UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

SPRING FULL BOARD MEETING

OCRWM Program Planning and Integration

April 30, 1996

Austin, Texas

BOARD MEMBERS PRESENT

Dr. John E. Cantlon, Chairman, NWTRB
Mr. John W. Arendt
Dr. Garry D. Brewer
Dr. Jared L. Cohon, Afternoon Session Chair
Dr. Edward J. Cording
Dr. Donald Langmuir
Dr. John J. McKetta
Dr. Jeffrey J. Wong

CONSULTANTS

Dr. D. Warner North
Dr. Dennis Price
Dr. Robert Williams
Dr. Richard Parizek
Dr. Patrick Domenico
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Ms. Helen Einersen, Executive Assistant
Ms. Linda Hiatt, Management Assistant

I N D E X

P R O C E E D I N G S

DR. JOHN CANTLON: Good morning. If you'll take your seats, we'll get the program underway.

My name is John Cantlon. I'm chairman of the Nuclear Waste Technical Review Board. It's my pleasure to welcome you all here. It's a pleasure to see so many of you in a place here in Texas. We should have a very interesting two days.

As most of you know, the Nuclear Waste Technical Review Board was created by Congress in the 1987 Amendments Act. The Board is charged to assess the technical and scientific validity of DOE's efforts in designing and developing the nation's spent fuel and high level radioactive waste management program, including the site characterization at Yucca Mountain.

My field of expertise is environmental biology. I'm former vice-president of research and graduate studies and dean of the graduate school at Michigan State.

Now, let me introduce my colleagues on the board: John Arendt, specialist on the nuclear fuel cycle and transportation of radioactive materials; Garry Brewer, Professor of Resource Policy and Management at the University of Michigan; Jared Cohon, Dean of the School of Forestry and

Environmental Studies at Yale University. Ed Cording, Professor of Civil Engineering, University of Illinois, will be joining us shortly, he's flying out from Chicago after having given professional testimony in a lawsuit. Don Langmuir, Professor Emeritus of Geochemistry at the Colorado School of Mines; John McKetta, Joe C. Walter, Professor Emeritus of Chemical Engineering at the University of Texas and our host here in Austin, Jeffrey Wong, Science Advisor to the Director of the Department of Toxic Substances Control in the California Environmental Protection Agency.

Past Board members who are now serving as consultants pending their reappointment or replacement, Ellis Verink, Distinguished Service Professor Emeritus of Metallurgy at the University of Florida, and Pat Domenico, David B. Harris, Professor of Geology at Texas A&M. Pat is a Hydrogeologist.

Richard Parizek, Professor of Geohydrology at Penn State, is also here as a consultant on the Board.

In addition, I'd like to introduce Bill Barnard, who is our Executive Director of the Board. Sitting with Bill are several of our professional staff.

I also would like to welcome two former Board members, Dr. Warner North and Dennis Price. They were, respectively, the chairs of our panels on Risk and Performance Analysis and on Transportation and Systems. We have invited them to join us for this meeting because of their systems expertise and their keen interest in the principal theme of this meeting, which is program integration.

This meeting is being held at a time of major change and uncertainty in the U. S. Civilian Waste Management Program. The appropriated funding level for fiscal year '96 is substantially reduced over the prior year. Further, in both the House and the Senate, several significant legislative initiatives are pending, which if enacted, would restructure the Civilian Radioactive Waste Management Program. These changes would add substantial storage responsibilities to the DOE and would take place just as the technical investigations at Yucca Mountain are achieving real momentum.

Today and tomorrow, we will be hearing how the overall program is being revised in response to the new funding context, and we will be getting the broad outlines of the changes, especially as applied to the site characterization and repository development program.

As I indicated earlier, the focus of the meeting will be on program integration. The Board will explore the rationale underlying the program and the integration of the various major activities within the program. We also seek a better understanding of the processes for developing the means and the degree of priorities in defining the tasks and in allocating resources.

Further, we would like to find out how the major pieces are related to each other; how, for example, is the Waste Isolation Strategy and the insights from performance assessment being used to guide the definition of the program and the early design of the repository? What other program elements play a role in program definition, design and prioritization? We believe that having a sound, technically based rationale for the repository development program is essential, especially in light of the severely constrained budget within which the program now has to operate. We also appreciate that articulating this rationale clearly and putting this meeting together is not a simple task. That is why we notified the DOE of our intent as early as last November, so that they would have sufficient time to prepare.

While it is important for the Board to get an overall picture of the revised program, it's equally important that we obtain an understanding of the underlying rationales and relationships among the major program components. In these two days, we will not be able to go into the level of detail about the various projects in the program that some of us otherwise would like, in order that we can more readily explore the integrative and synthetic achievements.

All of today and part of tomorrow will be devoted to a discussion of the revised program and its underlying rationale and integration. We will conclude with a round-table discussion tomorrow afternoon. And, in addition, we will have specific updates tomorrow on the ESF and the Yucca Mountain site assessment.

We have asked each speaker to leave adequate time for questions. After each talk, we will ask for questions and comments first from our Board members, then from our staff and consultants, and if time permits, we'll ask for brief questions from the floor. I do want to point out, however, that as with all of our meetings, we have set time on the agenda at the end of each day for public comments and questions. Thus, if you are unable to ask your question at the time of a presentation, you certainly can bring them up at the end of the day.

When you come to make any comments, please go to one of the microphones in the aisle and identify yourself, state your affiliation, and those wishing to make comments, are urged to sign in at the public comments register at the back of the room, staffed by Helen Einersen and Linda Hiatt.

Now let me introduce our first speaker, Lake Barrett, Deputy Director of the Office of Radioactive Waste Management. He will sketch for us the revised program and its rationale.

Thank you.

MR. BARRETT: Thank you, John. It's a pleasure to be here in this wonderful city of Austin. Dan Dreyfus sends his regards. He is out in Las Vegas at the High Level Waste Conference doing that, and he had the choice because I'm the deputy, so he sent me here, and I think I got the better deal.

So let me start to kind of cover a lot of ground as to where we are and some of the rationale, the main points that John mentioned on how we try to integrate basically the three parts of our program together. And the three parts are the Yucca Mountain activities, the waste acceptance, storage, the transportation and the program management. And that's the way it is set up.

Let me give a little bit of background of our history, because our history and our environment has very much shaped our program. I think as you all know, in '94, we revised and streamlined the program with a program plan which we issued in December of '94. We were on a track, according to the program plan in '95, and we made very substantial progress in '95. '96 was a tumultuous year. We had Congressional redirection, reduced funding. We were planning to--present requests for '96 was $630 million. We ended up effectively with 315.

We had to shed load immediately to keep from an anti-deficient situation, which has criminal penalties that go with that. I was very conscious of that. So we immediately shed a load. We tried to save the core aspects of the program, which the core aspects to us were the scientific activities at Yucca Mountain, driving down to get the scientists in the mountain through the tunnel. I think we've been marvelously successful in doing that.

We immediately had to start work within the administration to get administration position for the FY 97 budget, so a very high degree of interchange between ourselves, OMD, as the whole administration will be responding to the President's direction and also dealing with the forces from the Congress. This culminated in the President's budget in March, the Secretary's testimony and our testimony. We are now in the process of revising our program plan. We have sent that to the printer yesterday and I expect that we will actually release the program plan next week, and we're basically going to describe what's in that program plan over the next two days.

Now, moving into the program plan, the first and foremost aspect is the address the key unanswered technical questions as they relate to public health and safety. That's the performance at Yucca Mountain. We're going to focus on the scientific predictions of the performance of the engineered and natural barriers to isolate the waste at Yucca

Mountain.

We also will resume a path forward to a license application in March of '02. This is contingent upon several factors that we must not overlook. It's contingent on the physical findings that we find in the mountain will support our hypotheses. The model developments that you'll be hearing about in much detail later on will support our hypotheses; that there's adequate funding provided by the Congress to perform these functions, and that we end up with reasonable EPA, NRC regulatory criteria that would make this a sensible activity to pursue forward.

On the front end of the system, that's the waste acceptance and transportation, we have had a major shift, a paradigm shift, as we would say in the current jargon, away from the classical DOE management operating contractor implementation to a reliance on the private sector to provide through competitive forces the services at the front end of the system.

We are proposing a modest program to do non-site specific activities with the NRC on interim storage. As you probably have been briefed, the administration did issue a statement of administration policy last week where the president has stated that regarding the bills before the Congress, that information concerning the viability of the Yucca Mountain site should be available to inform the decision makers before a siting decision is made. Those are the principles that form our activities.

As John mentioned, just a little bit about the budget because the budget is where much of the United States policies are made. It's sort of like a roller coaster type affair. We had a $140 million increase in '95. We were on a track toward another $100 million increase in '96. That was reversed, where we had to drop down to 315, which was basically a $200 million cut. I believe we have done that in an efficient manner and preserving the majority of our vital functions.

The time never stops. Things continue on. The FY 97 budget, as I mentioned, is out. We are requesting $400 million of real money. That's within the caps, 497, which was a very tumultuous issue within the administration to do that with all the pressures on balancing the federal budget. Of that, the lion's share is to Yucca Mountain, $339 million, or 85 per cent, to focus on the scientific activities at Yucca Mountain, but also will allow us to resume our NEPA activities, which we deferred in '96, and also upgrade our licensing interactions with the NRC.

We have $10 million, a modest amount, in for waste acceptance and transportation. That's to perform our contractual obligations with the contract holders, some continuous planning activities and non-site specific activities, and $51 million for program management. You will be hearing a lot of that as Steve Gomberg and Jim Carlson talk about issues with the DOE materials, which is part of that budget, as well as federal salaries and programmatic QA, heat, light, rent, all of those issues are in there as well.

Let me remark on the program management line, that when I came back to this program in '93, 25 per cent of our money went into that line. Today it's less than 13 per cent is in that, yet I believe we're accomplishing much more.

'96 Congressional Guidance, you've heard that. That was basically to focus on Yucca Mountain. So for purposes of time, I won't go into that again. But I would like to talk a bit about the substantial progress that we have made, the team has made, at Yucca Mountain in '95.

We have a greater understanding of the site based on the scientific work that we have done. We are formulating a waste containment and isolation strategy. The Board is well aware of that. We believe that is a major guide as we are basically reducing the scope of our testing, so we can focus on the performance of the Yucca Mountain engineered barriers and natural barriers.

The total systems performance assessment activities is a key road map that we use to focus on the aspects of the ability to retain and retard the toxic materials in the high level waste. You will hear much more about that later on.

The exploratory tunnel is a key aspect of the program. We're now over three miles into the mountain. The tunnel itself is not as important as the science that takes place behind the tunnel. It's basically just a conveyance mechanism to allow the science to go on within the mountain. As we anticipated, we are finding many interesting things as the scientists get into the mountain and do experiments in the mountain itself and take samples out from the repository horizon.

An example of that is the Chlorine 36 that you may have heard about. There are indications from some of the samples that some of the Chlorine 36 found down at the repository depth is of fairly recent age, meaning less than 50 years, and Dennis Williams will be talking to you more about that on Wednesday.

Even with that information and other information, we still believe that the results that we're finding within the mountain supports our hypotheses as we continue forward on determining the performance of the mountain.

Rick Craun will be going through and explaining more about the tunnel, but here's just the coming out of the curve at the tunnel. We're also in the process of digging out those. We've now started our sixth alcove. That's the first Ghost Dance Fault alcove. It was started on this Saturday, and Rick will tell you more about that later.

Now, the plans for Yucca Mountain for '97, we expect to complete the tunnel and daylight the tunnel boring machine, winter this sometime. There's some uncertainty on what the ground conditions will be. I think as you probably know, at the south end of the repository horizon, it goes back from Category 1 to Category 4. The last time I knew, we were in Category 1, but it shifts. And coming back up the south ramp, if we encounter some of the soft ground like we did in the north ramp, it may be slower. So there's some uncertainty as to when we will daylight the machine.

It has been a struggle in the reduced funding that we have to keep that machine running all year. The initial plans were last fall, was to shut that machine down in the month of March because of funding, but we have been constantly looking in every nook and cranny for money to shift to the machine to keep that machine running. And it is our current plans to be able to continue running the machine the full three shifts the rest of the year.

The test alcoves are rapidly being constructed. We intend to start the thermal mechanical tests this summer in the heater alcove and the large scale drift testing in '97. The information in preparing the scientific program today will lead to the information that will be available for the viability assessment in September of 1998. This will provide crucial information on the repository performance, the constructability of the repository and the cost to continue the repository program on through licensing and construction and through its closure.

The NEPA activities would resume with a final environmental impact statement in the year 2000, which would accompany the site recommendation on the suitability to the president in 2001. Along that line, we're starting to revise the DOE regs, 10 CFR 960, to focus on the isolation and performance of Yucca Mountain and to delete the aspects in the regulation as they relate to comparison of various sites, because that has not been changed since the amendments of '87.

If the science confirms our hypotheses and if the funding permits and if we have reasonable EPA, NRS regulatory criteria, we could submit a license application to the NRC in March of '02, would be our milestone that we would plan against and track against. And then this would allow emplacement in the year 2010, which is the date that we have had. So we believe that we can compress it back up with a little bit of a stutter step we've had in '96, and still maintain a 2010 waste emplacement in the drifts.

Now, let me shift away from Yucca Mountain to the front end of the program. We have completed fabrication and testing of the half scale advanced technology truck cask. Westinghouse has submitted the design for the multi-purpose canister systems, the large and the small. Those design presentations are going on as we speak back in Vienna. We have submitted burn-up credit topical report to the NRC, and we've been working on the institutional issues of the 180 C funding to the states and to the Indian tribes. So activity continues there.

As I mentioned, the shift to the market-driven approach for waste acceptance is a major activity there. This is a creative innovative approach in concert with the DOE re-engineering activities that the Secretary and Vice-President Gore have directed that we do. This would be a major shift that would place greater reliance upon the marketplace to furnish the necessary management, hardware and transportation services to receive the fuel and transport it to the federal facility. That federal facility could be the repository or it could be an interim storage facility.

We will engage the NRC in pre-licensing discussions to shorten the time period from when a site is specified through the political process, to fuel receipt.

Again, another item that I'm especially proud of as we've searched for money to keep the tunnel boring machine going, we've also been able to free up sufficient funds to start activities for a Topical Safety Analysis Report for a Phase I safety analysis to submit to the NRC. We've started that work this month down at Duke Engineering, with Duke and the TRW team, and that activity has started even in this constrained '96 budget year.

We are going to take the substantial scientific work we've done, engineering work in the canister and cask technology, and make that available to the private sector to use in the market-driven approach.

Tracking milestones. In the spring of '97, May of '97, we'll submit Phase I TSAR to the NRC. And then we get into some assumptions on the interim storage. Informed by the 1998 viability assessment, we are assuming that policy direction will be given by the Executive Branch and the Congress through statutory direction in spring of '97. March of '97, we assume there will be new statutory direction. That statutory direction would designate an interim storage site somewhere in the continental United States, and that DOE would be treated as a commercial entity in the NRC's view.

It would also eliminate redundant serial activities such as NEPA. There would not be a requirement that DOE do an environmental impact statement and then the NRC do an environmental impact statement. So we assumed that that would be the case.

If we are allowed to proceed through Congressional funding on the Topical Safety Analysis work, with that being done with the NRC in the '97-'98 time frame, that we could very shortly after site designation--that's less than a year-

-submit the license application and environmental report to the NRC in the year 2000, and then in late 2002, we could start to receive fuel in dual purpose canister systems at the federal facility.

In the program management area, we have done a lot to reduce our costs and improve our efficiencies. This is basically continuation of what we started back in 1994.

Since time in growing short, I'll cut off the last couple of view graphs, which basically are talking about what we're continuing in the program management area. I would like to make a couple of remarks concerning some of the activities in Congress, and I think a very important role that the Board will play.

As you know, Congress is debating new policies and new directions for the program. The Administration and the Congress have not agreed to anything yet, and so we are constantly going to continue along the line that the President and the Secretary have articulated.

We continue to believe that interim storage undertaken in a rational manner is an important component of an integrated federal waste management system. Its pursuit, however, must compliment and must not jeopardize the policies on the long-term strategy. This is an issue the Board has already addressed.

As you have noted, our ability to sustain the commitment to permanent disposal has profound implications for the nation as well as international considerations as well in this post-cold war world.

Now, I'm very proud of what we, the DOE team, have accomplished in this year and also in our ability to accomplish even greater things in the future if we're permitted to do so. And I'd like to thank the Board for noting the progress in your February letter. This has been very important as we try to maintain a program, that there is a perception in some very strong constituency groups about what it is that we're doing.

It's very hard for constituencies to understand what's going on in a complex scientific program like we're doing. They know it costs a lot of money, even despite the cost-saving things we've done, and there is a reluctance in these budget deficit concerns in both the parties that this program can continue on.

Many of these important constituencies are influenced by very significant concerns to them that go beyond the classical technical things that the Board looks at and that we look at. These are societal issues, economic issues, financial cash flow issues in this de-regulated era of electric utilities, business concerns and political concerns. These are very, very strong motivators and it is important that the board and all the parties that have an understanding of what's really going on be able to communicate clearly to these constituencies about the value of what it is that we are trying to do, and to assist us as we try to establish rational waste management policies for this country and also for the world.

That concludes my remarks. I'd be glad to answer questions that the Board would have.

DR. LANGMUIR: Lake, we've also, as you know, been very impressed with the progress in '95. I think our concern has become one of the money that the tunnel boring machine is eating. Its productivity clearly has dropped, I gather from 90 feet a day or so, down to less than 50, and Russ McFarland has reminded us that that's $340,000 a working day.

If we could somehow reduce that figure by a factor of two by a smaller machine, that frees up lots of money to do science and engineering in the tunnel, characterization work.

I wonder if you folks are thinking about potentially going to a smaller TBM to do some critical exploration in the mountain, and providing yourselves additional funding in that way for more characterization work, if you've thought about that.

MR. BARRETT: We have talked about the underground cost, and Rick will be talking to you more on the tunnel. We are constantly reducing the costs. We have reduced the costs.

Right now, we are in basically blocky ground that goes from Category 1 to Category 4, and we have to be setting steel. It does slow the progress down, though if you look at the data, I believe you'll see we're doing better with time as we get more experienced with setting the steel. But from my understanding and discussions, that to shift to a smaller machine to finish the tunnel is not an effective way to go with the time.

As far as additional underground exploration, if we do the east-west drifting or any of that, we would be looking at a smaller machine, is my understanding in the planning aspects. But to shift from the present machine with the experience that we've learned with it, to a smaller machine to finish the last part of the loop, the five mile loop, I have not heard any of our people talk about that.

DR. LANGMUIR: What's the reason to have to use the large machine further? Is there any justifiable reason for continuing with the larger machine beyond this point? What we want to do is see what's there at this point; right? All we're trying to do is get to the--we're going to be talking about this, I'm sure, further on as we go.

MR. BARRETT: I'd prefer we defer.

DR. LANGMUIR: That's fine.

MR. BARRETT: It's my understanding there's not a cost savings if we were to stop with the big machine and transition to a small machine, with all the start-up and learning costs with the small machine, if we'd gain any time nor money. I believe the projections are this winter, we would daylight the large machine. I have not been informed of any savings that we could do.

DR. LANGMUIR: I guess all I was interested in is whether you have flexibility at the management level to think about such options.

MR. BARRETT: We would have flexibility to think about such options, yes, we would. But it has not been pointed out to us as an option.

DR. CANTLON: Other questions from the Board? Staff? Bill?

DR. BARNARD: Lake, you mentioned that you've got a new program plan that's going to be coming out in the next couple weeks. Can you explain how you determine the priorities for the activities at Yucca Mountain that are described in this plan? What's the basis for your priorities?

MR. BARRETT: It's basically driven by the waste isolation strategy and the TSPA work as to what are the critical scientific information that we need to get to reach the viability assessment where we can inform decision makers about what the performance of the Yucca Mountain site would be and its engineered barriers, the ability of present day engineering to competently build it, issues of thermal aspects and all that be done, the waste package materials. We would also need to have good estimates on the cost so we can talk to people what it would cost to go forward, because there will be those who say this is too expensive with too low a return.

We have got to be able to articulate what we believe the ability of the institutional processes to actually complete it and go through a successful licensing process. That's why the standards will become very important. If it's going to cost billions of dollars more and many years more if the standards are not reasonable to do, then you're going to have to go back and look at it that way.

So that information hopefully will be there, and that's what drives us toward that '98. If it looks like to go forward, if that's the will of the nation, to go forward, then we can march forward. We had to match those needs with what we believed would be available dollars in this environment that we're in, in the deficit reduction environment, we did not look at any huge increases in the budget at Yucca Mountain. This is basically being done with a nominal 300 to $350 million budget level.

We did not believe the environment was going to allow huge increases in the Yucca Mountain budget, as originally had been proposed pre-program plan and the program plan. So it's sort of a reasonable budget of the $300-odd million per year going forward to see if we could match it. And we just kind of pulled that together and we cut back the costs and the expenditures on the front end of the system to the bare minimum, and we took the program management down to the bare minimum to give the maximum dollars to Yucca Mountain. That's sort of the strategy and the logic that we had.

DR. BARNARD: Okay, thank you.

DR. CANTLON: Time for one more questions. John?

MR. ARENDT: I think the market driven approach for waste acceptance and transportation is an excellent move. I'm a little bit concerned, however, that in the absence of standards and DOE specifications, in that type of an approach, I can see a hodge podge of activity relating to transporting spent fuel to Yucca Mountain.

What kind of controls would you envision that you would have in a market driven approach? And I realize this may be a little bit early yet, but I don't think this is going to be discussed at this meeting today, but I'm interested in what are you going to do to prevent the kind of thing that I'm afraid might happen?

MR. BARRETT: This is a concern that we do have, and it's sort of like porridge. You know, you don't want it too hot and you don't want it too cold. You want it just right.

When it comes to performance, performance based specifications is what we have for that, it's a very delicate matter. You don't want to over prescribe and you don't want to under prescribe.

We are concerned about the proliferation of various aspects, and that's the down side to the market driven. You can't have your cake and eat it too. Dwight Shelor will be talking about that later today, I believe, or tomorrow, and we can go into some of the plans that we've done. We have base requirements, which are the NRC, DOT requirements, and then build up from there. And we'll be doing some things and some incentives that we hope will help standardize this into not a bulkinization of the transportation activities, and some central aspects such as the 180 C funding that the government would still do. So we can talk more about it, but your concern is a very legitimate one and we agree with you about it.

MR. ARENDT: The other question relates to the non-site specific interim storage activity. Is this just conceptual planning or are you actually designing a storage area that could be used wherever an interim storage area would be designated?

MR. BARRETT: We're actually designing. Phase One is very simple, a storage pad with dual purpose shielded canisters that would go on it that deal with the seismic aspects and the natural phenomenon. So it's actually designs that would be submitted to the NRC for that, with various vendor type systems in it.

DR. CANTLON: Okay, I think we'd better go ahead with Steve Brocoum. Thank you, Lake.

MR. BROCOUM: I'm going to provide an overview of the revised program for Yucca Mountain. And then the people following me will mostly be giving you more details on various areas.

What I'm discussing is the background that led to the revised program, the rationale for it, how we planned for it. We have quite a different planning process this year, kind of a new document that we're creating called a PISA, Project Integrated Safety Assessment, then kind of a summary trying to pull together, leaving it to the following speakers.

Now, the SCP, when we wrote the SCP in the mid to late Eighties, we had a very comprehensive program. We had to understand all the uncertainties of all the site features and all the processes. We didn't have, you know, total system performance assessments in those days, so we didn't know what was important and what was not.

In 1994, we had two TSPAs under our belt, in '91 and '93. We had a better understanding of the site processes and we had, you know, TSPAs telling us what was important, and we also at that point had limited resources. This program, the SCP program in '91, was costed out at about $6.3 billion and was climbing very fast. The '94 approach was costed out at approximately $5 billion for the total site characterization program.

As we started to revise our program with the program plan of '94, we started to emphasize understanding the information we had already collected, versus collecting more information. We had a lot of information, 15 years of data, and we really had to put it together.

We focused a lot within the project on integrating within the project, and one of the things we did was consolidated all the laboratories under the M&O that had agreements between the M&O and the GS so the project would have a much more integrative approach to doing its work.

And key to the '94 was milestones that demonstrated progress that were measurable. Those were the kinds of goals of the '94 program plan. And those milestones were mostly in site suitability and licensing.

Now, why do we have to change what we did in '94? Well, Lake mentioned some of the Congressional concerns and the actions and what happened this year. And also we've got a lot of information the last two years; three miles of underground tunnel. So we've been analyzing our data and synthesizing it, so we think we can focus on things that are really important. So we know what information we have. We're working on the waste isolation strategy and we want to focus on those things that are key to the performance of the site.

There's also been a recognition both in Congress, the '92 law, and among the agencies that, you know, it was time to look at the regulatory framework and see if it was really serving the needs of coming up with a repository that met public health and safety. And I think there's a recognition that we have to update the regulations. That led to the National Academy of Science's report. That's leading the EPA to do their update of their regulations. That's going to lead us to update our 960, and I think it's going to lead the NRS to look at 10 CFR, Part 60. I'll talk a little more about that later.

Finally, we've continued to focus on more efficiencies in the project, and one of the things we've done is the PISA, which I will talk a little more, that helps us focus to make sure we're all heading to the same goal.

What are the key things we have to look at. We've been collecting information for 15 years, and we've really not encountered any major unexpected conditions since site characterization started in '96. The tunnelling and the testing are more or less confirming what we believed was occurring underground back in the environment assessment/SCP days.

I wish we had the waste isolation strategy completed so we could put it out on the table. We have had a lot of dialogue and are working very hard on that, and we're using it to guide the program, but we haven't all reached what I call consensus on that strategy. So we don't have it for you today, but there is a summary of the waste isolation strategy in the program plan, which I think is coming out next week. We've had, like I said, 15 years of data collection and we've had now three TSPAs under out belt.

The PAs suggest that Yucca Mountain would contain and isolate radioactive waste with a reasonable EPA standard. I'll talk about the EPA standard a little more. Disruptive events, the kinds of events are unlikely to adversely impact performance, and our site and engineering database are increasing as we're analyzing our data. Our databases keep increasing and we're allowed to use more realistic bounding conditions in our PA.

The hydrologic models suggest that groundwater flux is limited at the repository horizon, and that's one of the key parameters that we need to understand, and that the infiltration may be laterally diverted away before it gets down to the repository horizon.

Our underground observations have increased our confidence in the ability to construct, we've got three miles of tunnel, and confirm what we thought our geologic characteristics were.

I just want to show a diagram that we used to use that was actually created in 1984, it was used in the SCP. It was used in the EAs, that basically showed matrix flow, fracture flow, potential diversion of water along various lithologic contacts. And if you look at a diagram, a more current diagram--this is not the diagram I really wanted, but this is what they put in the truck--the concepts are very similar. They have not changed. The overall concept of how the site might operate really has not changed.

So 15 years of information and three miles of tunnel, numerous bore holes, the concepts are more or less the same. If there have been any changes, it's that there might be less matrix flow, and any water flow through the mountain would be down through the fractures and faults.

A few view graphs on regulatory initiatives. Again, we want the regulatory framework to help us focus on health and safety aspects at Yucca Mountain.

These are some of the things we have done to date. We have made recommendations to EPA. We have made two sets of formal recommendations; one last November, one at the end of March. There are policy and considerations in writing the regulation. We want the policy things clearly specified. And there should be appropriate degrees of conservatism to protect public health and safety. But if you have over conservatism, it's possible that you would create a situation that you could have a site like Yucca Mountain, which might contain of essentially contain wastes for tens of thousands of years, be disqualified.

We're planning to propose changes to 10 CFR 960 on how we're going to proceed in Yucca Mountain from today on forward. What we're thinking is adding a new sub-part that would define that, and the rest of 960 would more or less remain the same. There would only be change to accommodate the new sub-part. The new sub-part would focus on, again, system performance. It would do away with the individual qualifying and disqualifying guidelines, and it would in one section describe to the public how we're going to proceed forward, and it has to go through a lot of internal DOE and legal reviews. But, you know, the schedule is to issue a proposed notice of rule making at the end of July.

We are also planning to have meetings with the NRS to give them suggestions on what we think they should do to improve 60. We are not going to petition the NRC for rule making, but we do plan to probably send them a letter of a document with our recommendations. That is in the works right now.

This is just a few of the key recommendations that are in the document that we sent to the EPA. We think that the time frame for compliance ought to be 10,000 years. One of the big debates that this revolves around is is that the peak dose at Yucca Mountain is not expected to occur until 3 to 400,000 years or 600,000 years in the future. It's a range depending on the kind of assumptions and the calculations you do.

And how do you handle something like that? Well, we are not adverse to have quantitative standards for 10,000 years and a qualitative standard or safety goal after that. But basically we think having a quantitative standard that goes out for hundreds of thousands of years might shift the debate to whether Yucca Mountain will meet or not meet a standard 3 to 600,000 years in the future, based on hypothetical populations, you know, very speculative calculations, assumed biospheres, and again, may not meet a standard like that for whatever reason, but you would have a site that would totally contain waste or essentially totally contain waste for tens of thousands of years. So is that really the best decision for society to make? That's kind of the issue.

Exposure limit. We think that the risk should be between 10 to the -4 to 10 to the -5 fatal cancers per year, something on the order of 100 millirem per year. We understand now it might have to be apportioned for other facilities in the area. And we think we need to have a reference biosphere and that ought to be based on a critical population based on today's characteristics.

With regard to 960, we want to streamline the compliance process and, again, focus on safety and health aspects as opposed to procedural aspects. One of the criticisms that we had with the process that we developed the site suitability a year or so ago was that it was very procedural and a lot of the guidelines were not directly related to health and safety, or the overall performance.

And the two key areas are for postclosure systems and for preclosure radiological safety.

We are going to have interface with the NRS on 60. And what is our philosophy for interacting with the NRC for the next several years, especially since we're focusing on our viability assessment for the next several years, and then we're going to focus on the license application? We want to focus on issues that are significant to the performance of the repository. We want to use PAs to help us define those.

We want timely feedback on the sufficiency of our regulations. We want to make sure that anything we do are sufficient so we can develop a docketable license application. That kind of interchange with the NRS is very important to us.

The viability assessment itself is not a licensing document. That's kind of a management document as to whether the program should continue to move forward.

A little bit on how we're trying to make the project more efficient. We have a revised planning process. We have this year, in a sense, created a very iterative process, which is really more a top down process than it's been in the past years. The DOE provided detailed guidance to the M&O. We defined the what we call level zero, level one and level two milestones. Zero was secretarial milestones. Level one are directors' milestones, and level two are project manager's milestones.

All those key milestones, the DOE along with its technical support defined, put together, made sure logic fit together, and then we provided that package to our contractor at the M&O to help fill in. And there's been a lot of interaction back and forth as the details of filling in that package have occurred. So basically, we defined the program and we're asking our contractor in a sense to help us plan so we can implement it.

This kind of how the process works. We created a DOE steering committee. The DOE steering committee consists of all the assistant managers, the deputy project manager, and the office directors of the M&O. And this is the committee that comes up with all the top level guidance. That committee has help from DOE staff, the WBS managers, of course, each AM has their staff, and we have a support team led by a DOE person, Jane Summerson, with PMO support that helps us interface with our contractors.

The M&O has a planning integration team and it has a lot more detail elements beneath filling in their planning. So we provided the planning, the steering committee and the M&O does the detail planning and the costing for the program, and this support team helps us work that interface.

I would say the steering committee probably meets at least once a week, and so there's been a lot of interface and a lot of interchanging at the AM office director level, probably the best integration that we've ever done since I've been on the project.

The revised program plan which we'd also like to have on the sidebar today, but is in the press and will be available in a week or so, identifies a document we call the Project Integrated Safety Assessment, we call the PISA, and it integrates all the technical elements of the program. So we're going to focus all our information into this one document.

And all the elements that make up the program, from testing and design and PA, will all feed the PISA so that they're all in a sense forced to integrate and coordinate, and all are using the same data sets. It's not that the PA people are going to do their PA and the design people are going to do their design and the site people are going to do their tests and then we'll worry how it fits together. We're actually working the document today, laying out detailed outlines for each chapter of the document so that each element of the program knows what they need to supply.

So the program, as Lake said, has a viability assessment in '98, site recommendation in 1001, LA in 2002, waste acceptance in 2010.

This is kind of a top level schedule for the program. The actual detailed schedules have I believe it's 2,500 activities. I believe that's the number that they have right now in the planning process. And you'll see on the side, we have licensing, PA, design, scientific programs, ESF and the NEPA process. So these are the different sections that will be talked about today, so I'm talking about the overview, and then Abe Van Luik will talk about performance assessments, Susan Jones will be talking about the scientific programs, Rick Craun will be talking both about the design and about the ESF, and Wendy will talk about the NEPA properties, and then Russ and the people following Russ will talk about how we're going to implement integrating all of this. So that's kind of the program we're doing today.

So the key dates on this are a viability assessment. I think--what did you say, Lake, it was the end of fiscal year '98. Site recommendation, late 2001. License application, 2002. Draft EIS, I think is late '99. Final

EIS, year 2000. So that's kind of how the whole program comes together, and all of this has been worked among the different groups to make sure that the logic is there and the data as needed flows.

For example, the site data and models is in time for the PAs, and so on, the confirmatory tests in time for the sensitivity analysis, and so on. I have another diagram that shows a few arrows.

I did mention the PISA a little bit. It's a single document that integrates the various elements of technical program. Technical data management and information become very important. We had an example this year where we issued the advanced conceptual design, and they used one set of data and we used a technical basis report, the same aspect, they used a separate database. We have to get all that under control and we're working very hard to do that. And, of course performance assessment helps us integrate the program.

This kind of summarizes the PISA. The key bullets here, the technical organizations that are responsible for the activity produced those chapters. So the engineer organization produces the chapters on repository design, and the site organization produces a chapter on site description, and so on.

We use common data sets and we're trying to minimize excessive review cycles, the inconsistencies and the redundancies by focusing on that one document. And it will of course be the basis for our license application and site recommendation. That's the purpose.

The next view graph tries to show you the various chapters as they stand today. These are subject to change because there's an activity to fully define the PISA, and so you can see that the engineer organization is responsible for these chapters, PA for obviously the PA chapters, core science for site characteristics and environmental, safety and health for radiation protection. So we're laying out where we need to go so everybody knows where we're going.

Now, technical data management becomes very important, as I said several times. We need to make sure we have the latest data sets available, they are properly in our databases, and when people need some information, they're all using the same set, and so on, for model development, for performance assessment and design. We're trying to do it a more controlled fashion.

When Abe Van Luik talks about the PA, I don't know if it's his first talk or the second talk, but he's going to say how we're trying to formalize the process so we know when the data should be handed over from, say, the site people to the PA people, from the engineering people to the PA people, and so on. And we need to make sure we track our data properly.

Of course this leads up to the licensing support system. As you all know, we're required to have a licensing support system. There is 10 CFR, Part 2, Subpart J that defines it. We're all working very hard. We're going to have a meeting Thursday and Friday of the LSS, licensing support system, and advisory review panel which consists of the DOE, the NRC and the affected units of local government in Las Vegas. And we have modified our records system. Everything now is either being scanned or entered into the computer, so we enter our information, whatever system we come up with. We're probably moving to some sort of an internet based system as opposed from a proprietary system we were thinking in past years. And we've gotten away from the microfilm in our current records management, so data will be easier to handle.

This diagram tries to show the flow of information leading to the PAs. So, you know, we have data collection and synthesis which leads to process models, which leads to an abstraction of those models for the PA, for the VA, and leads to performance assessment. We call this a TSPA that will feed the VA, and so on. So it all kind of comes together in a PA, and design feeds up and so on. So this is, again, the logic of how we're trying to put it all together. It leads to a license application in 2002.

So we will be doing another PA for the viability assessment, and subsequent to that, we will do detailed sensitivity analyses, or update the PA. We're also going to go into a review process that Abe will describe, I hope, late and where, you know, we'll have some kind of a review team make its analysis. That will start this year. We will review the models and the process models, the abstract models and the overall TSPA. This is a several year process that we're planning.

This is my final slide. Scientific program we'll focus on addressing priority data needs, and the transition from site characterization to performance confirmation in the '98 time frame. Design is planning three phases through the--you know, in the design process that Rick will talk about. And the EIS process will restart in '97. We'll use a common data set and support both the PISA and the TSPA and of course the license application.

So that's kind of the introduction. All the following speakers will of course now fill in each of those key areas that I showed you on the overall schedule.

Thank you.

DR. CANTLON: Thank you, Steve. Let me ask a question.

It was obvious in the interplay when you submitted the surface geology to peer review and the Academy that the scientists that generated the data couldn't really support the summary documents that you had.

If you'd put your slide, or overhead Number 24 back up on there? I guess it worries me that all of the arrows are going in one direction. It would seem to me that you really need to think about the feedback so the scientific group that generate the data can support what the higher levels of integration have to say. Could you comment on that?

MR. BROCOUM: Well, we are setting up various working groups that interface, say for example, that interface right here, and they'll all be formal groups between science and PA, and there will be that iteration between PA and engineering and between engineering and science. So we're setting up in this process those kind of work groups that will work that iteration in the feedback. This was just meant to be an abstraction of the overall process of how we're moving.

DR. CANTLON: So you're comfortable we won't see a repeat of the--

MR. BROCOUM: Well, we're going to do our best not to have that. I think that at a former meeting, you asked me a similar question like that and I said that we had to formalize that PA process more. And I've been working with Abe to make sure that happens, and he will be describing that. I think that's your second talk today; is that correct?

MR. VAN LUIK: Both.

MR. BROCOUM: Both talks.

DR. CANTLON: Okay.

MR. BROCOUM: So we're very conscious of that, that we have to have a PA that we can follow through that data that fed it.

DR. CANTLON: Thank you. Dr. Cohon?

DR. COHON: Jerry Cohon, Board. What's holding up the waste strategy, waste isolation strategy?

MR. BROCOUM: Several issues. We completed the document. We have a lot of comments. At the very highest level, we agree. And at the points that we agree on, we will have in the program plan. When it gets down to the details, as to, say, what test shaft to do, what things to depend on, there are dialogues going on. There are debates both on the scientific side and the engineering side.

I think all the people doing this are really giving us good comments. And so we need to have more time to talk these things through and make sure we can reach as good a consensus as we can. That's kind of what's holding it up. There are just technical debates, differences of opinion, for example, on the role of retardation, to give you one example. Another example is on the role of total containment. Those are some examples of the kinds of things that we're debating. And so we're trying to work all these things out.

DR. COHON: Let me just point out something that I'm sure you'll agree with, that where what you've shown us today I think is very promising in terms of you really pulling things together, it simply doesn't work without the strategy fully in place and fully specified.

MR. BROCOUM: You're correct.

DR. COHON: Is it fair to say that part of the delay is a result of the transition you necessarily have to go through from a program that was not top down at all, to one which is much more top down?

MR. BROCOUM: That's part of the problem. It's a much more top down program than it's ever been. We've laid out all the milestones, and these were all defined by DOE basically, and then we said all right, now you have a contractor tell us if we can implement that, or help us implement that. Right? That's correct. So there's a lot of things going on. But I wouldn't say that's the only reason, because we've worked very hard.

DR. COHON: When do you believe the strategy will be finalized?

MR. BROCOUM: Well, we're shooting--officially, it's throughout the summer. I think we have a June time frame in our planning, in our official date, but we were hoping to be able to get it out sooner. We have, of course, drafts. We've briefed the Board I think three or four times on it in the last year. The fundamentals of the strategy have not changed, but the details are under debate right now.

And so I agree with you, some of us think it's very important to get a strategy in place, but we really wanted to at least get a more expanded version out to the Board today, but we just could not, in all honesty, we could not do it, so we didn't.

DR. COHON: This has to do with some of the words you've used. One of the joys of the Board is keeping track of words that DOE introduces at various times, and then we spend the next several months trying to interpret what you meant, and you probably do, too.

The new one, for me anyhow, is confirmatory testing, and then also a version of that, I guess, called performance confirmation. Could you define what those are?

MR. BROCOUM: Performance confirmation is required by 10 CFR, Part 60 and it's required to start your confirmation during the site characterization phase, before you submit your license application, to make sure that all the parameters and all the miles are within a certain range that you specified they would be. So that you do more tests, and if things are in the same range, you know, that's fine. If they're not, you need to see what that means.

I think the confirmatory testing is to update the information between the viability assessment and the license application. In other words, we're going to feed process models to the PA, the PA will abstract them and do their PA, and then for the license application, those models will be checked, add any new information, and it will be updated as appropriate and they'll be used in the license application. Did I say that right?

Performance confirmation will go on for decades, before we submit the license application and as long as the repository is open.

DR. COHON: Okay, thank you.

DR. LANGMUIR: Steve, I had to unline one of your statements, the one on Page 6, which said, "No major unexpected conditions have been encountered since 1986." And I think we would all agree that that isn't true. We have found some very good things in the tunnel, for example, and what occurred to me when I read this was that maybe you hadn't written this after the Chlorine 36 discoveries of bomb pulses down in the fractures in the ESF. I think you might have written it before that.

MR. BROCOUM: Well, the statement was actually written before that.

DR. LANGMUIR: That's what I'm guessing.

MR. BROCOUM: You know, what exactly the Chlorine 36 means and what it shows is under investigation. But we've always recognized that there might be paths that water can travel rapidly down fractures and faults, and that's why I showed the diagram from 1984 that showed you these arrows going down faults. So one can argue that that's to be expected. In fact, some people said--I don't want to mention any names--but some people said they walked in the tunnel and said I want a sample there because if you find it, you'll find it there, and those were the samples that were found.

So the fact that you found Chlorine 36, it might have been transported down there by water, and if it's along fractures, it would not be necessarily an unexpected condition.

DR. LANGMUIR: I think some of the scientists might think it was unexpected. But my question after that then is what is the program proposing to do? I think those of us on the Board have learned about this and discussed it and have concluded it's one of the critical discoveries in the ESF, and understanding it properly and how it relates to the flux through the mountain is perhaps the most critical question you have to answer in the immediate future. That's at least my opinion.

I'm wondering what you're proposing to do because of this new knowledge, in terms of maybe redirecting your emphasis on research and characterization in the mountain.

MR. BROCOUM: I think you're going to talk about that or Dennis?

MS. JONES: Susan Jones. Well, the first thing we're going to do is finish the study that we have going now. What you're reacting to is the initial Los Alamos report which covers about a third of the plan study for this year. So the highest priority is to finish not only the analysis of the samples that we have, but also the additional ones that we plan to collect behind the TBM.

We also have the U. S. Geological Survey doing some other type of isotope studies. So we have to get those results in. Plus we have now the surface maps and the detailed ESF tunnel maps, and so we can bring in the geologic component and try to put the entire picture together and get that to our modelers.

DR. LANGMUIR: Okay. So the bottom line is you are redirecting some energy and some resources towards answering this question. That was my critical concern.

MS. JONES: Correct. In fact, it was one of our higher priorities. This was actually a new piece of work that we added in after the start of the fiscal year, because this was originally not part of our plan, but we took advantage of some funding that we were able to find and redirected it into the study.

DR. WONG: Jeff Wong, Board. I have a question on Number 12. You have in there that you want to set the exposure limits. Are your recommendations to EPA 10 to the -

4 and 10 to the -5 fatal cancers per year? And EPA traditionally has operated in 10 to the -4 to 10 to the -6. Why is it that you chose the upper part of the range?

MR. BROCOUM: But the 10 to the -4 can offer operating facilities, you know, not for something when you're talking about 10,000 years or hundreds of thousands of years. It's just that you're getting beyond what you might be able to do. I mean, for example, if you're going to have a standard, let's say, 4 millirem, and when the background is several hundred, how will you know you're even passing or violating that standard. There's just a lot of issues there when you're trying to project something out beyond what's been done before. So I think that that's part of that concern.

DR. WONG: Okay, thank you. And is that an individual risk or population risk?

MR. BROCOUM: That's an individual risk.

DR. WONG: Individual risk. I have another question. I have looked at the time lines, and I'm a new guy so I get to ask a few easy questions, I've looked at the time lines for Mr. Barrett and yours, and before, there was a term suitability and now I see the term viability and suitability not on either one of these time lines. For the new guy, can you describe the relationship?

MR. BROCOUM: What view graph is my overall schedule? Let me find it here. I'll just talk about this one here.

The viability assessment is just an assessment as to whether we should continue. In other words, is there any reason we should not continue? So it's an assessment of why we should continue, and it's also for the country to add on this thing what it means to continue, what it's going to cost, how much more work is going to be needed, and all that. So it's not really a formal site suitability. Okay.

The formal site suitability occurs right here when the Secretary of Energy sends a site recommendation to the President of the United States, so at the end of the year 2001. That is the formal decision point for DOE.

DR. WONG: Thank you.

DR. BARNARD: Bill Barnard, Board Staff. Steve, you described what you call the integrating planning process. When did you start doing this process? And do you plan on evaluating its effectiveness at some point to see whether it's accomplishing what you intended?

MR. BROCOUM: We started this process after the October Board meeting in the D.C. area when we had the Congressional staff. Remember the meeting that the Congressional staff came to? At that point, we were on a 250 declining budget, and we were shutting down the program I think in 1999. That kind of was the plan.

We pulled a team of people together, the AMs, key senior managers from the M&O and from the east and the west, and we started what we call a continuously planning effort. It was an off-line planning effort to see if we could come up with a program that would allow the program to get to a successful license application under the constraints that we were, you know, getting from Congressional staff.

The thing that really struck me at that meeting is we want to know what DOE thinks. That's what they said. It's not that we're against disposal; we've got problems with DOE. That's what they said at that meeting. So we got together to see if we can do this, and we started in October and we met weekly, several times a week. This was off-line. This was not the formal planning process. We made presentations to the director, to the project manager, to Lake, and after thought we can pull something like that off, or put together a plan, we had to sell it, if you like, to our management. We did that. That was the February and March time frame.

And then the contingency, the off-line plan became the formal planning process. So that process evolved from an off-line, unformalized to a more formalized process. But basically, it's top down; it's the AMs. It's not our staff. It's the AMs who get together, actually get together and decide what we can really do.

DR. CANTLON: Okay, two more questions; Leon and Metlay, and then I think we'd better take our break.

DR. REITER: Steve, there's two things; first a follow up to Jeff Wong's question. You have in your schedule, it looks like in the middle of '99, or six months after your viability assessment, a 960 compliance report. Is that suitability, pseudo-suitability? What is that?

MR. BROCOUM: No, that is not. This is a suitability decision.

DR. REITER: What is 960 compliance there for?

MR. BROCOUM: We have it as an off-line activity. You notice it's not part of the--if 960 still exists, in other words, if Congress doesn't pass a law getting rid of it, or whatever, if we revised it, we will at that point do an evaluation as to how we think we meet 960. That will just seed this recommendation.

DR. REITER: But isn't 960 a suitability document?

MR. BROCOUM: No. I mean, I think the wording is, you know, the secretary takes what we give her, any other information she wants to use, and makes a recommendation. A recommendation is the formal DOE decision.

DR. REITER: What does compliance with 960 mean? Tell us what it means.

MR. BROCOUM: Well, first of all, we kind of have a new 960. Well, we meet whatever criteria there are in 960. I mean, that's what--

DR. REITER: No overall qualitative, no qualitative judgment?

MR. BROCOUM: That will all be wrapped up in the site recommendation report. You know, there's going to be a lot of policy issues that feed that.

DR. REITER: The second question is you mentioned and we heard this a lot before that, you know, beyond 10,000 years, you want to look at qualitative arguments, and we heard that before. I know you haven't thought this out completely. Could you give us some idea as to what might be a qualitative argument and whether or not qualitative arguments will have any sort of regulatory impact?

For instance, if you find out that you have like a 20 or a 30 rem annual dose out in, say, 200,000 years, is that enough to say the site is no good?

MR. BROCOUM: I think to make a decision, the decision makers ought to have all that information. And so whatever that dose is, tens of millirem, you know, 10 rem of whatever, they ought to have that information available so that they can make the right decision. Our goal is to lay out all the information so that the right decision can be made, but not to have a criteria that for 3 or 5 or 600,000 years in the future, that, one, there's a pass/fail criteria, because it really is not that meaningful.

If you were comparing sites, so you can, you know, define reference biospheres, it might be useful to compare different sites. But we only have one site. We have Yucca Mountain. So I think it's fair to know how the site, or the country to know how the site is going to perform, but to set a clock way out in the future, I don't think, you know, serves us very well in trying to decide whether to go forward with a geological disposal.

DR. METLAY: Dan Metlay, Board Staff. Steve, you might want to kick this over to Lake. Probably I should have asked when he was up there. But you've talked about a viability assessment, which at least as we currently understand it, represents essentially four stacks of documents that you're going to prepare by 1998. Does DOE intend to make some judgments on its own about the viability based on those four stacks of documents? Does the DOE intend to develop criteria by which one could judge viability? And if that's the case, how might that be done?

MR. BROCOUM: Do you want to answer that?

MR. BARRETT: It will be a compendium measurement of information that can be used by the policy makers. The first person who will be using that will be the administration, in the President's budget requests and the secretary. If in the view of the administration that this is a no go, the costs are too high, the performance is too poor, it would be a negative decision.

As Dan Dreyfus mentioned, if we found the Aztec

Princess tomorrow morning from the tunnel boring machine, it would be all over. We would stop. So it would be the absence of a negative decision, is what that would be. But there is no positive decision, like it has met criteria A, B, C to go forward. It would be the absence of a negative decision.

DR. METLAY: So other than some real obvious clear-cut show stopper, DOE, when it forwards this viability assessment, will be agnostic on the question of viability?

MR. BARRETT: I think you will see in what we propose to do would be what the true decision would be. If we propose to go forward, it means that we have not made the negative finding. If we hunker back and say, well, let's now go back and ponder shooting the stuff into space, or whatever, it will be a negative one.

DR. CANTLON: All right, I think we'd better take our break. And we will return here at 10 o'clock.

(Whereupon, a recess was taken.)

DR. CANTLON: Abe Van Luik is our next speak. Abe, you're on. The people making the recordings are having trouble hearing some of the speakers, so if you'll move the mikes closer to your face, we can be sure we get a good solid record.

DR. VAN LUIK: When I packed for this trip yesterday, I started to put my dark blue suit in, and my wife says, "That's appropriate for a nuclear undertaker." So here I am in light gray. Sometimes it takes another person's perspective to see you as you're seen.

What I want to talk about today is what we're doing right now, just one view graph, that our major activity is planning for the total system performance assessment for the viability assessment. I want to mention very quickly, although Steve I think already did a better job than I was going to do on our Chapter 8, the total system performance assessment chapter for the TSPA-VA, and then I wanted to address the question of what we're going to do between the TSPA-VA and going to the LA, and then to mention a little bit about our participation in performance confirmation.

To sum up our key performance assessment activities in 1996, we are doing sensitivity analyses for both the engineered and the site subsystem to help basically plan TSPA-VA. And I think all the words on this view graph say exactly what I just said.

Our biggest activity this year is planning for the TSPA-VA. Let me show you why this planning is a big activity. This set of three view graphs that's coming up--or actually I could use the other view graph machine--used to be on one view graph, and I thought it was wonderful, but no one else could read it.

But if we look at the modeling hierarchy, we have a total system performance assessment model, a code like RIP or TSA. We have performance assessment models beneath that feed it. We have abstracted systems and subsystem models, and we have process models that are delivered to us from the scientific programs, the engineering design and the environmental program.

If we look at what we do with each of these modeling levels, you will see that there is a lot of, even if we do very little in each one of these boxes, there's a lot of boxes to be covered in order to assure that we have a complete assessment.

Now, in the past, we have never used the word complete assessment because we were not doing a license application, but for the VA, we would like to get as close as possible to complete. So whereas, in TSPA 1995, we said well, in '91 and '93, we did the volcanic and the seismic and it wasn't too interesting, we'll skip it this year and focus on, you know, the specific purpose for this particular assessment, which was to look at the near field in more detail. For the TSPA-VA, we want to try to cover all the bases.

And if you look at the next view graph, you see that it's a very ambitious program of actually feeding up from the site program from the site program from the engineering program the detailed modeling that they do at that level in the interpretation of data in the creation of conceptual models and the testing of conceptual models and the testing of alternate conceptual models, et cetera. We want to fee from that basis, that scientific and engineering basis, right up to the top of PA in a traceable and a transparent way. It's a very ambitious thing to do, and I guess by saying that, I'm admitting that in the past, we haven't done that, which I'm sure is a total surprise to this group.

Model abstraction, the way we're laying it out, and I am reporting now on things that are in progress, in other words, we are discussing even as I stand here with the site and the engineering programs, how we are going to carry this out in a mutually coordinated and satisfactory way. Working groups are being organized to perform the abstraction analyses. When we go from the very detailed process level models that Susan, for example, and Rick Craun's people are creating, we want to abstract the important features from that and carry them into the next level of modeling into PA.

In the past, we thought that PA could do that all by itself, and then experience has taught us in the review of the first couple of models coming from site, that in order to get the proper interpretation and the proper buy-in from the detailed process level modelers, they need to be part of this process.

So we are proposing and I think we have had an enthusiastic reception from both site and engineering, that these working groups are to be composed of performance assessment modelers and the process modelers, and we will jointly, not just talk about, but we will jointly perform the abstraction, testing and sensitivity analyses, and this is to ensure, and I think this addresses a question that was asked of Steve Brocoum a while ago, this will ensure that performance assessment's use of process models is correct, so that we do not have minority opinions in meetings such as this on or work.

What is the status of the working groups? We are in the process of defining the membership and outlining the resource commitment. We have learned by experience that if you have a good idea and you don't fund it, the good idea is a waste.

To date, the performance assessment organization has been working to prepare for this activity. We have defined what we think the expertise mix is for each subject area working group, and we have done within PA detailed work planning, and that's what I'm going to focus on for the next little while. But please don't confuse the detailed work planning with what is actually going to be done.

What we have done is created a set of plans to bring into the first of each of these working group meetings saying from our perspective, this is what needs to be done. And then we will negotiate with the other participants. But we did not want to go into a meeting and everybody sit down and say okay, what are we here for. You know, we've been there and done that and it's a waste of time. So this is all preparatory work, but I expect fully that it will be somewhat modified as we start the actual working groups later this year.

We want to focus on major improvements to TSPA components for the unsaturated zone and the saturated zone flow and transport. That's going to be key to the new TSPA-VA. We want to address seven major modeling topics and select working groups to address each one of those. None of these will come as a surprise; unsaturated, saturated flow, transport, both unsaturated and saturated, thermal-hydrologic mechanical coupling.

While I was gone, I asked backfill to be taken out because it's really part of the EBS performance analysis, and I'm sorry it's still there. Climate and biosphere modeling.

We have defined topics and issues. What you saw before was a list of seven topics. For each of those, we have a more complete list of issues. And then for each of the issues, we have defined data need and sources. And the point here is that we defined that to bring it into the working group. The working groups will have people from engineering and site, and they will say your data needs and sources is incomplete, or you're asking for things that we can't deliver, whatever. So these are things prepared to go into the meetings with. They're not the definitive final statements.

We have defined how we think we can implement this particular feature into the TSPA. We have defined in a rudimentary way what sensitivity studies would be useful to do jointly in the working group. And then we have made a statement of the status of the work, you know, whether this is a relatively mature process model, or whether this is a brand new one just coming on line that we've never seen before, et cetera.

And this is to reiterate that our objective here is to plan the TSPA-VA. And I think I have said everything on this probably twice over already.

I want to give you an example list of issues for one topic just to give you a flavor of what we did. For example, for the topic of unsaturated zone flow, the sensitive issues that we want the working groups to address are fracture-matrix coupling, fracture hydraulic properties, lateral diversion of water above the repository, a wonderful word if someone is keeping track of new DOE words, episodicity, infiltration of pulses versus steady-state infiltration, of course the rate of infiltration and heterogeneity and scaling.

We think these are out of a list, a much longer list of issues. We think that if we do something significant on each one of these, we will have a major improvement in the way that we address UZ flow. And then for each of these, the list that I showed you before, how we're going to implement it, data sources and needs, et cetera, has been already completed to go into the working groups so that we can get a rapid start on this work.

The next part of my talk is also part of the stuff that we're bringing into these working groups to negotiate with them. You should not interpret them as being the final word.

We made up a modeling flow hierarchy, and I'll show you that on the next view graph, and we'll keep this one up for a while. And I don't want you to get this confused either with all that you need to do to do a system level model.

In the past, when we created a near field modeling group and a far field modeling group, et cetera, and then had them bring their results together and one created input for the other, we found that even in the same organization with the same people, you come out with differences in units, and what's even more important, differences in scaling of the answers, and you have to almost create a separate program to translate the output from the one into useful input to the other. To prevent that, we are actually organizing the interface control process so that when we go from infiltration/percolation process level models to the interactions of the repository with the incoming fluids, that we will have predefined what the inputs and the outputs look like.

And so there are seven boxes here, and I will give you a little flavor of what we think goes into each box. The arrows show, and this addresses another point that was brought forward earlier, that there is a feedback mechanism throughout this process. And one of the ways that we assure instantaneous feedback is that the people helping us do this work are the people who create the data that feeds these models. So if we are doing a sensitivity analysis, we will discover jointly between us and site or us and engineering, that there is a hole in the data. It's not PA screaming again by itself, but they will be with us right at that moment when we discover that there's a hole in the data, and we may have to realign some work to fix it.

Let me go through the next six view graphs in a big hurry, because basically I just want you to get a flavor of the type of planning that we're in the process of doing. For example, here is the first issue on the box on the left, infiltration/percolation. The question to be answered is how do infiltration and percolation affect UZ flow to the repository. You know, if you have 20 centimeters a year coming in at the top, you probably have pine trees at the top, but what we really want to know is how does it affect the flow at the repository level.

The input data comes from the programs that give us precipitation, the infiltration/percolation data, and of course the climate change in terms of predicting the future. And the key on the right keys it back to the major models from the first set of view graphs, the three view graphs that show the modeling hierarchy. So if you want, you can go back to there and follow which of these models are being used to address this particular issue.

And then the output from that model is a modeling application, and that includes investigations of alternative conceptual models, alternative implementations of models, parameter sensitivity studies, et cetera. So that would then flow into issue two, which is how do the thermal-hydrological mechanical effects in the repository interact with the fluids coming in. And we don't know the answer to this yet. This is an area that is relatively new. TSPA-95, we began addressing it at the drift scale, and we think that we're making progress in understanding what the issues are in this area.

But the key here, and I don't need to go into this in great detail, is that this is the kind of data that we think we need. However, when we start doing the sensitivity analyses, if we have information needs that are not met by the current states of information, we will give that feedback to the program. And then these are the process level models keyed to those information needs.

And here we get very much into the near field environment and the engineering aspects of it, how and at what rate and what distributions do containers fail.

The next step is how are contaminants mobilized and at what rates. And for each of these key questions, we are trying to define and control the interfaces and make sure that we have agreement with site and engineering on what the proper data feeds are and what the proper model feeds are.

Everyone's favorite; unsaturated zone transport. How and at what rate are contaminants transported through the UZ to the water table? We are not looking at how and at what rate can a hypothetical mass particle be transported through the mountain, but we are asking what is the contaminant plume going to look like over time, which is a very different question.

Saturated zone transport becomes very important with the new wave in the regulation. How and at what rate are they moved in the saturated zone to the accessible environment? Again, what we think in PA, and we're going to negotiate this with site and with engineering, as appropriate, and with biosphere people, what information needs are available and what models those information needs are reflected in.

And then, finally, issue seven is one brought about by the likelihood of us receiving a dose based standard. Are the release, risk and dose standards met at the accessible environment, or wherever else the new regulation says it should be met? And this is the final point, and you can see that depending on the type of standard, the information needs would have a different mix, depending on how far they tell us to go and how strict they tell us to be.

All of this information, and it's a very ambitious program, the results of all of it will be reflected in Chapter 8 of the PISA. And I thought that Steve's outline of the PISA was actually more informative than mine. But we are preparing at this point an annotated outline for the PISA Chapter 8 with five sections, the way we see it. It will of course have an introduction. It will have system and subsystem descriptions that draw on the chapters done by site and engineering. It will have an evaluation of undisturbed performance, including climate change, because we say and we have consistently said for years that climate change is part of the expected case. We will have evaluations of potentially disturbed performance, earthquakes, volcanos, that kind of thing, and then a synthesis, summary and conclusion section. This looks like a simple document, but it's going to be a very large chapter in a multi-volume viability assessment.

Now, another question that was asked by the Board is what's the difference between TSPA-VA and TSPA-LA. We love acronyms. License application TSPA. And the answer is that we are going to have a peer review group hopefully starting later this year that will review our work and our products as we go along, and then give us, as we issue the TSPA-VA, will give us six months after that fact, or three months, however fast they can work, they will give us a final critical commentary on what they think we have done. That commentary, we will then take very serious in preparing the TSPA description for the license application.

There will be new data and process level modeling results, as Steve said, that we will want to put through sensitivity studies. And if the new data and process level models make radical departures from before, of course we will have to do a completely new TSPA. But we don't expect that.

We want to also do more in refining our evaluations of alternative models. We are already seeing that with the ambitious program we have laid out, every possible alternative cannot be properly evaluated for the TSPA-VA, but we think it's appropriate to take the ones that we think are the most likely and put them in the VA, and then leave some of the other evaluations for the LA.

And then another thing we need to do is even if we changed nothing in the TSPA-VA, we must add to the documentation to ensure that a complete reviewable package is created for the regulator. We have a great deal of sympathy, and I can say that without smiling, for the regulator having to review in great detail the voluminous products that we create. And so we want to make sure that it is a reviewable package, that it's transparent and that all the claims and statements made therein are traceable.

Performance confirmation has come up a couple of times this morning. And performance assessment is just part of the performance confirmation program. It is expected, as Steve said, that scientific, engineering and environmental work continues to evaluate the potential repository and to assist into the far future in the preparation of the LA and its updates to receive waste and finally to close the repository.

For this year, performance assessment is already a full participant in a confirmation concepts study being carried out under the systems engineering part of the program.

And just a final word, a little bit about that study. It's a systems engineering task under our WBS

1.2.1.5. It started 10/2/95, earlier this year. There's a draft report due 8/30/96, and an acceptance review by DOE at the end of the fiscal year. It's going to provide a technical basis for performance confirmation requirements focused on repository and engineered barrier system design for this year.

The customer focus, meaning broadening it to be a more comprehensive confirmation program, will begin in fiscal year '97. And it's this year, to provide the first start of the draft performance confirmation plan, presenting just an overview of the performance confirmation approach.

So this is, again, work in progress. Results will be available later this year, and PA is presenting this because we were asked, you know, what are we doing in terms of performance confirmation. We are full participants in this particular study. But performance confirmation and performance assessment, the only thing they have in common is the word performance. Performance confirmation, as defined in Subpart F of 10 CFR 60, is the same thing as site characterization was before the license application. So it's a much larger program. It involves both site and engineering and biosphere to make sure that when we go from the LA to its updates, we actually have something to say that's based on real work.

So with that, I will close this presentation. My afternoon presentation will actually step back in history to show you why we have gone to this very structured way of interacting with site and engineering and with ourselves within PA.

And let me make a comment to that effect. From a DOE perspective, which I now happily own, the reorganization and realignment of the contractors under the M&O has really helped to integrate the program within performance assessment, and I think in a lot of ways has helped the overall integration of the program. And I think in the PA, I know what I am speaking of there, the new concept of basically one contractor with subcontractors, or memorandum of understanding type participants, is working very well.

DR. CANTLON: Okay.

DR. VAN LUIK: I'm sure there are no questions.

DR. CANTLON: I'll dissuade you immediately.

In doing the '97 TSPA, which will I gather form the basis of the '98 viability assessment, to what extent do you have the flexibility to perhaps over-engineer the engineered barriers so that compliance is more easily demonstrated, with the understanding you may back off as you get, say, to site recommendation or even further on when you start to construct?

DR. VAN LUIK: The TSPA-VA, the reason we're calling it VA is because we used to call it '97, and then we flipped to

'98. It's actually the scheduled delivery date is in '98 now. But we're starting it in '97. In fact, we've already started the planning and some of the work for it now.

The question that you asked is really a higher level policy question than is in my bailiwick, and Steve is volunteering to handle it.

MR. BROCOUM: We have another systems study ongoing this year called the engineered barrier enhancement systems study, or something of that title, which is looking at ways to enhance engineered barriers to improve performance, looking at both 10,000 years and long-term. That study is about half done.

But one of the findings of that study to date is most of these improvements that you would do on the engineering, you know, drip shields, backfill, other things, would have to perform their functions for tens of thousands to about 100,000 years to make a difference. And so the issue is here now how does one demonstrate in a licensing proceeding that an engineered feature as opposed to a natural feature will continue to perform its function through these many tens of thousands of years. And that's one of the big concerns from an engineering perspective. So one can do these things, but proving them in an adversarial hearing condition setting is what we're very concerned about. It all leads to this whole thing about what kind of a standard should we have for this site and everything. That study will also be done about the same time frame as the study that Abe talked about.

DR. CANTLON: But if the engineered activity is one which is essentially geochemical in nature, that is the time scale on which those things operate, for instance, if you used depleted uranium in the backfill.

MR. BROCOUM: That's correct. In some cases, they are, but still you have to emplace the backfill and be convinced you're not going to make paths through it. You know, there's a lot of issues. The point is you can do things, but can you actually prove them in some kind of a hearing that they will actually work. It's a big issue, and depending on the feature, right, some of them might be easier than others to show.

DR. VAN LUIK: I think there's another aspect to this. TSPA-95, 93, 91 contains some speculation as to what you could do here or there or the other. TSPA-VA is going to not do that kind of science fiction what if. It's going to address the curb design as given us by engineering, and evaluate that in Yucca Mountain. So that if the answer comes out wrong, then between VA and LA, we will have to readdress that issue. But this particular TSPA is not going to go out on a limb and speculate in all kinds of different directions like we've done before.

DR. BREWER: At one point you were talking about peer review that you weren't going to put in place with the TSPA-VA, and given some unfortunate experiences with peer review and the National Academy of Science on your technical basis reports, I wonder what you've learned and what you propose to do to make sure that that comes out clean. What have you learned is basically the question.

DR. VAN LUIK: I think there are other people that could probably answer this better than I can, but my perspective is that what we have learned is that we need a different approach to review this particular product. One reason is it's not just one document. As you saw by that table, there are dozens of major modeling inputs that each have to be evaluated. What we want to do is put together, and this is still under negotiation with site and engineering, we want to put together a team that can address what we think the major issues in performance are, you know, and also a team that can work with us over a two year period to look at our abstraction process, to look at how we're using information, and to look at the final product, and perhaps even give us informal advice as we go through, so that at the end, we don't get hit with an unexpected torpedo of this is a big mess.

Another aspect is is that we are also having very vivid discussions with site and engineering on perhaps issues where data is sparse or on issues where data leads to many different ways of, you know, conceptualizing things. Perhaps we will put together panels of experts and use formal elicitation to come up with what the alternative concepts are, what the likely ranges are, and of course including our own people so that we don't go out into left field, but using a recognized professional to mediate this process.

We are under discussion of that and that's why it's not on a view graph, because we have not yet come to an agreement within our shop on how to do this. But we fully recognize the problem that you're speaking of and just having a peer review at the final end of a product would not serve us well. We would just get a long catalog of all the scientific things that would be nice to do. It wouldn't be helpful at all.

DR. COHON: Just to follow up on that point. That's welcome news. I would strongly encourage you to do that. I respect and accept what you said about an attempt this time around to reduce the amount of science fiction, but there is unavoidably, because you're doing modeling here and will never have enough data, there must be judgments involved in every box and sub-box, even those that we didn't see on the overheads. That means, I think, that documenting those judgments and getting as broad a perspective on that as possible, or as many perspectives--that's a better way to put it--as possible and being as formal as possible are all I think prudent. That's good to hear.

DR. VAN LUIK: Yes, I think I would agree with that, except one can get carried away with broadening the perspective to the point where you have basically brought the universe's opinion on each issue. But we're trying to walk a fine line between what's reasonable and what would be very good as far as making a defensible product.

DR. COHON: I have some questions about the conceptual way out of TSPA. I'm looking at this. This thing is the four level, and this is really simply to help in my own understanding, and I'm sure you know what you're doing. I'm just trying to figure out if I know what you're doing.

Is it fair to say that taking the four--I'm looking at the abstracted systems level--that taking the four boxes on the right and the five on the left, that those represent two very distinct kinds of modeling efforts? The five on the left--okay, you see my point. I won't pursue that further. And to me, that suggests a very different way to treat those in a management context. That is, the five on the left really are crucial for the guts of TSPA, whereas, the four on the right represent surprises, events with probably very low frequency, and they happen on a very different scale, time scale, and may even physical scale, than the five on the left and, therefore, are separable.

DR. VAN LUIK: For the benefit of anyone reading the transcript, if there is such a person, the five on the left you refer to are basically the guts of how the repository operates under expected conditions, and the four on the right represent what we consider to be unexpected or low probability events, that if they did occur, could have measurable consequences. And, of course, most of our resources are put onto the left side, because if you put all your resources on the right side, but you can't make a good case for your UZ and SZ flow and transport, you've lost the war.

DR. COHON: And the working groups are organized around each of these boxes in the abstracted system level?

DR. VAN LUIK: Yes, they are. They are organized, focused on the left again with perhaps one person representing the right boxes as part of the working groups addressing the expected case conditions.

DR. COHON: Will individual working groups be encouraged early on to identify subsystems, such as the sort you showed after this, that perhaps aren't very important to the operation of their subsystem in the overall system?

DR. VAN LUIK: In fact, to encourage the start of that process is why we created those diagrams, with the information needs being very limited. If you sat down with all the process level models being created and you wanted to be totally comprehensive, you would come up with a much longer list. But we took the much longer lists and already cut them down, and then we will negotiate with the site and engineering people on our panels, our working groups, to say is this the correct cuts. But basically, if we tried to do every possible thing that could be done, we would need till the year 2200 to do it.

DR. COHON: Just one last question. You said very early on you're really going to be pushing hard to get this done.

DR. VAN LUIK: Yes.

DR. COHON: It will be hard to get it done in time. Is it fair to say, though, that we can be pretty confident you'll have something, because you have something now, TSPA-95 is something to build on? It's not as if you're starting with a clean slate.

DR. VAN LUIK: In fact, we are very optimistic that this is doable. The things is that it is ambitious and it will take dedication on the part of our staff to get it done. But, yes, we are very optimistic, partly because from our past mistakes, and I'll kind of hint at that a little bit in a polite way in the next talk, but from our past mistakes, we have learned how to do this properly, I think.

DR. LANGMUIR: Carrying on from the subsystems model definitions, Abe, I was looking at your Page 10 overhead, which is really the same thing in text instead of in box.

I'm trying to identify for myself where those concerned with source term would be in this scheme, or are any people like that still involved?

DR. VAN LUIK: The EBS performance analysis basically is everything before it gets into the unsaturated and saturated zone transport system. So all of the geochemistry, all of the thermal hydrologic mechanical coupling effects on the waste packages life time, effects on the in-flow and out-flow is all in the EBS performance analysis box, and being of the same vents in interest that you are, have been very sensitive to that, and if you read the details in that, you will see that there are issues that address the kinds of issues you'd be interested in.

DR. LANGMUIR: Let me ask a very loaded innocent question. Having spent the last several weeks looking at the actinides as part of a textbook, I have a suspicion that Neptunium and Uranium are 10 to the -5 lower than any values you're using for your releases. They are about 10 to the -7 mols per liter or less at Yucca Mountain, and those may be the highest numbers you're going to see instead of 10 to the -2. What's that going to do to your performance assessment? I would bet it's going to help it a lot.

DR. VAN LUIK: It's going to make the whole performance assessment smile like this. Yes, that will help a lot, and I'd be very interested to find out what book you're reading that gives you the basis.

DR. LANGMUIR: It's mine.

DR. VAN LUIK: We will cite it.

DR. DOMENICO: I'm not sure you're the right one to ask this, or I should ask this question, maybe Susan should help me or maybe this may not even be the place for it. But if we were doing this project 30 years ago before we had any models, there would be no performance assessment, and the merits of the site somehow defined would be based on the geology. And that's what I'm asking; has the geologic effort fallen through the cracks here? I'm sort of curious as to the role that the geologists are playing in these assessments in terms of, let's say, structure contours on the Tiva Canyon, some identification maybe characterizing intensely fractured versus not so intensely. I've always learned that dollars spent on geology generally is a dollar well spent, and we're talking about process models and a lot of abstract things which of course I'm in favor of, but I just wonder if you know everything you think you're going to know about the geology, this already has been done, and there's no further effort in truly trying to understand some of the critical aspects.

DR. VAN LUIK: I think Susan will be happy to answer this. But let me point out something about this list of process models. This is the vehicle we have identified through which the site program takes its geologic information and hands it to it in a way that a performance assessment can use it to base a performance assessment on. So we feel that we are very much paying attention to what the site program is finding out from day to day, because that is being folding into their modeling from day to day. And I think Susan ought to take this one from there.

MS. JONES: I was going to start by saying, on behalf of all the geologists, we love your attitude. And what I was going to talk about is the way that the information from the 3D geologic framework model flows through our flow and transport codes into PA. So I'm going to talk about that and show you explicitly next talk.

DR. REITER: Abe, I want to go back to the first model you had about the unsaturated zone, and I'm pretty sure it's there, but I wanted to ask you about it. That's assuming we have the same percolation flux at the repository horizon, a critical question is how much gets into the repository? We've seen two radically different models. In the '93 TSPA, the proposal was a WEEPS model where we had flow down random fractures, such that many of the packages were never affected. And some of the conclusions were that when you had matrix flow, you had some of the worst results.

On the other hand, in '95, you made the assumption that none of the matrix flow gets into the drifts with the packages, but anything coming through the fractures does get into the packages. So you have, as the flow goes up, a large percentage of the packages start getting affected, and you've told us you get out to one to two millimeters a year, you start getting some really large doses. These are very radically different approaches. How are you going to resolve this?

DR. VAN LUIK: This is an excellent question, because one of the issues that we are trying to put on the table for an expert elicitation is exactly that issue, what conceptual model or what combination of conceptual models should be used to make a defensible assessment of the flow and transport in the unsaturated zone.

I must say at this point, though, the WEEPS model that you're referring to was a study because we had always feared up until '91, we had feared finding fracture flow. And so Sandia did a very admirable thing and said, well, let's take this to the extreme. Let's put all our flow into fractures. How many fractures can you support. And it turns out that it was a limited number with the in-flows that we were looking at. And if you have a limited number of fractures and no flow in the matrix, because all your flow is forced into fractures, the limiting case is that your performance is actually pretty darned good, because a lot of your waste packages never see water.

It was an intellectual exercise. It was never meant to be a suggestion that the mountain could actually work that way, because if it worked that way, how do you get 60 to 80 per cent saturation at the repository level. So what we tried to do in TSPA-95 is come back from that a little bit, and we had matrix flow, and in the unsaturated zone, it's very difficult to get matrix flow to flow into an opening unless, you know, you have some physical impairment or mechanism that forces it to flow in. It would rather stay in the matrix, and so we assumed advective flow from randomly spaced fractures for that assessment. We felt that that was a legitimate way to represent the way the mountain actually worked.

Things that we're finding out in the ESF right now are causing us to think about this again, and we think that perhaps we need to go to a--do a permeability model to properly capture the complexities of the mountain, and we're actively engaged in that. In fact, we have such a model available for use. But the more complex your modeling gets, the more difficult it gets to use, and the more you have a defensibility problem in terms of your database and your interpretation of the data. So this is actually one of the key issues that we do want to put a review panel, or even a formal elicitation on for the TSPA-VA. It's very important; I agree.

DR. CANTLON: All right. Let's proceed then with Susan Jones.

MS. JONES: For the presentation outline that I'm going to talk through, we're focusing on the site investigations strategy, and this is where I was going to address the idea of performance confirmation, how it relates to the site program, briefly step through key drivers of the site program, mentioning briefly the waste isolation strategy and some key drivers from performance assessment, talk about logic ties in the program plan, and in response to some specific questions we received ahead of time, talk about a couple of the key products that will be produced by the site program.

Overall, the idea is to leave you with an understanding of what kind of information you're going to be seeing and what kind of product and when.

The program plan, revised program plan, talks about focusing our program and streamlining it, and there were five specific pieces of that strategy that relate explicitly to the site program.

We've talked extensively about this first one, which is tying revisions of the process models to key decision points. Those key decision points are management points such as the viability assessment in '98, points such as requesting the sufficiency comments from the NRS, and also the final submittal of the LA.

If you think back to the '94 plan, what you would have seen there were annual updates of every model. What we've done here is reduced the number of cycles to make them more meaningful and tie them to these management plans. The '94 plan I believe had four cycles. We're going to be going down to two cycles, tied to TSPA for viability assessment and tied to the license application itself.

When I was here in front of the Board in January of '95, we talked about the shift in philosophy from data collection to the synthesis and the documentation of what we already knew, and we continued that in our '96 plan, and I think it's standing us in good stead to have done that in '95, '96 because modeling has had a chance to catch up with the data collection. Now we have the tools to evaluate some of these recent results.

As a result, we are conducting a smaller focused data collection program, and as others have mentioned, particularly Steve, we have a common data set that we're going to be working towards, and we'll be using the safety assessment, the project integrated safety assessment, as our management tool.

This time line is the one that Steve showed, and what I just wanted to point out is after I'm finished, Rich Craun will be talking about the design phases. Abe has already talked about the abstraction and performance assessment link, so my primary focus this morning is going to be on the collection of the data, the synthesis, and our process model development, and show those connections.

Conceptually, what we have done is think about the remainder of site characterization in two parts, and this is the key point and probably the biggest change from what we briefed in our '94 plan, and that's a focus on this date here, June of '98. That's the time at which we expect to have our baseline site description written. It's primarily, you can think of it as taking the Chapters 1 through 5 of the SCP, which were written at least back in '88, and updating it to reflect all of our current information. So that would be the collection and analysis of data primarily through the end of fiscal '97.

The code development that takes place, the last one of which is near field environment that comes out at the end of 1997, and then putting that together in that project integrated safety assessment, primarily Chapter 2, which is all of the geoscience information, in June of '98. In the meantime, we have been feeding information to total system performance assessment and design, with the documentations available in the middle of '98.

At that point, as each of the various models is released between the early and middle of fiscal '97, the programs that support it move into what we're calling performance confirmation, like ongoing monitoring, such as running the seismic network or meteorological monitoring, long-term testing. The key activities here are all of our thermal testing programs.

And then model confirmation activities which would be taking the information that we're getting from these programs, asking, as Abe indicated, do the results fall within the bounds that we've set in our baseline site description, and there should be, for those of you who like arrows, there should be an arrow coming back from here, down to TSPA and design as a feedback.

So if we find information that would change our models, we have to feed that back through TSPA design to see if it has any impact on those parts of the program.

Key drivers I'll go through quickly. The first one is the waste containment and isolation strategy. There is general agreement on the three bullets, the three main portions of that strategy. The rate of water seepage into the repository, the discussion there has been wording the hypotheses to ensure that not only that we're talking about infiltration, which would be ambient conditions, but also to ensure we're capturing remobilization of the water that's there. Near-field environmental conditions for the waste package, and then dilution and dispersion in the groundwater below the repository.

What I'm going to lead up to then is a short check list that shows the key parts of the program that we have in our long-range plan.

PA, I'll talk about the process models that we just did during Abe's talk. But the TSPA-95 results also were summarized in two statements; amount of water, we always come back to that, the amount of water in the natural system and what's contacting the engineered systems, and then the magnitude of aqueous flux through the systems.

No matter whether you're looking at the 10,000 years or the million years, TSPA-95 looked at both and percolation and flux came up as the top item, top date need in both cases.

Model connectivity showed up. Abe alluded to that, that fracture matrix coupling is one of the areas that PA has suggested we do a formal expert elicitation to provide and deal with the uncertainties in the models. Especially at the million years, we're looking at dilution and dispersion in the saturated zone, climate changes, the things that you've heard of many times.

This next view graph is again just to show the ones which the science program has particular interest in. We're providing the process models and assist in the abstraction of the ones I show in the shaded areas here. Again, unsaturated and saturated zone flow, the drift scale flux modeling, and so on. And we'll be participating in those working groups that Abe discussed earlier.

I hope that's clearer in your package than it is on the view graph. But what I've done here is shaded those process models for which the site program is responsible.

In terms of design, we've had good dialogue recently trying to understand exactly what type of information is needed and when in terms of scheduling the hand-off of data, and these are the drivers from the design side of things. Focus clearly is the near-field environment, because of its influence on the engineered barrier system and the waste packages.

From the environmental side, this is an interface that we've only recently established, primarily because of the start of the EIS with the scoping, and they've provided us with data needs that fall into these two broad categories, mainly the saturated zone transport and they're also interested in some of the outcomes of our drift scale thermal modeling.

Internally, we have our own data needs, and top of the list is the percolation flux, hydrologic properties of the major faults and their associated fracture zones, and so on. What all that rolls up to are the key parts of our program that you'll see when you look through the details of our plan for the next few years.

Probably the highest priority, because it supports so many parts of the project, are the in situ thermal testing program. That includes both the thermal mechanical tests which should begin in August, I believe it is, this summer, as well as the drift scale testing scheduled to begin I believe it's next year. Work on the unsaturated zone flow and transport, saturated zone, in situ transport tests, and then the geotechnical monitoring for design.

All right, this is the modeling flow of information that I was talking about earlier. By the end of 1996, in December, we expect to have the next version of our 3-D framework model. This is where we collect the fracture information. We also collect the information about the major fault systems, stratigraphy, thermal-mechanical properties, hydrologic properties; they're all collected in this particular model.

It then forms the basis for our unsaturated and saturated zone flow models. We also will have our climate scenarios developed to input to those modeling efforts. Those are scheduled, as you can see here, for July of '97 for the next iteration.

From that then, we derive our site scale transport models by October of '97, and feeding into it, the report itself comes out a little bit later, but information feeding in then is our near-field environmental model. All of that information then feeds data off to the waste package and repository designs. This chart is designed to show the primary tie, which is the performance assessment. Starting here with the site scale flow models, as each of these is developed, we move into that process of abstraction that Abe was discussing in detail. And so that's why it's shown as an activity that begins in 10/96 as we start pulling this information together.

The review of the process models may include the expert elicitation processes that we were just talking about. We're leaning away from the formal peer review for the same reasons Abe mentioned. Doing it after the fact isn't particularly helpful. So we're looking at more of an elicitation or ongoing review. My analogy is always the geoengineering board where you're getting your input as you move along.

So each of these flows in as it's finished into the abstraction and review processes. There is a feedback loop here. As we get suggestions or data comes in that would cause us to change anything while we're in the process here, we make those process model changes, and ultimately the information flows into the TSPA for viability assessment, and the documentation portion of that, which is the safety assessment.

So, again, we have everything tied here scheduled to be finished to support the TSPA in '98, as well as the preparation of our section of the project integrative safety assessment.

The question then is what happens after mid '98 as we move on to license application. Well, I mentioned that we have ongoing monitoring, but a couple of testing programs are really key in this time frame. We will have access to our Ghost Dance Fault in two parts by the end of this year, and so we will have the ongoing monitoring across the fault. We go up to a fault, collect some data, we do tunnel through the fault, collect samples, come back and do the long-term testing.

And we also have the drift scale thermal test which begins in the summer of '97, and then it continues on. This looks like it's the heat-up phase, out to the end of '99. And that allows us to collect ongoing data from here. It feeds into confirmation of first our flow models, then transport, and you cascade right on through to the near field environment model, which next iteration would then be in '99 time frame, all of this feeding into the sensitivity study.

One of the key users of some of this information on especially the near field environment modeling and the drift scale testing is design. And I noticed too late to change that we don't have our time lines lined up correctly. But basically we confirm our flow models and our near field environment models here in time to complete the phase to provide input here in Phase 2. And, again, what we're working out at the detail level is specific data feeds during these time frames.

One concern I noticed that the Board had expressed recently in one of its, I think, recent letters, we do get our drift scale testing, both heat-up and part of the cool-down, before license application. And this was a change from the program plan. It was a little bit questionable in the '94 version whether we'd have both heat-up and cool-down available. And as long as there's excavation going on, we do have our geological mapping, and then also the monitoring.

Some of the key products, and these are a--some of this is in response to a couple explicit questions from your staff. We were asked about the synthesis reports. You need to put that in perspective. When we first came up with the idea of something formally called a synthesis report, our guidance was clearly a 250 million declining case, we were going out of business. And one of the things I was very concerned about was that as we started reducing the size of the program and staff started to leave, that we would lose the information and the value of it that we had collected to date. And so we did aggressively schedule for '96 a series of what we're calling synthesis reports. These are basically technical reports summarizing all the work to date, generally targeting at the SCP investigation level.

It turns out most of those will also form the basis now of our safety assessment. So the work is valuable in and of itself. In some cases, we are relaxing the requirement because we're not longer in that 250 declining case. But these are technical reports. The key information that you get out of one of these is a full accounting of observations and data collected. We discovered over the past couple of years as we pulled together, particularly the volcanism program, that it's very helpful to have all of this information, a document prepared that tells you how to find all of the information that clearly summarizes it, and that's what a synthesis report is.

In addition to the interpretation and analysis of the data, the synthesis report will also focus on some things that are important to us as we move to licensing. We have to clearly segregate our quality versus our non-quality data. That means data that was collected under a QA program versus data that was not, because the next step will be to qualify that data if need be. So a piece of the work this year is to identify that.

It talks about the state of knowledge, confidence level of the data or the models and conclusions. It gets our reference material organized. And so that's the documentation phase. These large technical reports summarizing basically SCP investigations.

Key products also are our models that we've talked about. An important point to recognize here is in the documentation that goes with the model, in addition to the technical description, we are going to be comparing the model predictions with observations, and discussing alternative conceptual models.

And the next couple of pages just describe in detail the requirement we're placing on each of the modelers. This is information that was derived from correspondence with the performance assessment folks who explicitly asked us to ensure that our documentation addressed some of their needs. We also have been looking at the license application review plan and the type of things that we're expected to provide to the NRC. So we are looking ahead to licensing in our documentation of these models.

As Abe indicated, we'll be working jointly on sensitivity analyses. Again, a key piece is looking at alternative models that could explain observations, and the applicability of the models to long-term predictions.

We also are part of the program contributing to the project integrated safety assessment. And, again, this is going to be a technical compilation describing the individual components of the system, primarily focusing on the controlled area, or anything on the outside of the controlled area that would be relevant to waste isolation. And it's going to be addressing the geologic history of the site, ambient conditions, also future variations.

We're the primary contributors authors of Chapter 2, the site characteristics, and we also have a small secondary role in providing information to repository design, performance of the repository after closure, and the accident analyses. This effort is going to be starting next fiscal year, and the first chapter or section that we'll be writing will be the geology, because, again, that forms the basis and the framework for the rest of the modeling and descriptive material.

The next few pages just, for your information, give you the scope and the range of the system description that we'll be providing; geology, hydrology, climate, geochemistry, and so on.

On Page 27, again, you can see that the synthesis reports will be key references to the updated description of the site and our baseline geologic description because, again, it will be capturing the sources of information. In some cases, we won't have a synthesis report. You'll find the information coming out directly into the safety assessment itself.

Let me just skip to license application, Page 29.

It's in the license application itself where you go beyond the technical information. We will update it with performance confirmation results, if necessary. And this is where you start seeing your regulatory discussions of compliance with Part 60.

In comparing the revised program plan with the 1994 plan, we've tried to pick out some of the key testing programs and showing a comparison. The '94 plan didn't have the same level of detail, so I can't always show you one for one. But you can see that we're fairly comparable in our Ghost Dance Fault testing for the hydrology program, and in fact we've advanced the single heater test. It turns out there wasn't much description or much detail on the drift scale testing at the time, but this gives you an idea now of when we will have the various models and other types of testing programs completed.

I think our biggest advance, as I indicated earlier, was an ability to get both heat-up and probably cool-down into our data and into our models before the license application.

Another way of showing the same information; when you can expect the major iterations of our models to be available. This one is a feed to TSPA viability assessment, and then this is confirmation for the license application, with some ongoing monitoring and probably the last of the cool-down phase continuing beyond those last modeling dates.

In summary then, I broke the next few years between now and license application down into three phases, just to give you a feel for what was in each one. The next two years, '96, '97, we complete the baseline site characterization description for the viability assessment. We will be sending information for critical interfaces with PA, design and the EIS, and in terms of testing, the biggest program we begin is our long-term thermal testing.

'98, '99, we'll be working on the integrated safety assessment. We'll be continuing with our confirmation testing and monitoring, and we'll have confirmed flow and transport models for LA.

And then as I indicated, in the years 2000 and 2001, we'll be wrapping up some of the initial thermal testing, large scale thermal testing, confirming the near field environmental model, and working on the license application.

At that point, I'd like to turn it over for questions.

DR. CANTLON: Let me ask the first question. You've identified milestones for the viability assessment and license application, but there really is an intermediate step when the site is recommended to the president, which should be roughly between those two, 2000. You don't have any special milestones thought about for that difference between what you'd have to have in hand for that recommendation, which is beyond the viability assessment, much nearer to the concept of suitability?

MS. JONES: If you'd look at Page 32 where you look at the various models, those basically have the culmination of our work, along with their descriptive materials. And the site recommendation is in 2001, and the basis for that would be the modeling available in '99, anything from performance assessment and the designs that were available at that time.

So site programs doesn't have something explicitly called out; it's part of the process leading to that site recommendation.

DR. CANTLON: So basically the same set then for license application?

MS. JONES: Right, again, the feedback loop through the performance confirmation program, so that if we did find something, especially out of that thermal testing, there would be another iteration at that point.

DR. CANTLON: Thank you.

DR. LANGMUIR: Susan, on Page 15 overhead, and then further discussion, you have the drift scale thermal test and you have them running for two years total time, and then they're turned off. And we've had a lot of discussion over the years of what we could learn from thermal test in the

ESF, which was a critical place to run them, and the perception I had and have had and continue to have from talking to those in the program who deal with such things as the coupled processes that are likely to occur with refluxation, there's no way you're going to see any of this in a two year test. Are you going to just see the thermal mechanical effects? That would be my guess. Which you can probably presume for small scale tunnels, at least, are trivial. What else can you learn in two years?

MS. JONES: Well, for planning purposes, when we ran the calculations at the time this guidance package was put together, the results from the various simulations showed that we'd have the information we needed at anywhere from 18 to 30 months. Those were what the calculations showed us at the time. So for scheduling purposes, we did pick 24 months for the heat-up phase. But the intent and the scope of work is written such that if we haven't gotten the results we want, then we keep going. That's why I was hedging that we may not have cool-down at the time of licensing, because the intent is to run the test as long as necessary to get the data.

DR. LANGMUIR: But some of the data is the effect of couple processes and refluxion, and I can't imagine this would even be created as a system. A reflux system isn't going to be generated in a two year heat-up, I wouldn't think, and I would question whether you were in a position to even measure the effects during that period.

MS. JONES: I was going to look to Dennis Williams because he actually has the forward calculations for this test. He is going to walk through it tomorrow, but if he has a short answer to your question now as to what the current forward calculations show, it would be helpful to just give a short answer now.

MR. WILLIAMS: Dennis Williams, DOE. Now I have to recall the question.

One of the things that we did when we wrote the criteria statements, or the annual criteria statements for the planning process, was to frame in a context of we would run it for a year, do an evaluation, see whether to turn it off and run it for the next year. We had planned on doing that all the way out to the end.

With regard to some forward calculations, I will show you some things from some of our people at Lawrence-Livermore tomorrow during that presentation to see what the thermal effects are doing in somewhat of a time frame. But I think the most important part is we're getting into a mode where we don't shut anything off now until we know that we're getting exactly what we want. How that effects cool-down and cool-down for license application, we may have to wing that one a little bit. I think it's more important to keep the heaters going if we need to keep the heaters going.

DR. LANGMUIR: The sense I had was that a very, very major reason for having a 100 year or more retrievability time frame was to pursue long-term tests, in particular long-term thermal tests, perhaps corrosion tests, for which you can't get the information in a year or two, and I thought there was a consensus among the community within the program that you could not get the information you needed on couple effects in a one year or two year test. It was going to take you a lot longer than that before the system that you are anticipating to happen in a repository would be created by the heat radiating out and the moisture being evaporated, then condensing, so on, and that none of this would be seen in a two year test.

Are you telling us now, can you argue and defend that we'll know all we need to know about the thermal effects in the mountain in a two year test, no surprises will come up in a hundred year retrievability period?

MR. WILLIAMS: No, sir, I'm not saying that. I'm saying we have some predictions and we have a plan where we will evaluate at the end of every year to see whether or not we shut it off or continue to run the test. And this test may run out for several years under that type of a scenario.

DR. LANGMUIR: I guess I'd very much like to know at some point in time how these tests are designed, what they're proposing to learn from them and how they're proposing to learn it.

MS. JONES: The overall strategy was showing a scaling up, as you indicated, to a mountain scale test, if you will. And this is one of those where we were going from lab scale to a small field scale, a small block or the large block test, on into the drift scale, and then the next step beyond that would have been what was originally termed the large scale, long duration test, multi-levels and so on. And where we're at with this test would be one of those intermediate drift scale tests, and the decision that would come out of this, which clearly does not happen before 2001 or 2001 license application, would be whether to go in with a large-- another heater test similar to that large scale, long duration test, or whether to go straight to a performance monitoring program of emplaced waste. And that's a deferred decision until we see the results of these intermediate drift scale tests.

DR. LANGMUIR: I think we're coming back to this again.

DR. DOMENICO: Susan, I'm happy to see that somebody is finally putting something down on paper regarding this site in an organized fashion. The last comprehensive report was prepared by Jerry Szymanski, so I'm looking forward to seeing this.

My question, though, will the synthesis reports precede the PISA reports? And when will the synthesis reports be more or less available to look at?

MS. JONES: I'll try to answer that question from the top of my head. Some of them are coming out this year, and you're probably going to catch me totally flat without my deliverable list in front of me. But they start coming out this year, and then next year, we'll probably go straight into the PISA, the project integrated safety assessment. And so what you would see in our schedule then are not individual reports, because we're trying to get away from this concept of one lab writes one report and has to go through a review cycle, and then you just keep cascading and adding review on top of review. And so next year, you start seeing the geology chapter, followed by the various hydrology components.

DR. DOMENICO: This is the PISA?

MS. JONES: Yes.

DR. DOMENICO: Or the synthesis? I presume we'll see the synthesis before the PISA.

MS. JONES: Yes, I think there are eight or nine synthesis reports due out this year. Then we stop that process because we're no longer in that 250 declining scenario and we go straight into individual chapters of the safety assessment as deliverables, where we start synthesizing, if you will, the information in those documents instead.

DR. DOMENICO: You say there are eight synthesis reports?

MS. JONES: Yes, eight or nine this year.

DR. DOMENICO: Thank you.

DR. PALCIAUSKAS: I'd like to just sort of ask actually a question to Abe perhaps, and it's what information in the thermal tests is crucial or can be utilized by performance assessment? Because performance assessment sort of summarizes our state of knowledge of how we could process information. What information are you looking for from the thermal tests and that you will be able to utilize in performance assessment?

DR. VAN LUIK: The way that the performance assessment uses this information is through the process level model that comes from the site program interpreting this data, and interpreting it in terms of the conceptual models, et cetera, that fit. And then we would abstract it into our PA.

Off the top of my head, this is very important information. We feel that we have a pretty good handle on what to expect in terms of how water is going to be redistributed, how the geochemistry may be affected, how solubilities may be affected, et cetera. However, this test will be basically confirmatory in nature of the assumptions that we have made, and this is another area where we are negotiating whether or not we should have a formal expert elicitation to define what effects we should be modeling, until this data comes in from the intermediate scale tests and then will be confirmed from the large scale tests. You ask an interesting question, and happily we are working together within site, engineering and PA to come up with answers that are appropriate for the information available at given times.

MS. JONES: And I would add to that that some of the information also, such as the thermal effects on hydrology and chemistry, and so on, are fed through the design process rather than direct PA. So it's coming out of our near field environment model, and that then goes into the waste package modeling efforts. So it's not a direct tie; it's an indirect one through design.

DR. CANTLON: Other questions? If not then, we're recessed till 1 o'clock, so we get a little early break on lunch.

(Whereupon, the luncheon recess was taken.)

AFTERNOON SESSION

DR. COHON: My name is Jared Cohon. I'm a member of the Board, and I'll be chairing this afternoon's session, which is a continuation of the discussion about the revised program plan that we started this morning.

Please let me remind you, those who might be interested, of Chairman Cantlon's advice earlier today, that there is time set aside at the end of the day for public comment and questions. That will occur at approximately 4:30 today on our agenda. There's a sign-up sheet at the back of the room. At the moment, there's no staff there, but there generally will be, and if you're interested, we ask that you sign up in advance.

With that, we will resume and get right back to our agenda. Speaking next will be Richard Craun.

MR. CRAUN: Okay, I'm Richard Craun. I'm going to be discussing today the engineering approach as to how we're trying to integrate the design of the repository with the TSPA, science, community.

With the change in funding profiles, et cetera, we've really sat down and we looked at ways in which we could do this a little bit differently and try to ensure that the communication between engineering, science, TSPA was well developed. And I think not only did we look internally, but we've also looked externally. We've looked at how do we have to communicate with the NRC. It's important that we have a design product that they understand, that they can buy into, and also with the Board. We've used some successful tools in the ESF. We had a board of consultants team that helped us on the ESF constructability issues, and we are looking at transitioning that into repository design.

Some of the areas of interest there would be in drift stability and, thus, retrievable, those sorts of issues. So that board will probably be--it's another tool that we will end up using.

Today, however, I'm going to focus more on the internal integration with the project itself. I will be discussing today the revised engineering approach. I'll give you an overview of the schedule. I selected some of the models that we're producing and given you an interaction with the models, a discussion of that area. I also will be discussing some of the elements, some of the engineering integration over the different project elements, and then also trying to share with you the detail of what is a viability assessment design, how does that relate to a license application design and/or construction design. So those are the topics I'll be addressing today.

The new engineering approach really represents both a change in scope and a change in process. The slide says a change in the project, but it's really more of a change in the process, is a better description. We really are trying to shift from ACD, advanced conceptual design products to really more of a view of continuous design, from where we are today to actually construction. You can back that up to a license application and back that up to the VA. So we're trying to look out and look at the end point of where we're trying to go to with the design, and bringing it back to the license application and the viability assessment.

We're trying to focus on all of the activities that we need to do. Engineering, in my mind, needs to shift over from some of the model production that we're doing, or have been doing for many year, to really a production mode. We've got, as Paul Harrington I believe later this afternoon will be addressing, we have tens of thousands of documents that we have to actually start creating to build what we call a licensing basis that we'll use with the NRC to license this facility. So we really have to immediately start shifting over from some of the model issues to some of the just nuts and bolts engineering, how we actually do all the design and document that.

We are going to be focusing on and prioritizing the elements important to the waste isolation strategy. The viability assessment, we need to have a cohesive story that comes across to not only members in this room, but also to the NRC and the outside public on how our design fits and supports the waste isolation strategy.

As I indicated, we're going to try to develop discrete packets. There, we may have some work done on the drift stability, and so we may try to bring that to closure. And once that packet is done, we don't intend to open it back up again, whether we're in the initial phase, Phase 1, Phase 2, or Phase 3. So we're trying to develop these packets, these analyses and actually start building the licensing basis, which will be volumes of different analyses and volumes of different drawings.

Again, we are trying to eliminate some of the larger fairly standard DOE products. ACD, we did produce that, the Title 1 and Title 2. ACD took us about six months to pull that document together. We are going to try to focus on more discrete packets versus those larger products.

Now, this is the same schedule that I think Dr. Brocoum had on the screen, and he talked through all the different elements here, but I'll focus primarily on the design piece. You'll see it starts with the ACD, Phase 1, and then it goes to the VA design. And we really need to finish the VA design a few months prior to the actual VA document itself so that it can be tied together.

Now, the chart, or this cartoon, could probably be better if these two titles were changed a little bit. The license application design on those elements that are important to a lot of interface issues between Susan and I and between Dr. Brocoum and I relative to TSPA, they will be done in this time frame. But that's not to say that in fact the license application design as a whole is done at that point.

We will continue beyond that into those areas that have less interface from program element to program element. So actually the license application design will start completing more in the middle of Phase 3.

Once we submit the license application, or once we complete that phase and go into a license application submittal, engineering doesn't stop. We're going to continue on into the construction design. And actually the construction design picks up in here and starts transitioning over until we get to construction.

Now, later in the presentation, I have another little cartoon to try to describe what percent complete we're anticipating in these different phases and how we try to accomplish that.

Just to maybe touch on this a little bit more, again, Phase 1 are those issues important to the waste containment and isolation. Issues like retrieval I think it's very important that we have a very solid basis for retrieval, which in order to have that, I need a very solid basis for my ground support and drift stability in the emplacement drifts.

The other issues that I've pointed out here, these seem fairly close together or similar, they are those elements that the NRC is expecting to see, those elements that are important to safety, radiological safety at the site boundary, not radiological safety within the working element of the repository.

If an element or a concept has no NRC precedent before, licensing precedents in the commercial reactor technology, we're feeling that we have to be more complete in those areas. Our arguments need to be more developed in those areas. And, thus, in Phase 1, which is up to VA, this will be our primary focus, will be those elements.

Phase 2, we need to start picking up more and heading more toward the license application design itself. We will start picking up the standard designs that you will see, the HEPA filtration system on a glove box, very standard. There's a lot of them in the United States. The NRC has seen a lot of them. And so those types of designs we can delay until more of the Phase 2. And then the balance of plant will be picked up in Phase 3. So those are the different phases.

Now, in this discussion, I'm trying not to say that in Phase 2, I won't be continuing with any of the Phase 1 activities. My focus will shift. Phase 1, I will focus on those areas. Phase 2, I will pick up this additional, but will continue to do work on those elements important to retrieval and waste containment and isolation.

Now, what I tried to do to show some integration, I picked up this real busy chart of Abe Van Luik's, so I won't really use it too much, but this is the engineering section here in the center, and I've got another slide that shows that a little bit better.

The primary models, and they're not all of the models we're producing--I've got another slide that will show you more models that we are producing--are the corrosion resistant ones, or the primary ones are corrosion resistant, corrosion allowance, cladding, galvanic protection, also the waste form alteration and waste form dissolution models.

There's a lot of interface between the near field environment models that Susan is creating and all of these models here.

I wanted to go the next layer down, and it's kind of a decision as to how low in the process you go, but I've tried to put this together to communicate the attribute that we're focusing on here is containment. The hypotheses are associated, all tie together, the upper three all tie together to corrosion rates, which tie near field environment together, humidity, time, temperature models all get tied together.

The engineering piece that I'm responsible for will be the thermal behavior at the drift scale. So that's what our section is analyzing. Susan's piece actually goes out to the far field, so she actually does a far field model. We do more of a near field model. And in between these two, are Susan's models on humidity, time and temperature.

With those humidity, time and temperature models, we can then look at in parallel activities here the corrosion rates of both the corrosion allowance, corrosion resistance, and also we can look at the effects of galvanic protection. So that's how we've been interfacing between the two organizations.

Also off to the side is a lot of communication interaction with TSPA. So those are the types of interfaces we're creating here.

Now, I decided, being the engineer that I am, that I wanted to go to the next level of detail, and this I promise is the last level. But there's many more levels. I wanted to give you an idea that the models that I just showed to you are not all of the models. We have a whole series of other models.

Starting on the lower left, we have ventilation models, the thermal models of the waste package itself, thermomechanical of the rock, and the repository layout itself. We have actually laid out computer models that will take all of the constraining parameters and actually locate the repository itself.

These different models that we have, some on the upper left on the EBS will feed just into the scientific programs and some will feed more predominantly into the performance assessment models. In all cases, it's a feedback system. It's like a control loop. As we provide information to the TSPA, they will provide sensitivity studies back and/or feedback back as to what the effect of these models are. And so we'll be adjusting them.

So even though the arrows are one direction, all of the lines really have redundant arrows going the other direction. So there's a lot of communication on this.

I tried one last way, this is a chart that Susan used, to not only show communication and integration within engineering, but also external. Sometimes some sections of engineering don't talk to other sections of engineering.

Cladding degradation models; the models that you see up here are basically the flow path that we've defined there. The cladding degradation models will feed into the glass alteration and spent fuel oxidation models, which will then go into the waste form dissolution.

The galvanic protection really tied into the corrosion resistant and corrosion allowance material. So these models, modeling people or people involved in those processes need to communicate within their own little sphere of influence, but also they will produce then the models or tie into the models on the material degradation. Not only do we have to define what materials we're putting into the engineered barrier system, we also have to predict what's going to happen to them over time and how that might affect the near field environment. So we'll also have the EBS degradation models. That then flows into the same sort of discussion that Susan had with you earlier, into the TSPA.

And overarching all of these models is the underlying activity that we need to focus on and look at, is actually the preparation of the PISA chapters, the starting of the preparation of the design and structures components, the repository design, the waste package design, the engineered barrier design, and the radioactive waste management conduct of operations, how the facility will operate.

So these are the near term chapters that we are starting to, I think as was stated earlier, we're starting to outline those chapters now, starting to figure out what activities do we need in order to build these chapters or author these chapters.

Now, I'm going to shift slightly to some mechanic processes. We've gone through and developed--we like new terms and new processes--it's a Binning process. It's a standard process everybody has to do. But we have tried to break down all of the tasks that we have to do and we're trying to say these are very important to us, so we're going to put them in this bin. These are medium importance and these are of lower importance. We're trying to do that to make sure that we focus on those elements that are necessary for the VA and then the license application.

Some of the issues that we're finding, we need to start earlier than what one would normally just from the license application standpoint, we need to start them back in the Phase 1 because they have either longer lead times, higher risk or they're more difficult for us to complete.

We've actually gone through, and Paul will show you some examples, and I believe in Paul's presentation we've attached work in progress, but we've attached the complete binning of all of the structure systems and components that we've got right now. And what we've done is we've gone through all of the surface facilities, subsurface facilities and processes, what we have to build, and try to then specifically say this is Category 3, this is Category 2--or excuse me--Bin 3, Bin 2, Bin 1.

Bin 3 are again those items that are more important to us than the Bin 1. And I believe I will be coming up to a bin definition here shortly. I'm going to jump out of sequence and do that because it feels like the right thing to do.

Phase 1 was focused on those elements important to waste isolation, retrieval and non-precedence with the NRC. This is saying the same thing. This has radiological significance. It's a term more that the NRC would relate to, with no regulatory precedence or affects the waste containment and isolation. So the Bin 3, those items that we want to look at starting right now, are also the Phase 1 activities.

I'm going to go backwards. An example of that would be the corrosion models for the corrosion allowance and the corrosion resistant materials of a waste package.

Now I'll jump to Bin 2. Bin 2 again are those structure systems and components will go into that bin that have radiological significance, but have a lot of licensing precedence. So they don't need to be as complete. A good example of that would be a fire detection and protection system in the cask maintenance facility. It will be a safety related or Q system, but there's one in every power plant that you can see in the United States, nuclear power plant. Most of them have the same rating and classification, so that would be something that would fall in Bin 2.

And then those items in Bin 1 will be the balance of plant issues. They will be standard utility systems.

For the license application design, we need to focus on the Bin 3 activities. We'll have some minimal Bin 1 complete, and I will define in the next slide actually the completion of those, and then moderate Bin 2.

The second bullet here is to really capture the concept of the fact that we feel, or we're required under NRC requirements to go ahead and make sure that all of these processes on Bin 2 and Bin 3 are under our NQA-1 program, our Appendix B design control program. So all that last bullet is basically saying is we're not stepping away from the design control process or program. All of these bin activities will be accomplished under that program.

This is going to take a little bit of time. What I tried to do is capture some of our thoughts and discussions. And if you notice, on the next slide, there's even a disagreement between the Bin 2 for LA percent complete, which this shows about 70 per cent, the next slide will say 60 per cent. This is work in progress. We're having a lot of discussion on how much needs to be done to go forward with a license application, how much needs to be done to go into a construction authorization and how much do we expect to have done for the viability assessment.

As you can see here, for the VA, the end of '98, we really don't expect Bin 1. It's about where we are now. So a lot of the utility systems, those designs we're not really going to focus any activities on at all.

The Bin 2 is going to stay a little more advanced than where we are now, not much. So those safety related systems or Q systems that the NRC is used to seeing, we're not going to put much activity in for the VA.

The Bin 3 for VA, we're really wanting to focus a lot of our activities there, so that the next year to two years, that will be our primary focus.

Now, a lot of people have thought that when you go into a license application, your design is done. It really is not. From our perspective, the license application design will be nearing completion for the VA. It will be somewhere 60ish, 70ish per cent complete on those systems important to safety that have precedence with the NRC. And our utility systems, our background systems, will be very, very basic in the design. They will be very conceptual still.

Even at a construction authorization, in fact I had a discussion as late as even this morning on the fact that probably the Bin 1 should be drawn a little lower because when we actually start construction, if we build a repository, the design yet won't be completed on some of those systems. In fact, we should go into construction with a lot of the design, some of the design work still remaining.

As you approach construction, though, you'll notice that the percentages get complete, more complete.

Now, this describes what our focus will be. In that initial process, we will be looking at predominantly Bin 3 type issues, a little bit of Bin 2, and very little of Bin 1. Then as we go into the LA process, you'll notice that we're still working on the Bin 3 activities, but we've picked up a large bulk or large portion of Bin 2 activities, and then that will continue on into the construction permit.

This is a slide that basically tries to summarize a lot of what I just indicated. Again, Bin 1, and this would be for the license application, would be about 20 per cent complete. Bin 2 about 60 per cent complete, and then Bin 3 somewhere in the 80 to 90 per cent complete, and that's what we're really shooting for.

You will also notice that in the Bin, we're really very much conceptual, minimal work on physical design documents, design guidelines. A lot of that work will not yet be started. The Bin 2, and in part some of the Phase 2 activities, we'll get into more detail on the physical design documents and the guides. We'll start preparing those documents. And then on the Bin 3 items, a lot of the design guides will be complete.

The integration conclusion that I want to kind of share with you or leave with you on is that in my mind, there's three bullets up there that are all tied to schedule.

Engineering, the second bullet, basically says we need to transition over to a production mode. In order to build a license application, I've got hundreds of thousands of documents to create. We've got to get into a production mode of so many drawings a week, so many analyses a month, those sorts of things, and we need to have those scheduled out, and so we really need to focus on the schedule activities, how they communicate, and get that schedule built.

The bottom bullet basically says in my mind, the short-term focus has to focus in on the schedule, building a detailed schedule. We've got the upper level schedule that Steve Brocoum said that we as a team defined and shared with the M&O. As that schedule is working down into the Level 3 and the Level 4, we really need to drive it down into the lowest possible level so that each of the integration points or interface points can be defined, scopes can be well defined and we can go ahead and get on with the schedule of producing a design.

That's it. Are there any questions?

DR. COHON: Questions from members of the Board?

DR. CANTLON: Rick, you indicate in your overhead Number 10 that you have a fair amount of corrosion data need that will be essential for the viability assessment, which is fairly close at hand. Are you comfortable you're going to have the kind of data, other than just literature data, for those kinds of calculations?

MR. CRAUN: Well, we're starting the thermal gravimetric analysis tests at Lawrence-Livermore I believe this June. So we are starting that test. That will give us some information on the sensitivity of the materials that we've selected or are in the process of selecting for the corrosion resistant and corrosion allowance material, as to where that need is, at what humidity level do we actually start picking up some corrosion. So some of the elements, I think that's a fairly short-term test. I think some of that data will be available for the VA.

The longer term corrosion test, the galvanic test, I think we'll have some initial rounds of data coming out of Livermore. I see those transitioning for a long period of time. I see it as building confidence as we go through the licensing process. There will be more vulnerability up front, less as we get to the license application, even less as more information is available, less vulnerability on the construction permit, and the operating permit.

So in my mind, a lot of these tests really transition beyond VA, well into the actual operation phase of it. And so that ties into the performance confirmation, so I don't see a lot of this stopping.

DR. CANTLON: A follow up on that. You're still not, I take it, giving any credit for the zirconium cladding in any of this; is that correct?

MR. CRAUN: Well, you're right. One of the models that was up there, actually did not fund this year, and that is the cladding. I actually had some discussions last week and am going to be trying to find out exactly what I can do to take credit for that. We've got to come up with a model that PA can use. PA does not have that model now, so at this point in time, they are not relying on it.

As soon as we develop a model that we can give to the TSPA or the PA folks, then in fact they can start taking credit for that, if we can come up with that base model. But at this point in time, we're not developing that.

DR. CANTLON; Since the Navy fuel, spent fuel disposal program, really zirconium is a big actor in that. Aren't they able to give you some data?

MR. CRAUN: Well, the Navy fuel is distinctly different. I haven't yet had the briefings on that, but it is distinctly different. We had a change request that just went through the program that started looking at alternate fuels, the Navy fuel being one. So I have some meetings on that, and as I understand it, we wish--excuse me, this may be my wish--all of the fuel was as good as the Navy fuel, but I'm not sure that that's the right thing to say. But it should be a good fuel.

DR. COHON: I have some questions. I can understand very well, in fact admire the approach you are taking in developing these discrete packets as you put it, putting them in bins, tackling them with the priorities that you mentioned. What concerns me is that because of the press of time here especially, that you won't be able to take advantage of the performance assessment model to consider your design from a true systems perspective, rather than as a bunch of discrete packets put together. In fact, you went so far as to say that once a packet is closed, you don't intend to reopen it, and I don't mean to tell you your business, I know that you know that the most interesting part of design is the creativity that comes when you see how your design performs, and that's what TSPA does for you, and then being able to go back and adjust that design to make it even better. And it doesn't sound like you have the time or that you can afford a process that lets you do that.

MR. CRAUN: I think I need to be focused on the goal line, but not so focused that I convey a missed opportunity to interact between engineering, the systems people, and the TSPA people. There's a lot of very good work taking place right now. I think Steve touched on it on the engineered barrier systems; looking at some bounding conditions as to how that might affect the TSPA results. They must support that activity.

The piece that I want to make sure that we're locked into is that as we step forward with the design, that we are stepping in synchronous motion with TSPA. I don't want to infer that that interface, that creativity process, is going to be hampered. I think we do need to focus on a product very quickly. But I again am very convinced that in fact the communication, the sensitivity studies that TSPA is doing, the sensitivity analysis that systems engineering is doing, all of that is being orchestrated with engineering personnel that are actually doing the designs, Kal Bhattacharryya's group, Hugh Benton's group, all a part of the sensitivity studies. So that as the sensitivity study goes forward and they find galvanic protection has a real positive feedback, engineering needs to be in lock step close enough so that we can take advantage of that.

I would not want to represent that we're not in that position, nor do we intend to be. But I do need to be product focused. I've got thousands of documents to create. To that end, I want to look forward and produce definitive products and go forward, but not at the cost of truly integrating with the TSPA to get the best results out of the repository as possible.

DR. COHON: A couple of brief questions on this same topic, but from different perspectives. First of all, as we've noted and heard already, the waste strategy is not ready yet. Obviously that's fundamental to your developing design. Given how little time you have left, what kind of penalty are we paying here by not having the strategy in place?

MR. CRAUN: I wish it were issued. Dr. Brocoum and I were both trying to get--I know I spent several evenings and weekends reading it and commenting on it and marking it up, rewriting it. I don't see it as a negative. I see it as a very healthy communication that's taking place right now. For the first time, we're having discussions on these topics so that we can try to balance an engineered barrier design and its ability to be licensed, there is a balancing act there. If I try to stand up in a licensing hearing and say my engineered barrier is going to be there and in place and is geometry dependent and it's going to be there in 200,000 years, I may have an easier time now, but I'm going to have a tough time in a license process.

I think that pushing and pulling that's taking place, the reason why the waste isolation strategy is very near but not yet out, is a very healthy communication. We've had a lot of very active communications, a lot of participation, and that's good. So I see that as a very healthy process in trying to select a course that we can all own and we can all run down.

DR. COHON: Why won't the designs be complete at the licensing and construction stage? Is that because of time, or is that--

MR. CRAUN: I didn't hear your question.

DR. COHON: You've indicated that the designs will not be complete at license.

MR. CRAUN: Oh, we don't need to.

DR. COHON: They won't be because they don't have to?

MR. CRAUN: Yes, they don't need to from a licensing standpoint, and two, it's cash flow. To be honest with you, I'm trying to balance not only the technical side, but the money side. We've got only so many designers we can put on, and so there's a cash flow that has to be balanced.

DR. CORDING: Rich, I was just interested in what your-- I'm sure we've had some discussion today already on some of the other issues, but what do you see as key issues or key uncertainties in your design? As you proceed towards a design, what are the things that at this point you really need major input on to be able to produce a design? Which areas would you highlight as ones where you feel, and particular perhaps to get enough early information on it, or information in the next two years, that you can prepare a design that's responsive to what the site conditions are?

MR. CRAUN: Let me respond to you by kind of saying what kind of are the top issues on the plate right now, on my plate, that I'm trying to follow and make certain that we're progressing on.

I'd like to get drift stability behind me. That puts retrieval behind me. That puts health and safety of the public behind me, up to repository closure. So there's a lot of energy that we're putting into that topic, or I'm putting a lot of energy into that topic.

On the other side, not on the repository side, but on the waste package side, the near field environment, a lot of the stuff that Susan and I are interfacing on, so there would be the corrosion models, the effects of galvanic protection, the effect on the near field environment, how does my repository design, for example, if I use concrete or if I use steel, a steel liner system, those sorts of things. Those sorts of issues and trying to get the waste package corrosion rate, thus substantially complete containment kind of captures, are those issues that are consuming the bulk of my time right now.

DR. CORDING: What do you see in terms of, for example, the backfill. The way you'll be approaching that, I know you've been thinking about what characteristics you'd like to have in the backfill. I think that's a very good step to say what do we really want, and then looking at, before you come up with a design and saying this is what it does, find out what you need, but then you do have to get to that other part of what can you use that will achieve that and can be built.

MR. CRAUN: Absolutely. In fact, the performance attributes on the backfill, I had a real interesting meeting just the other day that tied the backfill discussion, that it may not be above the package, it may be actually below the package in the form of an invert. There may be some whole functioning type things that we can get going relative to criticality control and that sort of issue.

So I think you're right. We need to not focus on here is the device we need to install, but here is the performance function that we need, engineering, see if we can identify the performance functions and come up with solutions. That would be one of the engineered barrier systems that we are currently actively working on.

DR. CORDING: I think the problems are always time and schedule, to be able to determine what they really can do for you once you decide these are the characteristics we need. I'm just wondering how that part is going to fit in, because it seems to me it's going to take some time, even testing as well as analysis, to confirm what those barriers will be capable of, and that's going to be coming into your program in a period in which you're trying to come to conclusions about how you place that and how you prepare the design.

MR. CRAUN: To me, that's why I'm looking at development of the schedule. I want to drive the schedule down to the point where it's not me with the seat of my pants saying I'm worried about this because it's getting--I think I have to hurry on this one. I really want to break the tasks up into little scopes and fit them together. There is a sense of end of '97 is supposed to be the VA design, so there's a lot of opportunity to get a lot of design work done in the next 16, 18 months.

So I don't want to infer to you that I'm not feeling a sense of urgency to get after some of these designs. Truly we are. But I think those interfaces, many products can often times be broken into smaller sections, and I can get those little pieces out sooner to fit the overall schedule, and that's really what we're looking at, having a lot of discussion.

This is getting into a little bit of what Paul is going to be addressing this afternoon, trying to break the task down into multiple layers well below Level 3 and Level 4, Level 8, Level 9, Level 10, whatever level, so that we can isolate those little sections or segments that we feel more comfortable with building our products in a more timely fashion.l That's a very standard systems engineering approach also.

So I think that's why my focus is on the development of the integrated schedule. That's why I think my last slide, my near term focus is to build that schedule, because I need to be able to come to work, along with all of my people, and say this is what we need to do today and this is why.

DR. WONG: Again, I'm the new guy, so I want to ask a few questions.

MR. CRAUN: Okay.

DR. WONG: You emphasize continued need to develop a detailed schedule, and I'd appreciate your comments as to your timing of your schedule and the timing of the federal budget cycle. So if the Congress were to ask in May of 1997 or May of 1998 what have you done for me so far, what do you think you would say at that time?

MR. CRAUN: May of '97? Well, my crystal ball is coming out now. May of '97, I would hope that we would have the TBM out. I would hope that we would have access--I'm going from memory here--access to the Ghost Dance Fault up to the fault area. I don't think all the J hooks have been built by that time. So those are some of the construction pieces. I would really like to have drift stability, ground control selected for the emplacement drifts. I think that's a very doable thing in the March, '97 time period. I would like to be able to reach closure with that.

Closure, though, on that issue is going to be a lot of interaction with the NRC, because there is some discussion that retrieval may be Q, may be non-Q, and that makes a difference. So I think there's a lot of interaction with the NRS that we've got to initiate on that topic. But I would like to have that behind me. I would like to have the thermal gravimetric analysis testing, which will define the need and the curve behind me. Those are some, and I think those are good products, too, something that we could proudly stand up and say we've accomplished these tasks, especially if we can address the drift stability issue. That would be a major one.

DR. WONG: May of '98?

MR. CRAUN: Oh, May of '98.

DR. COHON: By that time, Congress would have gotten over the shock of knowing that you've gotten the thermal gravimetric behind you.

MR. CRAUN: Let me back up and kind of repeat. You're wanting to--let me stop and say repeat your question. I want to make sure I answer it this time. I didn't answer it, apparently, the first time.

DR. WONG: Well, I'm asking what are your comments or your thoughts about the linkage between your schedule and the federal budget cycle. As you go forward, as the agency goes forward and asks for another nearly half a billion dollars, that the Congress is going to ask what have you done so far and where are you headed, and so I'm just asking for how your schedule could be tied to the federal budget cycle, if it is, or what you think your answer is going to be to some Congressman saying what have you done so far. How much more do we have to pay?

MR. CRAUN: Well, I'm going to give you a soft answer, and if somebody wants to give a firmer answer, I'll give a little bit of a soft answer. My focus is going to be on LA. There is a whole lot of political things that feed into the DOE, Congressional issues, funding cycle issues, those sorts of thing. I'm going to try to stick with engineering. It's hard enough to get a design of a repository out in '97 for the VA. There will be key milestones and deliverables for the '97 time period and for the '98 time period, and I saw Russ lean forward and pull a microphone over, so I'll be quiet and let you add to it.

MR. DYER: Let me see if I can take off a little bit on this. Yes, obviously we're tied to the federal budget cycle, to the fiscal year. But a problem of course we've had in the past is running a program year to year, I mean, reinventing the program every year. The key to success of this project is going to be putting in place a long range schedule that has objectives in it and being able to make demonstrable progress against those objectives with time.

We felt we had a real good start on it in 1995 based on the program plan, the program plan from '94. We laid out the start of a long road to go down, and we made a lot of progress on that road. Now we've got some different constraints in the system. There are always some constraints, and in our case they happen to be some budgetary constraints that have been put in place.

So putting together a program that is viable to the sponsors of the program, how much it can cost, how much it can take, and how long it will take, and whether the scope will be adequate for the participants, the scientists and the engineers to stand behind it, is a real challenge. That's what we're doing right now. We think we've got a very good start on it.

There are--I had to give you a promissory note--but in the program plan, the new program plan that ought to be out in about a week, there will be a list of relatively high level deliverables, Level 2, Level 1 deliverables. Design products, major models or reports, activities, finishing the Ghost Dance Fault Number 1 and Number 2 that Rick talked about, those will be laid out in the program plan, and that should give you a pretty high level idea of what will be incorporated and flushed out in the details of the schedule. And we'll talk a little bit about that in some of the presentations that are going to follow Rick and Wendy here.

DR. COHON: I would have thought that by May, 1998, you'd be able to say to Congress if there is to be a repository--let me amend that--we have found Yucca Mountain to be a viable site for a repository or not, and assuming you find it to be viable, this is the best way to design and manage a repository at Yucca Mountain. Won't you be prepared to say that?

MR. CRAUN: Clearly, we will have a design for a repository.

DR. COHON: Based on what we know now?

MR. CRAUN: Absolutely. Clearly.

DR. COHON: Are there other questions from members or staff?

Thank you very much, Mr. Craun. We turn now to environment, safety and health and a presentation from Wendy Dixon.

MS. DIXON: It's a pleasure to be here today.

The presentation I have today focuses in on two major products, an integration of ES&H organization and the development and support of these two major products. One is the repository environmental impact statement, which we're, you know, the key lead on, and the other is the ES&H support to the preparation of the project integrated safety assessment.

The first part of my presentation deals with the repository environment impact statement. And just as a refresher again, the overall purpose of an environmental impact statement is to inform the decision maker of potential environmental consequences of a proposed action.

If you look at how we have defined a proposed federal action as it went out in our notice of intent back in August of 1995, we based this definition on what is in the nuclear waste policy act. The nuclear waste policy act provided us with a lot of guidelines in the preparation of an environmental impact statement. In fact, Congress, in the nuclear waste policy act, made a number of programmatic decisions for this program, one of which was we do not have to consider alternatives to geologic disposal. We do not need to consider the need for a repository. We do not need to consider alternatives to the Yucca Mountain site itself.

So in developing the construct of the Proposed Federal Action, as we stated in our notice of intent, it was to construct, to operate and to eventually close a repository at Yucca Mountain for the geologic disposal of up to 70,000 metric tons of commercial and DOE owned spent nuclear fuel and high level radioactive waste.

Now, in the development of this environmental impact statement, we are going to be relying upon the data that's being generated in large part by other elements of the program. So we will be turning to the scientific data that's being gathered to support the TSPA analyses. We'll be turning to the engineering organizations for the information that they're dealing with in preparing for design. Only in those areas where we have data gaps we'll be out collecting new and additional information for the development of the environmental impact statement, areas such as noise, such as aesthetics, such as water quality that aren't otherwise necessary for the license application, the PISA, the viability assessment.

Now, as a fact that a lot of these documents are being prepared concurrently, we'll be working on the PISA at the same time we're working on the environmental impact statement. At the same time, we're looking at suitability. It is critical that we all integrate through this process as we go and incorporate new and revised data as necessary and practicable. We cannot wait until these documents are complete and think that you can integrate them.

The EIS is a little different, though, in level of detail compared to what is being done or will be done in preparation for the PISA and the license application. A lot of what will be done with respect to the environmental impact statement will be done as it relates to bounding, bounding environmental consequences. For example, it's not important that you know the exact footprint of the repository. You need to know the upper bounds and the lower bounds and assess the impacts within those bounds. You may not know at the time you go forward with your EIS the exact event, but if you know what the lower bounds and the upper bounds are and you assess the impacts within those bounds, you have done what is appropriate for an environmental impact statement.

You may not know the exact number of waste packages that will be sealed at the source versus what will be handled at the repository, but if you bound it appropriately such that whatever is actually selected at a later point of time is within those bounds of impact, you've done the appropriate thing for an environmental impact statement.

With respect to schedule, the schedule that we have currently is not that much different than the schedule we had about a year ago, with one major exception, and that is the fact that the DEIS is now in 1999 rather than in 1998. It's a year moved further to the right. Now, this schedule that we put together for environmental impact statement is a schedule that was developed in concert with the rest of the program because as I described up front, we rely very heavily on the data input coming from design, coming from the scientific programs. So it was integrated with the rest of the program to make sure that we had the data needs at the appropriate time.

Now, there are several major sections of the environmental impact statement that rely very, very heavily on other parts of the program. One of those sections is a section dealing with the existing environment. There's a section dealing with alternatives. There's another section dealing with environmental consequences. We have a section dealing with responsible opposing viewpoints. None of these can be prepared without the input from design, from TSPA, from the scientific side of the house.

So with respect to defining and describing the existing environment at Yucca Mountain, we turn to the scientific program and we obtain from them information on geology, hydrology, water resources. We look to systems engineering for support on the rail spur alignments. My organization provides the lead on such things as socioeconomics, land use, ecosystems, cultural resources, air, water quality, and so forth.

In the section that's tied to alternatives for implementing the proposed action, we turn again to design for conceptual designs for waste handling and disposal, waste package, concept of operations. ES&H provides information on the conceptual site waste management plans and health and safety requirements. And again, we turn to systems engineering as it relates to regional transportation.

And the environmental consequences, we rely very heavily on TSPA. That would include releases to the biosphere for both pre and post-closure. We look to systems engineering for their support and releases from the design basis events and design basis accidents. And ES&H provides the input for biosphere modeling and ecosystems analysis.

Finally, as I mentioned, we'll also deal in an environmental impact statement with identifying and describing responsible opposing viewpoints. And, again, those prospectives will be obtained from other parts of the program and other people involved in this program.

The next part of my discussion deals with the PISA and our support in the development of the PISA. We are the lead in one chapter, that's Chapter 10, and with respect to this chapter, we couldn't do this chapter without support from engineering and systems.

This particular chapter basically describes our knowledge, our ability to operate a nuclear facility. It will describe our monitoring system. It will describe our ability to meet the requirements from a rad. safety point of view, operating boundaries.

We are also support to several chapters, Chapters 2, 7, 8, 9 and 11. And Chapter 2, we provide support on demography. We provide support on nearby industrial, transportation and military facilities, surface water hydrology, and we're the primary support entity for the meteorological systems.

In Chapter 7, we provide support as it relates to the potential for radiation exposures and releases of radioactive active materials. And in Chapter 8, we provide information as it relates to dose calculations. This is part of our biosphere modeling effort.

And, finally, Chapter 9, radioactive waste management, again, although we're not the lead, we provide support as it relates to radiological monitoring and sampling systems. And then Chapter 11, conduct of operations, we provide support as it relates to emergency planning.

That concludes my presentation and I'm open to any questions that you might have.

DR. COHON: Thank you very much. Questions?

DR. CANTLON: Wendy, in your overhead Number 11, you have a list of the EIS ingredients, and your bottom bullet calls for your group to generate biospheric modeling and ecosystem analysis. You've been working out there since '90, but you don't really have any real ecosystem information on the site yet. You were starting to generate some literature a year ago, and then that got terminated when your budget got cut. How are you going to have anything in '97 that would do anything to indicate you know anything about the ecosystem?

MS. DIXON: I'd like to take a step back and say I think we know quite a bit about the ecosystem. The element that we were talking about for clarification, as I recall, Dr. Cantlon, was the thermal loading aspects as it related to the ecosystem. And you're right, we had started doing some work in that area, in fact we had gotten as close to negotiating and ready to move into a new contract to get additional support, and you're right, the budget terminated that activity.

We are not at square one, however. We have been looking at information derived from natural analogues, north and south facing slopes, differences in surface temperature as it relates to, you know, just thermal issues, solar radiation issues, vegetation along fault lines, is there any difference there than there would be otherwise. We have also talked to or been talking to Los Alamos as it relates to their modeling efforts on the geosphere side of the house trying to provide them with additional information as it relates to wind speed and precipitation, to have their models address not only what the thermal load is at the repository level, but also at the surface level because we need to have some additional information from them as to what the temperatures might be at the surface to be able to really go much further.

So we have opened up the door to these next steps, so to speak, and we are getting cooperation from Los Alamos and them looking at their modeling activities and making some adjustments so that we have additional information as to whether or not we can just deal with the natural analogues as we have them today. Is the difference in temperature such that we're okay using natural analogues, or if not, if it's more than that, what we might need to do for additional modeling.

I do believe that we have enough time between now and the DEIS to get that information. From what we've seen today and where we think we need to go, I think there is sufficient time to do whatever the requisite work is. How much needs to be done is still open until we get some more information.

DR. LANGMUIR: You had a number of, as we were out there visiting, there were a number of activities you had going on in the field where you were monitoring performance of different plants, things you moved around, looking at the effects of changes in rainfall and so on.

MS. DIXON: Yes.

DR. LANGMUIR: When the EIS funding was zeroed out for a year or so, until next year, am I right in assuming that these activities continued, that you did maintain monitoring of field sites and what we were looking at there in terms of long-term behavior?

MS. DIXON: What we maintained was the basis of the program as it related to--all the met data was maintained. There wasn't anything that was stopped on the meteorological side of the house. There was, however, some work that we had started, as Dr. Cantlon was referring to, where we were actually starting to test our ability to assess, you know, ecosystem usage of water and, you know, that sort of thing, different types of measuring. That effort that was tied directly to thermal loading as it relates to the ecosystem was in fact terminated.

The general support as it related to potential impacts on the environment from site characterization or needs such as met that supports, TSPA and license application, those things were continued. But those things that only had a driver for the EIS were terminated.

DR. LANGMUIR: But you've not lost, you don't feel, important information that's not retrievable at this point?

MS. DIXON: No, there was nothing there that needed to--we would have preferred to continue forward with the information, but there's nothing there that I think--you know, we have the information that was gained for what little bit of time we were collecting the data. When we have funding again to proceed forward, we have now a better understanding of what techniques work and what techniques don't work and we can pick up where we left off.

DR. CHU: Wendy, I have a question about the scope and ingredients also. Is transportation part of the EIS in addition to the rail spur alignment?

MS. DIXON: National transportation of the spent fuel and high level waste to the repository is included in this environment impact statement. Now, in all honesty, we will also incorporate by reference other DOE or other EISs that have also looked at transportation of spent nuclear fuel or high level radioactive waste. So there's been a lot of work that's been done in this area already, and we will take advantage of whatever work is out there that we can, like I said, incorporate by reference.

DR. CHU: Part of the previous work that was to have been done was the transportation part of the MPC/EIS, which got suspended along with the MPC itself.

MS. DIXON: Right, but Idaho has recently done an EIS on DOE spent fuel. So the calculations and analyses, for example, that Idaho did on their DOE spent fuel environmental impact statement, that part of their effort that we can utilize or reference, you know, we will take advantage of that. So there are other EISs out there in addition to the repository EIS or the MPC/EIS, or Naval reactor EIS, excuse me, that we can utilize.

DR. COHON: Just a point of clarification. Since the EIS will include the national transportation system, why did your overheads focus on the rail spur on one overhead, and the regional transportation system on a second one?

MS. DIXON: The reason why that is the case is that with respect to the national system, we'll basically plug into what the DOT regulations are and the NRC regulations. With respect to the regional side of the house and the rail spurs, there is no rail line right now that goes all the way to Yucca Mountain. So with that part of the EIS we have to go a step further. I mean, we have to look at the construction of a rail spur from wherever the rail line currently ends, you know, depending upon what route is selected, to the repository itself. So there will be more effort as it relates to environmental analysis done within the state of Nevada for the rail spur construction.

DR. COHON: I see. Thank you. Any other questions?

DR. DOMENICO: Did you learn something from that, or is yours similar? Because apparently you've included also the results of performance assessment in your EIS.

MS. DIXON: You bet. We're going to rely on it heavily. We are keeping track of it. In fact, WIPP has done an EIS and they've updated or supplemented that EIS on a number of occasions. In fact, I think they're working on one right now. So we try to stay in touch with what's going on in the rest of the department with their NEPA documents for a lot of good reasons.

MR. MC FARLAND: A question on Page 10. You speak to describing alternatives for implementing proposed actions, conceptual designs in particular. Over the last two years, and moving from the proposed program approach, the program approach, the use of key decisions, and now into the program plan, there's been a lot of focusing, very needed focusing, a lot of decisions made with the assumption that they would later be examined.

In the EIS process, how important is it to be able to have a clear understanding of the conceptual design alternatives and what led to those decisions?

MS. DIXON: Let me step back and answer the question in two parts, and if I miss your intent, I'll try to fix it. But point number one is that when an EIS goes forward, it usually goes forward with a very small amount of design, very high level conceptual effort as it relates to design.

In this particular case, we're going to have a lot more information on design than is the norm when you go forward and prepare an environment impact statement. So our problem is not going to be sufficiency of information. In large part in this EIS, it's going to be the difficulty in ferreting through with all this information.

What really is important as it relates to an environmental impact statement tied to significant impacts, not just a bunch of information that may be necessary from a regulatory point of view to get your license application or to meet EPA regs, but is not important as it relates to an environmental impact statement.

So that was what I was trying to get at to some extent in my discussion on levels of detail, that EIS has a different driver in it and the level of detail is going to be different as a result of that, and there could well be a lot of information that goes into your license application that has no relevancy or inclusion into the environmental impact statement.

DR. COHON: Thank you. One last question, Dan Metlay.

DR. METLAY: Wendy, do you envision the EIS process as being the main or the sole opportunity for stakeholders to get involved in this new era of DOE program planning?

MS. DIXON: Well, it's certainly a key place for stakeholders to get involved. It certainly will not be the only place that stakeholders get involved.

DR. METLAY: Where else? I guess I haven't heard any of that and I've looked at the various charts and diagrams and schedules. Where else do you envision this happening?

MR. BARRETT: The 960 rulemaking process, which will be starting up this summer, will afford many opportunities for various constituents to say their view as we move forward toward the presidential recommendation, which the EIS is another supporting factor. So there's a major place for public input. Also, the reason we are putting out a program plan, it will be there for various constituencies to say their view, including the Board, as we go through.

One thing that you've noticed in this program, no constituency is shy to speak their views to Congress and to other policy makers as to what their views are about the program. So I think there will be many places besides the EIS that we'll be able to have interchange with the various constituencies.

DR. METLAY: Many places that DOE itself will create and structure, or just many places?

MR. BARRETT: The main one, the process that we will create is basically three. One, the EIS process, the other is the 960 process, and the others are continuing dialogue with the various affected parties, the state and local governments and other groups that we have relationships with, the scaled back but cooperative agreements with the states, the state radiation control program directors, et cetera, as we see that interchange as the program is modified based on input that we get.

DR. COHON: Thank you, Mr. Barrett. Thank you, Ms. Dixon.

MS. DIXON: Thank you very much.

DR. COHON: We'll turn now to the project implementation process and we begin with an overview from Russ Dyer.

DR. DYER: What you've heard in the preceding talks, we're going to shift gears a little bit here. What you heard in the preceding talks focused on things to come, and what this segment is going to focus on is a little bit of the how we got here.

We were asked to put together a talk that looked at some lessons learned, and really whenever we talk about project implementation, there's another couple of words we're going to discuss or weave around also; that's integration and evolution. And in keeping with the theme of integration, we're going to talk about how the programs evolve and we'll start by going back in history, back to the days of the site characterization plan, and work our way forward, look at some of the things that have changed and haven't changed, some of the lessons learned, some of the bad examples, good examples as we've gone forward seven or eight years now since the SCP originally came out.

I'm just going to set the stage for this. Most of the meat of the talks will be in the following talks that are going to focus on systems, and that's going to be by Dennis Royer and Rick Memory. Abe Van Luik will be back to talk about some of the lessons we've learned from performance assessment. Of course I'll talk some about that also. And Paul Harrington will add to what Rick talked about in the design area.

Let's start with the top level strategy in the site characterization plan, which of course was put together in an era of some uncertainty. And whenever we put it together, it was preliminary, it was very conservative. It was intended as a guide, a place to start from. In fact, if I remember back to one of the first reports from the Nuclear Waste Technical Review Board where you looked at the site characterization plan, it was seen as a place to start, maybe not the ultimate, but at least it was something that we could start working on and evolving from.

It was certainly a comprehensive program because we had a lot of areas that had uncertainty associated with them. We didn't know exactly where the most important parts of the program were. There was very little in the way of explicit prioritization in the site characterization plan. The idea was that we would develop a prioritization from year to year through the annual planning process. And in part, that has come to pass.

The SCP focused on five major elements that we thought dominated pre-closure and post-closure performance; saturated zone, the unsaturated zone, the EBS or engineered barrier system, design as it's captured in pre-closure radiation safety, and then disruptive events, either pre-closure or post-closure.

We knew that we had to understand something about all of these things, but we didn't have a working total system performance assessment at that time. We did have a list of things that I'll call components of each of these, information needs, if you will, that were tied to each of these, and we had an expert judgment level prioritization which steered us through the early days of activities in looking at these things.

As we have gained information and knowledge, we've iterated on our understanding in here, increased our understanding in some areas, and we've got a better idea of what we don't know.

Now, there were three things really that were supposed to tie together to help us evolve the SCP. The SCP was meant to be an iterative evolutional process. We were going to combine results from site, performance assessment and design activities.

Now, there's some lessons learned I can point out here. You remember in the early days of site characterization in the early Nineties, almost all of our effort was focused on site and performance assessment. We deferred very many of the design and engineering activities in those days in our search to look at site suitability. It was only a little bit later that we really understood that perhaps this was a false target. You really had to look at the system suitability, the viability of the entire system with both the natural and the engineered components.

Performance assessment, we started out from ground zero, got out first performance assessments really in the '90, '91 time frame and have been working forward from that point using performance assessment, as Abe will tell you, to feed back to site and design to help us prioritize the program. And, of course, the idea being to reduce uncertainties, but certain to reduce the key uncertainties.

What have we learned with the passage of time?

Well, our understanding of the site has evolved. We have considerably more information. Steve talked a little bit about it. Susan talked a little bit about it. Dennis Williams will talk much more about it tomorrow, about some of the information coming out in the site characterization program. Just as a top level bullet, we had alternative finding of low flux in the SCP. That seems to hold up under our current understanding.

We have revised the strategy in the SCP really to focus on the site characteristics that are most sensitive to the total system performance assessment. And the next several slides I go to will show you how we do this, and it is through the iterations of the planning process where every year you get a chance to go back, review your assumptions, review the basis of the program, either verify it or go search for new information somewhere.

We revised our strategy in the 1994 program plan, which we started execution of in 1995, and now we're into yet another iteration in the cycle of planning and execution or implementation.

In part, what we're looking at is the balance between and the convergence between tops down and bottoms up. If I were to characterize the original SCP, there was a lot of detailed information at the bottom, and now we've come back and forth, tops down, the requirements from the top mixing up with what can be done from the bottom, and I think that we're getting much closer to what at one time we called convergence in this program.

The program plan that will be coming out in about a week is a further refinement of the SCP strategy, and what we've introduced here is the waste isolation and containment strategy, a safety case. And as you've heard, there are some difficulties that we're working through right now. The dialogue associated with this has been very meaningful and constructive for the project. But it will provide the framework that will allow us to evaluate the safety case. That's one of the big targets that we have, the viability assessment in '98. Whatever we look at performance of the system at that time, what does it meet.

In the short-term, of course this year has been a very I guess traumatic would be a good word, a major change in the program, a major redirection in the program. It looked like we were going to be terminating the program around the '99 time frame, and that's what much of our planning basis for '96 was based on. The '97 plan that's coming out will take us and change our direction so that in fact we get back on the track to the license application in the relatively near term, 2002.

In the near-term and following the guidance from Congress, we have emphasized the core scientific activities, the excavation of the ESF and design activities that are needed really to do the evaluation, the performance assessment of the system.

Our scientific work that is right up here is focused on those parts of the natural barrier that are most important to waste isolation and containment. And, of course, the way we determine that is through performance assessments.

This schematic tries to map out the relationship between what I guess I would consider the major producing areas, those parts of the program that are responsible for major products that are part of the project, the license application, design, site characterization information or performance assessment.

There are these individual activity boxes that by themselves, they don't accomplish that much. They have to work with each other, and that's what the arrows are here. This is the interface, the dialogue, the communication that goes on between the individual elements, the AMs that you heard talked about this morning. This would be Susan, here's Rick, this is Steve Brocoum and Abe Van Luik, and this is Steve again.

A very large part of integration is assuring that these linkages are effective, that they do in fact work, that we have two-way communications across here and, in fact, through all of the linkages.

Now, how do we do that? You cannot assign an individual, an organization or a particular entity with the responsibility for integration. Integration is everybody's job. How do you do that? How do you facilitate integration across the project? The way we've chosen to do it is through the way that we implement the project, which starts at the very beginning with the planning process.

I'm going to go through the next several slides; it's really the how to for our annual planning effort. Of course planning is done certainly annually under the federal budget cycle. It's also done any time that some change occurs in the basic assumptions behind your planning, if your budget changes dramatically, if something comes up that brings into question some of your fundamental assumptions or constraints that you use as a planning basis.

The first several things on the list are things that in our current planning effort were initiated by the planning steering group, the group of DOE and M&O senior managers; review the results of previous work, identify those activities that are most critical to getting these major products in place, and then prioritize the activities.

Now, I'd like to emphasize this, that we went through and found out what was most critical to be done, then prioritized it, and then we started talking about the funding here. We're going to come back to funding again and again. It's always a constraint in a program of this kind, and it has to be worked out through an iterative process. We make a best guess at this level, go to the detailed level, find out what they're able to accommodate, then work it back and forth. So it's not a one shot thing; it's a continually iterative process within planning.

And of course one of the critical issues that Rick mentioned certainly was getting a schedule in place, and this has been something that is really probably produces some of the best dialogue, integration and communications on the project, is developing this integrated schedule. I'll talk about it in considerably more detail in the next slide.

Associated with the schedule, of course, is a detailed workscope. Workscope has discrete definition of everything that's on it, plus some estimate of the level of effort required to accomplish this workscope. There's also a programmatic risk that we evaluate. Rick talked about some of the risk evaluations associated with the design effort, what are those components of design that have the highest risk, and that's probably where we want to concentrate our resources, prioritize our resources.

And, finally, baselining the results and managing to the baseline. There must be a discipline to the management process. The baseline gives us that discipline.

The integrated schedule is really an absolutely critical component to our program. A logic network that doesn't just tie together activities in a bar chart sequence, but rather ties together the logic, the precursor successor logic between individual activities, so that if, as has happened, if we see that some activity is slipping for whatever reason, we're able to evaluate the impacts on the rest of the project.

If, for instance, a test is delayed for some reason because we can't get the equipment fabricated, how does this impact the project, what work arounds do we need to do, either material, alternative studies. This provides the basic tool that informs us by statusing the schedule against the baseline. By statusing it and looking at the logic network, we can determine what, if any, work arounds are needed.

The logical relationships are absolutely necessary to being able to understand why we need to do a particular activity to feed the next activity. The cost and duration for each activity of course is necessary for us to plan out the project. We have some real constraints on budget. We have some targets for schedule. Now, what can we realistically do within the schedule and budget that appears to be available.

There are, as I said earlier, numerous iterations of the network that are needed to converge on a project that is really viable for any given year. We are in the process of doing one of those iterations right now for the program starting in 1997. And, of course, every activity must have somebody assigned to it. There must be somebody responsible for and held accountable for the execution of everything on the network.

One of the things if we're talking about lessons learned, one of the things that we learned that we translated into our 1994 planning activity was that you gain much more out of the project if you focus your planning on products, not on activities, not doing geology, but rather focus on products which feed to the major products of the project, the license application, the EIS, the suitability determination. And so those have then become the focus of our planning effort.

These are two things which help us a little more; pre-closure rad safety provides a focus for the design organization, focus on waste isolation and containment, what are the key elements there. Again, this ties back into using performance assessment as a discriminator and a prioritization tool.

The risk, once we go through a schedule, put together a logic, resource load it in some way, then there's a next sweep through. Where are the risks in the schedule.

And risk can come of course in several forms; a technical risk, that is, a risk that we would get the license application, yet the principal investigators would not be willing to stand behind the results that we have. That's not acceptable. How do we mitigate this? How do we make sure that what we take forward is something that the actual work force will stand behind?

What's the schedule risk? How do we mitigate a schedule risk? And the cost risk, of course that comes in in several ways. The balance that we have, the delicate task is balancing all of these risks, get a program that is acceptable to all communities, to the technical community doing the work and the cost and schedule is acceptable to the customers, in this case, Congress, who is the sponsor of the work.

Now, what's the status of this current planning cycle? The '96 program that we put together was essentially based on the closing out at the end of '99 philosophy. Now we're transitioning into something back into a licensing environment, and what we've done is put together a preliminary logic network. This is a relatively high level network, which we call the project summary schedule, and I think there's around 400 activities, if I remember right, on the project summary schedule.

Each of these activities, we develop a workscope statement and acceptance criteria for. At this level, we've identified all the major deliverables that we need to accomplish between now and license application.

And this is, at least at the highest level, this is the summary schedule. There's really, on the summary schedule that we're carrying, there's quite a bit of detail below this, yet it's still not enough detail to actually plan the detailed work for an individual year. And that's going to be a rolling wave approach, and we want to do a couple of years of detailed planning at a time. And so finishing up '97, re-inventing a program in '98, re-inventing a program in '99, but rather carry a two year rolling window of detailed activities that we can carry forward to get rid of this artificial barrier that always occurs on September 30th of every year.

This shows the major activities between 1996 and 2002, and the major deliverables, broken out again by these focus areas.

What's next? This will be the program that we will be transitioning to at the end of this year, will become the basis for our project from now until license application, perhaps beyond, and this becomes something to which you would make discipline changes under the change control process.

The project implementation plan, that is, the details that fall below this, the annual details that one goes through, will be in place in September, '96. Really, it's hard to do this until you really have a very good handle on exactly what kind of budget resources you have to deal with for a given year.

Project implementation; implementation, integration, evolution. How do we do it? Well, you look at what has happened, what the results are, and define and integrate the workscope primarily through the annual planning process. Now, there have been several examples that have occurred outside of the annual planning process where we have had to go back and revisit our planning basis, add things to and delete things from the program.

The major things that we're controlling here and playing off against each other, this is not an exhaustive list, but the things that we'll talk about are total systems performance assessment, site studies and design analysis, and Abe and Paul will talk about the interactions between these activities through the planning process. Good communication of course is an absolute necessity.

Now, what I'm going to do, let's see, I can take questions now, or I'll be back at the end of the next four presentations, which might be a good time to wrap things up a little bit.

DR. COHON: Are there any burning questions, or can we wait? Let's continue.

DR. DYER: Okay. Next, we'll have Dennis Royer discussing systems studies. He'll be followed by Rick Memory, who will give us an example and some lessons learned from a particular system study. Abe Van Luik will follow up with some lessons learned from the interaction and performance assessment with design and site, and finally Paul Harrington will tell us a little more about the design process and prioritization of design efforts.

DR. COHON: Just one scheduling detail for everybody's information, we will take a break after this phase of the presentation, that is, after Mr. Royer and Mr. Memory. We'll also entertain questions before that break, and then we'll resume after the break.

MR. ROYER: Good afternoon. My name is Dennis Royer, and I serve as the team lead for Systems and Requirements under the direction of Dr. Brocoum with the Suitability and Licensing at Yucca Mountain.

My presentation today will provide an insight of where the integration is needed, the types of information in a high level form that is transferred between functional elements, how and why this information is controlled, also try and relate how a system engineering approach influences some of our implementation and integration, typically with systems studies as an example.

This diagram that Dr. Dyer had put up previously is a pretty good picture of the functional areas within the project. All of our assistant managers are represented, like Dr. Dyer pointed out, including the performance assessment in the middle. I want to dissect this diagram to show where the integration is needed and also show the major functional areas and how some of these ties are analyzed and some of the information in a little bit more detail.

This slide is meant to show where, as Dr. Dyer mentioned, that every one of these arrows back and forth between the functional elements identified interface areas. We also have an interface, which wasn't mentioned before, externally, which involves the program, oversight groups, regulators and Congress. It's all part of our mission.

In the next slides, I want to take you through a couple of these interfaces, go through basically the arrows, two of which will be discussed in detail behind me. Abe Van Luik and Paul Harrington will also bring these up later in much more detail.

I wanted to give you a feeling of the types of information vital to both the--some of the specifics and informational flows. The balance of these slides, I just picked up two, are in the back of your package. The first one I've chosen is performance assessment to the design interfaces. Like I said, Dr. Abe Van Luik will emphasize and add to these. The main types of information occurring in the interfaces are such products as the repository subsurface designs, engineered barrier system components, the process models, sensitivity studies, TSPA information, and also our technical requirements documents.

This next one is a site characterization design interfaces. Typically the kinds of information you see going back and forth will be the reference information base. Some of our determinations of importance evaluations, typically for test interference, voice isolation and quality inputs. We have a PISA, project integrated safety assessment. Again, we have design products, technical data information and again our technical requirements documents.

Now I'm going to describe a couple of the functional element interfaces and some of the types of information that transfer between them. I want to describe how it is controlled. Typically our process is through a baseline. It's three levels; program level, project level and a contractor base, one, two, three.

Typically, these boards within their areas will control information using thresholds for costs and schedule. They'll also have other important information that occurs between the elements.

This is all meant to show that it's under an umbrella of change control. The bottom would be a time line typically. Information can go from the technical baseline, feed the mission objectives, all the way across through the time, or from a controlled information or reference, up through the phase and then back into the technical baseline, all controlled by the CCB

Each one of these changes, if you were to go from a reference information base into the technical baseline, would be controlled through the CCB and evaluated for impacts by the plan integrated team, which is the CCB.

The next slide is intended to show what typically is in control under our CCBs. Technical requirements for design and site characterization, specifications for design, design architectures and descriptions, physical design interface drawings, all these are components of the technical baseline. The CCB will also include other reference information and data considered important enough to be controlled, but not in the technical baseline. Such examples would be design assumptions and non-qualified site information.

The next question is why do we use a technical baseline approach. As Dr. Brocoum pointed out earlier today, we have a tremendous amount of technical data coming in now. Technical data management is becoming very critical as we formulate our PISA, our models, performance assessment and design products. So basically, we use the approach to ensure our documentation and configurations are consistent.

All participants will use the same reference in the development of the waste system. All changes to the baseline will be evaluated in a uniform manner. We'll record all our changes, make sure that all our changes are traceable.

Next, I'd like to discuss our approach. Some of our system engineering fundamentals provide the project many tools that influence integration and implementation at Yucca Mountain. The basis for the approach is our integrated product team and our definition and accomplishment of activities. Integrated product teams have been called many things this morning. We have work groups, work teams, all meaning the same thing. Simply put, it's just a team of individuals with the needed expertise with different backgrounds, representing different functional elements, to find and provide the technical solutions for all these complex problems.

Examples of integrated product teams would be the CC board, technical requirements test teams, system study groups and performance modeling testing.

How do we get our integration through our system studies? This occurs through a structured and informal interaction led and controlled by a study manager. Basically, we've got our issue for study. This is kind of, if you will, an analogy of an orchestra and a conductor. Each one of these technical experts provide expertise, feed formally through structured interactions with the study manager, informally between themselves, cross all the bottom, and feed up periodically to the study manager, which provides us a technical basis of decision for study product.

Customers typically are performance assessment, environmental safety and health organizations, but it really can be any functional area.

Where do we get our significant issues? Basically, we're back along the same lines of the information. As the information goes back and forth, interactions between all the functional elements bring forward the crosscutting issues that basically they ask systems to identify them and study them.

My next charts provide past and present examples of systems studies, illustrating our customers, our recommendations, our program implementation within the project or the program. For '93 and '94, examples would be thermal loading of the repository. Our customers were design, performance assessment and site characterization. Also, we had the retrievability period. Customers again were design, performance assessment and performance confirmation.

'95, Calico Hills characterization. Customers, site characterization, design and performance assessment. We also had Nevada Transportation. That study was used to evaluate the rail corridors and heavy haul options.

'96, in progress. We have the engineered barrier performance requirements, previously called backfill, but it's more than that, as Rick had pointed out. Also performance confirmation program, definition and requirements. Customers, design, regulatory, performance assessment. All these are in process. Plan to finish in this fiscal year.

And lastly, we have the thermal loading alternatives, which is also in progress and should be finished this year.

In summary, I hope that my presentation has provided an overview of our approach to accomplish some integration and associated implementation mechanisms used in the systems activities and the philosophy. Following the presentation this afternoon will be a little more insight into the details of this information.

Mr. Rick Memory is next. He will expand on the thermal studies and give you further depth into the integration that's achieved in much more detail than I have here. Any questions?

DR. COHON: Thank you, Mr. Royer. Why don't we continue on with Mr. Memory, if that's okay, and then we'll direct questions at all of you together.

MR. MEMORY: Good afternoon. My name is Rick Memory, and we've been asked to discuss thermal studies as a recent example of taking the opportunity of a system study to integrate particular issues across the program.

Let me back up first just as a reminder of the role of system studies in the system engineering process, and that is basically to provide an integrated technical basis for both program decisions and technical requirements. We do that by considering performance cost and risk in order to determine a balanced allocation of requirements across the various system elements.

Thermal loading is indeed a good example of the system issue that offers great opportunity for integration across the system. It has far reaching system impacts, influences a number of things that I have listed here, long-term, large-scale thermal disturbance, near field impacts, repository design, very importantly, the area needed, drift waste package spacing and even to a certain extent the ground support issues that Rick was talking about, and finally, it influences the EBS and waste package design.

The extent or domain of influence of the thermal loading depends on a number of parameters, not the least of which is the level of thermal loading that we select. For example, if we select high thermal loading, then at least the physical extent of the influence will be greater than if we select a lower thermal loading. Rock properties will also influence the extent, and as another example, the presence and continuity, extent of fractures could strongly influence thermal loadings influence on the system.

And, finally, thermal loading is a highly visible issue. There have been a number of different opinions on the subject, should we go high or low. And at this point, there's not a great deal of data available to verify these influences I've mentioned here.

So the thermal loading studies that have been conducted in the past have utilized this integrated product team approach, which is led by a system study manager. The tasks are then assigned to the team members after discussion of the issues with the team members. The task results are provided as input to other potentially follow-on tasks within the study. The results are documented. The report is reviewed and revised as necessary, and then the study recommendations are published.

The outcome then can be that the document itself can be used as a documentation for a program decision, or it can be used in support of modification of a requirements document.

For the thermal study, the integrated product team included people from the organizations, from Design Engineering on down to System Engineering, including Environmental, Licensing and so forth. And then we draw on these three sort of skill organizations to feed into the actual organizations that are above there. They all play as part of this integrated product team.

The SCP originated a number of what they called thermal goals, and the goals were specified or developed in the sense as surrogates for performance. The SCP preceded formal performance assessment modeling capability. The idea was that if we meet these goals, then we have a good chance of meeting our performance requirements.

So the first thermal study that was conducted was conducted in '93, and did a reassessment of these goals. In this fiscal year '96, we're taking another look at these goals, because they are having a major, or potentially significant influence on the repository design.

But the goals as you walk down the left-hand column, 350 degrees C. waste package centerline temperature limit is there primarily to preserve the integrity of the fuel cladding. The 200 degree C drift wall maximum temperature is there for rock stability reasons. And then, finally, the 115 degree Topopah Spring 2/3 interface limit is to preserve the geochemistry, the zeolites and to perhaps limit the mobilization of the water that's in the zeolites.

So that was the thought that was behind the original specification of those goals. The influences they have are shown in the middle column where waste package spacing, drift spacing, drift diameter are influenced by those goals. So that if we could relax the goal, then maybe we can change some of those parameters in the middle column. And then, finally, this 115 degree limit does influence the horizontal extent of the repository.

And then its implementation has been in the ACD, with the waste package spacing we use and drift spacing, the drift diameter, and for this goal, it kept us to a 30 meter standoff from the repository, and the TSw 2/3 interface.

Now, the way that these goals, reassessment of these goals facilitates integration is through the process that we use here. As an example, the 200 degree C. drift wall temperature, the task was assigned to Sandia to look at the thermal mechanical impact on the host rock of a range of peak drift wall temperatures. Then those results are provided to subsurface design, which determines the ground support needed in the face of the impacts on the rock, and then the cost associated with that.

For long-term performance considerations, in '96, the performance assessment will take a look at the drift stability, implications with that limit, either increasing the limit or lowering the limit.

Then given that data, the study manager integrates the findings with the participation of the integrated product team, and determines whether it should be recommended to modify that limit, or remove any reference to the limit at all.

The thermal loading system studies' influences on the program have been that in '93, the thermal study recommended narrowing the range to at least limiting it to less than 100 MTU per acre, and that recommendation was then incorporated in the control design assumptions document and it's also used as input to our thermal loading strategy. It's also used in the ACD design and test planning.

We did an update, as I mentioned, on the SCP thermal goals, which were put in the controlled design assumptions document. And importantly, also going through this study, provided an initial consistency of assumptions pertaining to the waste stream, the characteristics of the fuel, its arrival time and so forth at the repository, a consistency in assumption on repository layouts, waste package and so forth.

The '94, '95 time period, the emphasis for that study was to look at priorities for thermal testing, and we also evaluated some potential thermal management approaches. But the key output of this was the study looked at ten features and processes and their potential impact on performance, and the outcome or the results of that were evaluated by the integrated product team members, that then went back to their home organizations and basically incorporated the findings into the test planning.

Finally, some of the process lessons learned here; this hasn't been as smooth a process as it might have sounded when I just went through it here. One of the things that we learned is that when you integrate a broad range of areas of technical expertise, it involves understanding and accommodating a wide range of different cultures or ways of doing business, and we need to respect that and understand it and spend the time to do that.

The next thing is to get the best use out of your integrated product team is you need to keep them involved in the study. The team can stay involved either obviously through direct involvement in tasks. Another way of doing that would be to have periodic status meetings to let the product team review what you've come up with to this point.

The third bullet, and this is certainly not unique to systems studies, but we need to allow ample time for review, a thorough technical review of the study report while it's still in the draft form. It's typically something like thermal loading or other studies that we've gone through are not trivial at all from a technical point of view. You need to give people time to review the document thoroughly so that you can have a well integrated and coordinated product at the end of the study.

Finally, it's important to anticipate and plan for completion of system studies to support the needs of the customer.

And I think that we've found that people are asking us what's the answer today and I'll say, well, I can tell you in six months. But they need the answer today. So what we're trying to do is anticipate what the questions are going to be. And I think we're doing that fairly well. Mr. Dyer addressed our planning from '97 to '02. We currently have a series of system studies identified in that time period, at least in the early time period, the '97, '98 time period, in which we have tried to address the needs of the customer. And that concludes my talk.

DR. COHON: Thank you, Mr. Memory. Questions from the Board for Mr. Memory or Mr. Royer or Dr. Dyer?

DR. LANGMUIR: I probably shouldn't be picking on a specific, but let the general questions go first, but I'll do it anyway.

Overhead Number 7, since you did pick thermal goals as your example, a couple of loaded questions. Maybe I'm wrong, but until at least recently, you were not even considering fuel cladding as a waste isolation factor. And so why do we care if we destroy it by going above 350 C. I'll ask that. Then the next one is 115 C., the lower criteria, and when I'm done with this, I'm going to ask you how it would improve or change our design if we didn't worry about them, the lower one, zeolites, my understanding is that zeolites are great for absorbing cesium and strontium, which are gone after a couple hundred years, and pretty lousy for absorbing actinides, which is the key issue. So who cares about 115 C?

So with those loaded questions, maybe you're not the right person to answer them--

MR. MEMORY: I'd be thrilled to try. The fuel cladding, you're correct, has not been used as a barrier in the TSPAs, but it has always, my understanding, been considered as something that provides additional confidence, that even though we aren't considering it quantitatively in our PA, we say, well, we've always got the cladding there to provide an additional defense and barrier, perhaps. But that is one of the questions, is why we're looking at it, should we just forget about this altogether, and what would it buy us in terms of the program if we forget about it. We'd lose the potential defense and depth capability that it gives us, but we might gain a decrease in cost or flexibility in design. We have to weigh those two things.

DR. LANGMUIR: Of course there's another consideration not listed there, which if I recall, is that at somewhat higher temperatures, you destroy the UO2 crystal structure. If it gets too hot, it oxidizes. And that perhaps is a far more important issue, because that then makes the solubility much higher than otherwise and the rate of dissolution increases.

MR. MEMORY: Yes. If we remove that goal, there maybe another goal that kicks in very quickly after this goal is removed; that's correct. Do you want me to do the 115?

DR. LANGMUIR: Well, sure.

MR. MEMORY: The question that you asked is basically the question we asked; do we really need to hang onto that. It is influencing the design. Do we need to hang onto it? We did the Calico Hills study and we said that, yeah, we don't see that we're getting a lot of value out of the zeolites, but the two questions we have there, one would be for in the early release, if we do get release, should we use the zeolites again as a defense and depth barrier against any early releases that might occur that they might be able to contribute to as a barrier.

Secondly, the water that is in the Calico Hills unit, as we heat it up and mobilize the water, the issue is where does that water go. Hopefully it goes down. I don't know if it goes up to the repository. So that's why we're looking at that goal, to see if there are any negatives that could occur if we eliminate that goal.

The influence on design, I think you'll see in the ACD design, that the southwestern portion of the repository is limited. We had to cut off emplacement of the waste to the area where the distance between TSw 2 and 3 and the repository was less than 30 meters, because if it got closer than that, we started violating that goal. So if we got rid of that goal, we could perhaps use more area in the upper block and even not have to go to the lower block.

DR. LANGMUIR: That sounds like a highly relevant question to pursue a bit further from that point of view.

MR. MEMORY: Right.

DR. CANTLON: I think, Richard, this is probably as well addressed to you as anyone. I'm very pleased to see the sort of waste isolation strategy as the framework on which you've hung this integration. And by asking specific elements of that strategy, you've now tried to look at the interrelationship of the various study areas.

While we were in Sweden this spring, they were also looking at their own waste isolation strategy and thinking about their next run of TSPA, and have followed this similar kind of logic. But then they wanted an independent way of looking at whether they had left out some significant interaction, and then put together a matrix of all of the projects and tested for interaction between every conceivable one of the projects, and came up with some interesting things that they had forgotten.

Do you have any kind of an independent technique here of looking for those things which in a prototype situation, which you're dealing with here, about possible interaction?

MR. MEMORY: I'd have a hard time with that question.

DR. COHON: Do we have any volunteers?

DR. DYER: Dr. Cantlon, it sounds like an interface matrix.

DR. CANTLON: Yes, just took all of their projects down the two sides, and then looked at every conceivable interaction between them. You gave me a number of something like 400 different activities. I don't think they have that many different real data sets, but it's a way of looking to the very important question of whether you haven't thought about a set of interactions that may be critical to the system. It's just an independent check, and I'm just wondering whether you have any kind of an independent check.

DR. DYER: I don't think we have systematically done that. It might well be worth the effort.

DR. CORDING: I wanted to just look at those thermal goals. Are you putting into this some of the goals in addition just to the temperature, the time that you'd be holding temperatures, the long-term effect of it, in other words, of the thermal and the dry-out sort of effect; is that part of what you're looking at in terms of thermal goals, and how the holding of the thermal load, the temperatures with time will affect the moisture conditions?

MR. MEMORY: Oh, yes. These are, I think you could call these near field goals, and they relate to how hot you can get the near field. If you're wanting to go to a high thermal load, these typically limit what you can do with the high thermal load, so if you want to go high thermal load to do the far field water movement, you've got to get past these kinds of goals often times. These sort of limit what you can do to the far field. And so that's, in a sense, in addition, these are surrogate performance goals, but they're also, you know, there's a hidden agenda here to see if we remove these, can we go to a higher thermal loading that allows greater movement and dry-out.

DR. CORDING: To what extent is this study focused on this question of the moisture movement under thermal conditions, and how are you going to look at that in the testing, and how that relates to the waste isolation strategy and barriers and depth and those sorts of things?

MR. MEMORY: Well, those are the issues that the study is addressing. Those are pretty much the key.

MR. CRAUN: Maybe I can add a little bit. As I presented in my presentation, there's an interface between Susan's area and my area. Some of those interfaces are on the thermal performance. We in the engineering side do the drift scale analysis and project the drift temperatures with time. So we do include a time dependent term there.

Susan's side is also looking at the humidity over time also, with that time dependent, so there is a time factor also on hers, so that we can also bring it back to then the knee in the curve as to where the humidity comes now up to the point where we can actually initiate corrosion on the corrosion allowance material.

So maybe the answer is in the terms of yes, Ed, there is a time factor. The time dependency of these issues is included, so that as the goal is released, it's not only in the initial loading of the repository that would affect that goal; it's the overall performance of the repository. So that time dependent issue is, in our view, as the system studies are being done.

DR. CORDING: One point on the interface. The temperatures there you talked about over the near-time, if you--it's not a concern if you can get by the near-term in terms of some of the radionuclides coming through in the near term. You don't need the zeolites as much. But I'm wondering what you meant by near-term. Are we talking 1,000, 10,000 or 100,000 years? Near-term has started to stretch out.

MR. MEMORY: Well, what the Calico Hills study conclusions found is that for performance standards of 100 to 200,000 years, you started not getting much benefit from the Calico Hills unit. So near-term is something less than that. I think really as a backup, this would be in the 1,000 year time period.

DR. CORDING: One thing I see here is that we have some major questions about this humidity corrosion and the ability for backfill and thermal effects to take care of that in, say, the 10,000 year time frame. And it seems to me that that's one of the areas, particularly with the developing strategy which is still waiting on input from other areas, that's really where I see this barrier and depth approach becomes extremely important, to be able to say if that doesn't work, do we have something that will take care of it in this near-term, which is perhaps the 10,000 year definition of near-term.

Isn't that part of what we ought to be looking at? It seems to me that that's part of that, and looking at the whole strategy is the importance of some of these barriers and depth, because we do have a lot more uncertainty right now, and going forward to perhaps even to licensing is certainly near-term decision. There is a lot of uncertainty as to what we can get out of some of these other barriers that are part of the strategy.

MR. MEMORY: Yes, these were examples. They are the ones the '96 thermal study is looking at. Of course, as has been mentioned a few times already, we're doing the engineered barrier system performance requirement study, and in that one, we're addressing the humidity issue and tradeoff in much greater detail.

DR. COHON: We're going to have to move on. We have two very brief questions from Pat, and then Don, and then we're going to break. Pat?

DR. DOMENICO: I'm just looking at Dennis Royer's presentation on Page 11, and FY93 issue, which was thermal loading and preferred loading of 80 to 100 MTU per acre. What you have described is yet a later study. Is that correct?

MR. MEMORY: Well, the '93 study is one that I've described here, and then there's a '96 study that is doing this as well. I should have a slide in here.

DR. DOMENICO: Well, Dennis has a slide on Page 11 that mentions the '93 issue.

MR. MEMORY: Right.

DR. DOMENICO: That's what I was referring to.

MR. MEMORY: Okay.

DR. DOMENICO: Now, what you have talked about, this right here, that slide, is yet a later study. Is that correct? Or were those considerations taken into account in '93?

MR. MEMORY: Yes, these were taken into account in '93 in terms of what drove the answer to say don't go above 100 MTU, because if you go above 100 MTU, you're going to start violating thermal goals, of which these three are an example.

DR. DOMENICO: So those goals were embedded in the '93 study?

MR. MEMORY: Actually, these goals were invented in the SCP, and they were updated or reassessed in the '93 study.

DR. DOMENICO: And did you say there's going to be a '96 study?

MR. MEMORY: There is a '96 study going on, yes.

DR. DOMENICO: How does that differ from what we see here?

MR. MEMORY: The reason for re-looking at these is I believe there is additional information that warrants looking at this, in addition to the fact of the recognition of how they're driving the upper bound limit and the design implementation. So they've been deemed to be very important. Our design customers have asked us to re-look at these, and because of that, we're doing so.

DR. DOMENICO: But still with the objective of at least 80 to 100 MTUs per acre, that's still the overall objective?

MR. MEMORY: That's the overall thermal loading strategy at this point.

DR. DOMENICO: Thank you.

DR. LANGMUIR: Just coming back to the same question I raised before, I'd love to hear the arguments fresh, not here, there will be no time, clearly, for the reasons for the 115 Celsius choice and the stability of zeolites, which I view as somewhat irrelevant at this stage of the game. If in fact they are, can't we get 50 per cent more waste in that much less space? Because that's the only thing that's keeping you at 30 meters between drifts. All the other criteria you've chosen, if we buy into them, you could go 20 meters.

MR. MEMORY: I'm sorry. That's not 30 meters between drifts. That's the distance from the--

DR. LANGMUIR: Okay. Can you fit more into the general volume you're dealing with?

MR. CRAUN: As was pointed out, it will allow us to expand the repository in the southwest region. That's where the quadrant is where we're coming in to that constraint. So if that constraint is relaxed, it would allow us to expand in some areas on the southwest corner.

DR. LANGMUIR: And that's the only place that this constraint is going to be a problem?

MR. CRAUN: At this time, yes. For example, if the information from the ESF allows us to then go more north with the repository footprint which we're looking at, then we may bump into that constraint elsewhere. But at the current repository layout, as defined in the ACD, it would be in the southwest quadrant.

DR. COHON: Thank you very much. Thank you, Mr. Memory, Mr. Royer, Dr. Dyer. We will take a break now. We will reconvene at 3:30 by my watch, which is 12 minutes from now.

(Whereupon, a recess was taken.)

DR. COHON: We continue our discussion of project implementation, now with a focus on performance assessment, and that's Abe Van Luik.

Dr. Van Luik.

DR. VAN LUIK: When a performance assessment person looks at this diagram, that person sees that performance assessment is at the center of the universe. However, when Rick Craun or Susan Jones or Wendy Dixon or Steve Brocoum look at this diagram, they say, "We have a common servant," and, actually, both things are true.

We are a service organization because we feed back and help them do their work, and, at the same time, we are the focal point for the regulatory compliance arguments, and that is, in essence, the second bullet, I mean, the first bullet on the second view graph. "Performance assessment integrates scientific, design, and environment information."

Total system performance assessment is one of the tools for that integration. It can be used to support decision making, to evaluate regulatory compliance, to optimize the overall system, and to determine where more information may be useful. All of these things are also addressed, however, through specialized sensitivity analyses.

This morning, I talked about planning for the TSPA-

VA, and I showed that a structured and interactive process is being defined. The past experience we have had of using an unstructured information exchange as a medium for influencing the program suggested that we needed a more structured approach.

The completion of process-level models by the site, and the engineering function at this time in history, and the need for us to abstract from them also forces close and structured cooperation, so it's not just our past experience, but it's also that all these things are coming together now at this particular point in time.

For historical purposes, we looked back at the way that we have interacted with site and design before. We outlined recommendations in each of the recent TSPAs, '91, '93, '95. In '95, we listed recommendations for more work to be done in site characterization, engineering and design, and I forgot--and I'm sorry, Wendy--to add in here that we also made some recommendations about the biosphere modeling that's needed.

TSPA '95 recommendations, to a large extent, have been factored successfully into the planning which was discussed in the first presentation. We feel very optimistic that the data needs that we have expressed are completely coordinated with the data needs that the other functions recognize, so the focus here is going to be on history, on

TSPA-93, and the informal way its key recommendations were handled, which--and I don't want to make it sound negative, because those things that we let them know in '93 we needed, did lead to the changes that you see in '95, particularly in the engineered barrier system, but it was a partial success. I guess I'm not supposed to say things that are not on the view graph.

The TSPA-93 recommendations were divided into three categories: site data, waste package data and near-field processes, repository and waste package design, and one of the things that Rick Craun pointed out very well is that there is coordination between both the site and engineering functions in addressing the near-field processes.

If we look for the site recommendations from TSPA-93, we see some of the recommendations that were based on knowledge at that time, which we probably would not repeat in the same form again, so this is a selected list of recommendations.

Susan said this with more emphasis than I have said it before, but looking at the flux and the mechanism of water moving through the mountain is Key Issue No. 1 for us, so we recommended a search for evidence of flowing fractured at the present and in the past, and we have a sizable effort currently dating samples from the ESF, which also address the second recommendation in TSPA-93, let's do some isotopic dating of fracture coatings and fillings.

Now, is there a cause and effect between TSPA-93 recommendations and what the site program is doing? You know, it would be silly to think so, because I think the scientists in the site program who were doing the process level modeling of these processes, were making the same recommendations internally, but at least we were in sync.

We also said gas flow is important, and, of course, new air permeability data have been obtained. We didn't care about gas flow that much for, you know, the Carbon-14 issue, but bulk permeability data obtained through gas flow measurements are useful for characterizing fractures for water flow and hydrothermal modeling, and, basically, the reason that work was done there is because they were in total agreement with us, or we were in total agreement with them.

Percolation flux, now, and for future climates. A lot of new work has been done here. Estimates of surface infiltration are now available. We have progress in the climate modeling, which will culminate in a process level model soon, and we have looked at the calcite-opal work, again, the dating work to constrain past and present percolation to some extent.

The amount of dilution in the saturated zone now and for future climates is another area that we made recommendations on, and we do expect, for example, from C-well testing, new data in this area, and there is additional modeling work currently in the plans, but this may be an issue for which future data will be obtained as part of the confirmation program.

We made a long list of potentially important items, and I just picked a few out of there. The double asterisks indicates current activities, and the single asterisk indicates where work was done, but maybe is not, you know, being done instantaneously at this moment.

But, colloids, fracture matrix coupling, persistence of flow paths through time, scaling of properties and heterogeneity, cross-correlations among parameters, we've done a lot of that ourselves, too, and hydraulic properties of almost everything in the mountain.

Fracture matrix coupling is an area that Susan mentioned is receiving special emphasis in the current time for the process level modeling being done by site.

Let's skip now to waste package and near-field process model needs. We recommended integrated testing to a development of near-field process models. That is either planned or in progress. Rick mentioned this. Would this recommendation have gone unheeded? No. The people doing the process level modeling were very well aware of this need, but it had to wait its turn.

We found, in TSPA-93, that container corrosion, including the transition between nonaqueous and aqueous corrosion and galvanic effects, you know, could be very important. Improved models of these processes in, you know, I think, as a direct effect of that observation, were provided by the engineers, and laboratory experiments to provide some underpinnings for the models that we used in TSPA-95 are either being planned right now, or in progress.

Waste package chemistry, and how it affects solubilities and fuel alteration rates, and this shows that I wasn't lying this morning, Don, that it's in there. It's being addressed as part of the process-level model development that we expect from the engineering side of the house, in concert with site, because this is a near-field process issue.

We also observed a bunch of general things. Repository performance could be improved if container failure could be spread out over time, moisture contact could be reduced, reducing conditions could be maintained, and I must say, these ideas were not new with us in performance assessment, and if you look at the design group's work, they have at least considered such concepts, either directly in the design work, or in the systems engineering activities.

We had a follow-on to TSPA-93 on seismic effects. It was done by Sandia. It was a nice piece of work, and it was published publicly in the "Focus '95" conference proceedings. The conclusion is basically the same as it was in TSPA-91 and 93.

Total system performance is not likely to be seriously degraded by seismic effects. However, there were a bunch of observations. Repository performance might be improved by backfilling drifts. I mean, if the rock has very little space to fall into, you're not going to do much damage, and there is a systems study in progress to evaluate EBS enhancements of various sorts, not just backfills.

We said that we would like to have some kind of an estimate of rock falls, frequency, and the size of fallen rocks, and we are pleased to see that work is in progress.

Now, I must say that all of these issues show work in progress; longevity of effective roof support, changes in fracture and fault apertures, drift stability, work is in progress. There has been additional work on damage to containers from rock fall and seismic shaking, one small effort.

The work in progress is a little misleading, because, basically, in the long list of all the things that need doing, yes, now work is in progress, but for a long time, the prioritization that we went through pushed these things down, in part, because performance assessment said and still maintains that system performance is not likely to be degraded by the types of seismic effects that we're calculating. So, I support the prioritization, and, at the same time, I see, you know, the Catch-22 here.

We say TSPA is not going to be affected too much by this issue; however, you know, if you want to make the case stronger, do this, this, this, and this. We are pleased that work is in progress, but we agree that it should have waited until weightier issues were addressed.

What do we think of our TSPA-93 recommendation experience? It really suggested a more structured, cooperative relationship is needed. It was informal. People said yes, we agree that this is important. We'll put it on the list, and when funding and time becomes available, we'll address it, and we're very pleased that the recommendations that we made for '95, particularly in the face of the fact that process level models are being completed, and that we are creating something that is very close to the license application-type performance assessment for the VA, and, then, two years later, we will finish a license application VA. We are all pulling together to make sure that the TSPA has a sufficient basis to make a defensible case.

We received two process level models from the site program and reviewed them; we being the performance assessment program. Interesting thing. We looked at the first model, and recognized that perhaps people creating models and people waiting to use them don't quite have the same perspective on every issue. That was a surprise to us. It shouldn't have been, but it was. So, we saw a need to specify PA needs and expectations for future models coming in.

So, we wrote a content guide, and Susan Jones referred to this this morning. It was written and distributed, and it actually, to my surprise, received positive feedback, both from the site and engineering program management, and even the modelers, because it basically made their jobs easier to know what should be included to make an acceptable product, and, as I explained this morning, to link all of these many process level models together to do a TSPA is not really a doable thing, so we are going to do an abstraction process, and we are going to do it jointly, and in a very structured manner so that we do not create more problems than we're trying to solve.

What is the expected outcome of this structured cooperation in modeling? A TSPA-VA that actually reflects what is in the site and engineering process-level models, and what is also important, a TSPA-VA that is understood and supported by site and engineering management and their principal investigators.

Now, you know, this may seem obvious, but this is going to be a large job of communicating internally what we have done, and the challenge, of course, is to coordinate and integrate this work so that we don't do the same work, I mean, our resources are extremely limited, and the time is extremely limited, so we want to address uncertainties and show the applicabilities of models. We recognize within PA that that is largely the process level modeler responsibility. Site and engineering are going to do most of that.

However, if we're looking at system-level uncertainties, and system-level sensitivities, that is largely a PA responsibility, so we are going to structure very carefully these joint abstraction working groups, which I explained this morning, to ensure that these responsibilities are properly shared and addressed in a coordinated fashion. The last thing we want is two organizations using the same model, running the same types of sensitivity studies. They're very time-consuming. Writing up the results is very laborious. We just cannot afford that kind of duplication.

And so, that's where I ended this view graph. Basically, our experience showed it. We needed more structure. The planning that I explained this morning showed how we are implementing this need, or addressing this need.

DR. COHON: Thank you.

Questions?

DR. CANTLON: Abe, this program, when it first put into action its QA system, spooked the scientific community pretty profoundly, as you recall, and I guess the question that runs through my mind now is that you're proposing a system which will, again, involve people all the way down to the data generators in this synthesis.

I take it from remarks I've heard in the last few hours that that process hasn't really begun yet. You haven't really gone down, so that most of your data generators really know what you're up to yet. Am I hearing the right message?

DR. VAN LUIK: I think you are projecting a past reality into the present reality, because I think the things that I heard, both from Susan Jones and Rick Craun, is that they're fully on board with this program, and, at my level, which is a couple of levels below theirs, I have been in the meetings where we discussed this in gruesome detail with both the site and the engineering folks, and, you know, we are having some negotiations with them, but, basically, they are buying into it. They are planning to dedicate the people and the other resources needed to do it, and I feel very optimistic that we're going to pull this off.

So, the picture you see is probably true of three to four months ago, but we've done a heck of a lot of coordination and internal arm-twisting to--and it's been arm-twisting in both directions. Don't get me wrong. It's not like we are the saints of the program, and all these guys are bad guys. We have come in with some very naive assumptions, and have been corrected by both Susan's people and Rick's people saying, "This is not the way life works in the engineering world, or in the science world," et cetera.

DR. CANTLON: But you're comfortable that down at the level of the actual data generators, they know what you're up to?

DR. VAN LUIK: I believe so. Now, I have to qualify that somewhat, because the level that we are reaching down to is not quite the data generator level on every instance. It might be in some instance where a model for a process is coming from the data gatherer, but in every other instance, the interface that we have is with the people who, on behalf of the site program and the engineering program, are interpreting the data, conceptualizing models to explain the data, and handing off to us that conceptualization.

DR. CANTLON: Might not it be healthy to sort of get that final step down started pretty soon?

DR. VAN LUIK: That final step down, in fact, I think is in full swing within the site and engineering programs, because how in the world can you create a process level model without consulting with and getting the buy-in from the data generators? And so, I would put that monkey back on the shoulder of Rick and Susan, and say we trust that they will carry out that responsibility, because PA isn't big enough to do that across the board.

DR. COHON: I'll simply observe that I'm very pleased at the role that you've carved out, or your understanding of the role of performance assessment. Models of this sort, mega models of this sort are not likely to discover new ideas, or to produce new ideas. If they do, then you have to start worrying about all the pieces that you used to build this mega model.

They tend to confirm what you believe to be the case, or maybe challenge you to reassess your assumptions, but they rarely produce brand-new, sparkling ideas, so that they would be used to confirm a prior expectation of a priority, I think, is completely appropriate, and that's what we ought to expect of them.

DR. VAN LUIK: Yeah, and if I can--I know that wasn't a question, but if I can respond to that, one of the things that I've been very pleased with is one of Susan Jones's view graphs that she kind of skipped over in a hurry. She acknowledged that it was her people's job to look at every possible conceptualization and interpretation that, you know, can come from the data that she has collected, and that's exactly the process wherein you make discoveries about perhaps the data indicates that the process that you thought was prevalent isn't, you know, and that kind of thing.

You're right. At the roll-up level, if you're making those kind of discoveries at the roll-up level, there's something wrong in the roots.

DR. LANGMUIR: Langmuir; Board.

Abe, I'd like you to comment on one of the problems that remains that I consider among the most important, and how you view it, your comfort zone with travel time. In other words, I'm told I shouldn't have been surprised, by some folks in the audience, that we have 50-year bomb pulse down in the ESF for some waters.

Clearly, to get the site declared suitable, we're going to have to say something about how much that is of the total infiltration through the mountain.

How do you feel about the evidence you've been presented and you've put in the TSPA in terms of having closure on the distribution of travel time waters moving through the mountain? Would you say this might be a plus or minus one per cent, a five per cent, or how far can you go with characterizing the amounts of water of different ages?

DR. VAN LUIK: Well, let's see, if my management will turn around and stop up their ears, I think this is an excellent question.

I, for one, was surprised by this information, but, apparently, some people in the site program, much closer to the roots rather than the abstraction level than I am, were not surprised.

In fact, I should not have been surprised, because I was part of the integrated task prioritization method that Russ Dyer set in progress a couple of years ago, and I was the one that voted that there was a high likelihood of locating fast paths in the ESF, where most of my colleagues said, "Nah, never happen." But, you know, you kind of forget that, and start to believe the things that we say among each other.

The Chlorine 36 data, which you are obliquely referring to, I think is not yet at the point where it's totally definitive, but I think by August, we will definitely know whether it is or not, and I think then the question becomes the same that's being faced by every fractured rock repository operation in the world, which is: How much of a volume, compared to the total volume--and you said it yourself--is being carried in these fast paths?

And if it's .0001 per cent of the total volume, it becomes a no, never mind, to the total system performance. If it becomes something like, you know, 5 to 10 per cent, then it's time to worry.

The indications that we have from the very simple one-dimensional modeling that was done by Los Alamos in interpreting this data is that it's a very minute fraction of water that has come down these flow paths, if, indeed, that is the explanation for the Chlorine 36 being there, so the, you know, the optimism is still there, as has been expressed by Russ and Steve, and by Susan, also, that the basic idea of slow flux or low flux in the total repository area still holds. That's our basic--

DR. LANGMUIR: What if, in the worst case, all the mountain water that infiltrates at the surface areally ends up in these fracture zones that you've identified so far, or these fast pathways that Chlorine 36 is located in the ESF. How is it going to matter? What's it going to do to your characterization and your suitability arguments, because that's the worst case, certainly, to say that all of it makes it down there; that the matrix is at a steady state condition, and that anything in excess of what's already in the matrix, makes it to the fractures.

DR. VAN LUIK: Then we begin to approach the WEEPS conceptualization, which I addressed this morning, and if we can localize the flow like that, with limited water, it may not be that bad after all.

DR. LANGMUIR: That's the worst case; right?

DR. VAN LUIK: Well, no, that's not--the worst case is something in between the two, of course, but I think the monkey is squarely on the back of the site program to, in their process level model of flow within the mountain, it's not on PA, it's on the site program to make sure that their model reflects observation, and the indications that I have from the site program is that they're very well aware of this, and they will address it, and I trust that they will.

DR. COHON: Thank you, Dr. Van Luik.

We'll continue on project implementation, now with a focus on systems design, engineering design; Paul Harrington.

MR. HARRINGTON: I'm Paul Harrington. Rick Craun talked earlier today about the new approach to the engineering activities, and a lot of the interfaces that engineering has developed with the other parts of the organization. What I want to talk to here are how engineering is going to take that and turn the inputs that we get into constructible, licensable design products, and how we'll feed that out to other organizations.

We're shifting to a production mode. Again, Rick alluded to that earlier. To do that, we need to really define what our products are; cost, scope, and schedule.

When we started the planning exercise, the first thing we looked at was what were the specific activities that engineering was going to have to perform over the next number of years to get to a construction application, so we had to come up with a method of identifying those products, and then establishing relative priorities to them, establishing our interactions with the other organizations, what data fits there are, when we need to develop activities or products to support the other organizations.

We need to develop a design basis for these products. Dan Royer's talk discussed the baseline control activities. This is another new term, for those that are keeping track of new DOE terms. I don't think we've brought this one up to you before. The design basis is the sum of the databases that Dan and others have talked about earlier. It's also all of the drawings, it's the sum of the drawings, the specs, the analyses that we're producing, and we'll discuss the binning process and schedules.

We want to be able to design a product once through. There were some concerns during Rick's question and answer period about what that meant. We have to be able to get the needs from other organizations into us to support our design, to hope to go once through. There are a number of to-be-verified and to-be-determined activities that are out there.

To try and identify those, engineering has gone through and developed a data needs document, and I sat through a number of the interactions between engineering and other organizations during development of the schedule.

Engineering took a lot of credit for what had been identified in their document in terms of reviewing what the other organizations were going to be providing to make sure that there were matches. What did we need? Was that coming from someone? If it wasn't, did we get it onto their schedule? Did we get it into their work scopes? So, that was to ensure that engineering got what we needed, and there were similar processes going on to make sure that what we were going to develop were the right things for our clients.

In that initial look at what engineering products were going to be developed, we did some scoping analyses. We looked at the size of the repository, the types of facilities that were going to be in there, the types of systems that were going to be in there, and came up with some scoping estimates of how many drawings we would expect to find. A lot of the models for this came out of the nuclear powerplant industry.

We chose some numbers for analyses, for specs, procurement specs, construction specs, thermal analyses, and, based on that, we came up with a scoping estimate, certainly subject to change as we go further through the design process, of around 14,000 drawings, 1100 specs, 2900 analyses.

To try and identify, especially in the few years that we have before going in for a viability assessment, and then license application, which of those have to be done first, we came up with a concept of binning, and, as Rick described earlier, the Bin 3 are the riskier items, things that don't have regulatory precedent, but are safety related, or, in our world, Q. Bin 2 were the things that were Q, have had some nuclear interaction, but there was precedence in the industry, and Bin 1s were the, essentially, balance of plan.

So, in addition to that, as we're doing the binning, we have to accommodate the other organization need dates, and we may find that, for example, Wendy Dixon's NEPA process needs some design inputs for her to be able to do her alternatives analysis. Some of that may not bin out to a Bin 3, because there would be precedent, or it would be non-nuclear, but we may need it earlier in the process. So, in our prioritization, we need to roll in the feeds to other organizations.

The Level 3s, at the time we wrote this, it was nearing completion. We did get the first cut from the contractor last week. I've included that in the back of the handouts there. That is certainly work in progress. There are some logic ties that we think we need to scrub, because as you go through there, you'll see activity durations that don't fall in our Level 2 guidance. We need to understand why that is. Does that affect the Level 2 guidance? Do we need to change some of the logic? How are we going to pull that together? So, that Level 3 detail is really supported by the Level 4.

The M&O is currently working through the Level 4, but even Level 4 is not a low enough level for us to come up with our ultimate product, which will be a drawing schedule. We want to be able to say that we'll have emergency power system drawings for the maintenance facility delivered on this date, and it won't be all of the drawings. The electrical one lines that describe how the system operates, that describe its fault, mitigation features, those sorts of things that the NRC is going to need to have to be able to make a determination, we need to get out early.

The actual cable routing, trace supports, that sort of stuff, that can come substantially later, so all of that is what we are ultimately shooting for. It's work in progress.

The design basis. Dan talked about the configuration control system, the configuration change boards. The design basis will be all of the products that we develop that describe the systems. There are requirements documents in there that we have, formal requirements documents. There's a requirements identification baseline, the RIB, control design assumptions. There are several others that he had on his slides.

In addition to that, all of the drawings and specs and analyses that we create are the basis for the facility, so part of that is in Level 2 baseline. That's controlled by the DOE. Part of that, right now, is in Level 3 baseline.

One of the management activities that we're working with the M&O is to describe what truly needs to be controlled by a change board, and what sorts of things should we have field change control authority on, without going to a formal change board.

The model for that latter is in the powerplant industry. There are some things that are controlled on a change board. Those typically are cost, scope, and schedule, the P&Is will be in there, the one lines will be in there, the things that describe how the system is established, how it functions. Those things are controlled there.

The implementation drawings, typically, are not. The detail of how you go out and build it typically isn't, so that's something that we're working through. As Rick said earlier, we are complying with the Part 50 design control process.

Systems is nearing completion of a review that they've been doing on the numbering systems, and trying to look at how can we make this whole activity more efficient. The numbering system that we have is long. There are a lot of numbers associated with that, so we're trying to look at a lot of different things we can do to streamline the original generation of products, to minimize errors. If you have welding inspectors trying to repeat a 20-digit number with no errors, you're going to run into problems.

This is a little elaboration on what Rick had earlier. This is at license application, what do we expect to have. The Bin 3 items, those that either have or affect radiological safety, typically, with no precedent, or that are affecting waste containment and isolation, we will have most all of the products developed. These design guides will be out.

Now, we use the term "conceptual" here to try and be separate from physical. This is not to be confused with the conceptual design document that we just produced. These are drawings or specs or plans that describe how the system works, but you cannot build it from those.

These are the drawings, calcs that actually get the product built. For the Bin 3, at license application, we will have most of that done. We've got 90 per cent on this slide. As Rick was discussing earlier, these numbers are subject to a lot of different things. We are going to the NRC in our next ESF technical exchange, scheduled for June, and presenting this whole concept.

The idea of binning is of interest, probably, to them, but, more importantly, in that discussion we need to be addressing what's in and what's out. How much, in their mind, are we going to have to have? We believe we can make a very defensible case for what we propose to have. We're looking for some acknowledgment from them.

Bin 2, we need the concepts down. We won't have design guides. I'm not off doing the design activities yet. Incidentally, on design guides, the commodity was more-- that's to indicate structural steel, piping. It's the bulk repetitive, cable-pulling type activities. The systems are to describe doing the design of a given mechanical, electronic, electrical system.

Bin 2, it does affect radiological safety, but there's precedent, so we don't have as much, and Bin 1, balance of plant-type things. We have to have enough to be able to understand that the system will work. We have to support at VA, again at LA, a cost estimate, so we have to have enough done to be able to say, "Here's what it is. It's going to work, and here's how much it's going to cost."

This is in the back of your handout. What this is is a scrub by a system, structure and component to a certain level, and this is also preliminary--this was done in about two weeks--to go through all of the SSCs that are shown on these, oh, dozen pages or so that you have there, and try and bin them. This is a first cut.

This is for us to use in our planning purposes as to what do we think the big ticket items are? What do we need to get on right now? How does this affect our '96 activities? What are the things that we think have precedence and can slide out? Eventually, we will have dates in here to say that this set of activities for this SSC will be delivered on X date, use that as our delivery product schedule.

I put this in there as an example of the Level 3 schedule that we got back from the M&O. The WP0035, the first line is the Level 2 guidance from the DOE to the M&O. The M&O has then broken that out into additional detail to try and describe what it is they have to do to accomplish this.

One of the actions that we're doing with this now is looking at the durations of these. We have more data as to what goes into the individual activities than is shown by a solid bar that's the same length as our guidance to them, so we're working that with them to get that data into these Level 3 and 4 schedules.

Definition of work scope. As we go through the binning process, the further breakout of the SSCs, the identification of the specific products that we're delivering, and create the schedule, we need to work the schedule. This is a very aggressive, overall schedule. We won't make it unless we're able to hold schedule focus.

We need to also make sure that we communicate with the NRC, with others, with yourselves, what it is we're planning on providing at license application. If we come up with the wrong product, we'll have some difficulty.

With that, questions?

DR. COHON: Thank you very much.

Questions?

DR. CANTLON: Cantlon; Board.

The repository really is a prototype system, and you're, in a sense, in the position of having essentially an iterative designing process, that you need one level of information for your viability assessment, and, later on, for construction licensing, but by the time you are ready, assuming the site is suitable, by the time you're ready to seek to emplace waste, you're going to have a lot more information, and what's your view of the broad categories of design change that are conceivable in that transition from viability, to construction license, to emplacement. What are the categories that are likely to be emergent?

MR. HARRINGTON: What we're focusing on right now are waste package designs and subsurface repository designs. We need to establish the repository block. You've heard some discussion as to which way we can go with that. Potentially, we can get away from the lower block.

We expect, at VA, to have fairly definitive designs for those areas. We are doing some repository surface work, basically, enough to support a TSLCC. As far as categories of changes, I think it's an evolution. As we're going to focus on the things that we need first, like the ones I just mentioned, work that design. As we work through, get additional PA data, get additional science data, we will go back and reassess the TBVs, the to-be-verified, the to-be-determineds, make sure that that doesn't change, and, if it does, okay, we have to roll in that change.

Seismic is probably an example. Right now, we're using some seismic models that are being reevaluated next year. We have looked at what we expect to have in terms of changes to that. The expectation is that those values, some of them may change on the order of 10 or 15 per cent.

We looked at how much of the load, if currently seismic, and I understand, at least for underground, that's on the order of 10 per cent, so if I'm saying 15 per cent change and the 10 per cent load, we're having to make sure that we account for that early on. It's not a big deal, as long as our design, oh, the allowances to tolerances are accommodating that, I will expect no change, but we'll have to validate that that doesn't.

DR. CANTLON: Two kinds of drivers, it would seem to me would be important in this emergent design challenge that you face, one would be that the uncertainty of containment, particularly, or total performance of the repository, the uncertainty is relatively high early on, and you're going to address a diminishing level of uncertainty as we gather better information.

This would seem to suggest that greater reliance early on on a far more robust engineered barrier system might be the way you'd start in the early stages, and then on a basis of cost considerations and time, to essentially diminish that down.

MR. HARRINGTON: That is under a lot of discussion now. That's one of the key issues associated with the WIS, just how much performance do we allocate to the waste package, and the potential effects on cost associated with that. Do we make it more robust? Do we put in thicker walls for longer corrosion protection, and what cost does that come at? That's a very active discussion right now.

DR. CANTLON: A similar kind of thing in the design, you now have TBM experience with the 25-footer, but you're surely not going to use that monster for drift emplacement.

MR. HARRINGTON: No. In fact, we're looking at putting that on the market.

DR. CANTLON: The sooner, the better. No offers here, right, but it would seem to me that some early experience in that rock with a smaller machine would argue that, again, we might take a lesson from the Swedes and opt for a small portion of emplacement so that you could work on the technology and efficiency of repository construction, get a better grip on the whole thermal property, with real fuel in place.

Since you're going to have a storage facility at hand now, which wasn't really contemplated early on, are you thinking about a fundamental shift in the way you go at the design challenge?

MR. HARRINGTON: In terms of smaller machines, it's our expectation to use smaller machines for the repository. The planning that we have addresses potential for an east/west drift. We would use a smaller one for that, also, just to learn what we can from that. We don't need as large a machine for that sort of activity.

DR. CANTLON: Lake, do you want to take a crack at the latter part of the question, the smaller model to get some real data?

MR. BARRETT: Well, you bring up a huge policy issue of basically emplacing radioactive waste in sort of a test and evaluation facility. I believe there's about 20 pages of the 82 statute address exactly that, and the limitations about it that you basically--the safeguards that were discussed in there is not to jump the gun and emplace it before society is really ready to say that is a repository.

It's a big medicine issue that we really have not dug into that big of a change or anything. We believe it's, right now, within the existing statutory framework to focus on, you know, the viability of the site and what would it cost and those kinds of things that Paul has talked about.

You made a remark about storage, you know, and we look at it as a very different issue. Storage is an engineered thing, preferably on the surface, and it is not one of these hybrid, underground storage ala disposal. We stay far away from that type of thing, because we don't believe that is appropriate policy at this time.

DR. CANTLON: Yeah. That wasn't what I was referring to. I was talking about a surface storage which gives you a chance to get the pressure from the utilities off of you so that you can continue on making the best repository that you can make, and, again, I wasn't arguing that you put down an experimental thing, where you're not reasonably certain about the suitability of the site.

You're not going to do any of this until you're reasonably certain about the suitability of the site, but why proceed to do the whole ball game before you've learned how to optimize the way it should be done and could be done? You see, that's, I think, the question that runs through my mind.

MR. BARRETT: Our primary focus right now is the feasibility of doing it both technically, socially, and economically. Optimization, in my book, is sort of a secondary issue that really will change the cost. Almost all of these things, emplacement is engineering-type of things for production, are cost items.

DR. CANTLON: But it may change the safety, too. It may change the safety dramatically in terms of emplacement.

There are a lot of things that could be improved if you view this as a prototype system, that you approach in a prototype way.

MR. BARRETT: It's expensive, and, my personal opinion, I want to reflect upon this change, not just react negatively to it when it was brought up, because there's a lot of interesting concepts, but it almost sounds like optimization at a later stage relative to where we are at this time, but it's clearly something I think we'd like to reflect on a little bit later.

DR. COHON: Carl Di Bella has a question.

DR. DI BELLA: Carl Di Bella; staff.

I'd like to follow up on something that Rick Craun mentioned in the early part of his talk, and that was that he was going to be phasing in the board of consultants into the engineering process.

I'd like to know a little bit more about when that might happen, and, also, I believe that that board of consultants consists largely of people with underground construction expertise, and don't necessarily have the expertise in waste package design, or even in setting requirements, and, besides that, they're very busy people.

How might the board be augmented in that case, or would there be?

MR. HARRINGTON: As Rick has worked that, I'll let him take that one.

MR. CRAUN: Rick Craun; DOE.

I see several different roles for the board of consultants, and it's maybe not just one board. You're assuming that there's just one topical area, and that may be repository design.

The people that we've got on the current ESF board, I think, really can help us address some of the underground drift stability issues. You're right. Lemley has a tremendous amount of construction background. So does Bartholomew, and so does Hoyer. Those people have a lot of expertise that they can bring.

I think, as you look at the waste package, and look at the corrosion rates on the corrosion allowance material, a different group, maybe, of people would be more productive in that area, so, in my mind, the model that's in my mind is the model of expert, not opinions, but obtaining expertise in those areas where there's a degree of vulnerability.

The reason I was focusing and mentioned this morning is that that board would be good for the repository design, I think they could really help me a lot, or help us a lot in drift stability, ground control, and emplacement drift stability.

The same sort of discussion is taking place--I didn't mention that this morning, but the same sort of discussion is taking place as to what sort of expertise might we want to bring on board to confirm the galvanic protection issues, the corrosion with humidity, so those same sort of discussions are taking place across the board in the engineering area. That's not an isolated area, although it would just be those three people, because, in my mind, you'll need a broader range of expertise than what you'll find in just three people. So, the concept would be across the board.

DR. DI BELLA: Is this something that's still in the idea stage, or it's definitely going to be implemented, and the question is, how?

MR. CRAUN: Well, the repository board--excuse me--the current ESF board, their latest draft report concludes that, from their standpoint, that the ESF activities are pretty much done, so they're proposing that the board basically be complete.

We have scheduled a visit for June 24th, 25th, and 26th of this year for that group to reassemble, and we're trying to recharter under a repository format, so this has gone a little bit beyond the thinking stage into the implementation stage. We've got contracts going. We've got activities scheduled, so, yeah, we're going forward with this.

Did I answer your question? Good.

DR. COHON: Other questions for Mr. Harrington?

(No audible response.)

DR. COHON: Thank you very much.

We turn back now to Dr. Dyer to wrap us up.

DR. DYER: We've spent the last couple of hours discussing some of the details of what we've called project implementation process, or integration, or evolution. What I wanted to do was go back and hit a couple of things. I'm going to steal a couple of diagrams out of some of the talks that we gave, and just kind of reinforce some of the main themes that we have behind what you would call the project implementation process.

The first point I'd make is that the planning effort is essential to our project. The surrogate for it here is a schedule, but the dialogue that goes on during the planning process, the clarification of expectations between the providers and customers of information, making sure that we can get what we need on a reasonable period of time, and that everybody knows what their job is on the project is absolutely critical.

Another thing I would point out is that, well, let me use the same one. The project evolves. We've been through three major planning efforts since I've been with the project; the SCP, the Program Plan of '94, and our current program planning effort.

In each of these different generations of the project, there's been some things that carry forward, and some things that evolve. Every year, we go back and look at the basis, our basic assumptions and constraints, and essentially validate those as part of the planning process.

If I go to this schematic model of the project, there's a couple of points to take out of this, also. One is that no matter how good you are in each of the focus areas, in order for this project to succeed, we have to have integration through communications and dialogue between the individual elements.

And, finally, that the interface must have some structure to it. You need to have some kind of a--it can't just be totally informal interactions back and forth across these--between these different program elements, but there must be a structure to it. That's a lesson that Abe brought forward.

If we go back and look at what our speakers said, these are some of the things that they brought forward; the system studies using the integrated product teams, using people from all of the different involved focus areas as part of the team to actually solve the problem. You don't charter a team to go off and solve the problem for you. Rather, you nominate one of your people to go be on this team, and you solve it as a joint team effort, and providing the integrated technical basis, using a single integrated technical basis that everybody uses throughout the program, so that design and performance assessment are essentially working from the same database.

Performance assessment, we maintain that it's the primary tool for technical integration on the Yucca Mountain Project. We have maintained that for some time, but it has become more and more the truth, and we see that through the planning process. The recommendation, as Abe went over in his list of findings, what came out of the '93, '95 TSPA. We see that those recommendations are being implemented by various parts of the program.

And, finally, out of design, we've had a real change in design, actually ramping up from something that was almost nonexistent five years ago, to something now where we're looking at really putting together, moving into a production era on design, and, again, some of the things that Paul highlighted, and Rick, before him, was the need for a common technical basis so that the performance assessments, the site information, the regulatory information and design is all speaking from a common basis. And, finally, also, the need for disciplined change throughout the design process.

That's pretty much a very brief summary, and what I'd like to do now, with Dr. Cohon's permission, I'm available for questions. I'm not sure if we want to open it up for all of the previous speakers, also.

DR. COHON: Sure.

Questions for any of our speakers today?

Don Langmuir.

DR. LANGMUIR: I get the sense--Langmuir; Board--that what we're doing is looking backwards, and making it look as if we actually thought this all out ahead of time, which I know we didn't, but I appreciate what you're doing and I can understand where we've gotten, and it's a good place to be, I think, overall.

I worry, though, about--I'm thinking back at the individual PIs who've contributed to this over the years, and the surprises we keep getting about who we need to have next look at something or other that has just become important to us, whether they're still there, whether the expertise persists in the system long enough to resolve surprises as they appear.

It's more of a philosophy query about how you can deal with this sort of an issue. You've got people. They have the expertise. They carry it through the program, of they're gone, and you turn them off from year to year, and sometimes you get surprised by what you need them for again, and they're not there.

Maybe it's not a question so much as how you feel about this sort of a problem, because it's come up, and keeps coming up as we cut back our funding and no longer have the expertise in different parts of the program.

DR. DYER: It's a very real problem, and it hits us in several ways. You're absolutely right. You have to prioritize the program. The resources are not adequate to have everything going.

We've made a concerted effort to be able to, whenever it looked like the program was going through essentially termination in the '99 time frame, how do you keep on board the problem that we address then and we still have now? How do you keep on board the talent that stands behind, that provides the basis for your undertaking whenever the exciting work is drying up.

Most good people have other things to do. They don't want to just sit around waiting for a telephone call, and it doesn't look like we can afford, or really, in some cases, whether we really need to keep all of a research program going in a certain area, yet you've got to keep an adequate, knowledgeable, technical staff on board that can help you address issues as they come up, and help you summarize clearly, evaluate the existing information and translate it into your final documents, your licensing documents.

It's a very large issue that we face now, we will face probably for the next decade.

DR. LANGMUIR: And when it comes time to defend your arguments in a permit licensing request, you'll need that expertise at that time to defend what you've done with the fundamental scientific knowledge that was the basis maybe years back of a decision you've made.

DR. DYER: That's right. And whether we will be able to keep, say, a full technical staff on board for some specific area, I'm not sure we'll be able to do that. We need to be able to have access to people, though.

Let me give you an instance. We've already talked to the USGS about maybe taking some of the PIs who are currently in the program, letting them go back into the GS, back, maybe, even into the geological division, do work, but essentially, we have recall rights on those people. They are still available to help us. They still have part-time responsibilities in this program, yet we don't need them to serve as the full-time PI running, you know, a series of sub-investigators running a particular program.

In some cases, these programs have gone to completion, or almost to completion, such as the tectonics program.

DR. COHON: Other questions? Leon Reiter.

DR. REITER: Russ, I have a question that, I guess, Dennis Royer brought up when he gave some examples of significant system studies, and going back to a FY 95 Calico

Hills study, and, if I remember correctly--and I think it's right, but I can stand corrected--it was concluded that, you know, it really is not worthwhile going to the Calico Hills if we're looking at short-term release or long-term dose. However, if you were looking at 10,000 years, this relatively short-term dose, then it could make a difference, and it would be worthwhile doing it.

Since the DOE is recommending that criteria, and since Congress is certainly considering it, is that something that you will pursue if you, indeed, they decide upon a 10,000 year dose?

DR. DYER: Well, I think Rick alluded to this a little bit in his talk whenever he was talking about the last thermal goal on the list might be of use for short-time isolation.

DR. REITER: I'm talking about 10,000 year dose.

DR. DYER: Right. Steve's going to answer it.

MR. BROCOUM: The one case is for if you had high flux rates for 10,000 years; in other words, and so if the percolation flux is high, you may need to look at the Calico Hills. That's the one case, as I recall, from that study. I'm looking at Rick here to say yes, I hope. Yeah. If you have low flux rates, it doesn't buy you much.

DR. REITER: Steve, by high flux, do you mean like we told TSPA-95, like one millimeter or above?

MR. BROCOUM: Do you remember how it was defined in that study?

MR. MEMORY: Rick Memory, M&O.

No, I don't remember the precise number. There were a number of what we called in the study, a number of very conservative assumptions, and flux was one of them that said, yeah, that is the one standard that might cause us to want to understand Calico Hills better.

DR. COHON: Seeing no other questions, I'll just say thank you very much, Dr. Dyer, and to all of your colleagues for the good presentations. I'm going to come up there to close this session.

(Pause.)

DR. COHON: Are there any members of the public who would like to ask a question or make a comment?

(No audible response.)

DR. COHON: I'd like to close this session by observing that this is my third meeting of this Board, I think, if I can remember, and for myself and other members of the Board, our contact with the program comes at that point in time, every three months, so we get this, I think, a very useful perspective on how the program is faring.

From my perspective, based on what we heard today, I think what the program has achieved since January--I guess we could say since October--is quite remarkable. The amount of connectivity here between the pieces is very impressive. You truly were reading from the same page, and I think that's a great step forward.

We will never know whether having our budget cut in half, and being threatened on a daily basis by Congress serves to focus your mind enough to really integrate things, but, perhaps there is a certain causality there. In any event, from where I stand, congratulations. I think the systems part of this is--systems in a broad sense, not the way you use the word--is very impressive, indeed.

We stand adjourned until eight-thirty tomorrow morning.

Thank you.

(Whereupon, at 4:45 p.m., the meeting was adjourned, to reconvene at 8:30 a.m. on May 1, 1996.)