Under the very likely possibility that the license application will be delayed more than a year, it would seem to me that DOE could benefit greatly from going through a procedure of that type.

BOYLE: William Boyle. I'd like to give you some assurance that the changes we do make, we usually, I can attest, on the postclosure side, we take risks, you know, the probability and the consequences into account. That's, generally speaking, probably the primary consideration in terms of helping decide which changes we want to go after. It's the most important ones.

GARRICK: Andy?

KADAK: I'd like to get a better handle on the decision making process, and perhaps using the shield as an example. If you could choose between Alloy 22 and titanium, from a general corrosion, structural strength, mission, which would you pick, Alloy 22 or titanium, forgetting this argument about additional level of defense in depth?

BOYLE: William Boyle. I can't answer that. I'm not a corrosion, nor a structural engineer.

KADAK: Okay. But, that's point one. The other issue I read in the paper the other day, or heard about, was this decision to take the structural support in the tunnels away from I guess safety classification. And, again, the real question is going to be relative to this Technical Management Review Board that apparently is making some of these decisions. And, how often does this Technical Management Review Board meet?

LACHMAN: Lachman, DOE. It meets weekly.

KADAK: Every week?

LACHMAN: Yes, that's their plan. If there's nothing to bring forward for a decision, of course, there is no meeting. But, it does meet weekly, yes, sir.

KADAK: Okay. And, the line responsibility of Nancy Williams is what in the pecking order of, I guess it's BSC?

LACHMAN: Yes, she reports to the general manager, John Mitchell.

KADAK: Okay. And, are there any outside members of the Board to challenge what might occur sometimes in terms of group think?

LACHMAN: Outside members other than DOE or BSC employees?

KADAK: Yes.

LACHMAN: No, sir, not to my knowledge.

KADAK: Okay.

BOYLE: William Boyle. I will offer up, you know, the group think can be a problem, I suppose, in any big organization. But, I can assure you that many topics through the years on the project, people get an opportunity, you know, group think doesn't happen all that commonly. People are very free with their comments and they're captured in e-mail, too, so if somebody has an issue, it gets raised. And, we actually have people raise them informally, and we also have many formal systems in case somebody has a problem about something, they have numerous opportunities to be heard, and people exercise those systems all the time.

CRAUN: Craun, DOE. I'd like to add just a little bit. Above the TMRB is our own DOE Board. So, there's thresholds for the decision making authority for each of these board levels. So, as the decision thresholds are broken, DOE will be involved in those decisions as to whether or not it's accepted or not.

And, then, the TMRB, all of those documents are forwarded to the Department of Energy, so we have access and we are involved often times in the review of those documents. So, it's not as if we're not participating. And, we do have the authority to elevate at any time a decision from the TMRB up to our own Change Control Board.

KADAK: Thank you.

GARRICK: Garrick. Mark Abkowitz came awfully close to hitting on the issue that I'd like to bring up again here. Both Bill and Kirk spoke with some passion about the existence of a process that integrates the TSPA and the design activity, and I just want to be darned sure that I don't leave this room fuzzy about what that is.

Clearly, the TSPA has a process that is risk based, and it is understood and it is a driver for what's done there. Both of you spoke to the design activity process in the context of change control, configuration control, and this Technical Management Board. But, I'm still seeing a discontinuity in terms of a fundamental and underlying process that forces feedback between the TSPA in both directions, and the design.

What is there, and as Mark was alluding to, an example of a process that would establish continuity between the TSPA and the design activity would be some sort of a risk based structure or framework. Can you recite for me again what the underlying or overarching process is that really does tie those two things together besides something like a design control process or configuration control process? Because I view these things as different.

BOYLE: Right.

GARRICK: So, I'm not seeing a clear indication of what the interface, what gets across the interface between the two.

BOYLE: Right. William Boyle. I'll give it a try, and I'll try and restate in my words I think what you're trying to get at, because I did it at the first discussion, the preparatory meeting that led to this talk.

Are you asking as a business, do we, you know, habitually, as a matter of course, and engrained in process, always ask ourselves are we doing, can we go better faster, cheaper, that sort of thing? And, although I showed many examples where we did it, I think for some of those examples, they occurred because of outside stimuli, and, in part, comments from the Nuclear Waste Technical Review Board. But, in the discussions related to the preparations for this talk, and that observation, we questioned ourselves internally. Are we doing the best that we can do?

And, with respect to a process, it was decided in a meeting, you know, we could do better, and I know that I don't think the charter has been signed yet, but there was to be a group of senior DOE officials who were going to meet periodically to ask themselves can we do better.

GARRICK: Garrick. I can appreciate the fact that you have a management, and you have all of these other structures. I'm looking for this thread that connects these two activities, and is overarching.

ARTHUR: John Arthur, DOE. I agree with you. I mean, there's been a lot of good work through the years, and I think the folks are trying to say where we've been. I mean, even when you talk titanium drip shield, I went back earlier and I said what were the trade-offs, including backfill in the drifts versus titanium, other metals, and that, and one of the areas that I'm still not comfortable trying to formalize more, and I'd welcome your comments on that, is the finalization of that structure, because we did our license, I'll give you just a real time example, we did our management review of the license back in the September time frame, you know, the concrete sleeves that we put in the ventilation ducts in time.

There was a late night discussion, everybody was getting a little tired, and it comes out, well, in time you have to remove all that. I said why, it's going to cost me tens of millions of dollars to remove those sleeves in your operating life. Well, it's a TSPA issue because of various minerals in there. And, I said we've got to push that harder. So, I know my folks know we're trying to formalize some more structure. We have a ways to go on that, and I'd welcome your thoughts. I'm not diminishing the work that's been done, but there needs to be a continued pressure on this.

BOYLE: William Boyle. I'll try one more try. If either of the groups propose some fundamental change, ultimately, you know, dose is the common link. Like, if something changed in the repository system, the preclosure people would have to look and say okay, if you change from that to this, and we would do the same on postclosure, and then as a group, we could look at it and go do we like that trade-off, however things turned out. So, it can be done, and I think it was done--certainly it was done in the EIS, if you will, when we looked at hot and cold, both pre and postclosure. So, ultimately, I do think it's some measure like that that links them together.

GARRICK: Yes, and I think dose would be a good example. I think throughput would be a good example, and I think cost would be a good example, and really the question has to do, well, what is the overlying feature that forces this driver for these things. And, you've provided some answers, and I appreciate your comments, John.

LACHMAN: Lachman, DOE. I'd like to add one more thing, sir, if I could. The culture is a questioning attitude. Just recently in the surface facilities, the question of the ALARA, could we do better on doses, led to, the human dose, led to the trolley that Richard Craun talked about, the change in the design that we're working on now. That's just people questioning do we have to do it manually? Can't we do this automatic? Can we not do this remotely? And, the designers took up the challenge, and did it.

GARRICK: Well, as we said this morning, 90 per cent of what you're going to be handling is commercial spent nuclear fuel, and 100 per cent of that experience is, for the most part, within the nuclear utility industry. And, we're hoping that you exploit that resource of experience in whatever you do.

Okay, any other questions? Okay, I'll turn to the staff. I know that a couple of people on the staff have some comments? Leon?

REITER: Leon Reiter, Staff. Bill, I have a couple questions about the drip shield. The first question is you said that it arose during the LADS process. Well, what caused it to arise? What were the reasons that people started considering the drip shield? And, the second question has to do with the--we had some discussion about drip shield corrosion. How important is corrosion in the drip shield, and your risk analysis?

BOYLE: Okay, why did people go to the drip shield, I'm testing my memory, and I think you probably already have an idea of the answer, but people's understanding changed, you know, that whether you think it was the chlorine 36 evidence, or a change in a model that maybe people felt that, well, maybe there's more water available than prior analyses might have indicated, so can we do something about it? Yes.

Now, the second question was, oh, yes, we can do a sensitivity study, and, you know, we've done them, if you will, the one offs and one ons, in the past, you know, with the models we had at that time of, okay, let's take the drip shield out and see what happens, and that sort of thing. And, it depends upon the circumstances, and, you know, if we take out the drip shields day one, day two, the performance is still spectacular because the waste packages work so well. But, the drip shields, they perform well, and if you remove them, the system suffers some.

REITER: I've just go to try and feel how important it is, how much does it suffer? Can you give me any sort of qualitative?

BOYLE: I'd have to go to the old slides, you know, based upon the old models, the one offs and one ons, I don't, off the top of my head, I can't answer that.

GARRICK: John, did you have a question?

PYE: Yes, kind of a ground support question. You mentioned shotcrete, and you indicated I think the value engineering team had a preference towards that. Why was it eliminated?

LACHMAN: The reason for the elimination of shotcrete in the emplacement drifts, and I'm speaking strictly of the emplacement drifts here, was for the chemistry concerns of the folks in the in drift environment. They related their concerns, expressed what that does, what their modeling showed as far as that alteration of chemistry, and challenged us to come up with an alternative ground support system.

BOYLE: William Boyle. It's, as I alluded to, if you look at our, you know, existing calculations at longer time frames, neptunium becomes the leading contributor to dose, and its solubility is highly sensitive to pH. In high pH waters, it becomes more soluble.

PYE: Okay, that aside. The concerns were based on models, on model studies, or model evaluations? Did you do any testing to support the assumptions used in those models with respect to using cementatious materials?

LACHMAN: This is Lachman, DOE. I do not recall any, Bill.

BOYLE: William Boyle: With respect to the understanding of neptunium solubility, it's not only based on models, there are measurements of neptunium solubility as well.

PYE: I understand one of the thrust areas in S&T now is to look at slag based cements, which is a chemical solution to this problem. My question is slag based cements were available ten, fifteen years ago. They were commercially available solution. Why weren't they looked at when you made this decision?

LACHMAN: Lachman, DOE. We brought in outside experts for the ground support value engineering study, as well as the internal ones, and they looked at a variety of different low pH cementatious materials, which is what I believe you're leading me to with the slag based cements. I don't recall specifically if they looked at those individual ones when you were on the program. I'm not sure if your testing program looked at those, off the top of my head, it's a little before my time. Bill, do you recall?

BOYLE: No.

PYE: Okay. A drip shield, the integration between design and PA, the drip shield has evolved now, it's quite sophisticated, it's being dimensioned. Where were the trade-offs, for example, on water diversion, the joint configuration related to, for example, the installed configuration of the drip shield, how were those things integrated?

LACHMAN: I'm not sure I understand your question, John, could you rephrase it, please?

PYE: All right. You have a sophisticated joint which overlaps, which couples one drip shield to another. So, you have two issues. You want to maintain water diversion integrity, but you want to make it installable. So, clearly, there's a relationship there between how much aperture I can have in the joint, how I configure the joint. One is a performance requirement. The other is how do I design, fabricate and install the drip shield? How are those issues integrated?

LACHMAN: Lachman, DOE. We did some testing on sizes of gaps in drip shield, holes, if you will, not necessarily a specific joint configuration. The joint configuration was looked at by the designers as far as how would advective flow travel around that joint. I don't recall off the top of my head what the exact study was, but I do know we did testing of different hole sizes in a simulated drip shield to see what kind of--how any advective flow would occur and what would occur to those holes.

PYE: Okay, one last question. Along with the major design features, the layout, some of the major design decisions were based on LAD studies. But, the PA at LADS was a PA/VA. Many of the design features couldn't be adequately characterized. They simply couldn't be incorporated into PA. So, qualitative assessments were made. But, the design essentially is being locked in by the decisions made at LA. Would it be interesting to go back with the PA you have now for LA and look at the design features and try to optimize them and improve on performance?

LACHMAN: Lachman, DOE. I'd like to address the part that the layout was locked in back in the LADS time frame.

the layout has changed significantly. The area of the underground was--an interdisciplinary team worked on maximizing that, and then the actual drift, emplacement drift layout has changed significantly since 2000, and that has been presented to this Board.

PYE: I have one last question. But, again, the variables, the drift diameter, the drift spacing, the volume throughput from ventilation, all of these things were fixed then, and have never been looked at again?

LACHMAN: Lachman, DOE. I disagree that they've never been looked at again. The ventilation AMR was revised as recently as last year, looking at the ventilation flow rates and were they adequate to remove the heat that we needed to be removed in the preclosure time period. I'm certain that the others have been looked at. Bill may be able to discuss more on the individual AMRs, but that one is close to me, being a subsurface guy.

GARRICK: Okay, I have Dan, and then I have David of the staff.

METLAY: Dan Metlay, Board Staff. I'll direct this to Bill, because he sort of opened it. But, maybe John or Margaret would care to comment also. I don't quite understand what the meaning of this January 28th closure of the crack is in the context of the fact that the EPA standard still has not been resolved. So, could you explain what exactly the January 28th, the meaning of the January 28th closure is?

BOYLE: William Boyle. I don't think it had anything to do with the EPA standard. You know, I don't know when EPA is going to do what they're going to do. In terms of day to day, we're going ahead and doing work, and, you know, we'll see what happens with the EPA. That's my answer. They have nothing to do with each other.

ARTHUR: On the January 28th, there's internally right now reviews and modifications to the license. Arthur, DOE. So, there are modifications that I think were pretty open this morning about they're underway in a license. And, my point is have we said clearly, we'll wait and see what EPA comes out with in spring, summer? But, as far as planning to have an LA ready, we are in the process of some final reviews in certain areas, and tighten up certain sections of that license, versus just keep everything open and just go on from year to year with any uncertainties. You have to manage a project like this, and while we're continuing to try to optimize, we're trying to continue to improve in areas, and work for readiness of a license this year.

BOYLE: William Boyle. I'll follow on, Dan, and I'll show you that they're not related. The TSPA that we're working on now is a 10 to 20,000 year TSPA. Yet, the EPA could conceivably come out with a standard that goes out to a million years, and if they do, we'll have to deal with that. I don't know what they're going to do.

GARRICK: David?

DIODATO: Diodato, Staff. This is more of a process sort of a question I guess. John, if we could have Slide 8 to illustrate this, this is the value engineering studies idea, and what I'm curious about is whose values are actually represented in the value engineering study? You have a list of evaluation criteria there, and presumably some or the other of these criteria have more weight, carry more weight in terms of your decision making process. So, what I'm wondering is who sets those weights, or do the individual evaluators use their own weighting system?

LACHMAN: Lachman, DOE. The weights are set by the team. As you see on there, there's a certified value specialist that approved this as a check of those weights. The team again, and this specific one included not only BSC, DOE, MTS staff, but also outside world experts in cementatious materials, George Yaggi (phonetic) was on this. Mark Board was on this team. This is a group of knowledgeable experts in the field.

DIODATO: So, you have a consensus system of weights in your evaluation process?

LACHMAN: Yes, which is the value engineering method, yes, they followed the value engineering methodology. This wasn't an invented process. It's by the certified value specialist.

DIODATO: Does it ever happen that you get a result from one of these studies that gives you the wrong answer, and you revise it? Again, you go back and maybe you revisit the study by tweaking some different weights or that sort of thing?

BOYLE: William Boyle. The ESF alternative study, which I have some knowledge of, I showed the slide of it, and I'll use it as an example of what I think is the common practice of such studies when they're looking at multiple alternatives, is a good practice is to vary the weights, you know, take derivatives with respect to the weights and see is the answer sensitive to one of the weights, two of the weights, any of the weights at all. So, I can't speak with respect to these studies, but for the ESF alternative studies, the weights were looked at to see whether or not they changed the information that came out of the study.

DIODATO: Okay, thanks. I'm still going to try to figure out in my head how or who makes the ultimate decision about what weight is acceptable for what criteria. Is that the individual value, this person that does the certified value specialist?

LACHMAN: Lachman, DOE. No, it's a team effort to set those weights, but it's a consensus, as you stated. Each individual then has their--doing their rankings on the value matrix, if you will, uses those same weights. They're not each picking their own.

DIODATO: They accept whatever they come up with?

LACHMAN: Yes.

GARRICK: Okay. Garrick. We, as you know, we have a public comment period scheduled for the end of the day. But, one person has requested to speak prior to lunch. Atef Elzeftawy. I'm sure I butchered his name. But, you have the floor.

ELZEFTAWY. Thank you very much for allowing me to present for a second here. I understand that most of you are new to the Board, except maybe one or two, so welcome to the Board. And, I'm not sure if that was a good decision for the Congress in 1987 to create that Board, or not, but I was very, very optimistic when the fathers did that, except I was very sorry that they decided that Yucca Mountain only has to be characterized. That's the politics of it. But, that's reality.

I have one personal comment, actually a little story, and then I'd better take the Las Vegas Paiute Tribe name tag now, because I have one official comment for the record.

But, for most of you who are carrying that nice beautiful title, PhD, it comes with it a lot of responsibility. If you remember, your graduate school a long time ago, your professor asked you to be honest, asked you to be correct, asked you to be forthright, and I think you did. And, then, you stood up in front of about 10 or 15 people, like I did two times, once in Egypt and once here, they grill you, and then after that, they say, well, we'll give you a piece of paper, now go and get a job.

And, then, you work for a private company. Your boss will tell you what to do. If you don't like it, tell the boss I'm leaving, or you work for the university until you have quote, unquote, the freedom of thinking, of doing things you do, or you work for the Federal Government. John Arthur will tell you if you go and tell him with some crazy idea, he said you're crazy, get out of here.

The chancellor of the university, or the president, can't tell you that. So, this is at least a little bit of freedom that it's assured, and it's better yet when you'll be like stupid like me, work for yourself, nobody gives you money, and you are comfortable in life. You send your kids to Berkeley, and you pay $45,000 a year for each one of them until they graduate, and because you were born in Egypt, you consider whites are no more of these goodies, but anyway, that's a long story.

I want to tell you one thing to refresh you before lunch, and that is there's two people comes in mind, they're both gone, one of them, Linus Pauling, and the other one is Bragg. And, even though they were the best scientists in their field at the time, they had a little bit of arrogance in their career. And, Linus Pauling decided that the DNA should have three strains, and you know the rest of the story. He didn't get his third nobel prize.

Bragg, in England, was so mad at Crick, because Crick has a loud voice and Crick was sort of bringing all these ideas, resolve this all the time, so he pushed Crick all the way down to the haul, and he didn't like the guy, and he never thought that Crick would come up with something. And, he even thought that he's a loser as far as peach of the year, and they almost fired him. Well, they can do that in England. They can't do that here. But, the rest of the story is known. Fuell knows Crick, and you know knows Watson, and you know that DNA, and the rest of the story.

So, I think a good lesson of this story is for all of us who hold a responsible position, you need to come to grips of telling the truth, the whole truth, to the public, to the citizens like me.

Now, this is my formal comment with regard to Las Vegas Paiute Tribe that is paying me a couple dollars to come here. When our chair got the letter that you guys send to everybody else, especially to the Honorable Dennis Hastard and Ted Stevenson and Spencer Abraham, she read it and the council people read it, and it has to do with the corrosion issue. Now, the Chairman of the Board, John, tells us that this is the official Board decision. Now, when it comes to the corrosion issue, I think the jury is still out, with the exception of you'll get yourself a loop hole, keeping the calcium chloride.

Now, the perception of the letter for the politician and for the people who don't know a whole lot about Yucca Mountain and don't know the details, gives the clear perception that the corrosion issue is solved, and it's done. And, as a physicist, as a chemist, as a hydrogeologist, I think I beg to differ with the Board.

So, the official comment of the Las Vegas Paiute Tribe is, for the record, you need to go back as a Board and look at the corrosion issue and not to give yourself a little room and say calcium chloride, that it's potassium chloride, as all other chemicals, there is sulfate, there is nitrate, all other chemicals you need to look at. It's a critical issue because I commended the Board before you came along under bold action when they took that and they said, hey, DOE, we have a problem with the corrosion.

That was the first time the Board as a Board stood up and said, hey, do something. You asked a lot of questions on your own, good questions, all of you are honest, all of you are decent, but I think once in a while as a Board, you need to tell DOE, just like the CIA guys told Bush some time ago, it's a slam dunk, and you know the rest of the story. It's not slam dunk.

Thank you very much for your time, and I appreciate that. Good luck to you tomorrow and good luck to you for this afternoon. Thank you, Mr. Chair.

GARRICK: Thank you. Andy, did you have something?

KADAK: Yes, I have a question for John Arthur.

GARRICK: Give you name.

KADAK: Kadak. John Arthur, please. You know, I was looking at your slides and thinking about it a little bit relative to the license application. Typically, NRC wants to know who the licensee is, and I'm assuming in this case, it is the DOE.

ARTHUR: That's correct.

KADAK: And, as part of that license application, they look at organization and qualifications of the organization, and this relates to the question earlier about who's going to run this thing. What is your intention in that regard?

ARTHUR: Well, where we are right now in the license application, a particular chapter, as you point out, that has an organization, will be presented as the licensee. Right now, I'm accountable for the actual license application, accountable for that design and engineering reported through Margaret in Washington to the Secretary.

If we move ahead in one of the areas we've been working, some of the key positions in time, it is clear that for a project of this caliber, DOE will be the licensee. And, as I think Chris Kouts pointed out this morning, we are looking at a long-term contracting acquisition to make sure we have the right mix of contractors for this kind of work.

Outside of that, we're developing a formal qualifications program, and I've been real careful in some areas to say every position will not be federal. We're going to have either assignments, like right now in the seismic area, we have John Ake, that many of you have heard before, that's assigned from the Bureau of Reclamation, and other key resources. Some of those will be filled by senior contractors, but the Department of Energy will be the licensee.

And, in time, I'd be glad to come out and present to you more details about the organization, the structure, our qualifications program, and how that's all going to be operated. That may be a good topic for the May meeting. But, that's where we are.

KADAK: Thank you.

GARRICK: All right. Well, I think we've had a wonderful session this morning, and we're on schedule, and unless there's a burning question that remains, I think we'll adjourn until 1:15.

(Whereupon, the lunch recess was taken.)

AFTERNOON SESSION

GARRICK: If we could get the afternoon session underway? We're going to start this afternoon with Paul Harrington. Are you ready?

HARRINGTON: Good afternoon. I'm Paul Harrington. I'm the Senior Technical Advisor in the Office of Project Management and Engineering to talk to you about our thermal management strategy. The focus of this will be broader than a lot of the thermal discussions we've had in the past, in that I'll be talking about how we'll address thermal controls that we apply in the surface facilities, and we'll do management of incoming waste streams, and we'll define loading patterns for waste packages, and then take it to the subsurface.

That begins with an integrated waste stream management approach. We'll talk about the requirements and criteria relative to thermal management, some of the design features that we have that address those, the concept of operations for surface, subsurface, waste package loading, and some ongoing evaluations that we're doing relative to thermal management.

Next, please? The waste stream management starts at the utility and at the DOE sites. We're using the waste generator records to derive the thermal content of the incoming waste stream. It's primarily an issue for the commercial spent nuclear fuel. For the DOE SNF, we're using historical records that the DOE has. For the high-level waste stream, that's being fabricated, created by DOE, so we're creating the records to support those.

That thermal management strategy needs to be maintained throughout the preclosure period. It's not something we can step away from at the point of emplacement of a waste package, because we need to monitor the heat generated by that waste package throughout the preclosure period, so we can assure ourselves that as we start the postclosure period, we will have met the postclosure initiating conditions.

The waste form thermal content is primarily driven by the commercial fuel, because it's hotter, it's much more of a key variable than the colder DOE fuels. We can age relatively young fresh out of reactor, that has to be at least five years out of reactor, to be considered standard fuel. If it's older and colder, it may not require any sort of aging. And, we will blend fuel, commercial fuel, to meet the thermal goals, both of the waste package and of the subsurface emplacement drifts. The blending is insertion into a package of a combination of older, colder fuel assemblies, and younger, hotter fuel assemblies. We do have to meet the overall thermal criteria, though, for that waste package.

There's a DOE product called a design basis waste stream report, and that's what we use for planning purposes. That pulls information together about the likely waste streams that we'll get from utilities. It defines several different fuel paths. There's a youngest fuel first 5. YFF5, approach that says you can take, or you will receive, and would need to accept youngest fuel from reactor sites first, with a minimum of five year old out of reactor age, or YFF10, be ten years old out of reactor.

There's also an average waste stream, YFF10, that we use for most of the planning purposes. That's an average of 17 years out of reactor, 4 per cent enrichment, and 44 GWd/MTU burnup.

The waste packages get emplaced in a nominal pattern, intermixing the hotter commercial packages with the cooler DOE SNF, high level waste, Naval packages. The actual emplacement pattern may vary, but the overall thermal goals have to be maintained at point of closure. So, that will require some alternating emplacement. And, I'll talk a little bit later about campaigning, and how that might affect this.

The tools that we have for managing the waste stream, there's a total system model that was discussed earlier today. That's looking at the entire system, including throughput. We're also doing more specific throughput modeling for the individual facilities that looks at the waste receipt to the repository, the selection of a facility to run that waste through, the management of individual fuel assemblies, aging needs, the loading of the waste packages, and then followed by emplacement.

The Total System Performance Assessment is looking at the postclosure performance. That is based upon certain thermal criteria that the preclosure has to deliver in its waste package loading and thermal management.

The waste forms, shifting to design requirements and criteria, the waste forms themselves, we need to maintain the commercial spent nuclear fuel cladding below its allowable temperature limits. Those are for normal operations in the surface facilities, 400 degrees C.

We're currently working on polishing, if you will, the off-normal temperature limits. We are using a particular value now, but a lot of the information that's out there is based upon commercial fuel in an inert environment. I'll mention later that our fuel transfer will be in air, so we're validating an appropriate and off-normal upper temperature range at this point. They haven't concluded that exercise yet.

The subsurface operations postclosure, we want to maintain 350 degrees C temperature limits. For DOE SNF and high-level waste, we'll maintain canisters below allowable temperature limits. There's a range of those. For example, the high-level waste and glass form has a 400 C limit. The Naval canisters actually have a time temperature curve associated with them, and we're working with Navy to ensure that the facility will satisfy those requirements.

The natural and engineered barriers have a rock wall temperature of 200 degrees C max. The center of the drift pillar is still to be below 96 degrees C to provide a zone for liquid water to drain between pillars. The waste package surface temperature, 300 degrees C max. The waste package thermal output at emplacement is still limited to 11.8 kilowatts, and the initial maximum average thermal line load is the 1.45 kilowatts per meter. That's unchanged from where it's been the last several years.

GARRICK: While we're on this slide, Garrick, what do you consider to be the most limiting?

HARRINGTON: In terms of thermal output? Certainly commercial fuel, relatively fresh.

GARRICK: As a criteria, as a design requirement?

HARRINGTON: Right now, I believe that the 11.8 is the limiting. If one of the thermal analysts has a different take on that, please--okay, I'm getting a no. So, 11.8 would be the max, and that's to ensure that the other thermal limits are maintained. Any other questions on that?

GARRICK: No. Thank you.

HARRINGTON: Okay. For repository closure, we need to ensure that the thermal pulse, once we do close, cease any ventilation operations, there will be a temperature spike. I want to make sure that the emplacement drift wall stays below 200 C, the waste package itself, below 300 C, maintain the cladding of the commercial fuel below 350 C, the high-level waste canisters below 400 C. Those temperature conditions are important to initiation of the postclosure period.

We have to ensure that the repository temperature profiles, both of the engineered waste form and barriers, and also the profile through the rock are what we expect to have. That will define the thermal energy contained in the repository system. We need to ensure that the repository thermal output is what we expect to be at point of closure. Specifically, the 11.8 is the waste package thermal content at point of emplacement. It will continue to decay during that period prior to closure. We need to validate that at closure, that's where we expect to have it be, so that postclosure, the amount of heat generated will be properly addressed.

And, also, the thermal power rate of change. If it's relatively fresh fuel, it will be on a steeper part of the decay curve. It will cool off more rapidly in postclosure. If it's older fuel, it's on a flatter part of the decay curve, so it would not tend to cool off as rapidly in postclosure. So, all of those things need to be validated prior to closure. Repository performance confirmation will confirm the thermal calcs.

Next slide, please? Just to reiterate some of the features and functions, on the subsurface, we need to control the waste form temperature, the containers, cooling systems within the buildings will do that. We'll talk a little more about that in the conduct of operation section in a moment. Maintain the engineered barrier thermal limits. Subsurface, much of the same, as well as the natural barrier.

Now, not a lot has changed here recently. This is still the set of facilities at the north portal. The portal entrance, the individual transfer takes place in these buildings, and this is the 20,000 MTHM worth of aging. There's an additional 20,000 available as contingency. There is 1,000 MTHM local to the facilities.

KADAK: These are all above ground?

HARRINGTON: Yes, that's above ground.

Next slide, just a reiteration of the various waste forms coming in and the packaging for them. The transportation casks for rail and truck, both large and small dual purpose canisters, individual spent fuel assemblies, a series of DOE SNF canisters, as well as high-level waste canisters, and a range of waste package perturbations to accommodate the different waste forms.

Next, please? We'll shift to the design features themselves. Each of these play a role in thermal management. The transportation casks have thermal limits on them that the shippers have to meet prior to shipping. The waste packages have thermal limits on them. The aging system is there to accomplish cooling of relatively uncommercial spent fuel. The waste processing facilities have to maintain the allowable temperature limits on the different waste forms. One of the means of doing that is through the HVAC systems in those facilities. The emplacement and retrieval system has some temperature criteria on it. The waste package transporter has a very heavily shielded device.

So, as the waste packages in that transporter are being taken underground, we need to make sure that the waste package doesn't exceed its allowable thermals. Likewise, we have to be able to do the retrieval action, if there were some reason to do that, which might include thermal issues.

The subsurface facility layout has a lot of thermal criteria behind it, the spacing of the emplacement drifts, the rate of ventilation through the subsurface. All of those contribute to thermal management.

Shifting to the concept of operations in the surface facilities, again, we'll use the waste generator records and evaluate those prior to shipment to the repository to then be able to predetermine the disposition when it arrives at the repository.

If commercial waste, for example, is cool enough that it would support direct placement into a waste package, and emplacement subsurface, we can do that. If it happens to be younger, hotter, that cannot support the waste package thermal criteria, then it can be put out into the aging system.

Okay, the buffer areas and aging pads, one thing I did not mention on the graphic, was the buffer area, the initial waste package receiving area, both for rail as well as truck casks, and also another area that can contain up to 30 transportation casks on SRTC, site rail transfer carts, the sum of those two areas is considered the buffer area.

Now, we can maintain transportation casks in that area. We can use that to do some staging for campaigning. But, that's also another means of doing some thermal management. The interspersed emplacement of waste packages affects the extent of campaigning.

One way to address that, if the program were to try and do extensive campaigning, one effect of that would be to send a series of like waste packages underground relatively close in time. Now, we've talked a couple of times about the need to intersperse them for postclosure purposes. We could do the series of similar ones subsurface in preclosure, but then you'd likely want to go back prior to closure and reshuffle those into a pattern that would more support the postclosure performance requirements.

KADAK: Is that part of your plan?

HARRINGTON: To do that reshuffling? Not at this point. But, in terms of campaigning, if you wanted to do an extended campaigning, that's something that could be done. But, at the current point, we're expecting to emplace in a pattern that we could likely leave it as is, and not have to go back and do additional subsurface handling work.

Next, please? Also, on the surface facilities, we need to maintain thermal limits. Within the two dry transfer facilities, each of them includes some staging for individual fuel assemblies and for the smaller DOE SNF and high-level waste canisters. In the transfer cell area, these are the capacities, 48 PWR, 72 BWR and 10 of the smaller DOE SNF or high-level waste canisters. There's no staging for full diameter canisters, because there's no real reason to do that. You receive it in a transportation cask. Then, you would put it directly into a waste package. Or, if it were, for example, a DPC that was going out to aging, you'd put it into the aging overpack and send it out there.

But, the smaller canisters and individual fuel assemblies that come in in transportation casks, the receipt of them and the transportation casks will not directly match the inventory of a waste package. So, we need to have some staging within the facility to accomplish that. So, this is the amount of staging inside each of the DTF transfer cells to accomplish that.

The CHF, because it only handles canister, does not handle individual fuel assemblies, only has the small canister capability for the 10 DOE SNF or high-level waste. No individual fuel assembly capability.

The FHF is the newer smaller building. That came into being January a year ago. I know when I briefed you about ten months ago, it had just come into being, and we had some very conceptual sketches of that. That has developed, and part of the development of that is that rather than having staging racks per se in that building, it does have a transfer cell arrangement similar to the DTFs. Instead of a staging rack, we'll actually have an aging cask in there. So, fuel would come into that building in a transportation cask, and it would be off-loaded in the transfer cell, either into a waste package or into an aging cask. There's no separate set of staging racks in there.

To reiterate, the transfer cells themselves are not inerted. These will be transfers in air. So, we're continuing to do evaluations to make sure that we have a prudent approach for that that we can maintain thermal criteria.

The thermal analyses that we're doing for these structures are being done based on the bounding heat loads, rather than the average PWR waste stream that I showed a moment ago. The bounding for PWR is the 80 GWd/MTU, 5 per cent enrichment, 5 year out of reactor. So, for thermal calcs. for shielding, we used the bounding source terms.

For off-normal conditions, such as loss of ventilation, we're doing evaluations for those also.

The aging pads themselves will support thermally cooling commercial fuel assemblies until they satisfy the emplacement criteria. We anticipate having a capacity of up to 21,000 MTHM. That will likely use a combination of different types of aging casks out there. We're in the process of developing what those will be. We're talking to existing Part 72 vendors, looking at theirs to see how translatable they can be to a Part 60 environment. We would have to do, all the aging system has to be licensed under Part 63, so we'll have to satisfy Part 63 repository seismic criteria, for example, which may or may not be enveloped by some of the existing components. So, that's what we're doing now as one aspect of the aging.

We also would expect to have the capability of receiving some of the existing DPCs. If they were capable to be shipped to the repository, we certainly need to be able to receive them, open them, and for aging purposes, we may put them in a compatible overpack and put them out on the aging pad, rather than doing an immediate unloading at point of receipt at the repository.

Waste packages. We will develop waste package loading criteria. That is not developed at this point. That will have to address the thermal, as well as criticality, shielding, other criteria. It will likely be similar to some of the controls that are on the existing dry cask systems. There are nolangraphs (phonetic) and other methods to ensure that the patterns that are loaded within those dry casks will satisfy the safety analyses for the casks. We'll have to do the same thing, too. We have not yet developed that level of detail, though, for aging casks, or for waste packages.

The main waste packages are the 21 PWR and 44 BWR capacity. We do have a 12 PWR capacity. That was intended primarily for the South Texas fuel. It's longer than most of the rest. That also could be used to dispose of particularly hot fuel assemblies if there was a need to go directly to a waste package for emplacement rather than continuing with some aging.

Likewise, rather than filling either of the larger waste packages up to their full inventory, we could short load them, put 17 or 18 or 19 into a 21, instead of filling it. But, that would be an inefficient use of them. It would require more waste packages, and more emplacement drift for them. So, that's not an optimal solution.

The subsurface facilities have to maintain the thermal limits also. The duration and flow rates for preclosure ventilation have been established to do so. We're still looking at the 15 meters per second per drift as the flow rate. The duration is on the order of 50 years from initiation of subsurface ventilation.

As time goes on and the emplaced waste packages cool, the flow rates may be able to be decreased. We have talked in the past about going to passive cooling, rather than continuing to run the fans for the entire preclosure period. As we look at the thermal output, and that will be in part dependent upon just what the actual received CSNF is, we'll determine whether or not the ventilation needs to be maintained mechanically, or if we can at some point later, shift to a passive system.

The waste packages and cladding, though, can withstand extended interruptions in ventilation subsurface before the thermal criteria are met and any damage would have been caused to them. Extended is on the order of weeks or months. We've done some preliminary evaluations there. Those are continuing.

Again, I'll reiterate, though, the initial postclosure conditions have to be met by the preclosure functions, including the ventilation and thermal management, prior to initiation of postclosure.

The next slide is a graphic of a typical dry cask storage system. This uses independent vertical casks. There are other types that use horizontal canisters inside a large module. This is similar to what the aging pads would look like. We would likely expect to have a combination of the independent vertical ones, as well as the horizontal type.

Some of the ongoing evaluations in thermal management. We're doing throughput modeling of the waste facilities. We're doing system optimizations. It's, in part, some of what the thermal--or the total system model was to cover. We're doing individual safety and operational evaluations, looking at operator doses, minimizing the handling operations, also to provide input to the safety analyses.

We're recently done a series of worker dose assessments for each of the waste handling buildings to get a sense of what might the workers be exposed to. We're using that in some facility optimization evaluations. Look at how we can remove workers from the need to do as much close handling of transportation casks, for example, just a general ALARA process, figure out how we can best reduce worker dose.

So, thermal evaluations are ongoing. There's one graphic that I particularly like that was too busy to put up here, though, that basically addressed temperatures throughout the waste receipt, processing, transfer, and emplacement cycle. So, it had temperatures on the exteriors of transportation casks as they come in, as they're being handled, lids removed as the waste transfer is taking place, of the waste packages, as they're being moved into the closure cells, as the welding progresses, then as the waste packages are taken underground. It's very busy. It wouldn't have worked for this. But, it's significant ongoing thermal evaluations throughout the facility, and that's the real message I want to get across.

Also, a significant amount of effort is being put into the handling of commercial fuel in air. As I said earlier, a lot of the data that exists is relative to fuel in an inert environment. Given that we're intending on doing transfers in air, we want to make sure that the expectations that we have for that fuel performance in terms of whatever oxidation and potential unzipping it might have are supportable. So, those evaluations are ongoing.

Next, please? The total system model, I'll reiterate that, I think it had much more in depth discussion earlier, is looking at the effects of the varying waste streams, and will provide information to help optimize some of the operations.

Total System Performance Assessment. I'll repeat again the importance of the integration between the preclosure activities, particularly in thermal management, with the TSPA to ensure that we have a mutual understanding of what the initiating conditions need to be for postclosure, that the TSPA folks will use to support their evaluations, such that the preclosure folks can ensure that we've delivered that.

And, in the preclosure safety analysis itself, something that we have to do under Part 63 to look at the total system, if you will, preclosure performance to ensure that we satisfy the performance goals for worker and public dose. So, thermal plays a role in that also.

In summary, the thermal content of commercial fuel, particularly if we get a preponderance of the younger, hotter stuff, will likely require some aging capability. Those systems will be similar to the existing dry cask storage systems. We do need ventilation, surface and subsurface, but we can withstand interruptions in that ventilation for periods of weeks. We need to make the thermal goals prior to closure, and we're continuing some of the analytical work.

So, with that, I'll go ahead and take questions.

GARRICK: George?

HORNBERGER: Hornberger. Paul, it strikes me that from your presentation, that moisture is totally independent of heat, and vice versa. We know that's not true, and I guess my question is do you ignore things such as the cold trap effect, because you have evidence that it isn't important, or because you can't manage the waste emplacement, minimize the effect anyway?

HARRINGTON: I'm going to defer those sorts of postclosure questions, cold trap questions, to Bob and his follow-on presentation. I had really been expecting, and I thought the questions were more toward how does preclosure ensure that we can deliver the postclosure set of initiating conditions, rather than what happens once you have gotten into the postclosure. So, I'm sorry, I'm just not really prepared to talk to that right now. Bob would do a better job.

GARRICK: Howard?

ARNOLD: Arnold. You're starting from the assumption that you can blend fuel assemblies into a canister. That wouldn't be allowed, you wouldn't be able to do that if we had a dual purpose canister system.

HARRINGTON: A dual purpose canister system, as we have defined it, is storage and transportation. So, there are DPCs out there. At the repository, we're expecting to have to open those up.

ARNOLD: We talked this morning about the possibility of not doing that.

HARRINGTON: Right. So, if that were the case, if there were a disposable canister, then the sorts of criteria that I discussed there would need to be satisfied at point of loading.

ARNOLD: Right.

GARRICK: Andy and then Ron.

KADAK: Kadak. What do you define as hot and what do you define as aging relative to how long before you can dispose of, say, a standard spent fuel assembly?

HARRINGTON: Well, 11.8 kilowatts is the total for the waste package at point of emplacement. So, that's basically point of loading, because we don't have any staging area for waste packages once they're loaded. So, that would be an average of on the order of 500 watts per assembly at point of loading. Now, fuel that's five years out of reactor is certainly a lot hotter than 500 watts. It's well over a kilowatt. So, if we got a series of five year old fuel--

KADAK: I'm asking you how long do you anticipate aging of the spent fuel before you're comfortable in loading it into the repository? Is it 10 years, 20 years, 30 years, what number are you looking at?

HARRINGTON: That would depend very much on the fuel itself.

KADAK: Understand.

HARRINGTON: That said, I'm expecting on the order of 5 to 10 to 15 years.

Preston, is there another value that would be better to respond to that?

KADAK: I mean, the concern is you're modeling for the extreme, and you may not even get there in terms of most of the fuel you have to dispose of. So, all your pads, all your storage facilities may not be necessary to be as big as you're planning, because--and you may be able to put the canisters closer together, because they're really low, maybe significantly less, because of the age of the fuel. So, I'm just trying to get a sense of how far out you're thinking of, given the standard PWR, BWR fuel today might be--need to be aged. Is it 10 years, 5 years, 15 years?

HARRINGTON: If you can answer that, then I'll go to his follow-on point.

MC DANIEL: Okay, my name is Preston McDaniel with Bechtel SAIC. It depends on the waste stream coming into the facility. But, it could be 20 years plus, depending on what we put out on the aging pad, and then, also, what is the other waste stream that's coming in.

KADAK: I'm asking for commercial spent fuel. What is your expectation? Keep it narrow to that point.

MC DANIEL: I'm trying to answer as I can, but it depends on the incoming waste stream.

HARRINGTON: Can I go to the second part of that? Your concern was that we could potentially need to build a lot of staging and not need it if we had an older, colder. The intent is to build the staging--I'm sorry--the aging in stages. We have some graphics that show the progression of the facilities through time.

When the first building comes on line, the fuel handling facility, the only aging that would be associated with that is the 1,000 MTHM adjacent to the north portal facilities. When the next building comes on line, the CHF, the aging associated with that is the first of the 5,000 MTHM modules. The other three 5,000 MTHM modules are tied to the DTF-1. But, really, we would only build them as we found them to be necessary.

So, if we ended up getting a preponderance of older, colder waste that did not require aging, we would not build that.

KADAK: How much interaction have you had with the utilities, physically talking to them about what's in their spent fuel, and how old the stuff is, and what the general content is? Because our approach is oldest fuels first, not youngest fuel first, which is completely different than what your standards are. So, I'm just trying to see whether you're communicating verbally with these people, so you can I think more realistically plan your strategy, not only for storage, but also for loading.

HARRINGTON: The discussions with the utilities have taken place through our Waste Acceptance group in Washington, not through me. What I get is the design basis waste stream report. That's their best guess, if you will, as to what the result of that will be. But, that would be a Chris Kouts question.

KADAK: And, when you say their, you mean the DOE group in Washington, not the DOE utility groups working and trying to understand this?

HARRINGTON: DOE/RW has an East Coast and West Coast. Part of the East Coast organization is Waste Acceptance, and that's their role, is to do those interactions with the utilities. They're the ones who have done the data calls, who have had some conversations with them. So, we have not. What the Waste Acceptance group does is create something called the waste stream report, and that's what we use as a basis for our modeling.

KADAK: And, you think they're having conversations with the utilities?

HARRINGTON: They have some. There are some constraints on those also.

GARRICK: Ron?

LATANISION: Latanision, Board. This is a corollary or follow-on to Andy's question. Let's go to Slide 14. I learned this morning for the first time that the capacity of the aging pads has decreased. I understood it to be more like 40,000 metric tons.

HARRINGTON: Right. In the EIS a couple years ago, we had gone for a bounding approach to this. So, we had a value of 40,000 in there. And, then, the repository design, up until about last spring, we were carrying that 40,000. That's why on that one graphic, there was the one set of 4,000 or 5,000 MTHM modules. Slightly remote from that, there was another set of four modules. We did some throughput analyses, though, and determined that the likely amount that we might need is on the order of 17 or 18,000.

So, in order to keep the 5,000 module approach, plus the 1,000 local, we just backed it from the 40,000 back to the 21,000.

LATANISION: But, in order to make that judgment, you must have done the calculus that Andy is talking about, based on the arrival of waste, the character of the waste, and--

HARRINGTON: Based upon that waste stream report, yes.

LATANISION: Right. So, I mean, I think it emphasizes how important the discussions that Andy was asking about in terms of the communications with the utilities.

HARRINGTON: I agree those are important.

ARTHUR: Arthur, DOE, if I can? First of all, Paul is right. I don't think Chris is here, but, I mean, the report, we go out to utilities on, I forget what the frequency of the basis is, to ask for information for those reports. So, when you talk about our requirements, we're setting up requirements based on what we received. As you're well aware, there are a number of litigations because of our failure to open in '98, so, it's not as frequent telephone calls, that kind of thing, but we're going based on information provided from the utilities in those reports. And, Ted can answer some more if he would.

GARRISH: Garrish, DOE. Andy, let me just tell you from our standpoint, this has a lot to do with the delivery commitment schedule. As you know, we put out a delivery commitment schedule this summer, and then because of the change in when we're going to file the license application, we had to withdraw that. At the time, the utilities, under their contract, can designate which fuel they're going to send us, and the concept is oldest fuel first, but it's a contractual arrangement whereby the utilities can determine which fuel to send. Therefore, there could be substantial variation in what that amount is.

We did, at the time that we sent out the delivery commitment schedule, we did ask the utilities if they would tell us in some rough idea which fuel they intended to send us first. There was a relatively minor number of utilities that told us what that might be. But, that is a question that we intend to pursue, and in the long run, this is something that's going to be very important to how we start up and how we operate. But, right now, we are constrained by the utility contract.

We do intend to have discussions with the utilities, as we can do that, with the Department of Justice on some kind of arrangement. But, it's an important point, and your point is well taken, and we intend to follow that through.

GARRICK: David?

DUQUETTE: Duquette. I've asked this question before of the facility itself, and I've never really been happy with the answer, or happy is probably the wrong word, but never really understood the answer. Everything seems to be predicated on the fact that we have a certain number of utilities that have nuclear reactors at the present time. Should the U.S. go back to a nuclear power policy and build new reactors, are you designing anything into your aging pads to take into account the fact that there might be an increase in the nuclear power capabilities in the United States?

HARRINGTON: No. I can elaborate on that a little bit. I mentioned earlier there was a contingency area, if for some reason there was a need to put more out there beyond the 21,000, there's real estate certainly to accommodate 40,000, we would have to redo safety analyses, the current safety analyses are being done based upon 21,000. So, there's nothing that would preclude us from being able to do that, but that's not part of our current plan.

DUQUETTE: Duquette. And, that would also include the fact that that fuel that came in, since it wouldn't be held at the utilities longer, would be younger and hotter, which would mean a longer aging period at the site. Am I correct on that?

HARRINGTON: Yes. The standard contract defines standard fuel as five years old, at least. So, we may get a lot of five year old fuel in those sorts of scenarios.

DUQUETTE: Thank you.

GARRICK: Andy?

KADAK: Kadak. Could you explain why the waste package loading criteria haven't been developed yet, given all your other limitations and criteria you've established for the package and the temperatures?

HARRINGTON: Because that's something that we believe can be done. There's certainly precedent out there for that in the dry cask storage. Our focus today has been over the last several years to get the facilities designed. I'll be able to load a package once I have a building to do it in, but our focus needs to be to get the building done also.

KADAK: But, don't you think the waste package loading criteria are important in terms of the integrated design of the facility above and below ground?

HARRINGTON: Certainly.

KADAK: I was just curious as to why it hasn't been done.

HARRINGTON: For example, the 11.8 criteria, that will be one of the major drivers for the waste package. That will determine in part how long waste might have to stay out on aging. So, that thermal analysis has been done. What we focused on most recently is the building, to be able to accomplish it.

GARRICK: Carl?

DI BELLA: Carl DiBella, Staff. Could we turn to Page 7? I want to ask a question about the thermal criteria. It's my recollection, and please correct me if I'm wrong, that that 11.8 kilowatt max is actually derived from calculations that answer the question if we have a thermal line load of 1.45 kilowatts per meter, and these other criteria, what's the maximum thermal load that we can accept in a waste package, and it turns out that number is 11.8. I think the limiting criteria is the wall temperature, but I could be wrong on that.

As far as I know, and, again, this is my question, you have not done any sort of design examinations to determine if there are design changes that could be made, either in operations or in the engineered barrier system itself, to allow a higher thermal power load in the repository, am I correct on that, or not?

HARRINGTON: There actually had been some analyses done several years ago prior to the adoption of the 11.8 max. I remember that the waste package thermal limit used to be 18 kilowatts a few years ago. We shifted to 11.8 to achieve lower postclosure temperatures. In the future, that may be re-evaluated, but that's not something that we would do near term.

DI BELLA: I may not have asked my question right. Have you looked at design changes that would allow a higher number than an 11.8 kilowatt, with all of the other criteria remaining the same?

HARRINGTON: Not in recent years.

DI BELLA: I didn't think so. And, then, one other follow up question on the same line, on Page 16, I'm looking at the 50 years there, which is only 25 years after the last package is emplaced. We heard 100 years earlier today, and we've 300 years before. It seems to me that you are limiting some valuable flexibility that you have available to you by choosing this 50 years. Can you tell me why it was chosen?

HARRINGTON: What I was trying to get to in this was active ventilation, and as I read this this morning, I realized that the word active is not there. That was the discussion that we did a little bit earlier about shifting from active to passive. If we were to leave the repository open as long as 300 years, would we need to have 15 cubic meters per second per drift for that entire period? No. At some point, it will have cooled enough, the waste thermal output will be cool enough that you can back off on the forced ventilation system, and go to a more passive system. That's what I was trying to get to here. Certainly, there will be ventilation throughout the preclosure period, would be a better way to have said this.

GARRICK: Garrick. I have a question from the audience regarding Slide 17, and a design to identify the facility.

HARRINGTON: Oh, I don't know which specific facility this was. I'm sorry.

GARRICK: Is this one of the nuclear plant sites, dry storage facility?

HARRINGTON: It likely is, but your next question will be which one. I don't know.

GARRICK: Okay. All right.

You indicated, Paul, that among the evaluations you make are operator dose calculations for, I assume, different management strategies, or thermal management strategies?

HARRINGTON: The operator doses are driven primarily by the need to handle the incoming transportation casks.

GARRICK: And, when you say operator here, is that synonymous with worker, or is it a special category?

HARRINGTON: It is actually a special category of worker. It's the people who would be doing the physical hands on receipt and handling the bolt untorquing, the gas sampling, that sort of action. It's that set of workers that receive the highest dose, and we're looking at ways of minimizing the dose to them.

GARRICK: I'm not a proponent of collective dose as a measure of risk, but it seems to me you might have an ideal application here for collective dose calculations, and that is it would be very interesting to see what the collective dose is as a function of different thermal management categories, or thermal management strategies, or scenarios.

HARRINGTON: Okay.

GARRICK: Is there anything equivalent to that that you're doing, or anticipating, including possibly scenarios that are outside the specified limits? For example, if you could show that the exposure risk was ever so much less if we increased or decreased or changed one of the design criteria, such as the wall temperature in the tunnel, drift. It would be very interesting to see how the collective dose, where you have--collective dose is valuable when you have a controlled population, and you certainly have a controlled population here.

So, if you had a list of different scenarios of thermal management, or different strategies, or what have you, and had the collective dose calculations on each of those, I would guess that would be kind of informing. So, there's a couple questions there. One, is have you looked at different scenarios, and have those scenarios included conditions where some of the temperature requirements are exceeded. And, number two, have you calculated collective doses for those scenarios?

HARRINGTON: The worker dose assessments that I've seen were not thermal management approach dependent. Likely, there would be some effect on them, possibly through handling more or fewer transportation casks, or certainly there would be an effect if you minimized the amount of times you'd have to send something out to the aging pad, for example, I'm not aware of analyses that are currently planned specifically to that end. But, that will be I think contained in some of the throughput analyses, and the maturation of the ALARA analyses. So, the next time we meet, we can have you go into that in more detail.

GARRICK: Yes, I see. All right, David on the Staff, and then Daryle.

DIODATO: We'll let Daryle go first maybe.

BUSCH: Whenever you said that the thermal demands of decrease after 50 years, or somewhere in that extended period of time, I'm wondering about two things. One, surely it won't be uniformly distributed throughout the whole mountain, so that wouldn't it be true that in some areas, you would have the equal of some of the higher demands for that period of time?

HARRINGTON: No--go ahead.

BUSCH: And my other question is suppose that the number of sites, nuclear sites that are sending us fuel, increases, can we really safely assume that this isn't a growing thing. All along, it will be an indefinite number of years before anything can be sure that heat demand is going to decrease a lot. I guess a way to ask that is less complicated. In your estimation, are you considering the scenarios in which there would be an increase of number of sources of spent fuel?

HARRINGTON: There is a limit in the NWPA on how much fuel the repository can actually receive and emplace. So, whether or not that comes from the current number or the current number plus some additional, that limit still exists.

BUSCH: But, the time is different?

HARRINGTON: Yes, if that caused to shift to a preponderance of younger, hotter fuel, that's similar to the discussion we had a little while ago, we would have to be able to accommodate that. That might mean that there would be a relative increase in the amount of or duration of the aging. If, on the other hand, there was a preponderance of the older fuel, then that could go the other way. But, simply potentially having some additional plants come on line, given that there is the finite limit on repository inventory provided by NWPA, I don't see an immediate dramatic effect.

GARRICK: Okay, David?

DIODATO: Diodato, Staff. Paul, thank you for your presentation. I'm hoping you can help me to clear up some confusion in my mind. My understand in your response to the discussion with Carl DiBella was that you didn't see any reason there couldn't be passive ventilation for much longer time periods beyond the 50 years. Was I correct in hearing that, that could be the 100 years passive ventilation, or something like that?

HARRINGTON: Yes.

DIODATO: Okay. This morning when Bill Boyle and Kirk Lachman talked about TSPA integration and repository design, they gave quite a compelling case for all the different agencies and organizations, and agents that worked together to make sure everything fits together and there's coordination between these two branches of OCRWM, these two missions. And, one of the examples they used was the idea that TSPA wanted the drifts backfilled at a certain period for their analysis. Now, do you know what period that is? Did I hear that wrong? Did I understand that wrong, or not? Is TSPA flexible on when the backfill goes in, or do they require that or not, plugging the end of the drift kind of idea.

CRAUN: Richard Craun, DOE. The backfill that Bill Boyle, I believe, referred to, and since Paul wasn't here this morning, I'm going to try to help a little bit. The backfill that was discussed was the closure of the circumferential drift, not the emplacement drift. So, it's a much different drift, and, so, there's no intent in the design currently to backfill the emplacement drifts. So, that backfill would be in the circumferential drifts and there would be I believe the current design is in between each of the emplacement drifts, is a key that is installed that would also be backfilled.

DIODATO: So, would there still be an opportunity for passive ventilation at that point, or not?

CRAUN: Well, the backfill is one of the steps, along with the drip shield installation, that is the closure process. So, once the repository is closed, then all of the access mains, all of the ventilation shafts would be closed in that process. So, the natural ventilation would not work.

DIODATO: Is that specified at a certain time in the PA, that it happens at a certain time?

CRAUN: I would have to transfer the TSPA question to Bob Andrews.

DIODATO: Thank you.

GARRICK: All right, I think we've come to the end of--

oh, Andy, I'm sorry.

HARRINGTON: Bob is going to answer a question.

ANDREWS: This is Bob Andrews, BSC. Let me try to address the two comments, then I don't have to address them later on when I appear.

GARRICK: Don't count on it.

ANDREWS: On the first one, there is a specified time when the, if you will, the backfill that's in the access mains and the key way associated with the backfills are emplaced. At that point, then the thermal hydrologic simulations start, it's 50 years after the initial emplacements.

Going to Dr. Hornberger's question, the so-called cold trap effect, and that name got started I think from a key technical issue agreement item between the NRC and DOE, it really relates to processes occurring within the drift, convective processes, heat transfer processes, and the potential for condensation processes occurring within the drift. And, those processes are included. We have a model for those processes. Those processes are included in the performance assessment.

Most of the condensation, but not all, is in the outer portions, in the coolest portions where there is no heat being produced, i.e. beyond the end package, if you will, and in the turnout areas, but there is some condensation that can occur on the cooler packages, or on the cooler drip shields, I should say, and that is included in the performance assessment.

HORNBERGER: Hornberger. Bob, I guess my real question is is there an opportunity for thermal management related to condensation patterns? I mean, something is--

ANDREWS: It does affect the thermal distribution, and the thermal distribution that we have affects condensation. I mean, they are coupled clearly. We haven't used it as a design parameter to try to take design credit for it. We're just trying to include the processes, it's a FEP, you guys talked a little bit about FEPs this morning, I understand, it is a process that we've evaluated and included.

GARRICK: All right, Andy.

KADAK: Kadak, just a couple of very quick questions.

Are these shafts designed for passive ventilation, specifically, so that in case you want to turn off the ventilation system, it will naturally ventilate?

HARRINGTON: Yes. So, you would have natural ventilation has been something we've wanted to ensure we can accomplish for quite a few years.

KADAK: Okay. Now, let me give you what I understand is going to happen, and correct me if I'm wrong. You will essentially have hot cells, where you will be remotely opening up canisters or spent fuel storage--or transport casks. The spent fuel will be stored in racks somewhere, or perhaps in other kinds of storage systems, perhaps like the ones we're looking at, and then when you're ready to package it into your waste package, we'll bring it back into the facility, and you will reload it to yet to be defined criteria, but it's probably a thermal loading criteria.

One of the very high exposure operations in taking spent fuel out of pools and putting them into those casks is in fact in the welding and inspection. We have yet to be able to do it completely automatically. Have you calculated the doses for opening, closing, rewelding, opening, welding and, you know, handling all this stuff, in your assessment of how you're going to do this project?

HARRINGTON: Yes. And, let me elaborate on the process. It's a little different than as was described. I'll use the DTF as an example. That would be the major production facility. The incoming transportation cask would be brought to a port in the transfer cell, lid taken off, and individual fuel assemblies removed from it, and moved to a waste package, or to an aging cask.

If the pattern isn't right for loading the particular assemblies in that transportation cask into that waste package, there is a very limited amount of staging in that cell. It was only 48 PWRs and 72 Bs. The general transfer would be into the waste package.

KADAK: But, if you go into a scenario where you're storing it outdoors, again, wouldn't you have to go through the welding, verification of weld integrity, because you don't know how long you're going to be storing it out there; right?

HARRINGTON: Actually, the aging casks, we would expect to use bolted closure ones rather than welded, just to avoid the problems associated with the welded.

KADAK: And, those could all be done remotely?

HARRINGTON: Yes. And, to finish with the original one, the worker dose assessments that I mentioned earlier, those actually look at the incoming transportation cask, the handling of that, the removal, all of the sampling, et cetera, the unloading. Now, once you actually get it over to the port, that's done remotely, remote/manual. The welding of the waste packages themselves is also done remote, automatic. So, there won't be any sort of local access to that. So, the doses associated with that part of the process are relatively very, very low. It's about a tenth of the dose associated with handling the actual incoming transportation cask.

KADAK: And, the demonstration of being able to do this all remotely has already been done without an inspection?

HARRINGTON: No. We have one of the Idaho labs working on developing the remote welding equipment for us. So, they're working on that now. That's real time. Has it already been fabricated and tested? No.

GARRICK: All right, thank you. Thank you, Paul. I think we'd better move on to the next speaker. We've intruded on his time a little bit, but maybe the question and answer session will work it all out. So, I guess now we're going to hear from Mark Peters.

PETERS: It's good to be up here talking to the Board again. I'm actually a sub here. John Wangle would normally be giving this presentation. He had some matters that had to be taken care of back in D.C., and he did want me to tell you that he regrets not being here, and he looks forward to presenting to you in the future.

So, what I'm going to give you today is an update. Since we've got a lot of new Board members, I think the last time you heard an update was prior to a lot of the new members coming on, so I'm going to give you more of a I'd say a management update on the status of the S&T program. I'll walk you through at a fairly high level what technical scope we're currently going after, and I'll be happy, if I don't touch on some details that you want to talk about, I'll be happy to handle it in question and answers. I've got several people in the audience who could also stand up and help me, several of the thrust leads are in the audience.

So, I'm going to first talk about background of the program, then get into the goals and objective of the S&T program, Science and Technology program, a little bit about the organization, how we fit relative to the repository organization. I'll give you a sense of our funding history, how our project mix has evolved, and also how the performer profile, meaning laboratories versus industry versus universities, how that's evolved. I'll describe to you the concept that we're currently, words we're using are targeted thrusts, how we've organized the Science and Technology program to better manage it. And, then, I'll walk through each of the Science and Technology areas, again, sets of bullets to try to give you a flavor for the technical scope, what we've got in place for review process, external peer review process, then, finally, some thoughts on what's next.

So, again, this is the third update to the Board since the program was formally started. Bob Budnitz gave, I believe, two of the previous presentations. We now have an institutionalized program with a formal structure. It's an office within the Department back on the East Coast at headquarters.

It is distinct from the Yucca Mountain licensing program. The design, analysis and regulatory activities that you heard a lot about all morning, you'll hear more about from Bob Andrews after this. The S&T program is intended to be distinct from that. That being said, this is an applied program. It's part of OCRWM, so there does need to be communication, coordination with the project, because ultimately, a lot of the projects that we're doing in S&T we hope ultimately will be transitioned over to the project for further implementation.

I'm going to talk some more about the funding. We've had some real good news on the funding trends. And, finally, I think you heard this morning from Margaret and John, and we've been hearing it I think for several meetings, the commitment that we have for this program from senior management has been great.

So, just to remind everybody, what are we after? Again, fundamentally, we're after enhanced understanding of the repository system, and also looking at possibilities for reduction in costs, and potentially schedule for the OCRWM mission.

It's also an important part of our objective to keep current with nuclear industry best practices, even though we are separate from the licensing basis. We still feel that it's important to have a mature S&T program to keep current with those practices.

Next, please? This is just a graphic to try to underscore the differences as we see them between what I'll call the repository baseline program, licensing end of things, and the Science and Technology program. Again, we're after enhanced understanding of the science supporting the repository system. We're after new technologies and approaches. Demonstrating feasibility of those approaches has meant we would intend to, if successful, that if we demonstrate feasibility, we would then pass that off for implementation to the projects.

It's not required for regulatory compliance. On the other hand, everything else you've heard today, and that you'll hear from Bob, as well as Debbie Barr later this afternoon, is focused on the licensing basis. And, there, we're talking about engineering and design, like you just heard from Paul, modeling and analysis of the site, prototyping, and all of that, of course, is within NRC's regulatory purview.

Next, please. A little bit about organization. As I mentioned, by design, in order to be distinct from the other projects by design, it's been set up as an office within OCRWM based out of headquarters. So, the Office of Science and Technology and International led by John Wangle reports to the deputy, Ted Garrish, up to the director's office, Margaret Chu. John Arthur, of course, sits here leading the Office of Repository Development. There is close communication between the Repository Development folks and the Science and Technology folks. But, we do stress the importance of being distinct.

The way that we're organized underneath Science and Technology and International, there continues to be an international program that focuses on I would call it policy consideration related to international, bilateral agreements, multi-lateral agreements with other countries, other waste management programs.

Science and Technology program, we've now structured, I'll put it into a science, and I'm going to talk more about this, but we've got now four targeted thrusts in the science area, and we've also got a thrust in the Advanced Technologies area, and I am going to describe these in more detail.

Real quick on the targeted thrust concept, then I want to switch back to budget, but I need to describe what I'm getting at with targeted thrust before you'll understand the budget slide.

Again, we're targeted on the key research initiatives to support the mission. We set up a management construct that involves leadership from folks from the national labs, as well as universities, who are leading these areas. We have representatives from the repository side involved with our teams to ensure coordination. Then, we also have headquarters folks who also work with the thrust leadership to make sure that everything is working in terms of the administrative and project management aspects.

The thrusts that I'm going to walk you through are current thrusts. As we develop new initiatives, if we develop new initiatives, we could, in fact, develop new thrust areas with new leadership.

So, switching back to our funding, we've currently got four thrusts in the science area, source term thrust, let's call that performance of the waste form, the materials performance, which focuses on corrosion processes, metals, natural barriers, which focuses on unsaturated and saturated zone processes, and a getters area where we're looking at advanced materials for potential absorption of radionuclides in a repository.

And, then, finally, we've got an advanced technologies thrust area that focuses on advanced materials. You heard this morning, something was mentioned about concretes, advanced tunnelling techniques, and things like that. And, I'll go back into these in more detail, but I did want to emphasize the funding profiles.

And, by the way, in the backup, there's two charts that have pie charts that show a breakdown by year of each thrust area, as well as the performing, the evolution of who's been doing the work for us. You're welcome to look at those in your leisure. We can talk about them during the questions and answers.

An important point is, a couple important points, we started out in fiscal year '03 with a relatively small program, I believe a little less than $2 million total. And, fiscal year '04, we went up to around $16 or $17 million. In fiscal year '05, we're up to nearly $20 million, and I believe it was mentioned this morning the '06 request, President's request, has $25 million. So, we've seen a very positive trend in terms of our funding.

We've also been trying to evolve our portfolio, bring more technology focused work in to balance the science work. So, you can see, this is color coded. The blue here shows the increase in the advanced technology budget from '04 to '05, and we intend to continue to look at that as a trend in '06.

The other thing that is in the backup is the change in the performers. This program started in fiscal year '03, dominated by National Laboratory and USGS participation. We still have a strong component of National Laboratory and USGS participation, but we've started to bring in a lot more university and industry participation into the program, which we think is a very good trend.

Next, please? So, now, I'm going to go back through the targeted thrusts and describe to you a little bit about the scope in those areas. First, back to the leadership. I mentioned that the thrusts are led by, with the exception of myself, internationally recognized scientists and engineers. I happen to be working with Rod Ewing on the source term area.

In the getters area, we've got co-lead between Sandia National Lab and Pacific Northwest National Laboratory. In the materials area, Joe Payer, who we all know well from Case Western. And, then, in the natural barriers area, Bo Bodvarsson from Lawrence Berkeley Lab.

Also shown on here are the folks who we work with primarily in the Office of Repository Development, as well as the headquarters folks, who work closely with the thrust teams to help facilitate management of the thrusts. This is, again, what I'll call the four so-called science thrusts. That's the way I refer to them. We'll talk about technologies a little later.

So, let's start with the materials performance or corrosion thrust. In here, we're after enhancing the understanding of material corrosion performance. There's really three areas that we're focused on. Looking at corrosion processes on metal surfaces in thin films, evolution of corrosion damage due to localized corrosion, and, finally, the evolution of the chemical environment on metal surfaces.

This is conducted by--the linchpin to this program is what Joe refers to as the corrosion co-op. It's an integrated group of university performers that are working with Joe to develop a lot of the enhanced understanding that we're after in the corrosion area. So, you've got folks from Ohio State, Penn State, I won't be able to list them all, University of California Berkeley, Case, so we're really trying to bring in a lot of world class expertise to the problem.

Next slide, please. Natural Barriers, again led by Bo Bodvarsson at Lawrence Berkeley Lab. Here, we're after enhancing the understanding in general of unsaturated zone and saturated zone processes. You can read the bullets underneath there just like I can, looking at flow paths within the UZ, looking at matrix diffusion in the UZ, in unsaturated zones.

Something that's not on here specifically, but it is a focus, is also looking at coupled processes in unsaturated zones.

In saturated zones, we're interested in looking at plume characteristics in a variety of saturated zones, existence or non-existence of non-oxidizing environments, matrix diffusion effects again, and also sorption. So, there's a whole series of projects that really touch on all these areas that are currently ongoing.

Next slide, please. Source term area, again, this is led by Rod Ewing, co-led by University of Michigan, Rod Ewing, Argonne National Laboratory, where I'm involved.

Here, we're after release mechanisms of key radionuclides primarily from spent nuclear fuel. Right now, we're not focused too terribly much on high-level waste glass, although that's something we could potentially bring in. We're focused now on SNF, spent nuclear fuel.

Really, three areas that we're focused on here. What sorts of effects you might get from engineered materials that would be in a repository, and how that might affect radionuclide release. Could you set up reducing conditions inside of a repository, due to the presence of engineered materials. How might that affect radionuclide release.

Secondary alteration phases. Alteration of the U02 of the spent fuel, how does that play into uptake of radionuclides, again, after enhanced understanding here. And, then, finally, matrix dissolution. This is focused on unsaturated environments, because that's, again, we're in an applied program, looking at the effects of the influences of thin films of water on spent fuel as opposed to saturated conditions on a spent fuel rod.

So, we have a series of projects put together here. The players here are primarily the University of Michigan, currently, the University of Michigan, Notre Dame, PNNL, Argonne and Sandia. If I missed somebody, I apologize.

And, I'm going to get to we're actually starting some new work in this area in the natural barriers area.

We're actively looking for new projects in an open solicitation as we speak. So, we hope to bring in more university involvement into both those programs.

Next slide, please. Getters area. Again, here, we're looking at new materials that might be able to adsorb or absorb radionuclides, looking at a variety of materials, nanomaterials, tailored minerals, appetites, manganese oxides, things like that that might be useful in a repository system for getting radionuclides. We also always have to think about how these getters might fit into a system, how they would be emplaced, how they'd be fabricated, how would they all fit into the repository system.

Finally, I mentioned new starts. We did get some additional money in fiscal year '05, and, so, some of the money went to what I'll call directed starts, where we had projects that we had already thought would be important to start, but we also put a significant component of our additional budget into new starts, and that's in an open solicitation that's been sent out, and we're actually expecting proposals from the national labs, USGS and university systems here very shortly, this month.

The focus of that call was in the natural barriers area on both couple processes in an unsaturated zone, as well as saturated zone processes. And, then, in the source term, a waste form area. Our focus there was looking at getting ideas in terms of secondary alteration phases and how that might impact radionuclide release from spent nuclear fuel. And, also, an important component of this is we're trying to bring in some additional expertise from the international side, trying to bring in some international researches to supplement our current primarily U.S. based research team. There's a lot of work gone on in the international community in the area of source term, and we want to try to tap into that.

Switching gears now to the technology activities. This is a set of bullets that talk about some of the things that we either have going or we're contemplating starting. Advanced welding, I believe this was on John's slide this morning. We have a procurement that we're just about to finalize, looking at advanced welding processes. The program, the design, Paul spoke to it, has a welding process that will go into the license application that will satisfy the licensing basis, we feel, as we submit a license application. But, that's not to say that it's not--there isn't improvements that could be made to that welding process.

So, what we're doing here is we're exploring some potential welding processes that might be brought to the project for consideration, that might improve welding time, potentially reduce cost. So, we've got a set of proposals, they're in final stages of evaluation. We will then do that as a phased approach. We'll probably select more than one process to pursue for a period of time, down select to probably one, and then ultimately, hand it off to the project for potential implementation.

Handing it off to the project doesn't mean the project would choose to replace it in the baseline. It will simply be a handoff for them to consider. We do work closely with them, hoping that when we have successes, that will be implemented in the project baseline.

Advanced waste package materials. That's really there, primarily right now, we're doing a lot of work collaboratively with DARPA, the DOD research arm, Defense Advanced Research Projects Agency. That's work that we're co-funding with DARPA. Livermore, Oak Ridge, Nano Steel, Caterpillar are all involved as well. So, a multi-member team, looking at primarily high performance iron based amorphous metals.

Some applications might be to coat welds to potentially coat teeth on cutter heads, those are some of the things that you can think about them applying to. Right now, we're in the preliminary stage of looking at some of these materials, how they might perform.

Advanced understanding of seismic hazard. The program, as you all have heard in past meetings, is actively working to update our bases for seismic hazard for the performance assessment, for postclosure, in support of a license application.

The S&T program is also exploring the potential to develop an advanced seismic hazard assessment approach beyond what the program, for that matter, what the community at large is looking at. That's something we had a group of experts come together, and they're putting together a recommendation, a report, with a recommendation for us on how we might go about that, what it would look like, how long it would take if successful, and we're waiting for that report. Once we have that, we'll make some decisions on whether we proceed with that, and how and how much.

Remote material handling and robotics. We had Oak Ridge National Laboratory as one of our early starts do what we termed a scoping study. They've got a lot of experience with these sorts of technologies, particularly as they're developing this spallation neutron source at Oak Ridge. And, so, they spent a lot of time looking at what was within the capabilities that they had, and also out there, and we're in the process of more of an information exchange with the project to determine whether there's really anything there for either them or us to pursue in that area.

And, finally, tunneling, it was discussed this morning, I believe, concrete. One of the things we're looking at is potentially some concrete formulations that might be able to be brought to bear to the repository that wouldn't perhaps perturb the natural system quite like we had thought in the past.

So, that's what we're about to--we've actually got Oak Ridge starting to put together a team. We're going to dedicate about $500,000 to that in fiscal year '05, and pursue some advanced formulations for concrete, and see if we can come up with anything that could be transferrable to the project.

Next slide, please? Review process. One of the things that we've spent a lot of time on in the last year is coming up with a more rigorous review process. Whenever we fund anything, when we funded the majority of our '04-'05 work under the new targeted thrust concept, the thrust leads played a very strong role in helping John and the staff at headquarters prioritize where the money went.

As we start to go to a process where we do more open solicitations, the formality will become even greater. The open solicitation that we're just about to close will go through formal peer review, much akin to the way DOE's Office of Science follows, where you have an external peer review that's done. With this particular case, for those of you who know that, that part of the world, ORISE, and Oak Ridge does those reviews for science. We'll also be using ORISE. And, they will do a straight technical peer review. That will then be provided to John and the thrust leads for a programmatic relevance review, and then we'll select projects from there.

Each of the thrusts have also been asked to put together small groups of external peer reviewers so that we'll meet on an every six months to annual basis, and those folks will come in and do a peer review, be presented the results of the work that's gone on in the thrust, do a peer review, and provide individual perspectives on how they think the thrust area is doing.

We tried to bring in some real world class folks, names you might recognize, Craig Shopan is helping us with getters, Alex Nabroski (phonetic) is helping us with source term. So, we're trying to bring in some real world class folks to help us with the peer review.

Finally, at John Wengle's level, he's also established a review panel, seven member external review panel that will provide him perspectives at the S&T level. Portfolio mix, areas that we're not currently looking at that we might want to look at, questions such as that.

Next slide, please? So, what's next. Funding. A couple of messages that John asked me to convey. This is a relatively small discretionary program. I mean, we've had positive growth in funding, but I don't think any of us sit here and expect to get a lot more money beyond where we are right now. It's going to be a small program. It's going to have to be focused.

We're going to need to continue to look for projects and look for successes, and continue to work with the project to integrate, but not only that, start to transition some of the projects.

That brings me to the next bullet. One of the things that we haven't yet done, we thought a lot about how to do it, but we haven't yet done it, is taken one of our projects to completion, as we see it, and transition it to the project. We think we've got a process for it. Some of it's going to be case by case. Welding would be very different than getters. But, we've started our process, but, again, we need to test the transition process, and how we're going to pass it off.

Finally, prioritization. I mentioned that the funding, you know, the funding will level off. I think we've got more ideas than we have funding. We've got a good program now, but we're going to have to continue to be vigilant about coming up with a transparent focused prioritization process, so that we're doing the right things.

And, finally, public outreach/communications is what we call it here. We're actively encouraging publications. We're trying to get as much of our information as we can out on the website. We're trying to get our message out at presentations at national and international meetings, and I mentioned at least in the source term area, and we hope in other areas, we're also going to try to strengthen our international collaborations.

So, I think the bottom line message is we're encouraged. We've got some work started now, and it's going to be interesting to see once we start to transition things over to the projects, and I'm happy to entertain any questions.

GARRICK: David?

DUQUETTE: Duquette. I was on the Board when the program was first announced. I think it was my first meeting, in fact, that I was at. There was some concern among the Board at the time that the projects would simply replace projects that were being funded outside the Science and Technology program, that is, they would be natural extensions of that, for example, the welding program, rather than being step function jumps in new technology for the project. And, I know it's not your program, but from what you described, it looks like a lot of that has happened, that is, that these are things that are perhaps there's a slightly different change in the slope of how you do it, but that many of them are things that were a problem that would have had to have been addressed if there weren't a Science and Technology program, and that have simply been folded into the Science and Technology program.

I'm not sure if I have a question more than a comment. But, I suppose the question would be a certain amount of it was supposed to be for really blue sky type research, and I don't see that from your description so far, unless you can point to something in particular. Do you see that being part of the program in the future, that is, something that's not tied directly to the things that are ongoing. I mean, welding is something you have to address right away, for example, in the technology side. Corrosion is something this Board has, of course, been very concerned with, and we're all very happy to see the effort that's being put into that, and where it's being put? But, I'm not sure that it's not just an extension of what wasn't being done before the Science and Technology program came along, and you just didn't put a different label on it.

PETERS: I'm not sure there was a question in there, but I will comment.

DUQUETTE: I guess I would ask you to respond to my comment.

PETERS: Yes, I'm happy to. Well, first of all--well, let me just say that your perception is correct. It's been a struggle, I'm speaking from a personal perspective now, and I was there from the start, it's been a struggle to draw that distinction. There was always a natural tendency to be perhaps too close to the project. We're very sensitive to that.

Let me reiterate something. Everything that we're about is not in support of the license application. Okay?

DUQUETTE: I didn't say that either.

PETER: Well, but, for example, welding, they don't need us to do welding. If I don't exist, they can go forward. So, your example is probably the one I'll use back at you, that it's not--they don't need me to go forward. They can go do arc welding, NRC, I shouldn't presume that they think they can go in and defend that, it's an established process. If I come up with a single pass process like electron beam, or some other kind of thing that optimizes it, maybe they'll okay, if we think we can defend it to NRC, we'll take it because it's going to save us X dollars, or it's going to help us with operations. But, they don't need it.

DUQUETTE: Duquette. Let me interject. I never mentioned license application in my comment.

PETERS: Yes, but you used welding, and I'm trying to tell you that it's actually an example where they don't need us. The minute I do something that's relevant to the license application, I've stepped over a boundary.

GARRICK: I want to just add to it, because it's appropriate to David's point. When I think of advanced technologies and I think of waste management, I think of other things in addition to what you've discussed. I think of separations chemistry. I think of partitioning techniques. I think of transmutation. I think of all kinds of creative and often highly discussed waste management methods of the future. I think of some of the dialogue that went into the Generation 4 Nuclear Energy System Studies, and I don't see any of that here.

PETERS: That's because it's not our mission.

GARRICK: Okay.

PETERS: It's--let me--

GARRICK: It's a very narrow mission.

PETERS: It's nuclear energy's mission. It's not our mission.

GARRICK: Okay.

PETERS: There's people in Argonne who do it. But, it's now RW's mission.

GARRICK: Now, who is doing that sort of stuff?

PETERS: Oh, advanced real cycle issue, for example, that NE runs out of the Department, has Argonne, all the labs are involved.

GARRICK: Okay. So, there is--

PETERS: There's extensive research that RW is aware of, but it isn't the role of RW to do any of that work.

GARRICK: So, it's another problem of consolidating activities that are going on that are really relevant to future thinking about waste management, and this doesn't come close to that.

PETERS: But, this, by virtue of what we are allowed to do and not allowed to do by law, we--

GARRICK: I understand. I understand. We're just trying to understand what it is.

PETERS: But, all the examples you gave, we try to integrate with NE on, but that's a completely separate talk.

GARRICK: Okay, thank you. Ron?

LATANISION: Slide Number 125. And, your comments, Mark, about advanced waste package material, did you describe that as being focused on iron based amorphous--

PETERS: Ron, I'm not going to be able to give you all the details, but they've been looking at a wide variety of materials, and I was told by the folks doing the work that the most promising they've seen so far is iron based amorphous metals.

LATANISION: I could believe--this is Latanision, Board--I could believe they would probably be very attractive from the point of view of corrosion resistance. But, on the other hand, if there are an overlay, and I understood they were--

PETERS: Well, that's one potential application.

LATANISION: But, I would think you'd want to look at nickel based.

PETERS: And, they have, and I probably can't tell you how that compares to iron based.

LATANISION: Okay.

PETERS: We can get you a lot of information on it.

LATANISION: It would be useful to do that. I would be very interested in knowing.

PETERS: I mean, I think there's several presentations in this that I'm not qualified to give on the results of some of these programs.

LATANISION: Then, if I could follow up on Number 19, one of your backup slides, your first backup slide? There's a sizeable increase in the advanced technologies budget, as I read it.

PETERS: Right.

LATANISION: And, am I correct in understanding that DARPA is providing some of this, or are they just--

PETERS: Right now, I think the advanced materials were putting in, yes, it's about a million or a million and a half each.

LATANISION: Okay. So, DARPA is a player in that sense?

PETERS: Yes. These are DOE funds. Those don't include the DARPA funds.

LATANISION: That's what I was wondering.

PETERS: In addition to that, there's about a million, million and a half of DOE funds, and then about a million,

million and a half of DARPA funds that aren't in this pie chart.

LATANISION: Okay. So, it's even larger than it appears?

PETERS: Right.

LATANISION: I think that was my question. Thank you.

GARRICK: Andy?

KADAK: Kadak, Board. Could you explain what the advanced understanding of seismic hazard might be, what kind of things you looked at there?

PETERS: Bob Budnitz could do it better than me, but there's established techniques that I believe Budnitz, et al, established for probabilistic seismic hazard assessment that we're currently using in the community. All the things that the project is doing right now, looking at improving the conservatism within that established process, is something the project is going to continue to do.

What is envisioned here is the next generation seismic hazard assessment process. So, community-wide, basically pushing the envelope on how the seismic community deals with probabilistic hazard.

KADAK: Generically, not just at Yucca Mountain?

PETERS: Right. That's not funded yet.

GARRICK: George?

HORNBERGER: Hornberger. Mark, of course, there are dozens of questions that we could ask specifically about the science, because it's very interesting. So, I have two questions. First of all, do you have some kind of abstract volume that you could share with us for the project, so that we would have a sense of the kind of work that's being done?

PETERS: We've got those, they're all in the midst of various sorts of reviews to allow for release. And, so, I'd like to say that we can do that.

HORNBERGER: The second thing is I'm particularly interested in the secondary mineral phases, and I assume, because I had conversations with Rod Ewing starting more than ten years ago, that this was a really important problem. Is this basically aimed at developing fundamental thermodynamic data base for things like neptunium and how it gets incorporated into secondary phases?

PETERS: That's a large component of it. Looking at all variety of phases, shopites, uranyphanes, all the ones that you're familiar with.

GARRICK: From the staff, Bill?

BARNARD: Bill Barnard, Board Staff. This is for the Board members. John Wangle has sent us more information on the S&T program that we do have with us. We'll give it to you on Friday.

GARRICK: Okay. I think--oh, we have one more question from the staff. David?

DIODATO: I'll try to be brief, but Diodato, Staff. I'm just trying to get a sense of the overall program and where you're going with it. And, then, just a few details, Mark. On Slide 16, there's a seven member external senior level review group that meets. And, how frequently do they meet?

PETERS: They haven't met yet. They just were established. They're going to meet for the first time in March.

DIODATO: Okay, so next month, they're going to meet, and then they'll figure out how--

PETERS: It will probably be once or twice a year.

DIODATO: A year, yes. That will be helpful for us to keep up with their findings and deliberations, just to kind of keep abreast of that. From your understanding, you involvement with the program from the get-go essentially, what's the average duration of a proposal in these things, an average duration of fundings? Is it one year, two years, three years.

PETERS: It's typically been three or four years. That's a broad generalization.

DIODATO: That's what I'm looking for.

PETERS: Some of them would be longer.

DIODATO: Then on Slide 19, you have a backup slide, I'm just looking at the natural barriers change from one year to the next, and it's like a loss of, say, a third overall funding. So, I extrapolated out two years, I'm hoping that that extrapolation doesn't hold, but in that case, anything that's more than two years might not be so healthy in terms of planning for that long-term. But, you're figuring that these levels, according to your statement, these levels are probably going to hold?

PETERS: I didn't mean to say that, but your comment is noted.

DIODATO: Okay. I mean, you said you don't expect things to grow anymore, but they could shrink?

PETERS: I can't tell you what it's going to look like next year, but I understand what you're saying.

DIODATO: Okay, for natural barriers in particular, on Slide 11, you listed a number of things, and Bill Barnard referred to the distribution from John Wengle that was very helpful, the summary document that he put together. There were like 14 items identified in there, study areas for the natural barriers thrust area. Here, you have about nine. So, five aren't there, I guess, and that would mean that maybe that's because of the way these are grouped, and you have kind of concepts and ideas in particular areas, instead of particular studies.

PETERS: For example, with the stuff that you all have, and thanks, Bill, for reminding me that you have that, there's two or three on matrix diffusion.

DIODATO: Right. And, the unsaturated zone workshop is another one that's still on that's still coming up, or what's going to happen?

PETERS: Yes, we're planning, we've already had two workshops in collaboration with DOE's Office of Science, one on passive films and metals, and one on the getters program. And, those working with folks from the Office of Science to plan one on UZ.

DIODATO: And we will be notified of that when that's--

PETERS: The previous ones have been scientists talking to scientists, and they haven't been open.

DIODATO: Yes, okay. What about the integration of the site and regional flow models, the last detail level question? That was one where there's an incompatibility between the boundary fluxes and the regional site scale model, is that still an ongoing activity, or is that over now?

PETERS: It's actually gone pretty well. They're working on, and Doug can clarify, Doug Duncan can clarify this if I'm wrong, but if I miss it, Doug, just correct me, they're working on a publication, they've made a lot of progress, and I believe we're actually trying to gear up to start to transition that one over to the project.

DIODATO: Okay. So, that would be transitioned. Okay, thanks very much. I appreciate that.

GARRICK: All right, I think we're going to have to terminate the discussion right now. Thanks a lot, Mark, very much. We'll take a 15--or, we'll take a break until 3:15. Thank you.

(Whereupon, a brief recess was taken.)

GARRICK: Let's go.

ANDREWS: Good afternoon. My name is Bob Andrews with Bechtel SAIC. It's my honor and privilege here to spend the next little while with you discussing some of the science updates since, let's say, last summerish time frame. This is a talk that frequently in the past with Board members, Mark Peters has given. You can see Mark has advanced to Washington and Science and Technology, and I'm back here in Las Vegas, and we'll talk about the baseline program, if you will.

Let's go onto the next slide. A lot of the information in here, in fact virtually all of the information in here is preliminary in nature. Some of it has not gone through the formal, if you will, QA process of check and review. Some of the data have been submitted, and those have been checked and reviewed through the quality assurance process, but others are in draft form. So, I want to alert you to that.

Some of this information may go into the SAR, as the SAR continues its evolutionary process that Margaret and

John Arthur probably talked to you about this morning. But, maybe not all of it will get into that.

We'll expect that some of it will get into updates of the analysis and model reports, but some of it is data, and there's confirmatory type data, and so it may sit there as data and not go into an actual update of any analysis or model report to directly support the safety analysis report.

And, as usual, I am not the data collector. I am not the detailed modeler, so I am presenting the results of many others. Some of those others in this room, but not all of those others are in this room. So, I will do my best to answer your questions associated with any piece of information, and its interpretation, and how it may affect the analysis of postclosure safety of the Yucca Mountain repository facility. I might call on some of my colleagues if the questions become too detailed in particular areas.

You can see there's a number of Bechtel SAIC folks and contractor folks, and then there's also representatives from the USGS, Sandia, Lawrence Berkeley Lab, Lawrence Livermore Lab, Los Alamos National Labs, and the management and technical support contractor to DOE. I apologize for the shorthand notation. When we actually get into the science, I'll keep the shorthand notation to a minimum.

Let's go to the next slide. A brief outline. What we're going to talk about, talk about what we have, some new information, and then summarize it. As I understand it, this morning, there were some other questions related to other processes and other work that the Department may be having ongoing, and, so, I'll be free to answer any of those questions that might come up as part of this presentation. But, the main focus of this is updated science and modeling that support and evaluate the postclosure performance of the Yucca Mountain facility.

Let's go onto the next slide. As you know from Margaret and John, and from the press, DOE did not submit the license application last December. By not submitting it last December, it allows us all the opportunity to incorporate new information, science that had been collected, that was being collected in the summer and fall, and winter of last year.

As I think John probably told you, there were certain cutoff dates for analysis and model reports that supported the postclosure Total System Performance Assessment, and that generally, depending on the technical area, was last April, May, June sort of time frame. So, what I'm going to be presenting now are some results and information generally collected after that particular time period.

I'm not going to hit every scientific discipline of the ongoing testing program, or modeling analysis program. I did some picking and choosing. I think some Board Staff members had some particular ones they wanted to hear about, and we got those in here, but it's sort of a potpourri of technical information.

These testing and modeling results that we're going to be looking at have multiple purposes, or multiple potential purposes. Some of them simply evaluate features, events and processes, and evaluate the relevance of those processes and events to Yucca Mountain conditions for postclosure performance assessment. Some of those support the models and the confidence we have in the models and parameters, and may, in fact, lead to revisions of models as we learn more information, and continue to test the system.

Some of these modeling results may be used to evaluate and in fact exclude conservatisms that may be in various piece parts of the postclosure science and safety analyses. We'll hit those as we go through them. And, others of these things may address, or may be used, to add additional information to support any analyses that may be required after 10,000 years. So, as you had some discussions with John this morning, you're well aware I think that we discussed it in the September meeting, that the Court remanded the peak, or the lack of a peak dose requirement. the fact that peak doses have been performed, they are in the FEIS, was, I don't know if that was noted by the Courts, or not, but it was not a requirement. It was simply in the

FEIS. So, some of these things we're going to talk about relate to assessments of greater than 10,000 years performance.

Let's go onto the next slide. Okay, this is the potpourri of things we're going to talk about, and given that I'm a PA kind of guy, and a Total System Performance kind of guy, I kind of start at the surface, and go down through the Mountain, and then at the end, talk about disruptive events. So, that's the logic in the order. They're not by importance. They're not by weight, they're not by significance. I have not provided any risk insights associated with why I chose which ones I chose.

Some of them have been of interest to the Board in the past. Some of them have been of interest to other review agencies in the past, but not this Board in the past. So, there's a little potpourri here, and if I missed your favorite one, I apologize and I could take that in the question and answer period.

So, let's go on to the first one. I will try to talk about the main participants in a particular technical area. So, where the information, expertise, data came from, as I said, most of this is in draft form, so there's not a report I can point you to, it's coming from the goodness of the principal investigators and scientists and modelers giving me this draft information.

The first one is USGS activity, principally. There's been some support from this by LBL, but the actual data I'm going to show you are USGS data, in collaboration I believe with Stanford University. It's clear, and we've talked about it with this Board many times, that climate is likely to change. It's probably not an earth shattering conclusion, and the climate change has been included, has been assessed, has been evaluated with respect to how it changes other downstream processes, such as infiltration and flow through the unsaturated zone.

The results of the climate change information, and I think some of this was summarized to the Board last March, but probably not to very many members who are currently sitting here, by Saxon Sharp and her co-workers at the University of Nevada, Reno. And, you get a distribution of the percent of times that are in glacial type climates, this is over the last 500,000 or so years, and we presented the times it's been interglacial and the percentage of time that's in kind of transition between those two climate states.

We are now either at the end of an interglacial stage, or in an interglacial stage, depending on who you ask and what day it is.

The USGS for years has been looking at opals and uranium series, aging of opals within the rock mass when they see them at Yucca Mountain, to look at the effects. There's a lot of reasons they've been looking at these opals, but, in part, it's been to look at how does the opal chronology, essentially the tree rings on opals, what does it indicate about how Yucca Mountain has responded to past climatic events. And, it appears that Yucca Mountain is very hydrologically stable, even if the climate may be somewhat unstable.

If I can go to the next slide, on the right-hand side are some earlier work by the USGS. I hope to point out the difference in scale, and I will try to point out scale things as we go along, but I think most of the figures and pictures have scales on them, so you can read them. But, the right-hand side, we see kind of a coarse scale of one sample. This was worked on several years ago, and you see you kind of have about a three centimeters-ish of opal, and the age dates of those opal deposits. That was kind of previous technology, if you will.

Over the last year, year plus, USGS researchers, led by Jim Paces, Zell Peterman, who is here, and others, working with Stanford University, have done a much more detailed second assessment using the Secondary Ionization Mass Spectrometry. And, you can see the scale there is one millimeter, a thousand microns, so it's a much finer resolution, and you can see the amount of information, the amount of data with respect to, if you will, the tree rings of opal precipitation in these calcite, or calcite/opal coatings.

Those data are summarized on the next slide, with a series of plots. I picked just three of their plots. These are all from a paper that Jim Paces gave to GSA, Geological Society of America meeting last November, and that was that reference that I had on the previous slide. There are a number of other locations where they've done similar uranium age dating and comparison to the stratigraphic depths.

There's a couple of things to note. These are three different locations, so you do see some spatial variability. There is a variation of on the order of .24 to 2.4 microns per 1,000 years in those different locations. If you just look at the last 300,000 years, it's a little more stable, you know, .47 to 1 1/2, you know, a factor of three. these are not, I want to say, percolation fluxes, don't correlate rate of opal growth directly to percolation flux, although there's probably some indirect relationship that's difficult to quantify, although the Survey folks have done their best to try to quantify that relationship between opal growth and percolation flux, that being the flux through the unsaturated zone at Yucca Mountain.

These variations, Jim and his co-workers have identified as possibly due to spatial variations, due to the reasons that I've indicated there, plus the potential, there's variability in percolation flux. You know, our models show a variability in percolation flux. The infiltration models show a variability in percolation flux. So, it's not so surprising that you would have a spatial variability in percolation flux.

But, the more important and interesting observation that USGS researchers have identified is how incredibly stable the rate of growth has been over the last, you know, 300,000, 400,000 years. Remarkable, how consistent, if you look at the lower left-hand corner, where there's about 20 data points on there, and you look at the correlation co-efficient, it's almost, well, I don't want to say unbelievable, but incredibly strong correlation indicating very little change with time.

In that same time period, the climate has changed. If you look at tree rings, you look at, you know, levels of playa lakes, et cetera, in the area of the Southwest, there have been significant climate changes over that last 300,000 years. But, within the unsaturated zone, due to buffering presumably of the Paintbrush non-welded unit, the USGS is continuing this work, so the cause for the stability is still being evaluated, but a very consistent and unchanging trend of indicating the climate at the surface had little effect at depth.

So, the likelihood of getting peaks and valleys in percolation flux, based on these observations, seems extremely limited.

Okay, let's go onto the next topical area. Because the next few areas we're going to talk about testing underground, and because we have some new Board members, I felt it worthwhile to put a map of the ESF, the exploratory studies facility, and the ECRB, the enhanced characterization of the repository block, or a cross drift. We're going to be focusing on a couple places, one is Alcove 8, Niche 3. Also, shown here, by the way, is the repository footprint in the current design, superimposed on the current test facilities underground at Yucca Mountain.

We're going to look at Alcove 8, Niche 3. We're going to look at some samples from mechanical degradation, strength properties, new data there, and we'll look at the thermal test alcove, which is Alcove 5 shown there right at the bend of the ESF. So, this is just a, you know, where the information is coming from slide.

Next slide? Okay, the drift scale test, the Board has been briefed on this several times. We are now, after January, whatever date, 5th or 6th, on the third year of cool down. We had four years of heat up, and now we're just past the third year of cool down. The plan is to go to the fourth year of cool down, and then other things happen after that, including some limited amount of deconstruction activities to evaluate moisture in rock properties, et cetera.

The monitoring of that has continued. The monitoring, both temperature or mechanical response, chemical response, has continued beyond what was presented to the Board last, beyond what is presented currently in the analysis and model reports. But, the models of coupled processes, of which there are many, you know, thermal hydrologic models, thermal hydrochemical models, thermal mechanical models, continue to be confirmed by the continued observations in monitoring from the drift scale test.

Onto the next slide? There's been a number of laboratory test measurements of rock strength conducted. These are being conducted by New England Research under the direction of Dr. Mark Board of BSC. I should point out on that previous slide, the research teams involved in the data collection from the drift scale test are virtually all the national labs, it's Sandia, Livermore, Berkeley, and Los Alamos as well.

So, I have here sort of two plots. One are the data, which in part are analog data, in fact, were in large part analog data, plus the data available as of 1997. We did an extensive testing program last year. A lot of that was from samples collected in the ECRB, the enhanced characterization of the repository block cross-drift. I think we talked about these testing with some slides last summer, but I don't think we had much data or results from the testing.

What you see is a time--well, a strength/stress relationship, and two functional fits, if you will. One is the fit that's used in the current models, with certain strength dependency. These are usually used in drift degradation models and seismic response of drift degradation models, in models of ground support for preclosure safety purposes, et cetera. And, you see then the new data plotted with the diamond shaped, both green and yellow, different sets of samples.

So, it's much stronger, the rock appears, from these laboratory test data, and these are, I think, about one foot diameter large cores at New England Research, taken from Yucca Mountain, it came from the cross-drift. So, our models are on the conservative side with respect to drift degradation. We may evaluate the degree of conservatism, you know, how much this would affect model results for drift degradation, rock fall, et cetera, but it's a useful indicator of conservatism within a current model. You see the basis for the data before, and the basis for the new data.

Next slide? Okay, the next one is Alcove 8, Niche 3. They exist about 20 meters apart vertically, Alcove 8 being in the cross-drift, Niche 3 being in the ESF main. And, a number of tests have been conducted there since about 2001. Most of this testing and analysis of this work is done by LBL researchers, Lawrence Berkeley Lab.

The first set of tests done in 2001-2002 kind of ended in early 2002, were looking at the back part of the alcove where there was a fault identified, and there was ponding that we superimposed on the fault. We force water into the fault, and then we tried to collect water down below. That test was used both for a seepage evaluation, as you're evaluating how water moves in the rock mass, and how it might move around an emplacement drift, and also used for understanding of transport processes in the rock mass between the Alcove 8 and Niche 3. And, as you can see in the left-hand side, you have both of the main repository blocks, or repository rock types. Well, I'm sorry, maybe you can't see.

That TPTP UL is the Topopah upper lith, and the TPT MN, that you can just barely make out there, is the middle non-lith, different rock units of the strata within Yucca Mountain.

Following that fault test, there was a large plot test that's shown schematically in the upper right-hand corner. There's essentially twelve cells. Those cells are, the width and length of those cells are shown there, and we did additional infiltration experiments followed by monitoring of seepage and the addition of a tracer.

If I go to the next slide, I'm going to focus on the large plot test rather than the fault test. The fault test has been presented to this Board several times, and also has the large plot test. Shown in the blue, or black, or whatever it is, is the infiltration rate, that being the infiltration rate in the ponded test setup in Alcove 8. Remember, we forced water in. We ponded it there, and you can see it varied with time. There's a lot of reasons why it varied with time. In part, there was some plugging going on, you know, small micro particles plugging fractures, et cetera.

And, in the red, the right-hand axis, is the seepage. You can see in this case, this infiltration rate, by the way, is orders of magnitude above the ambient naturally expected infiltration rate. Probably, we were forcing it by a factor of a thousand or so. Bo would probably be able to give me the exact number. You can take this rate and divide it by a cross-sectional area, and develop a flux, and compare that to the infiltration rate, the real natural infiltration rate.

So, we're forcing things to occur, because we want to see them in the time frame that's observable, not in repository sort of time frames. So, we have seepage rates that are about a tenth of the applied infiltration fluxes, as you can see here.

These data have been used, you can see these started in August of 2002 and ended essentially in August of 2004 when the infiltration rate was stopped, though we've continued to monitor the seepage through December or November of last year, and there is no seepage anymore, because we're getting back to ambient type conditions. And, these data have been used to develop, validate, compare against our seepage models, and they do a very good job of comparing with the seepage models, even the continued down trend of the seepage you see as you go into last summer.

But, going onto the next slide, is a little different story for transport. What we've done as we normally do is do some pretest predictions. You know, before you do a test, especially in a natural system, you want to make sure you're using the right information, the right sampling frequency, the right constituents if it's a tracer test, et cetera. So, shown in the lower right-hand corner are some pretest predictions for the Alcove 8, Niche 3 large plot test. There are a number of other of these predictions that are in an appendix for one of our technical basis documents that was part of an NRC/KTI agreement. I've just chosen one as a representative one for this Board.

So, you can see the tracer was added in March of '04, was stopped, depending on which area you're talking about, in the end of March or mid April '04, so one would have expected, if our models were reasonably correct, would have expected to see the break-through of tracers in the order of days or tens of days, that being driven by the fracture characteristics, et cetera.

To date, there's been, with one exception, and I have to correct myself here, but, to date, about ten months, that's true up until last December or November when there was an additional pulse of water added after the data points that I showed you on the previous slide, where there was a slight observation of some tracer in the collection system in Niche 3.

But, if I just take it out through eight months, so from March through November, there was no tracer observed. Well, eight months, you can see on that lower right-hand figure, is at 240 days, so obviously, the test does not very well match the model.

A number of explanations have been provided for that in the analysis and model reports related to this particular test. Principally, it appears that the transport model, the radionuclide transport model, the unsaturated zone, radionuclide transport model perhaps does not capture either the fracture/matrix interconnectioned frequency, which affects the amount of matrix diffusion between the fractures and the matrix adequately, or the amount of fractures and the distribution of fracture is maybe not captured adequately.

In either case, the model is a conservative, you might even say extremely conservative, representation of reality. The fact that the tracer, you would have expected to see break-through if the model were correct in that particular area. The fact that it doesn't break-through or hasn't broken through indicates there's something going on in the fracture/matrix interconnection area, and matrix diffusion.

There's a number of recently published literature in the open literature, which indicates the strong possibility of a scale dependency of matrix diffusion processes. If that scale, i.e. if you test something in a lab, the amount of matrix diffusion you have there is perhaps not relevant when you're at the scales of meters or tens of meters or hundreds of meters. Evars and Retnick's (phonetic) in Sweden has been a leader in that area, as have a number of others in a number of recently published papers over the last year or so on this.

So, it was very possible that the scale dependency of matrix diffusion is an important process that has been missed from the conceptual model of unsaturated zone transport.

Some of the other transport data in the unsaturated zone, such as transport tests at Alcove 1, and other transport tests at the Alcove 8, Niche 3 area, have been matched with the model, although there's one caveat on the Alcove 8, Niche 3 fault test data, remember there was two parts of this test, the fault test and then the, if you will, the large plot test, even in that fault test, they had to manipulate the fracture/matrix interaction term to get a reasonable approximation to the break-through behavior of tracer. As I say, that's fully described in this appendix for the KTI, key technical issue response with NRC.

Let's go onto the next slide.

KADAK: Excuse me. Kadak. In this previous slide there, to be sure I understand it, are you saying the water went somewhere, but you're not sure where?

ANDREWS: The water went into the drift, at least some fraction of it.

KADAK: Okay.

ANDREWS: That was the previous slide. The tracer that was in the water, some of it held up between Alcove 8 and Niche 3.

KADAK: But, some of it came out, and you swore they modeled it correctly; right? On that slide.

ANDREWS: The water is modeled reasonably correctly. That's just water, just flow rates of water.

KADAK: Right.

ANDREWS: The transport, going to the next slide, was radionuclide transport, the model did not at that location for those 20 meters, the model did not reasonably reproduce the test data, and the model is extremely conservative. In other words, the model is predicting break-throughs in tens of days, but your data say the break-through hasn't occurred at least in 240 days.

KADAK: Okay. At that location.

ANDREWS: At that location.

KADAK: So, the water went somewhere, but not there.

ANDREWS: No, the water went through the fractured rock mass. And, a certain fraction of it, go back to the previous slide, John, a certain fraction of it, roughly 10 per cent, did come out into, as seepage, into the alcove. The other 90 per cent went somewhere.

KADAK: Okay. And, you don't know where?

ANDREWS: We suppose it went around the niche. It might have gone, some of it, to the back end of the niche.

KADAK: So, why do you conclude this model is conservative?

ANDREWS: This one isn't. The next one is. Because my model predicted that I would see tracer in tens of days.

KADAK: I understand that part. What I'm saying is--

ANDREWS: Factor of transport is conservative.

KADAK: Yes, but you don't know where it might have appeared in a different location?

ANDREWS: That's true. But, I did not see it in the location where I collected the samples.

KADAK: Right.

ANDREWS: Where I thought I would see it.

KADAK: Here's my distinction. Is the model conservative or is the model wrong?

ANDREWS: The model is probably wrong at that location. There's some parameter or some other process going on.

KADAK: And, we need to account for where else the other water is; is that correct?

ANDREWS: The seepage part, we need to understand where did the water go.

KADAK: Right.

ANDREWS: That's right. The other 90 per cent, we have, you know, I don't know if you have observations of water saturations in nearby boreholes, but other than what we directly collected, we don't know exactly where the 90 per cent of water went.

KADAK: Is that a problem?

ANDREWS: No.

GARRICK: Ron?

LATANISION: Just to follow up. Latanision, Board. The transport models is based on some distribution of fracture paths; right?

ANDREWS: Yes.

LATANISION: Which are short circuits relative to the matrix diffusion, which is Fickian (phonetic); right?

ANDREWS: Yes.

LATANISION: So, isn't it possible that that water which Andy is so concerned about, is in fact diffusing through the rock, but by a Fickian process, which is extremely slow, as opposed to a short circuit process, which is driven by--

ANDREWS: Well, I think you wouldn't have gotten--the infiltration that you are getting is not by diffusion. The matrix porosity and matrix permeability of the tuffs at Yucca Mountain is exceedingly small. So, water is only moving, 99.some per cent of the water is only moving through the fractures. So, from a volumetric perspective, from a flux perspective, it's all in the fractures. When you have transport, now I have an individual particle that will be transported through fractures, but also, you're right, can interact with the matrix by diffusion.

LATANISION: Right.

ANDREWS: And, the degree of correctness, if you will, of capturing that diffusive process, the magnitude of matrix diffusion, if you will, is probably what we're not capturing in the model. In other words, there's more matrix diffusion in that 20 meters of rock than what's in the model.

LATANISION: That's exactly my point. I think Andy hit it on the head when he said is the model conservative or wrong. I mean, I think it could be said that the model in terms of description of that fracture distribution is not correct in this instance.

ANDREWS: At that location. At other locations, that might be a very reasonable model, based on other observations.

LATANISION: Let's go on. Thank you.

ANDREWS: That's why I said, the transport model does not--or does reasonably reproduce Alcove 1, but is conservative or i.e. does not reasonably reproduce what you saw in Alcove 8, Niche 3, this test of Alcove 8, Niche 3.

Okay, sorry for the confusion, let's go onto the next slide. Okay, there's a series of three or four slides on salt deliquescence and dust deliquescence. This was a matter of some discussion last May, and the Board wrote a letter sometime last summer that said we agree that we don't have calcium chloride dust, I'm paraphrasing here, so you should probably get the actual letter for the quotes, agree we don't have calcium chloride dust. We agree dust deliquescence does not appear to be a major localized corrosion issue, given the fact that we don't have calcium chloride dust.

So, Margaret I believe wrote a letter in January of this year that talked about other salt contents of those same dusts, not calcium chloride, not magnesium chloride, but a range of other salt compositions, not only in the dust that we've observed, and most of this dust work is USGS work, but also in, you know, the arid Southwest, once you get away from Coastal areas. There are a wide range of soluble salts.

In the Yucca Mountain dusts, the fraction of soluble salts is less than 1 per cent. This is information that Carl presented last May. However, in atmospheric dusts, reasonable available information, including Red Rock area just outside of town here, about 10 per cent of the atmospheric dusts are soluble constituents. Those soluble constituents have a wide range of chemical constituents, and they're quite variable, and a bit uncertain.

We have sodium chloride, potassium nitrate, calcium sulfate, you know, et cetera, et cetera, and a series of potential ammonium type salts. So, we, the Department, most of this work that I am showing down at the bottom of this curve was conducted at Livermore National Labs, did a range of experiments saying, well, what if, because it's fairly well known that although individual salts may have relatively low deliquescent--or high relative humidities, low temperatures, at which they would deliquesce, what happens if you happen to get mixed salts, i.e. two salts, two or more salts come into juxtaposition with each other.

I think some of the researchers at San Antonio and for NRC have also done some mixed salt deliquescent experiments using different ranges of different salt compositions. So, what we see here is the possibility that if I look at the lower left-hand corner and look at just the red squares, and look at the case where I haven't added any sodium chloride crystals to the mixture, we see boiling points that, for two salt combinations, in this particular case, potassium nitrate, sodium nitrate, you see boiling temperatures right at about 160 or a little bit less, in the 160 to 150 degrees C range.

As you add more and more sodium chloride, the possibility of that boiling point significantly exceeds 160 degrees exists. So, it is possible that you could have some combination of some salts that could come into geometric, you know, connection with each other, that could deliquesce above 160 degrees C. None of these are calcium chloride salts, we agree, but it is possible to have such conditions.

On the right-hand slide, you see another type of experiment, and there's a number of these experiments at Livermore conducted over the last four, six months, or so, that show as you increase as a function of time, but essentially what they're doing is increasing the relative humidity and seeing at what point do they get to something that will conduct electricity, which might be equivalent to, might be equivalent to a continuous type film, water film. these are at 180 degrees centigrade, and you see that at about 14, 15 per cent relative humidity, you have a dramatic drop in the impedance, implying that there could be, it's potential that there is a liquid type film that is allowing electrical current to exist.

I don't want to say that these experiments, of which there are many others like it, are definitive proof that there is a liquid film, but it's at least reasonable to assume that a liquid type film could exist if these salts got into juxtaposition with each other.

By the way, this slide, these two data plots, and the other data plots that go along with it, were the nature of Margaret's letter back to you on January 26th. It was these data plots that we were talking about.

GARRICK: I think Daryle had a question.

BUSCH: I just don't quite understand what the boiling point means at the left. This is in an aqueous environment of some sort. What sort?

ANDREWS: Yes, of that salt mixture. These are very--

BUSCH: Just a binary system?

ANDREWS: I starts at binary in the lower left-hand corner, with just potassium nitrate, sodium nitrate, and then we may get a tertiary system by adding varying amounts of sodium chloride.

BUSCH: Okay. So, that's three different salts. No water?

ANDREWS: It's not really water. It's more like a syrup. It's kind of hard to describe the constituency of this system. These are very high temperature--

BUSCH: I'm just curious about the composition. This is a dry salt mixture; is that correct?

ANDREWS: Yes.

BUSCH: Saturated with water?

ANDREWS: They're saturated with those constituents, yes. Okay, let's go onto the--

BUSCH: With water?

ANDREWS: Yes. Let's go onto the next slide. Because this slide leads into the following four slides.

The previous slide showed that it is possible to get some possible combinations of salts that could potentially come into juxtaposition, that could lead to a soluble phase or could deliquesce. One could factor in the possibility of that occurring. In other words, it's an unlikely set of combinations of getting the three salts directly in juxtaposition, and evaluate that from simply a probabilistic point of view, a geometric point of view. So, the likelihood is low that you would get that juxtaposition, but we felt it worthwhile to then go on and say, well, even if you did get that combination of three salts together, what would happen following that?

So, we're going to look at a series of slides of ongoing data collection and modeling and analysis. The data collection has mostly been at Livermore, and the modeling analysis part has been at Livermore, Berkeley and Sandia.

So, I'm just going to walk through Slides 17, 18, 19 and 20. The raw data are USGS data. So, these are our salts, the soluble fraction of our salts at Yucca Mountain. You can see that the most, if you look at the lower right-hand corner, most of the salts have a fairly high nitrate/chloride ratio. They're plotted here as a weight percent ratio. Normally, when we've talked about it from a corrosion perspective, we talk about the molal ratio of nitrate to chloride. So, a significant fraction of just the raw measurements have a high nitrate to chloride ratio.

I want to point out this last bullet, there is still some ongoing, quite a bit of ongoing work in this area by the Survey and others, about the ammonium portion of the soluble fraction. The fraction that is in each of those mineral constituents is uncertain.

So, let's go onto the next one. Okay, what we've done there is look at the ammonium salts. The ammonium salts in the arid Southwest have a fraction of the total, I'm not sure of the exact fraction, it's not quite 50 per cent, but it's in the 30, 40, 50 per cent range. So, we wanted to look at what happens to the ammonium salt phase, where it's well known that they do sublimate, especially at higher temperatures, and you see here some data from Livermore, looking at this sublimation of, which is mass loss, if you will, from ammonium chloride, and then ammonium sulfate. There's similar data for ammonium nitrate.

Generally speaking, ammonium chloride is favored over ammonium nitrate. Therefore, given the higher sublimation of ammonium chloride, you're going to lose more chloride, if it exists, due to sublimation than you would nitrate, which would lead to yet a higher nitrate to chloride ratio, due to this process. But, not all the salts are ammonium type salts.

So, going onto the next slide, we've done a number of deliquescent model experiments, if you will, not numerical experiments as opposed to direct observation now, taking the composition in our dust, the same compositions that we talked about last May, and that were on the two slides previously. And, the upper right-hand corner, looking at it as a leachate phase only, i.e. the soluble phase only, versus the soluble phase with the remainder of the solid phase.

Remember that in our dusts, at least from the ESF during the construction of the ESF, in those dusts, 99 per cent are silica or carbonate type solids. They're not soluble fractions. So, we have 1 per cent or less that's a soluble fraction. So, what we're essentially plotting on the left-hand side are just soluble fractions, and, if you will, the horizontal axis is let me mix that soluble fraction with the other 99 per cent of insoluble fraction that's there, i.e. the other solid phase. And, you can see the relative humidity, treat that as the deliquescent relative humidity, when I mix it with the other solid phases, it becomes very stable, in the range of between 60 and 70 per cent, .6 and .7, whereas, the soluble fraction itself has quite a wide variation, just considered the soluble fractions of the salts.

So, reaction with that other solid phase, the reaction of the 1 per cent with the 99 per cent, which one would expect to occur once that 1 per cent, if it did deliquesce, would start reacting with the other solid phases. I would quickly get it back to a more ambient type system.

In the lower right-hand, and these are again numerical experiments of how that would behave, if you will, for all of the 53 samples that we have, in the lower right-hand corner, what we're looking at essentially is de-gassing, removing of HCL and nitric acid in the exact equivalent of their relative abundance. In reality, you probably expect the Cl to volatize a little quicker and a little faster, but for numerical purposes, just made the assumption that they remove at the same rate. And, you can see the nitrate/chloride ratio curve significantly increases to that point where the chloride is completely removed. You've removed all the chloride from that soluble fraction.

So, let's go onto the next slide. Okay, another line of evidence is even barring all of those, you know, the low likelihood of the salts coming into geometric contact, the large likelihood of sublimation or de-gassing, the much more likely de-gassing and sublimation of the chloride bearing phases than the nitrate bearing phases, even if you forgot about all that, and looked at it simply as a volume perspective, and there are a number of assumptions that go into this evaluation of what is a reasonable volume that could possibly form, but it's on the order of 1.7 micro liters, and I probably should have rounded it up a significant figure or two, but let's just leave it at the 1.7 for consistency, 1.7 micro liters per square centimeter. Now, that's at a particular RH and temperature, that volume will become less as you go to lower RHs and higher temperatures, but let's just use that as a nice round number.

That makes a film thickness, if it was a uniform film thickness, which, of course, it wouldn't be because you have other grains there that it's going to want to adhere to, of 17 microns. That film thickness, as you look in the upper right-hand corner, is so small that the oxygen diffusion through it, even at very high temperatures, is so high that one would expect a fairly uniform oxygen potential through that 17 microns film, even if it formed. Remember, the likelihood of it forming to begin with is small.

So, therefore, and I think there was some discussion of this in this same process in EPRI's report that was attached to the Board summary last May, so, because of the thin thickness of this film, now, this is not to be compared with the protective film layer, this is the water film, if you will, or brine film thickness, the likelihood of initiating localized corrosion with this kind of oxygen potential through here is extremely low. So, we still don't believe this mechanism, based on all the previous slides, and other pieces of information, would lead to the initiation of localized corrosion on the Alloy 22 waste package.

Let me go onto the next slide. I think that's the last dust slide. So, going onto now the ongoing testing program principally--not principally, I think all these data that I'm going to show next are from Livermore, the varying types of testing of the Alloy 22. This is kind of a snapshot of what's the additional data, some of the additional data since Dr. Payer talked to the Board about the testing program last May.

GARRICK: Bob, let me interrupt just a minute, because I want to optimize our time as much as we can to take advantage of this presentation, because this is really very good material. The problem we have is that even if we give you 15 minutes extra, because of the maybe 5 to 10 minute late start, we're already into, under the revised schedule, what would be considered the discussion session. And, the other problem is that if it were just the presentations that we were talking about, it wouldn't be a problem, we'd just go on. But, given that we have the public comment period, I would rather not like to have to postpone that too long.

So, the issue is if we give you 15 minutes rather than wrapping everything up, including discussion at 4:30, at 4:45, I guess I'd like to give you that as a target, and at least have ten minutes or so to ask some questions, if we could do that. We have another presentation, that's right. But, if it were just that, if it were just a matter of that, we would just delay that. But, it's the following presentation and the following public comment period that I'd rather not postpone too long.

So, is there a way we can get this--

ANDREWS: I can skip over corrosion.

GARRICK: That's been well-discussed with this Board before. Let's see if you can articulate it in a very effective manner in half the time you were planning.

ANDREWS: Okay. Well, all of these data confirm what we just showed you in May. So, it's just more of it. So, let me go onto 22. I'll go through them fast.

These are the short-term, like 100 day, corrosion rate measurements, you know, less than .1 micron per year.

We've done a range of specimens, a large number of these tests and discussions are to address particular key technical issue agreement items, as well as our understanding of how Alloy 22 behaves when it's welded, and when it's solution heat treated, et cetera. No significant difference, depending on the treatment or welding mechanism here. But, these are new data from Joe's presentation last May.

Next slide? These just show those corrosion rate measurements from Livermore for a couple of representative samples from the previous slide.

Next one? We continue to measure long-term corrosion potentials. Remember, the initiation of localized corrosion is a function of corrosion potential, and a critical potential, or the repassivation potential. When the former exceeds the latter, there's the possibility of initiating localized corrosion, at least in our representation.

So, there's some additional data here, under a range of different environments, and I just grabbed a couple of snapshots of these to show that, you know, the Department has not stopped collecting corrosion type data of a wide variety under relative wide range of environments that are applicable, potentially applicable to Yucca Mountain.

And, as we said in our letter response to you, we do test the environments outside of the explicit narrow range that one might likely expect, because we want to see what happens outside of the exact range, and things might deviate outside that range.

Next slide. Here's some repassivation potential information. Some of these data might have been on other plots in Joe's talk, but there's a lot more of it, showing it as a function of temperature, and as a function of nitrate/chloride ratio.

The repassivation potential uncertainty is quite large when you get to lower nitrate/chloride ratios. As you go to higher nitrate/chloride ratios up in the .5 range, you can see the scatter, or the range of the repassivation, equate that to critical potential, is much tighter, a few tenths of volt.

These data, and ones that preceded it, are used, or used to evaluate the nitrate/chloride ratio, and nitrate/chloride concentration effects on repassivation potential, which are included in our localized corrosion model.

Next slide? Okay, another very thin, coupon is not the right word, probably a thin, film is not the right word, foil, thin foil experiments at Livermore, Chris Orme and her co-workers have been doing very detailed analyses of these thin foil samples in autoclave specimens. Here you can see there's one at 9 months. I think Joe presented some data at four months, last may. Those tests have been ongoing. Here are the 9 month data at 220 C, with a nitrate/chloride ratio of .3. What she's then done is gone in and done all of the detailed micro radiography, et cetera, of the films that are created on the Alloy 22. And, so, there's some representative cases here. By the way, the scale there is 200 nanometers, that scale at the lower-left corner.

Okay, next slide. This is some new data. I don't think we talked about this. We talked about this potential when we talked last May, but this is current density by fixing the potential and measuring current density as a function of time, seems to be pretty strong evidence of a stifling type mechanism, once localized corrosion had been initiated. Currently, although this is ongoing work, although it seems very positive and encouraging that there is a stifling type mechanism, I think the EPRI folks in their letter to you talked about this at some length.

We have still, to date, chosen to conservatively not include stifling as a process to arrest localized corrosion pit propagation in our models. But, here's some interesting data that seem to confirm that that process exists and it's very real.

I want to put a plug in for S&T. There are a number of S&T projects that Joe is managing that go beyond this on stifling type evaluations of pits and crevices under a local corrosion attack.

LATANISION: Just a point of clarification. This is Latanision. Are we talking about pitting, or are these crevice samples?

ANDREWS: I believe these are crevice samples. I'd have to verify that.

SPEAKER: Prism crevice assembly.

ANDREWS: Okay, they're prism crevice assemblies.

LATANISION: Okay.

ANDREWS: Okay, next slide. Okay, this is an example. We continue to evaluate once fuel is degrading. Now, I'm inside the package. Once fuel is degrading, a range of controlling mechanisms on radionuclide solubility, i.e. the amount that can go into a solution. There are a number of radionuclides that are of concern for long-term disposal, and neptunium is one of those. For those in the FEIS, as an example, neptunium was the dominant dose contributor. I believe neptunium is the dominant dose contributor in NRC's models, and it was the dominant dose contributor in our site recommendation analyses.

So, this happens to be a fairly relevant risk informed example of a process that occurs once fuel is degraded, it's exposed to oxygen, it's exposed to moisture. We continue to evaluate the representativeness of varying controlling phases, solid phases, on the solubility of, in this particular case, neptunium. We're doing it for the other ones as well, but this one is neptunium.

Shown on this plot are really two models. One is the NP205 model, and one is an NP02 model, and for the NP02 model, we have two temperatures, at 25 degrees centigrade and 100 degrees centigrade. And, for the 100 degrees centigrade one, we show the uncertainty band on the model. Those are compared to the data, and you can see at 100 degrees C, it's not an unreasonable fit.

The data, I should point out, are over a range of different temperatures. The Argonne data are generally at 80 to 90 degrees C. Some of the Wilson data that's indicated there, Wilson 1990-A and 1990-B, some of those data are at 80 degrees C, 85 degrees C, and some of those data are at 25 degrees C. So, there's a mixed bag here.

Also, there's a range of different times indicated in these data. Some of these are short-term data measurements, you know, months long, and some of these, especially the Argonne data, are nine years worth of test information. In other words, they've been dripping on the samples for nine years, and the nine year data came out last fall time frame. So, it's plotted somewhere on there.

There's still a large amount of literature, however, that indicates that potentially, NP02 and NP205 are maybe not the best controlling solid phases, but that there is secondary incorporation in a wide range of uranyl solids, maybe not shopite, because there's some recent data that say neptunium is not incorporated in shopite, but other uranium bearing minerals, sodium compregnisite (phonetic), as Mark pointed out, and others. I've listed some of the references down there that have talked about in the last year, neptunium incorporation in some way, shape or form, with some uncertainty on or in the uranyl solids.

There's ongoing work in this area. Some of that work Mark alluded to that Rod Ewing and his co-workers are leading up as part of the S&T program. To date, we have not, within the--well, I'll just leave it at that.

Let's go onto the next slide. Okay, saturated zone stuff. Nye County is continuing an aggressive testing program. They've just started over the last months with DOE, and a lot of this work is on the DOE side, is conducted by LANL and the USGS, but it's really Nye County boreholes and Nye County testing program. This is at 22-S. This is the replacement, for those of you who have been around for a while, of the alluvial testing complex essentially.

And, on the next slide, I show some very preliminary data. These are single well injection withdrawal type tests, very similar to the types of tests that have been conducted in the alluvial testing complex, further south. And, coming up, are the cross-hole tests, which are much more relevant for tracer transport evaluations. Those are being planned for later on this year. The analyses of these data are still ongoing, so I don't have that. I apologize.

Next slide. Okay, John talked about this a little bit this morning. When we did our biosphere model for the site recommendation report, we had an international peer review of that. They were IAEA folks and Nuclear Energy Agency and from Europe, and they reviewed our model and said why aren't you using the latest stuff. I'm paraphrasing a little bit. Saying there's better models, dosimetry type models out there that you should be using. We were not at that time.

There's been a lot of discussion on this. I think this was discussed with the ACNW Board last summer/fall time frame. The ACNW Board made essentially an equivalent recommendation. I believe it was after John and George left that review board. Made a similar recommendation. NRC has said in an executive paper, this is essentially a quote, "It is generally agreed among the national/international scientific community that the newer models--read that ICRP 72--provide more accurate dose estimates than the models used in Part 20."

EPA has also used these new models in a number of their activities addressing CERCLA type licensing--well, maybe not licensing activities, but CERCLA activities. So, we are investigating, I think as Margaret or John talked to you this morning, on the use of ICRP 72 as our dosimetry model within the development of dose conversion factors.

I have one slide, the next slide shows when you use ICRP 72, for groundwater, the BDCF up there means biosphere dose conversion factor, that's a factor that takes concentration and converts it to dose, essentially, factoring in all of the biopathways and ingestion/inhalation type pathways and parameters, and uncertainty in those parameters, et cetera. All I've shown here is what is the, when you use ICRP 72, in our models, the biosphere, which fraction of the dose conversion factor is coming from which biosphere pathway, which is very enlightening to know what are the biosphere pathways of potential concern.

Next slide? Okay, seismic and mechanical damage. Go to the next slide. We talked a lot to you the last two times on peak ground velocity and the probabilistic assessment of peak ground velocity. Now, this is on the consequence side now, not the probability side, but on the consequence side. And, as you can imagine, when a large seismic event hits a drift, a lot of things can happen. You can have drift degradation, rock fall, drift collapse, and you can have the packages and the drip shield moving around with certain seismic stimuli.

How you then approximate the damage that might result, as a result of the packages being subject to such low probability seismic events, is somewhat a function of how you conceptualize the interaction between the package to package interaction, the package to drip shield interaction, the package to pedestal interactions, and I guess those are the three main interactions that we have. You can imagine in the upper right, a stiff wall, and a package is just potentially bouncing against a stiff wall, with a large seismic vibration. Or, you can imagine, as is indicated in the lower right, you know, a lot of packages, and they are all kind of moving around more or less together.

So, there are assessments being done on both conceptual models of package to package, package to pallet, package to drip shield interactions that have been going on since last summer, fall time frame. There is a difference, as you can imagine, in conservatism, depending on which representation you believe is more representative. And, we believe the lower right-hand corner is more representative.

KADAK: A quick question. Are there any lateral or horizontal restraints on these packages?

ANDREWS: Well, you have the packages sit on the pallet, which is a V-shaped thing. But, other than that, there's none. There's no restraining. They're allowed to move, based on some friction of course, on that pedestal.

KADAK: And, the pedestals themselves, how are they embedded in the--is it a concrete pad, or something?

ANDREWS: That's a design detail. You should have asked that when the designers were here. I believe it's just gravity. I'm not sure--yes, I think they just sit there on the invert.

Okay, next slide. Okay, this is a lead-in slide. There is a certain amount of interest in buried aeromagnetic anomalies. There's a number of--it does potentially affect the probability of future igneous activity, the age of such buried anomalies. The Department has done a significant amount of, let's go to the next slide, of flying over the last year. Most of this flying occurred last April, May, June time frame. You can see the helicopter in the lower right-hand corner. You see the flight paths on the left-hand side. And, just so you don't get scared, there's little white eyeballs. The upper two, the helicopter for safety reasons avoided people, avoided places where people were, which sort of makes sense, and people were at the north portal and south portal, which are the two eyeballs on the top, and people are, of course, resident at the intersection of Highway 95 and 363, which is that little white bubble down in the bottom part of the thing, where you have that intersection in Amargosa Valley.

So, this is the flight pattern. The data are shown on the next slide. The data interpretation is still ongoing.

There is an update to the probabilistic volcanic hazard assessment that is planned. It is ongoing as well. I believe there's a meeting on that group sometime this month or next month--next week, okay. There are plans to drill into certain anomalies. Those are shown in the stars. I think Nye County is going to do one of the drillings, probably at Star I, and I believe the Department is drill two first, I'm not sure. Is that right, Doug? Okay, and that drilling will start in the next month, I think.

Okay, next slide? We're done. Any questions?

GARRICK: Very good. I appreciate the accelerated pace, and I'm sorry, and I know there's some questions. So, Ron, do you want to lead off?

LATANISION: Latanision. I don't want to ask a question at this point. I just want to make a comment that I think as in the case of the conversation this morning about the drip shield, I would like to have a fuller conversation on the deliquescence, corrosion, discussion in May. You raised a number of issues here that need to be pursued, and, Mr. Chairman, I'd like to ensure that we get that on the agenda for May.

GARRICK: Okay. We've got time for some questions. We'll take time for some questions. Andy?

KADAK: You're the Bob that was referred to this morning a couple of times?

ANDREWS: No, I don't think so.

KADAK: But, one question I have is in the FEPs that have been done for the 10,000 year time period, I understand that you have done a cursory look at what would happen to those FEPs if the time for compliance was extended. Can you give us a sense of how many are significant, and will require some attention early rather than later?

ANDREWS: I'm not sure how many, I don't think any are significant. The ones that we have included in our assessments to date we think are the same that we would include for longer term assessments. They are very analogous to the ones that we included in the FEIS when we did the peak dose assessments as part of the final environmental impact statement.

Having said that, though, it will require, depending on how the rule is, you know, written, and how EPA decides to write the rule, require some potential assessment of those processes that are very slow processes, that may be reasonably excluded from a 10,000 year assessment, but you have to do some other assessments associated with them, or might have to do some assessments of those at longer times.

Our preliminary evaluation of some of those processes is that they tend to slow with time. They are generally things that are temporally or thermally dependent, and the thermal environment does slowly come back to an ambient type system. So, the degradation processes associated with those are generally of second order effect, and can be shown demonstrably to be of second order effect to the processes that are already included, and have been included in previous assessments of long-term dose.

KADAK: The other question was relative to the Total System Performance Assessment, and there was some question about were you really focused in on, say, 10,000 plus another 10,000 years for quality and verification of data, although you've run many to a million year time horizons, what do you see you would have to do different in terms of model verification to demonstrate that you're modeling even out to a million years is acceptable, realizing of course uncertainties would be higher?

ANDREWS: With respect to model validation, given that the processes are reasonable processes, and you've incorporated the right processes and the right process couplings, which we believe we have for the assessment of 10,000 year compliance demonstration, and given the models have been developed and verified, validated against observations, whether those observations be analog observations, which can be long-term analog observations, or whether those observations be in stress systems, like I showed some this morning, or this afternoon, on seepage, that that is a reasonable representation of that process with that model, acknowledging the uncertainty in the model and the parameters that might describe that model, so extrapolating those, if you will, let it run longer, seems like a reasonable approach to do.

That's what we did in the final environmental impact statement, and depending on how the final rule or draft rule is written, it would seem to me as a technical person, that would be a reasonable approximation. That is what everybody else does when they're doing much longer term dose assessments, you know, whether you're in Sweden or Switzerland or anyplace else that has had these as requirements. And, that's what we did in the FEIS.

GARRICK: Garrick. I wanted to ask you one of the most interesting things you presented was the information on the insensitivity of the repository horizon to climate over long periods of time. Is that reflected in the TSPA-LA?

ANDREWS: No.

GARRICK: What kind of an impact do you think that would have?

ANDREWS: For the TSPA-LA, what we've presented to you last--or I presented to you last September, and the leading presentations to that, the possibility of a discrete climate change causing a discrete change in infiltration and a discrete change in unsaturated zone flow, has been included, i.e. the potential for a dampening type phenomena or a long-term temporal average flow has not been considered. We believe that's still reasonable, even given this information from the survey, in light of the fact that in the first hundreds or thousands of years, thermally dependent processes will be occurring.

We think using the present day type conditions for, which the current infiltration rate represents and the current percolation flux represents, is a reasonable thing to do when thermal processes, and other repository induced processes, especially in the first hundreds or thousands of years when those transient processes can be important, is a prudent and cautious thing to do for, if you will, shorter term assessments of dose.

The evidence there, I agree with you, John, is very compelling that for longer term assessments of dose, read that during the time of geologic stability, which the Academy talked about, seems to me technically, as a technical person, that would be more appropriate to use a long-term average stable percolation flow. Recognizing the climate can still change, the climate might change biosphere processes if we need to consider those, which we do now, but from an unsaturated zone long-term assessment of flow, those data that I presented appear to indicate that it's very, very temporally stable, extremely so.

The Survey is continuing this work, I want to add, as with collaboration from LBL, but I think the interpretations, and I think in Jim Paces talk to the Geological--last November, he essentially makes that same conclusion.

GARRICK: Any other questions from the Board? Okay, from the Staff, David?

DIODATO: Thank you, Dr. Garrick. Just to follow up on this line of discussion, on Slide 8, there's the USGS data, the middle and the right-hand plot are from two different grains collected about 100 meters apart in the ESF, and it is very compelling that there's a very uniform rate of mineral growth, according to these data, for long periods of time. But, both of them also have this feature, this break that occurs in the slope. And, that's in the one case, somewhere around 300,000 years, and in the other case, it could be like 600,000 years. So, there's various explanations offered for that break by the USGS research, but nothing is really nailed down. And, so, it kind of calls to mind some questions about why would some two grain so close together have such a different growth history and have this dramatic shift, you know, 300,000 year difference, and only 100 meters apart? What's going on in terms of the geology? Maybe that speaks to the spatial variability of infiltration. That's a question. But, I think that's a question that ought to be able to be answered if we're going to think longer term.

ANDREWS: That's a good observation, and as I say, the work is ongoing and Zell is here, so I think he heard your comment and he and Jim and Bo are working on this.

DIODATO: And, the second thing, just to put it out, was the Chlorine 36 story. We didn't hear any updates on what the status of that investigation is.

ANDREWS: That's a potpourri. I'd have to ask DOE, because that's being funded from DOE to UNLV, so I don't know, Bill, do you want to talk about Chlorine 36? Drew? Okay.

COLEMAN: Drew Coleman, DOE. The Chlorine 36 work was kind of delayed for about a year while we did some maintenance to the tunnel to ensure the safety of workers in the underground. But, that's restarted sort of as of January 1, and is moving ahead pretty well right now. They've got a dust protection system that they're assembling right now, and we should be sampling in the next week or two, and the UNLV researchers have gotten some samples to begin working on, and they will be present for the collection of some Chlorine 36 samples to look at over the next week or two, and the work will probably continue to roll for about the remainder of the year, and maybe some results will be presented next fiscal year. They have some quarterly meetings and maybe be able to supply some updates from those quarterly meetings that they generally hold.

GARRICK: Thank you. I believe we're going to have to truncate the discussion at this point. It's very interesting material. Thank you very much, Bob.

Okay, let's go to our final formal presentation, Deborah Barr.

BARR: Okay, just out of curiosity, how many of the Board and Staff here have heard some variation of this talk before? Twice, okay. Well, the only thing I want to ask is that you don't start snoring into the microphone, because it would be very distracting. And, the talk is primarily meant for the rest of you who have not had the opportunity to hear anything about this before. It's a very summary introductory sort of talk, and I've tried to include some information that's an extension on what I covered in past meetings. So, hopefully, there will be some new material for those of you who have heard this before. So, that's where we're going here. And, if I get to the new material, I'll pound the podium and let you know that you need to start paying attention. I used to have an instructor that would do that whenever there was test material that came up.

Okay, so what am I going to talk about today here? Essentially, first, I'm going to talk about why we're doing performance confirmation, what are our requirements for doing it. And, then, I'll go onto talk about what are the things that we consider as we constructed out program, and then I'm going to set the context here of how performance confirmation fits into bigger broader testing and monitoring categories that may be occurring. Because performance confirmation isn't the only place that testing and monitoring occur.

Then, I'm going to give you a very brief discussion on the approach that we used in selecting the performance confirmation activities. And, then, I'll walk through Revision 5 of our performance confirmation plan, tell you about the kinds of material that are in that document. Then, I'm going to over the next four slides, or four categories here, there's more than four slides, talk about each of the activities very briefly, first set them in the context of how we're addressing each of the barriers that are in our current project documentation, and then also talk about them in terms of timing. And, then, lastly, I'll give you a path forward, where we're going from here.

So, the next slide here, the NRC requires that as a part of our license application, we include a description of our performance confirmation program. Now, there's a lot more. I have a couple of sections of the regulations in 10 CFR 63 here, but there's obviously much more in 10 CFR 63. I have only included these to show you sort of the philosophy of what performance confirmation is.

And, so, in 63, they talk about how, "Performance confirmation means the program of tests, experiments and analyses that is conducted to evaluate the adequacy of the information used to demonstrate compliance with the performance objectives."

And, then, they go on to talk about how, "The program must provide data that indicate, where practicable, whether natural and engineered systems and components required for repository operation and that are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated."

So, basically, what this is saying is that this program is confirming what's in our licensing basis. It's not new. It's not an extension of site characterization. It's not exploratory. This is confirming what we establish in our licensing basis.

Next slide. So, what are the things that we considered when we were constructing this program? First of all, clearly, it's based on 10 CFR 63 requirements, and we also used the Yucca Mountain Review Plan expectations, as well.

Now, 63, 10 CFR 63 does not give us a check list. The NRC doesn't say, you know, we want you to do this, this, this and this. We believe that the intent there was that we be a responsible licensee, that we essentially critically evaluate our program and determine what are those things that are important to measure that would give us confirmation of the barrier and total system performance.

And, so, in doing that, we've looked at the critical aspects of our overall system and barriers in determining what's in our program.

Now, as you can imagine, there are an infinite number of possible activities you can do as a part of performance confirmation. And, the possibilities are infinite, but not all activities have the same value. They're not all of equal value. Some of them are more aimed at getting at things that are important to performance, and others are less important.

And, so, we used a risk-informed performance-based approach in determining how complex an activity needed to be, the extent of the activity, and even the number of activities that we thought were appropriate to have in a program such as this.

This program is intended to support an eventual license amendment for repository closure. The information gained in this program will go into supporting that amendment.

And, then, on the last bullet here, basically what I'm saying here is is that we have worked with TSPA continuously throughout this process. They have been involved in the development of the program. They will continue to be involved in the development of the program.

In developing where we are right now, it was based on an in process understanding. We had people at the process model level and at the TSPA level involved all along the way here.

And, then, we'll also continue to coordinate with them, including a qualitative evaluation against TSPA. This is essentially a last reality check. We have no reason to expect that this will give us any surprises, and yet we want to make sure that continually along the way, as new information becomes available, or as things may change, that we have the right program in place here.

Now, this slide here is essentially to show that performance confirmation is not the only program here. And, I continually tell people that what I really like to use for this slide is like a mass ascension, you know, balloon thing from the Albuquerque balloon things, where you have like different balloons rising at different rates, and some of them are still on the ground, and, you know, kind of flopping around, and everything. And, each of those would have some testing or monitoring category on it, because performance confirmation is only one of a number of kinds of testing and monitoring which will be occurring.

On this chart right here, I only mention the ones that are explicitly described in 10 CFR 63, and there are, you know, who knows how many others as well. So, performance confirmation is one thing that's called out in the regulation. These others are mentioned in 63, 10 CFR 63, and there will be others as well for other purposes. So, this is just to kind of respond to the question that some people, you know, always ask, which is, you know, how come you don't have this activity in there. Well, it may be a perfectly appropriate activity to be doing, it just may not fit the definition of performance confirmation. So, it may occur in some other program.

Okay, so those of you that heard this presentation before got kind of the Reader's Digest version of how we selected the activities that are currently in our program. And, that being the case, this slide here, it doesn't even rank cliff notes, okay? I mean, this is so abbreviated, and I'll spare you the gory detail, because it was painful enough living through it.

But, essentially, we have gone through a formal rigorous process in developing our program right now. We used a multi-attribute decision analysis process. We brought in experts who knew how to do this, and were skilled at it, and I learned a tremendous amount about this process. And, so, we feel we have a very solid foundation for where we're at in the program right now.

Now, one of the first steps involved in this decision analysis process is that you need to determine what criteria is important to you in developing your program.

And, so, the criteria that we've developed was sensitivity, confidence and accuracy. And, so, sensitivity is how sensitive is barrier capability and system performance to a particular parameter.

So, for instance, temperature and relative humidity in an emplacement drifts, how sensitive is the barrier capability and system performance to temperature and relative humidity in the emplacement drifts. That would be a criteria that would be applied to any possible activity that we were considering in that area.

In terms of confidence, that's what is the level of confidence in the current knowledge about the parameter? If it's something that we think we've got nailed down, you know, we've done extensive testing and modeling and it's just not an issue, it's not a likely candidate for performance confirmation, and yet those things where we have made more assumptions, or there's less confidence in it, those would be more likely candidates for performance confirmation.

And, then, the third, accuracy, how accurately can information be obtained by a particular test activity. Can you even measure, is it measurable? If you make a measurement, is it telling you what you really need to know about this particular parameter? Okay? So, for instance, if we want to know temperature and relative humidity in the drifts, would we have sensors by the packages, would we have sensors on the packages, would we have sensors at the end of the drifts, or would we just kind of guess because of the temperature of the air that came out of the exhaust. You know, any of those are possible scenarios for measuring these kind of things, and yet they will have differing degrees of accuracy in the information they'll give you.

Okay, next slide. So, Revision 5 of the performance confirmation plan is our current document. And, this was completed in November of 2004, and in this document, we provided a crosswalk of the requirements and guidance to the program. Essentially, we've tried to lay out in very clear fashion the way that each of these activities address the specific requirements. So, we want to make sure that we've covered everything that we need to, and we meet all the requirements that are upon us in this program.

It describes each of the PC activities and then it goes on to give expanded detail and control processes. So, these are things like a general description of the data management, analysis reporting, things like that. There is a general description of the test planning and implementation process, and then there's a high-level schedule as well in the document.

Now, one of the things that we need to do for these activities is we need to basically define the ranges, the expected ranges of the information that we're going to gather, as well as condition limits, you know, when do we reach a point where we're seeing things that aren't exactly what we expect, and how do we then decide at what level we need to go about notifying the NRC that maybe we have an issue that we need to look at more closely.

So, there is general guidance in this document for how these things will be developed. However, the details, the actual ranges and condition limits, will be developed in the underlying test plans for each of the activities. There is also a discussion in the plan about the evaluation processes and the notification criteria for notifying the NRC.

Now, one of the things that's introduced in this document is the role and function of a PC integration group. Clearly, when you're looking at barrier and system capability, it's not just a matter of a series of tests where you monitor the results. You need to look at the bigger picture. You need to say how does all of this come together, and what does it say about the performance of a repository. And, so, this integration group here is described a little bit in the plan, and basically examines overall repository behavior in light of the performance confirmation, testing and monitoring, as well as any other testing and monitoring information that would be useful in this.

This group also would retain the flexibility, I mean, we need to have the ability to look at the program and say are we really measuring the right things as we gain more information. So, there needs to be a certain amount of flexibility built in that we may need to redirect a little bit, or change things as we gain more knowledge. If those would affect the program as we've described, as a part of our license application, then clearly that would be done in coordination with the NRC.

So, this slide, I'm not going to spend a whole lot of time on it, but basically this lists all of the activities, the performance confirmation activities, and it just groups them in terms of the barriers, and this is just to show you that we capture the spectrum of all of the barriers that we've described here in our documentation.

And, for those that are in Italics, basically, those are ones that appear more than once, because they address more than one barrier. So, I'm not going to spend a lot of time on this slide, but it's just to set it in context of how we address all the barriers. And, actually, we do more than just address barriers in the program. We also address total system, as well.

Next slide. Okay, so ultimately, where we've gone now is we have this decision analysis process, and we've had subsequent evaluations, and at this point in time, we have 20 performance confirmation activities.

Now, this may seem like a low number, given the number we started with, but actually it's not, because one of the steps that was involved along the way is that we grouped a lot of activities together. So, this actually represents a number of groupings that represent a wide range of activities.

These activities are described in detail in the performance confirmation plan. And, in the plan, we list the individual activities purpose, the justification in the selection of the activity, both technical and regulatory, there are some that have both of those, and then our current understanding of the activity. That's a very brief description there. Clearly, if you want to understand the overall context of an activity, the AMRs are the best place to look. But, it gives a very brief description of our current understanding of the kind of activity and the context that it's in. And, then, also, there's a description of the anticipated methodology that may be appropriate for testing and monitoring in this activity.

And, so, for ongoing activities, ones that have started during site characterization and are continuing on, or ones that are in the near future, this is going to be a lot more solid. But, for those that are further out, it may be more conceptual.

So, then, I have here that the activities are initiated in three phases. First is ongoing activities. These are continuation of ones that started during site characterization. They may continue in their current form, or they may be modified and focused to some extent to serve the purpose of the performance confirmation goals.

The second is the construction period. This one, although it says construction period, it's really as early as practicable. These are ones that have not been started yet. They're new activities, and they will either start during construction, or as early as practicable.

And, then, the third is during the operations period. This is during and after waste emplacement. So, these would be for new activities on top of these ongoing ones, which clearly wouldn't be started until there was actually a repository in place to make the measurements.

Okay, so I'm going to start in a brief list of the activities here, and what I'd like to do is, because in the interest of time, I couldn't put a lot of information in here, so what I'm going to do is the backup material that's a part of your presentation is where there's more information. And, that's the test stuff. If you go to starting on Slide 20 in your backup material, for each activity that I'm going to go through, there's a separate page for the activity, and on this page, you will see more information setting it in the context of the processes that it's looking at, and the rationale for why it was selected as an activity. So, that's a little bit more information than what you'll see on the brief listing that I'm going to go through here in this meeting. So, this is for you to look at at your leisure.

So, going back to Slide 10 here, the first activity here is precipitation monitoring. And, you may say, you know, well that sure seems like a silly thing to measure, because ultimately, it doesn't really peg the meter in terms of changing performance of the repository. And, yet, if you look at the following activity, this is seepage monitoring, and, so, the two of these work together. This is essentially, the precipitation monitoring is putting the seepage monitoring in context. And, so, these two are tied very closely.

So, we have precipitation monitoring, seepage monitoring, which would occur in alcoves on the repository intake side, so this is outside of the emplacement drifts. And, then, in the repository, are thermally accelerated drifts. Now, the thermally accelerated drifts, there are two performance confirmation drifts, and these are ones where we would modify it so that we are attempting to simulate postclosure conditions during the preclosure time period. And, so, this would be done through a combination of things like ventilation periods, as well as loading of the packages. And, so, there are two drifts which are intended to be able to give us information on postclosure conditions, in a time frame that we can measure here.

And, so, I'll talk a little bit more about these later if there's time, but essentially, this monitoring right here would go on outside the emplacement drifts and in these thermally accelerated drifts.

And, then, there is subsurface water and rock testing. This is essentially giving it assumptions of fast pathways, and, so, that's another testing category there.

Next slide? Then we have unsaturated zone testing. This is essentially seepage testing, and this occurs in ambient seepage alcoves or a drift with no waste packages in place. So, essentially, this is altered by the thermal cycle here.

Saturated zone monitoring, this is things like water level, EHPH, things like the transport behavior, and this would be in saturated zone wells, which would be upgradient beneath, you know, or upgradient near and down gradient from the repository itself.

Then, we have saturated zone alluvium testing. This is the alluvial test complex, and essentially this gets at the alluvium transport properties.

Next slide? And, then, we have subsurface mapping. This is a good example of one of the ones where it has technical and regulatory requirements. This one is actually called out explicitly in the regulations. They said thou shalt go forth and map. And, it supports the technical basis for the distribution of fractures and the kinds of things that support all of our modeling. So, that's one of the activities that is part of the program.

Seismicity monitoring. This is essentially, in its current form, it's the UNR seismic monitoring network, the regional monitoring here. And, we will probably end up focusing the ones that we actually call performance confirmation in terms of those that are most directly relevant to the repository area. But, that is something that is ongoing, and will continue to be a part of the performance confirmation program.

Construction effects monitoring. This sets at things like the tunnel stability assumptions.

Okay, next slide, please. Corrosion testing. In its current form, that's the kind of corrosion testing that occurs at Livermore. There will be some form of it continuing on as performance confirmation, and this is laboratory sample testing of waste package and drip shield materials in their range of expected repository environments.

Waste form testing, this will be laboratory testing of waste form dissolution and waste package coupled effects, with mock-ups of a waste package.

Next slide. Now, this is the beginning of the construction phase performance confirmation activities. Again, these are the ones that would begin as early as practicable. Saturated zone fault zone hydrology testing, gets a fault parameter assumptions in the saturated zone, and then seal testing is something, again, it's explicitly called out in 10 CFR 63, and essentially it's testing the effectiveness of things like borehole seals, and we're doing that in the laboratory and in the field.

And, so, this would be things like the ability of it to limit preferential pathways of seals, to limit preferential pathways, or this would be like precluding human intrusion, or precluding magma flow, things like that.

Next slide, please. Now, we're into the operations phase. These are ones which would occur in the presence of a repository. In addition to those ongoing ones, some of those ongoing ones address these as well. And, so, this would be like drift inspection here, and this is periodic inspection of the emplacement drifts in some remote operated form here. And, this gets at things like their stability, rock fall size, and it also addresses the issue of retrievability.

Then, we have dust buildup monitoring. You've heard a lot about dust for a while now. So, it should be no surprise that we would have some dust monitoring here. And, this would be evaluation of the quantity and composition of dust on the engineered barrier surfaces. And, this will also occur in the thermally accelerated drift.

And, then, we have waste package monitoring here. This gets at, you know, whether the waste packages are performing, whether they're leaking, things like that. So, this is monitoring the integrity of waste packages. This will be done with a visual inspection, and possibly with some sort of internal pressure measurement.

So, let's look at the next slide here. This is continuing operations phase. Now, all of these activities occur exclusively in the thermally accelerated drifts, those performance confirmation drifts. And, so, we have near-field monitoring, this is monitoring of rock mass and water properties in the rock, and this is getting at coupled processes, the THMC processes here.

Then, we have environmental monitoring. This is evaluating the environmental conditions, including gas and water compositions, temperatures, film depositions, microbes, radiation, radiolysis effects, all using remote techniques.

And, then, we have thermal mechanical effects measuring. This is looking at the construction deformation, the drift shape. This is looking at drift and invert shape and their integrity, and the assumptions about drift degradation.

Then, we have corrosion testing here. This is another corrosion testing activity. The previous one was in the lab. This is basically where we scatter samples around throughout the drifts, and in the thermally accelerated drift, and periodically, we take them out and we study them in the laboratory.

Okay, next slide. Now, this is basically just to show you about these thermally accelerated drifts. This is the Panel 1 here, and keep in mind that these drawings change so frequently, I mean, I can't guarantee that this is the absolute way, but essentially, two of the drifts here will be performance confirmation drifts in the first panel. And, then, there will be a drift underneath that will be there so that we can study those two drifts.

So, that's essentially the configuration. The exact drifts are possibly subject to change, but there is intended to be two drifts in the first panel there.

Okay, where are we going from there? We will continue to iterate with TSPA and the underlying process models. It's very important that this program be up to date and current, and based on the latest available information, and we've made every effort to do that. We will work on establishing those data ranges and condition limits that I talked about earlier, and those will be countered in the test plans.

We will develop the procedures that would implement and control the performance confirmation program, and we'll prepare those performance confirmation test plans that will contain the information of how we will implement these tests.

We will engage the NRC regulators on the program and control processes. We've had a few interactions with them in the past in terms of how we were developing the program. We'll have more interactions with them in the future in terms of refining things and making sure that we're all in agreement that we're heading in the right direction here.

For ongoing tests, as appropriate, we'll continue to monitor tests and collect the data. And, we will continuously work with the construction and operations people in terms of making sure that we're all in sync and that everything continues to work properly and smoothly. And as needed, we'll continue to update and maintain the performance confirmation plan.

So, there we are.

GARRICK: Thank you very much. Questions? Andy?

KADAK: Kadak. In terms--I mean, the program sounds quite complete, but I would question about the practical reality of such confirmation, given the short time, say, 100, 150 years that you'll be doing this monitoring. And, I thought you would be relying more on validating the models, such as the Total System Performance Assessment model, to be able to say that that model is a good predictor for long times in the future. Have you looked at what is it that you need to know about this model that you can demonstrate in the first 100, 150 years that will give you confidence that this model does in fact predict long-term requirements?

And, let me just add a little parenthetical thing. Does the model, can the model handle physical loading as it occurs, or is it just too big to be able to model a canister, watch how the rock heats up, next canister, such that when you load that accelerated heated, I guess you call it, that you'll be able to see how the rocks behave and then the model hopefully predicts how those rocks behave, and then you can say, wow, that's really good, because then I can use that for longer-term projections. Just help me understand that.

BARR: Okay, now I heard two parts to your question, and the first, I can answer. The second, I'd need help from TSPA, somebody in TSPA. The first part, we believe that these tests are actually getting at the ability of TSPA to represent in postclosure time period what is occurring, because basically, these kind of measurements, while they may not always directly measure a parameter, which is an input to TSPA, they in some fashion get at parameters that make up TSPA. They could get at their assumptions, they could get at the process models that support them. They could get at things that are direct inputs to TSPA.

And, so, you know, certainly you could do some computer validation of your models, and yet when you make field measurements in terms of testing and monitoring, you are ultimately getting at the processes that support all the models. So, does that answer the first part of your question?

KADAK: Yeah.

BARR: Now, the second part, if I understood you right, you're asking if TSPA or the supporting process models can actually show the staged emplacement of waste?

KADAK: The short timelines required to be able to predict what should be happening in the repository versus what is.

BARR: Okay. Now, is there somebody who can help me out with this part? I've been abandoned.

BOYLE: Bill Boyle. Yes, they can. You know, to do a 10,000 year calculation, we're not doing one week time step or one day time steps, but the models can, and I can turn to LBL, Bo, for the UZ model, or the drift scale models and say, okay, just do a one year analysis with the as built condition, you know, the operations people have now told us the waste packages actually have X, you know, we actually know all the as builts. Yes, we can do that. And, that's probably, you wouldn't want to use something with a 200 year time step to try and look at the first ten years of measurements.

KADAK: Do you think that would help convince people that you understand what might be going on? Or, do you think that's not important enough to do.

BOYLE: You mean match up the measurements and the--oh, yeah, I think that's one of the intentions why NRC put performance confirmation in the rule. They know that there is uncertainty in the performance, and, you know, our models and our ability to predict, and that's why, you know, when the public raised questions in the NRC rule making about why should we believe these black box models for unprecedented time frames, the NRC had a multi-part answer that always included, you know, we get a chance to check the models through the measurements and performance confirmation.

BARR: And, let me mention also, and I don't think I made this point earlier, is that we're not just going to do the measurements and basically, you know, look at the data and say, wow, it looks great, compare it against our baseline and our expected ranges, and our condition limits, things like that. In many cases, we'll exercise the process models that are a part of the Total System Performance Assessment to evaluate it.

For instance, these thermally accelerated drifts, I mean, that's a complex system, and evaluating the data that comes out of the measurements in the thermally accelerated drifts will involve using the process models that are the basis for TSPA.

GARRICK: Okay, we have Ali, George and Mark.

MOSLEH: Dr. Kadak asked the question that I was going to ask, but I want to kind of get clarification on reading the two parts of the 10 CFR, kind of the wording that has been used, one points to the I would characterize input validation to a complex model. So, you can look at the specific aspects of that model, and assumptions behind them, and then try to confirm, validating the assumptions.

When it goes to kind of output validation, or confirmation, it's kind of vague because of the inherent nature and uncertainty of predicting over long periods of time. So, that in itself is not really the scope of the confirmation for validating a model that cannot be really confirmed in terms of performance, just impossible, it's over 10,000 years or longer. But, I was curious as to what you are, I think, referring to. You said they had a kind of partial validation of some models, and you would run some of these models that are part of the TSPA, and try to get at least partial or local confirmation of those sub-models. Is that what you said?

BARR: As appropriate, yes. I mean, that's not necessarily always the case, but, for instance, when I described that performance confirmation integration group, we envision as role of that being, like I said, to look at all the data and how it works together, and what it says about the barriers and system as a whole. And, that may very well include exercising the process models with the data that's been collected in performance confirmation to see what the results are and how they compare to our understanding in our licensing basis.

GARRICK: George?

HORNBERGER: I have a specific question. Why does saturated fault zone hydrology testing have to wait until the construction phase?

BARR: That one, I tried to kind of emphasize, I called it construction time frame, but essentially it's as early as practicable. I know that there has been discussion about, you know, whether we need to do something earlier or later on that one, and, you know, it will be considered, you know, at the appropriate time, and that may be before construction, and it may not be. It's entirely based upon the needs of the project, and the ability to do things in a timely manner.

GARRICK: Mark?

ABKOWITZ: Abkowitz, Board. I'm also on the path of seeking clarity. I've got two questions, and I'll just ask them one at a time. Hopefully, I'll remember the second one when the time comes.

To my way of thinking, performance confirmation is the process that's implemented after you have put a system in place and you're trying to validate whether that system is conducting itself as expected. But, after seeing the way you've presented the performance confirmation program, it seems to me that there's a large gray area where performance confirmation is really part of performance assessment, because you have ongoing experiments now that are yielding information that could be used to change the performance assessment itself.

So, am I correct in my understanding of this gray area?

BARR: Let me clarify. One, 10 CFR 63 requires that performance confirmation start during site characterization. And, there are two ways you can look at that. One is that you actually have activities that, you know, that you did during site characterization that are a part of your performance confirmation program. But, second is more of a philosophical look. In order to figure out what's important to have in performance confirmation, you have to have studied a broad spectrum of things, and then distilled that down to those things that are truly confirming what's important in your repository.

And, so, in that sense, during site characterization, we basically were studying a lot of things, and without that information, we wouldn't be able to make those informed decisions on what was appropriate to have in performance confirmation.

So, while some activities are completely new, and they're intended to, to the best of our ability, get at processes that we may have either modeled or measured in some other way, others, it's really no surprise that they should be the same kinds of activities that we did during site characterization, because they're truly getting at something that's important. However, they wouldn't have been selected unless they had been, you know, performed for a while and we gained enough information to realize that this is an important factor.

ABKOWITZ: So, I'm still having some trouble here. So, is there a feedback loop between the performance confirmation results that you have to date, and where the performance assessment is and could go before license application?

BARR: The ongoing activities are, some of them are, when we say ongoing activities, let me give you a couple examples. You know, one is the seismic monitoring network. Okay? And, that's something that we measured in the past, we're measuring now, we'll continue to measure in the future.

Other things that we called ongoing activities were things that we did in some form during the construction of the ESF and the ECRB, but maybe we're not doing them now. And, so, an example would be mapping, underground mapping. So, we mapped the alcoves and niches in the tunnels in the past. We're not doing mapping now, because there's no new excavations to map. And, yet, in the future when there are new excavations as a part of the repository, we will do the mapping then.

So, in a sense, there might be a little bit of confusion there when we call things ongoing activities, you know, they were things that we did at some point in the past, and will do in the future, but it may not have been a continuous activity. I'm not sure if I'm getting at your question here.

ABKOWITZ: Well, I'd like to move on to my second question.

BARR: Okay.

ABKOWITZ: This one might be equally as delicate. The strong integration between--I'm sorry--you make reference that the performance confirmation program is grounded in a risk informed process. You also make reference to there being a strong integration with TSPA. I may need some help from my colleague, Dr. Garrick, on this. But, would you characterize the TSPA process as a risk informed process? And, if it's not, do we have an apples and oranges problem here?

BARR: I think there might be somebody better suited to answering whether TSPA is risk informed. Is there somebody here that could that?

BOYLE: Bill Boyle, DOE. I'll try and restate the issue you're raising, which I think has been raised publicly before with respect to our TSPA, and other activities similar to it.

To the extent that you've put conservatisms in the model, and you start, deviate from best estimates, it starts to color the information you get from the model. So, we're using the risk information out of the model that we have, which does have some conservatisms in it. Would we get perhaps different risk information if we changed some of the representations in the model? And, the answer is probably certainly yes. But, have we, with the model we have now, even with the conservatisms in it, which, you know, change the nature of the outputs, do we still believe we have a reasonable handle on the most important risks in the system? And the answer would be yes.

But, now, Dr. Garrick can answer.

BARR: And, actually, in terms of the performance confirmation activities being risk informed, I would say that the decision analysis process that we followed in developing our list of activities was very risk informed. I mentioned that the criteria that we use, sensitivity, competence and accuracy, and that generated a question which we applied to all of the activities that were under consideration, and they would ask things like, for instance, one of the questions was if you were to measure something for this activity outside of your expected range, would you have to reconsider your conceptual model? You know, there's those kind of questions that were applied to the consideration of each activity, which I believe very much makes the list of activities we have risk informed.

And, one thing I forgot to mention in the talk is we documented that entire decision analysis process in relation to the performance confirmation plan in excruciating detail. And, so, if you really want to wade through all that, I'd recommend revision to where there's even tables of all the responses to the question, the questionnaire that was done, the entire detailed process of the decision analysis.

GARRICK: Garrick. One piece of evidence that would offer some encouragement that it was risk informed would be the ability to map the emphasis, or the scope, of the performance confirmation program to the importance ranking that comes out of the TSPA. Is that--

BARR: Absolutely, and we've done that. And, we'll continue to do it. We have had a periodic assessment against the TSPA in terms of the factors that, you know, that drive TSPA, and we'll continue to do that in the future.

GARRICK: Well, thank you, Deborah. I think we'd better move on. It was a very interesting and comprehensive presentation. We look forward to hearing about it in the future, and having these issues that we requested clarification on, clarified. So, thank you. Thank you very much.

All right, it's now come to the time of our meeting where we open the meeting up for public comment. Five people have identified an interest in making a public comment. We've heard from one of the five. The next one on the list that I have before me is Peggy Maze Johnson from Citizen Alert. Is she here?

TREICHEL: She gave me what she wanted to say. So, do you want me to come up and read it?

GARRICK: Well, sure, yes. And, then, you can just stay up and give your comments. This is Judy Treichel.

TREICHEL: For all those who didn't know that.

Peggy Maze Johnson is the Executive Director of Citizen Alert, and Citizen Alert will be 30 years old this year. It's a state-wide organization that was formed around high-level nuclear waste storage in Nevada. So, this is the work that they do.

Peggy had a statement here, but as I read through it, I found that most of it was more appropriate for tomorrow. So, I will save that part, and if she's not in Caliente, talk about that tomorrow.

But, she said, "As I sat this morning and listened to presentations by DOE, I wish I could believe them. But, this is the same Department of Energy that was ready to file a license application last year, until they got derailed. When I listened to all of the things they had not done yet, like casks and transportation issues, I was stunned. I also object to the fact that they are submitting a final environmental impact statement that does not include a final transportation plan." And, we have talked a lot about the poor quality of the EIS. We believe it's of poor quality in the fact that it had no record of decision, and it lacks a lot of things, and that probably will be talked about in future meetings that you have.

Now, going on to my statement. I asked the question that Dr. Garrick asked about where is this, and what is it, and it's obviously not a graphic, as Paul Harrington had said. It's a photograph, and it's obviously a dry cask storage facility, and as such, it obviously has a Part 72 NRC license on it. And, we've had a lot of arguments about the fact that the plan for Yucca Mountain includes what we call a dry cask storage facility, and he showed this as being something akin to what will be built there.

So, it appears to look like a duck and quack like a duck, and I would like to know what the difference is, other than the location, for the facility that will be here at Yucca Mountain, and why it would not have a Part 72 license. And, I don't need an answer for that right now, because I know it would take too long, but I just would like to put that out there, and say that that sort of bolsters what I've been saying for many, many years, that this program and the presentations and the sort of messages given out, are not always completely honest. And, a lot of word games go on, and I think we've seen a tremendous amount of word games today and of kind of screwing around with meanings of things, both in performance confirmation, but particularly in Science and Technology.

There's a whole lot of the stuff that's part of Science and Technology, like materials performance, which looks mostly at corrosion, natural barriers with the saturated zone and unsaturated zone, and possibly some of the work being done on spent nuclear fuel, what it is, how it works, what goes on, that clearly should have been finished in site characterization. And, I stood at this podium for years, even back when I was a young person, saying that this site is not ready to be recommended. Site characterization is not done. Please, TRB, do not sign off on this thing to allow it to be recommended.

And, I think it's just had a new hat put onto it in the Science and Technology program, and there's a lot of tortured sort of well, it's independent from the program, but then it transitions. And, we all know what happened. They wanted to get rid of things that were a problem, as was asked here, and they also wanted to be able to recommend this site before some of these problems came to light, and this Science and Technology program almost looks like a built in mechanism to come up with fixes after the fact.

In performance confirmation, I think there are a lot of things that are ongoing that also should have been completed during site characterization.

Now, the parts of the Science and Technology program that I like that I think are really valid are the part about getters and some of the international work, and so forth. Yes, a lot of that should be shared. I think we could probably learn more from international programs than they could learn from us. But, I think that should go on, and it should happen.

The 10,000 years has come up here. I don't know that there's anything the Board can do about 10,000 years. We all just need to wait for the EPA, but many of you who are sitting at this table now were not here over the many years that the Board's been working, but you ought to go back and look at some of the old transcripts. Obviously, it would take forever to read through all of them, but there were an awful lot of times when presentations were given by the program, and it turned out that, my God, are we lucky this doesn't happen until 11,000 years, that that material is going to last, that canister is going to be fine, and the first one falls apart at 11,000 years, we made it. So, it's not like it doesn't matter. For a lot of years, it's mattered, and it still matters.

I think part of the problem comes, of course, from what we've said all along and what I believe, and others may not, but that's too bad, that's why you have public comment, I don't believe this is deep geologic disposal. If it was geologic, if it was geologic dependent, if it was deep geologic disposal, you wouldn't even need a confirmation program, you wouldn't need a compliance period. It would be gone. It would be within the geology, and it's not. It's container dependent, and that's why all of the corrosion studies have to go on, that's why the guess work is there. But, this is not geologic, and it's really not deep geologic.

If you look at elevations, which I asked the program for, they gave them to me, if you look at the contours out there, this waste sits a thousand feet above the heads of the Amargosa farmers. Now, I mean, you know, to somebody who's not a scientist, that seems real shocking. Maybe it doesn't to you. But, take a look at it. The waste is sitting at something like 3,000-some feet above sea level. Those people are farming at 2,000 feet above sea level. So, this is something that can really, really hurt people, and people that are nearby.

So, it's very, very important. Thank you.

GARRICK: Thank you. Irene Navis?

NAVIS: Good afternoon. I think the only thing worse than following Peggy Johnson is following Judy Treichel. I always feel like such a boring speaker. But, anyway, Irene Navis with Clark County Comprehensive Planning Department. I'm the planning manager of the nuclear waste program.

I'm very sorry I won't be able to be with you in Caliente tomorrow. I have some meeting conflicts, and, so, my comments will cover today and tomorrow.

I want to thank you for conducting this meeting here in Las Vegas today, and being one of our 37 million visitors to Las Vegas this past year. And, I wanted to especially thank you for your focus on systems integration.

Your questions, as usual, led to a better clarification on some of the issues and details related to DOE's program. I encourage you to continue to ask for such details to be presented in future meetings. For example, I hope that you will consider further detailing, discussions further detailing a comprehensive and coordinated approach for identifying roles, responsibilities and authority during the licensing, construction operation, closure and postclosure phases of the proposed repository.

As a followup to the Western Shoshone presentation tomorrow, I'd like to offer up to you two reports that have been done in the past by Clark County. One is a 2001 report related to the Moapah Paiutes on public safety concerns for their community, and also another report that was more general to the native American community related to socioeconomic impacts and cultural concerns that we did in 1003. And, we can work with your staff to provide those to you.

I'd like to just quickly wrap up my comments with a request that you ask tomorrow's speakers who will be addressing rail transport to address what the mostly rail scenario means in terms of some truck shipments through all the communities that will be impacted in Nevada by the transport out to the repository.

So, thank you very much. I appreciate you being here, and we'll see you next time you're in town.

Thanks.

GARRICK: Thank you very much, Irene.

Our last speaker will be Abby Johnson, Eureka County.

JOHNSON: I'm Abby Johnson. I'm a nuclear waste advisor for Eureka County, Nevada. I have three comments and appreciate the opportunity to address the Board.

First of all, we've heard several times today about things that will be done before closure. In addition to the procurement, manufacture and emplacement of the drip shields, we also heard about emplacing waste underground temporarily, and then repackaging and reshuffling it before closure. This assumes a great deal of reliance on institutional memory, regulatory continuity, and multi-generational funding.

I question DOE's reliance on those assurances, and I hope that you will, too.

Secondly, Mr. Boyle's presentation on drip shields was a helpful historical overview, but raised more questions than it answered. It is unfortunate that DOE deferred a substantive presentation on a critical issue of interest to Nevadans, which leads to my third point.

My impression is that many of the unanswered questions raised at this meeting will be addressed at your next meeting in May in D.C. It would improve public access to the Nuclear Waste Technical Review Board information if TRB meetings, especially those held in D.C., could be broadcast on the internet.

I have recently begun to watch the Southern Nevada Water Authority meetings on the web. Their integrated water advisory committee is a large group like this, and the internet broadcast seems to work. We urge the Board and Staff to investigate the feasibility of broadcasting your meetings on the internet by May, if possible. And, thank you for considering our point of view.

GARRICK: Thank you, Abby. All right, are there any final comments or questions by any member of the Board?

(No response.)

GARRICK: Okay, then, with that, I think we'll adjourn for the evening.

(Whereupon, at 5:38 p.m., the meeting was adjourned.)