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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE

147TH MEETING

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WEDNESDAY

NOVEMBER 19, 2003

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LAS VEGAS, NEVADA

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The meeting was called to order in Dallas Ballroom D, Texas Station Hotel, 2101 Texas Star Lane, Las Vegas, Nevada, at 10:30 a.m., by Dr. B. John Garrick, Chairman, presiding.

MEMBERS PRESENT:

B. JOHN GARRICK, Chairman, ACNW/NRC

MICHAEL T. RYAN, Vice Chairman, ACNW/NRC

RUTH F. WEINER, Member

STAFF PRESENT:

SHER BAHADUR, ACNW/NRC, Designated Federal Official

JAMES H. CLARKE, ACNW/NRC

NEIL M. COLEMAN, ACNW/NRC

HOWARD J. LARSON, ACNW/NRC

MICHAEL LEE, ACNW/NRC

I-N-D-E-X

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

(10:30 a.m.)

CHAIRMAN GARRICK: The meeting will come to order. This is the first day of the 147th Meeting of the Advisory Committee on Nuclear Waste. My name is John Garrick, Chairman of the ACNW.

Other members of the committee present are Michael Ryan, Vice Chairman, and Ruth Weiner. Also present is the consultant, Jim Clarke, and George Hornberger is absent.

In today's meeting the committee will hear an introductory briefing on the status of the Yucca Mountain, receive an information briefing on the status of the Yucca Mountain repository design, and receive a status briefing on the DOE approach to drift degradation analysis at Yucca Mountain; and we will reserve some time for interactions with stakeholders and meeting participants.

Sher Bahadur is the Designated Federal Official for today's initial session, and this meeting is being conducted in accordance with the provisions of the Federal advisory Committee Act.

We have received one request for time to make oral statements. We will honor that in the afternoon session dedicated to that activity. Should anyone else wish to address the committee, please make your wishes known to one of the committee staff.

It is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

And there is a couple of items of interest that I want to note. On January 2nd of this year, or on January 2nd of 2004, I'm sorry, after 40 plus years service with the Nuclear Regulatory History, Carol Anne Rowe, administrative secretary of the Executive Director, ACRS/ACNW, will retire.

Her 32 plus years of experience with this office will be sorely missed. It won't be quite the same.

Dr. Hossein Nourbaksh has been selected as an ACRS Senior Staff Engineer. He has been serving both committees as a Senior Fellow, concentrating in the risk assessment area.

As you can see from our program our first topic will be the Yucca Mountain Program Status, and as I understand it, John Arthur is caught in an airplane, but is expected to get here probably before our meeting ends today, and will drop by I am told.

But in the meantime, an able replacement will be Russ Dyer to kick off the first presentation, and he will be followed as I understand it by Joe Ziegler. So, Russ.

MR. DYER: Thank you, Mr. Chairman. Yes, unfortunately, John Arthur sends his sincere regrets to the committee and to the members of the audience. He got trapped in Washington last night, and was on an early flight this morning, and we do expect him to drop by sometime today.

But he pressed into my -- I happened to be in Washington with him last night, and when we found out that he was going to be detained, he gave me his talking points, and asked me to give this presentation today.

I am going to skip over some of the initial points that he was making because they are quite personal, and I think he wants to bring those personal views to you whenever he does get a chance to stop by.

But his objective and mine was in part today to provide you with a high level summary of the Yucca Mountain project, and where we are and what we are doing the way that things stand.

And that is what I intend to do here in the beginning. There is going to be quite a few presentations over the course of the meeting that will add much more detail to my brief high level summary.

But our highest priority for John and the project remains the submittal of a complete, high quality license application in December of 2004, including the completion of the necessary design work, and demonstration of an operating environment appropriate for a licensee.

At the same time, we remain clearly focused on what it takes to open a repository in 2010. Now, we are going to talk about several things in here, and the first thing that I would like to address is what is the status of the license application.

And this is one of the management tools that we use, this chart that is upon the viewgraph right now, and there are five major components that constitute what needs to go into the license application.

KTI agreements, of course, and the LA, the license application document itself, and the Preclosure Safety Assessment, the Postclosure Safety Assessment, or the TSPA, and the design components.

And what you see on the left-hand side is kind of a weighting that we provided each of these areas. This is somewhat judgmental, but it is based primarily on our feeling of how much effort each of these constituents of the overall licensing effort.

And then there is a couple of columns that have the percent complete, and we have given a comparison here between where we were in June of '03, and where we stand at the end of October of '03, and you can see that we have made progress in all areas.

Overall for the LA itself, we are about 43 percent complete now, some things being further along than others, but we do have confidence that we are going to be able to submit a license application compliant with 10 CFR 63 and the applicable QA requirements. And we have increasing confidence that we are going to meet the schedule of the December '04 submission date. Next slide, please, Carol.

One of the things, of course that lies behind the license application is the pedigree, the quality, of the underlying information, the data codes and models. This is a snapshot in time of where we stand in the qualification and verification of data codes and models, and data being on the upper left, and codes being in the upper right, and model reports, the AMRs analysis, and modeling reports, being at the bottom.

And this is another area where we have

been making steady progress. Again, the commitment is to have all of the necessary codes and models verified for BLA. The next slide, please.

KTIs, the key technical issues of the progress on those agreements, I know that the committee received a pretty substantial briefing a month or two ago about a new approach that we have for organizing the KTI agreements.

And from the schedule that we are currently on, you can see some real high blips on there. We had very aggressive targets in the September/October time frame, and we are actually a little ahead of our schedule right now. Our intent is to have over 200 of the KTI agreements submitted by the end of this calendar year.

And of course we will have addressed all KTI agreements at the time of the license application. Next slide, please. We have a new organizing principle for the KTI agreements, and these are the technical basis documents.

I know that you received a substantial briefing on these 14 buckets or areas if you will, where we have taken essentially the TSPA story for the nominal and disruptive cases, and broken those down into sections if you will that integrate and provide a context and framework for the KTI agreements, and then fold up to tell a coherent story of the total system performance assessment. Next slide, please.

Now, as you are well aware, it is just not our goal to have a good quality assurance program, but also to operate in an environment that is conducive of being a credible and deserving NRC licensee. In this context, there are a couple of topics that I want to talk about.

The Corrective Action Management System, and the Corrective Action Program, and Safety Conscious Work Environment, and Accountability, and Procedural Compliance.

First, let's talk about quality assurance and management processes. We developed on September 29th of 2003 of this year, we implemented a single, improved corrective action program that actually subsumed and swept up about 4 or 5 different systems that were in use for addressing corrective actions of various kinds.

This single system will increase our confidence that all issues will be treated appropriately, and they will be properly prioritized, addressed, and tracked to closure.

The key to this approach is this single

entry system that is on the slide here, where anybody can generate what is called a condition report, and it can be generated by an individual, and it can be the outcome of an audit or surveillance.

It can be the result of an evaluation of a trend analysis, and it will all go into the system and be evaluated for its importance and urgency, and drive, or ensure that proper management attention is provided to each issue so that management resources are identified to deal with issues as they arise.

The corrective action program will be used by management at all levels as a tool to drive continuous improvement of products and processes, and to track, prioritize, and status issues for management use. Next slide, please, Carol.

A safety conscious work environment has been a very high visibility element throughout the nuclear industry over the last, oh, 5 to 10 years or so, and one of the challenges that we have as we move from a research and development culture into a licensee's culture is making sure that we are making adequate and appropriate progress to being up to industry and NRC expectations.

We are continuing implementation and assessment of the a safety conscious working environment committee to providing a work environment where employees feel free to raise concerns without fear of reprisal.

We engaged external experts from International Survey Research, who conducted a program-wide safety conscious work environment survey beginning in July, and those results just came out recently.

The results were distributed throughout the Office of Civilian and Radioactive Waste Management during the week of October 6th, and they are being presented by -- they were presented by ISR, International Survey Research, to the NRC staff at the last management meeting last week.

And they have been discussed with managers, and we have distributed them to all of the staff throughout the project, and there are some follow-up meetings actually going on this week.

This is just an overall high level view of percent favorable response in a number of categories. At the top of the list, 82 percent of the employees on the project felt positive about the level of engagement that they had in the project.

Some of the other ones that were I think pretty powerful is empowerment. Approximately 77 percent of the employees felt that there was appropriate empowerment throughout the program. Similarly, goals and objectives, a strong majority of the employees on the project felt that there were clear goals and objectives laid out and understood throughout the project.

Down near the bottom, safety conscious work environment training and programs, and that is at about 70 percent, and that is a place where we have some opportunity for improvement.

Down at the very bottom, you see reports and recognition, and obviously these are areas where we need to look at opportunities to improve those particular areas.

CHAIRMAN GARRICK: Russ, is there any other national programs that you are able to benchmark this performance against?

MR. DYER: ISR was able to benchmark us against two different populations. One is their overall general industry population, which include a number of Fortune 500 companies, and then there is a another population that we were benchmarked against, which is government R&D organizations.

So the national labs, NASA, Naval Research Labs, organizations of that type, and the report laid out how we stood against those norms. A question that we have is actually how we stand up against the nuclear industry also.

And ISR did not have the database to allow that kind of comparison. We have asked for help from IMPO to seek if they can provide us with some comparison of how these results would compare against the utility industry. Next slide, please.

This survey went out to about 2,300 people throughout the project, and that includes the Feds, the contractors, national labs, the U.S. Geological Survey.

We had a return rate of about 65 percent margin of error, about 1.5 percent, and so we had a large enough population to do some meaningful statistics on quite a bit of this.

This is a good report that we are going to be able to use to really determine where we need to put some of our emphasis over the next year or so. Next slide, please.

Rather than going through each of the individual results, and there were quite a few areas that were delineated for us. The report essentially gave us an area where there was a recognized strength, and where we need to maintain that strength in areas where we have challenges to improve some of these areas.

So on the strength side, there is a clear recognition of an emphasis of quality and a commitment to quality. I won't read the list. You can read down the list. Keeping a safety conscious work environment is a priority.

There is a clear recognition that a safety conscious work environment is a priority, and maintaining that environment is going to be important and critical for us.

In the areas for improvement, of course we are going through an enormous amount of change within the project, and changes are a time of turmoil for all, and one of the keys to successfully navigating through change is very frequent and communications at all levels.

And keeping all involved in the form of where we are and where we are headed, and that is a challenge for us as it is I think it is for any organization going through change.

Looking at organizational performance, I will talk a little bit later about some of the issues that we already had in place to look at and communicate organization performance, and ensuring sufficient authority at appropriate levels, and so aligning rolls and responsibilities, and accountability of authority appropriately and at appropriate levels is an area for improvement.

And one of the areas that came out reasonably negatively in the survey was the effectiveness of the corrective action program, and the existing corrective action program, where he talked about the new program that was put in place.

That program was put in place after this survey was accomplished, but one of the things that we have got to look for is to make sure that just putting a new system in place and of itself doesn't solve the problems.

It is going to take continued management attention and looking at increasing the effectiveness of the corrective action program. That is going to be a large challenge for management here over the next several years. Next slide, please, Carol.

In the realm of accountability, we are continuing our work to ensure that all employees understand the expectation on compliance with procedures and quality in other key areas. Our performance matrix --

CHAIRMAN GARRICK: I hope you can

summarize that. This one has gone beyond my age.

MR. DYER: Oh, yes. I am going to talk about this a little bit here, and there will not be a test at the end of this. Getting a set of meaningful performance matrixes at the appropriate level for management to essentially see the top level, and rolling up appropriate indicators of performance to something that management can look at has been a challenge that we have had for quite a while.

And about 6 months ago, we started using what we would call an enunciator panel approach, where we have got a number of areas laid out, and the way that this is laid out here, the left-hand column is the top tier of important things if you will.

So the license application, the work execution is the box on the left, and it is not the top line, which is white. But it is the next line, or series of lines below, about 5 or 6 lines there, and those are the things associated with the license application or the safe operation of the site itself.

And in each area, going from right to left, each of the areas such as license application, there will be a number of sub-tier metrics that roll up to an overall metric.

So in the license application itself, some of the feeders to it would be the things that we talked about earlier; the total system performance assessment, the design, the preclosure safety analysis, the license application document itself.

Each of those we evaluate on a monthly basis on how we are doing in that area, and actually this overall enunciator panel has hundreds of subtier metrics that we collect, evaluate, and roll up into this overall look at the -- if you will, you can use this as a visual to focus on the areas of the project where there are issues and that we need management attention.

We used a color coding on here, where green is something that is running pretty much on schedule. Yellow is something where you have issues that are deserving of management attention.

Red are areas where management attention is urgently needed, and you will see that there are four areas on here, and actually one at the top level shows a red indicator, and that is the quality assurance arena.

And although there may be -- and if this happens to be in the licensing area, there is a red up towards the top. In the other areas, and that is an area that needs management attention, but overall in that area the overall summary if you will is that that is a yellow.

Yes, there are issues, but you don't need literally day to day top management attention on those areas. You will see that there is a lot of light on this graphic, because this has been an evolutionary process finding out which metrics really makes sense, and what gives you useful information.

And we have gone through some metrics that are there because the data was there, but we find that the data is not really very conducive to finding out how effective your program is, and that is one thing that we are looking for here, is not level of activity, but level of effectiveness.

So some of the areas that show white are areas where John Arthur has said yes. That is an area that we need to track that I am not happy with the metrics that you have established in that area yet.

So this is still a work in progress, but we hope to populate these other -- the white areas -- soon with meaningful metrics, but it will change with time as we learn more and find better ways to do things.

And we hopefully will be improving this continually because this is going to be one of the major tools that we use to focus management attention on the program itself. Next slide, please.

And this is kind of a wrap-up slide. Fiscal Year 2004 will be a very, very busy year for us, with an approved budget sufficient to meet our schedule, and a good management team to ensure progress to achieving our goal.

We will continue to focus or will continue our focus and vision on submitting a quality license and a national -- let me start over again here. We will continue our focus and vision on submitting a quality license application and on meeting the national need of operating or opening and operating a repository in 2010, and what I show here is the as is if you will.

If you have been out to the site recently, this is the current status of the site, which of course was all put together to support the site characterization effort.

There are many things that need to be changed, constructed, and brought into operational status before this station has an operating repository. Next slide, please.

And this is a concept at this time, but at the time that we have an operational repository, we expect that Yucca Mountain would look something like this, with transportation coming in, with a new set of operational buildings capable of receiving, and handling, and disposing of waste here at the surface, and of course with the attendant subsurface facilities in place.

And with that, Mr. Chairman, if the Commission has any questions of me.

CHAIRMAN GARRICK: Thank you. Any questions from the Committee? Ruth.

DR. WEINER: I have -- I wrote down a number of questions, but I expect the answers to them are pretty quick. How do you determine percent complete? What is the benchmark that you use?

CHAIRMAN GARRICK: Joe Ziegler is going to get into that quite a bit more, but in general we have laid out a plan with a number of deliverables in it. You can look at the number of deliverables that come in and how many have been accepted.

We also use an earned value system so you can get an estimate of how you are doing for things in preparation.

DR. WEINER: Okay. I will wait until Joe makes his presentation, but that essentially answers it. Your corrective action program, how does this compare with ordinary standard QA CAR programs? How is your program QA? Do you have an external QA? This is my ignorance showing by the way.

MR. DYER: Help me here, Ruth. What is it that you are looking for exactly?

DR. WEINER: Well, on other programs that I have worked on, we had a QA plan and QA project plan, and identified where you submitted a corrective action request, a CAR, and then you did a root cause analysis.

MR. DYER: Right.

DR. WEINER: And I just wondered if your corrective action program followed along those lines.

MR. DYER: It does, but it goes a little bit further, and what we are doing is importing some of the lessons learned, and the knowledge from the nuclear utility industry.

One of the challenges that we have had is that with 4 or 5 different systems in place, whether it be what we used to call the condition information reporting system, the QA system, the NCR system, the various systems that we had, if somebody came across a deficiency, a perceived deficiency, they first had to make a judgment as to what system they would take it into. And then what set of processes would be used.

What industry went to some years ago is to take that monkey off of the individual's back and use a single entry system, where you identify an issue, and you get it into the system, and it becomes the system's responsibility to figure out what the level of severity is, and what the urgency and importance of that particular action is, and to get it before management for action.

And also to do the follow-up to ensure effectiveness of whatever action was taken. So this is something that we have imported from industry.

DR. WEINER: And you have some industry examples --

MR. DYER: Yes.

DR. WEINER: -- that tells you that was a preferable way to go?

MR. DYER: Yes. Yes, we do.

DR. WEINER: On your safety or on your questionnaire that you handed out to employees, was there any significant difference between the responses that you got from the Feds and from contractors, or were they pretty much the same?

MR. DYER: No, there were some significant differences, and we were able to break it down by organizational elements. So, in Feds, there are differences, because we surveyed the entire OCRWM population.

We looked at Feds in the east, and Feds in the West. We looked at -- you can break out each laboratory, for instance, and look at differences in laboratories, and see that some laboratories feel better about rewards and recognition, for instance, than some others do.

So that can identify areas where you can focus some management attention.

DR. WEINER: Do you as overseerer of the entire project, do you get down to the laboratory contractor level and say, look, this is where you need some improvement, or this is okay, or something like that?

MR. DYER: Well, we recently about 2 months ago established a leadership council, one of the things that John Arthur put in place, which involves the leadership from the Feds, contractors, labs, and U.S.G.S. sites.

So there are principals for all of those organizations sitting in that forum, and things like this are discussed in that forum, and we can discuss what works in some places, and what or if somebody else might need some help.

DR. WEINER: On your I-Chart slides, what are the other red areas? You pointed to quality assurance, but there were a couple of other reds.

MR. DYER: Well, quality assurance, and there was one up in -- and Joe is going to have to help me here, but surface design.

MR. ZIEGLER: Yes.

MR. DYER: Yes.

DR. WEINER: And there was one other, I think.

MR. DYER: Well, there were two in the quality assurance area, and there was one in the QA roll up.

DR. WEINER: Okay. And my final question is do you have a metric for how well, or in what detail management knows what the technical staff being managed are really doing, and how familiar they are with the technical work? Is there a metric for that?

I mean, my experience as a managee and as a manager that very frequently the managers, especially the higher up you get in the management level, really becomes removed in some sense from the technical work.

And I just wondered if you have a metric to measure how good that connection is. If you ask a manager of some department, can that person tell you about what his stuff is doing in any detail, and how familiar he is with it, or she?

MR. DYER: Well, that is one of the expectations that we addressed in the roles and responsibilities area. Of course, you don't expect a reasonably high level manager to be able tot ell you all the technical details, but they should have a general idea of what is going on, and know who to go to very quickly to get the details.

DR. WEINER: So you do have some sort of metric that measures that connection?

MR. DYER: We do. It is more in the effectiveness area I think.

DR. WEINER: Okay. Thanks. That's all.

CHAIRMAN GARRICK: Thanks, Ruth. Mike.

VICE CHAIRMAN RYAN: Thank you. Actually, Carol, if I may ask you to put up that chart that show the responses. I had a couple of questions and it might help if I saw that again. Thank you.

MR. DYER: Is this the overall SCWE bar chart?

VICE CHAIRMAN RYAN: The results.

CHAIRMAN GARRICK: The results.

VICE CHAIRMAN RYAN: And while Carol is putting that up, one that caught my eye was the integrity and ethnics one, and it is for 73 percent. And I turn that a different way, and I say that 1 out of 4 people don't think very highly of that category.

So I may be picking on it the wrong way, but what I would like to understand is how do those results bear up against your benchmarking and things like that, because I really don't know what to make of that on its face.

MR. DYER: I think the one that he wants is the bar chart.

VICE CHAIRMAN RYAN: The bar chart, yes, please.

(Brief Pause.)

MR. DYER: The one that has about -- yes, that one. Right. It is hard to take this out of context. Whenever you do the benchmarking against the two populations, it turns out that in every one of these areas that we are at least at or significantly above in a positive sense the norms for both the national population and for the government R&D population.

There are none where we are statistically significantly below the norms.

VICE CHAIRMAN RYAN: And the norm being what, what most industries think, or -- well, for example, the nuclear power example, I wondered how you -- because they have been detailing with a safety conscious work environment.

MR. DYER: Right, and we don't have that comparison yet.

VICE CHAIRMAN RYAN: That would be an interesting one, because it would probably be a little bit closer to home.

MR. DYER: But for these areas, for instance, there is one population that we would compare it against, that would include people like Boeing, and Proctor and Gamble, some of the Fortune 500 companies.

And you could see how -- and certainly this report could be made available to you. We have made it available to the NRC, and the report is much more exhaustive than this.

VICE CHAIRMAN RYAN: Yes, I know, I figured that it was. It just caught my eye, and I am glad to have your additional explanation. Thank you.

MR. DYER: Just a minute. Joe Ziegler would like to add something here.

MR. ZIEGLER: Joe Ziegler, DOE. One thing also is that in all of these areas there is a significant percentage of I have no opinion, and so all of the questions had an option of saying that I have no opinion, or I don't know on each question, and I don't know what the percentage is on that one.

But in almost every one of these, there was a fairly significant percentage that fell into that category. So a lot of people just had no opinion about mentioning that.

VICE CHAIRMAN RYAN: So part of that 25 percent would be they have no answer?

MR. ZIEGLER: No opinion. My recollection is that the greater part of that 25 percent is like that.

MR. DYER: Yes, that is a very good point to make, is that most of the questions had a five point scale, with a three being somewhere in the middle, and with no opinion.

So you go from highly positive, to positive, to neutral, to negative, to highly negative. This is only the positives. It does not count the neutrals or the negatives.

VICE CHAIRMAN RYAN: And that is real important for understanding this graph, and I am glad that you clarified that, Joe, because otherwise you would have to conclude favorable means one-quarter is not, because there is no other choice there.

MR. DYER: Right.

VICE CHAIRMAN RYAN: And I just didn't want to leave that out of the detail.

CHAIRMAN GARRICK: Now, one of the things that I was looking for on this chart were those things having to do with public outreach issues of ethics and integrity.

In the other chart, on the results, you have building trust and openness, and all of these are important factors to that. But I guess I was a little surprised to not see public outreach as I would call a primary category.

Is that in your judgment covered in these other categories, or was this intended to do something else?

MR. DYER: I am thinking back to the structure of the survey, and I don't believe I could say that that was an element that was evaluated.

VICE CHAIRMAN RYAN: I am just curious about the difference in changes.

MR. DYER: Well, this program has a more than 20 year history as an R&D organization, and the site recommendation (inaudible), and so this has changed to becoming a credible licensee.

VICE CHAIRMAN RYAN: And so the phase that you are in now as opposed to where you were?

MR. DYER: That's exactly right, and of course that is not a one time change. As one moves from R&D, to licensing, to construction and operations, each of those is a change, and you have different skill needs in each area.

You have different management focuses in each area. So this is not a one-time change, but it is kind of a harbinger of continuous change.

VICE CHAIRMAN RYAN: That clarifies that. Thank you.

CHAIRMAN GARRICK: Any other questions?

DR. WEINER: Yes. Carol, could you put up the bar chart? This is kind of a tough question. In my other life, I took one of these surveys as a Sandia employee, and it occurred to me as I was taking the survey that some of the questions that I most wanted to answer were not asked.

I think John touched upon one of those, which is the public communication, and I wanted to ask you are you sure that your survey asked all the right questions, and how can you be sure of that? What can you use?

I know that you used other surveys as a benchmark, and I wondered if they don't all miss the same question.

MR. DYER: Well, now there was a focus on this particular survey, but there was an opportunity for people to add additional information. There was like an assay block at the end if you have additional comments or questions.

And we got, if I remember right, around 400 written comments that came back. So that is an area that we need to mine, and to look for things like you are talking about.

CHAIRMAN GARRICK: Any other questions? Anybody from the staff wish to ask a question? All right. I think we can move to the next speaker, which I understand is Joe Ziegler.

While I was making introductions, I failed to acknowledge an alumnus of this committee in the audience, namely Charles Fairhurst, and we are pleased to see him again.

Charles served on this committee some time ago, and is still happily associated with the project, and we are pleased to hear about that. Go ahead, Joe.

MR. ZIEGLER: Good morning. My name is Joseph Ziegler, and these are the basic topics that I am going to cover today. I am going to give you a brief status of our license application and our activities leading to December of '04.

I am going to also very briefly go over NRC's risk ranking and KTI agreements, and the NRC had asked us to look at their risk ranking, and give them some feedback.

We did that last week in our management meeting with the NRC and I am going to share the same information with you. I will go into a little bit more detail about the status of our key technical issue agreements, and then talk a little bit about our design evolution, and in not very much detail, because you are going to hear most of the details of where we are today with design activities this afternoon from Paul Harrington.

Just in a nutshell, we still do plan to submit a license application in December of '04. There are areas where we get a little bit behind schedule, and we have been able to recover that part of the schedule when we have problems from a scheduling perspective.

I will go into some of the same slides that Russ did go into in a bit more detail about some of the other issues associated with getting a license application done in three areas in particular where we have had quality assurance issues in the past because of the nature of the program and other reasons, and what we are doing to resolve those.

And I will just mention, and this is the only mention, and I will take questions, but I may not be able to answer them, that we do plan to certify our initial certification as a licensing support network in June of '04 as required by Part 63, in Part 2, I think in the NRC regulations that would certify a LSN 6 months before you make a license application.

The next slide just shows a very brief schedule, and I will concentrate on the upper part of this slide, to the left of the slide, and in the yellow part, it shows activities that we have completed leading up to, and including site recommendation, and site designation by the President and Congress.

On the right-hand side of the chart shows the key activities that are a part of what is necessary to be able to submit our license application, as we expect the LA design, the license application design, to be complete in March of '04.

The pre-closure safety analysis that will be associated with that design and operation of those facilities also to be completed in about the March of '04 time frame. Our long term safety analysis, and what we call total system performance assessment, it to be completed in the June time frame, and then be able to certify LSN initially in the June time frame.

Of course, we will recertify LSN at the time that we make the license application in December of '04 Next slide. In this next slide, I will try to answer some of the questions Ruth raised, and try to answer them later about how we came up with these percentages.

The percentages, along with each element or each component as labeled on this chart, are just weighted percentages. Those are subjective in nature, but they are based on the level of effort that we anticipated.

This is an overall measure of where we were at the time that the site was designated, up to the time that we would submit the license application. So these are measures for that element of work.

The KTI agreement and the TSCA, the KTI agreement almost entirely deals with post-closure performance. So the weight of the agreement is 10 percent, but you will notice that we rated total system performance assessment at 30 percent.

So overall the weight for the long term performance of the repository is given about a 40 percent weight. Now, most of these things are inextricably connected, okay? So they are not really necessarily individual pieces of work. Everything has to fit together.

The LA document itself, we have rated this at about 20 percent, because that is a significant effort on our part, and not putting the pieces of the application together to make sure that everything is integrated and consistent across the board.

So we have given ourselves quite a bit of time to do that, and mostly that will happen between June and December of '04, but we do have drafts of several license application sections that exist today, and we are continuing on schedule to complete that.

The preclosure safety assessment is basically -- it was significantly behind schedule because it was closely tied to the surface facility design efforts. We have been through one round of pre-closure safety assessments since the time of the site recommendation, and we will go through additional rounds.

I am going to mention right now one of those red boxes in the performance indicators was surface facility design, and that work was significantly behind where we would have liked it to have been from a schedule perspective.

If you will recall over the last 5 or 6 years, our budgets have never been what we requested of Congress. This year, it looks like we are going to get a budget close to what we requested.

But, for instance, last year, I think our budget was $130 million less than what we requested, and I think we requested 590 or so million dollars. So when we had to defer work, especially in a three site recommendation and site designation, we tended to focus the monies and the resources that were available on the post-closure performance assessment, because that is what made this site suitable or not suitable.

Where we deferred work, it tended to be on the surface facility design effort, and on the safety analysis on surface facilities, because those types of activities have all been done and licensed in many other places.

So we knew that work was not a first of a kind activities, and we knew that it could be done. It was just a matter of going through the process of doing it. So that effort and the reason that it got behind schedule or behind where we would have liked it to have been in the schedule is because basically of funding.

But we have made a lot of progress over the last six months in catching up in the pre-closure safety assessment and the on surface facility designs. So, Paul Harrington will go into more detail on the design later on today. Next slide.

I am not going to say a whole lot about this, but these three areas, data qualification, software development and coding, and model development -- and we divided software and models. And software being the physical software itself, and the models being the algorithms that do the estimates of long term performance, and the various components of that.

There have been some longstanding quality issues in each of these areas, and that is one of the reasons that we track this religiously. This is not just fixing the problem of how we do work today. It is also going backwards.

You know, some of the datasets that exist are as much as 20 years old, and making sure that the work that is done in the past is adequately qualified to support the safety analysis that is required for the license application, and for the NRC to make their judgments in the evaluation of our analysis.

It has been a difficult process. You talked about the quality assurance program, Russ, and I am going to elaborate on that a little bit; is that 10 years ago there was not one quality assurance program for the program.

The lab said that their quality assurance program, and GS had theirs, and we had ours, and since then, one, the program has been defined in what we call the QARD or quality assurance requirements document, or requirements description, and that document has been submitted to the NRC.

And while there is no legal requirement or regulatory requirement for the NRC to approve or accept that document, over the last 5 years the NRC has accepted our quality assurance premise document.

So what we are trying to do is to act as much as a licensee and assume the process as soon as possible. Well, some of that has been painful in the transition over to these multiple programs and into the one program.

And I think what you are getting at, Ruth, is that we applied this quality assurance program to all of the work done on the project. So if it a quality affecting activity per the NRC regulations, we apply the one quality assurance program whether or not it is done by the national labs, or the GS, or Bechtel as the IC corporation, or DOE as a Federal entity. We apply the same program.

So that is where we are. I think that is enough on that, and so Russ basically covered it, but we are making great progress. We have had what we call significant conditions adverse to quality open in each of these areas for a long time.

We are close to closing those significant conditions adverse to quality in the area of models, and again it is not just what we are doing, and what we are doing now going forward. It is also going backwards in time to make sure that everything is adequate as it needs to be.

In software development, we are not quite as close, but we are within a couple of months of probably being able to close that deficiency, and I say significant condition adverse to quality, and you talked about CARs, or corrective action reports.

In our old terminology up until two months ago, that is what we would have called it, but right now since we went to the single reporting system, we call it a condition report, Level A. That is equivalent to a CAR in our old terminology.

And the datasets again, we have plans for all of these. The data is a little bit more problematic, and that it is going to take us -- I think we are scheduled into the spring of next year to get all of those datasets reviewed and verified.

And again in each of these elements, we are not just looking forward. We are looking backwards and doing some reverifications because of the multitude of different quality assurance programs that existed when some of this information was developed.

To put it in perspective, we have not found problems that we are not able to go and resolve. So we are not losing big chunks of data, or are not able to use big chunks of data because we are not able to quality it.

We have not run into a situation where we are not able to use the software that was developed. Sometimes it is more convenient just to redevelop the software instead of going back and qualifying old information.

But the same thing in the modeling area. So we have been able to do it, and we have a systematic plan and approach to doing that. Skip that one and go to the next one. Just a brief feedback on the NRC's risk ranking, and I will get into this a little bit later when I show the site on schedule of KTI agreements.

It will give you an idea of some of the agreements that follow later in the schedule, and what their risk ranking is, and what they are, and what we are planning to do to address those.

The main point that I want to make here, and I made this point to the NRC, and I don't think that they are in disagreement with this, is that the NRC used the terminology of high risk, medium risk, and low risk.

Our position is that there is nothing really associated with a repository that is high risk, okay? We are looking at any potential radiation dose to the public is measured in millirems or fractions of a millirem.

The post-closure performance for 10,000 years, the analysis that we have done today, and I think we have been fairly consistent on this, shows a potential for fractions of a millirem to a hypothetical person of 10,000 years from how.

To term that as the high risk in relation to other NRC licensed activities, such as a reactor, when you go back and look at the reactor safety goals, which puts it at something like a 10 to the minus 6 probability per year of a large scale core melt accident, is the risk associated with this facility is in all cases is relatively low.

That said, we don't have a lot of contention with the NRC on their relative risk ranking, and we are able to say that some things are more significant from a risk perspective based on the way that we model the repository and the repository systems than other things.

We are not in probably complete agreement as to what follow upon the high side, and we have agreed to go back and take a closer look at the NRC's high risk areas, but here are some examples.

And we agree with the NRC that the corrosion of the waste package and the drip shield is at relatively higher risk than many other components of a repository operation.

The probability of volcanic disruption is relatively higher than other elements of the model. An aircraft crash is relatively higher because although I think most of the risk would be to the workers on-site from that type of an event, is relatively higher than some of the others.

Other things where the NRC has labeled it as high risk, such as mechanical degradation of the waste package and drip shield, our modeling doesn't show that. We don't think that those components are particularly vulnerable.

I think that there are some differences in the way that the NRC is doing it and the modeling. Mark Board may be able to go into that in more detail later. I think he is supposed to speak to you tomorrow.

I think that the NRC made some pretty conservative assumptions in their modeling, and I think that they have gone to what we consider to be too conservative in that area. In other areas, and this came up in the NRC meeting last week, such as radionuclide transport in the saturated zone, our models really don't take much credit for that.

Our models are probably pretty ultra-conservative in that area. Therefore, if you look at our models, this does not seem to be a very high risk important factor.

If you look at the NRC's models, I think they are probably closer to realistic in that particular modeling. So it is a larger component in what is important to the overall risk of the repository on a relative basis.

So we have agreed to go back and look at the NRC high risk areas, and I think we will be able to draw conclusions that follow either into we are about the same, or it falls into one of these categories, in the way that we model the systems.

Okay. Now I am going to go into key technical issues, and I will try to bring in some elements of the high risk and medium risk from the NRC's staff's perspective.

I think we have been over this with other parts of our staff in pretty great detail. We did come up with an approach in the summer to bundle agreements together, groups of agreements that look at certain parts of the systems, or repository systems, and how those things interact and work together.

One of the key reasons that we did that was that the NRC was asking for additional information on several of the agreement responses that we sent in, whereas we thought that something was basically obvious the way the overall system is set up.

We get questions back from the NRC staff that basically -- and the way that we read the questions, says how does this information fit in to an overall greater perspective of how the repository operates.

So to do that, we needed a broader

explanation in just responding to each agreement individually, because while we answered the agreement, it didn't really give you that perspective, and the NRC staff wants that perspective in the documentation before they close an agreement.

So we came up with this approach of bundling, and coming up with something we called technical basis documents. And I will give you a list in a minute of the ones that we sent in, and the ones that we plan to send within the next few days.

But they are in those 14 areas that Russ showed you on that slide earlier, and within those technical basis documents, we can cover about 85 to 90 percent of the key technical issue agreements, and put it in the context of how the repository systems operate, and how they will function to isolate radioactive waste.

There will be some separate agreements still for some agreements, separate submittals for some agreements. Some of the agreements just don't fit neatly into any of these particular categories. They are kind of -- they are individual questions that don't need to be in that context, and we will continue to respond to those as necessary.

But most of the agreements do fit into

these categories. We revised our schedule and submitted it to the NRC in June, and that is the schedule that Russ showed you. I am going to show you that again in a minute.

We are also working on a further revision to that schedule to accelerate some of our responses to the NRC. One thing that I will mention, too, is that we try to interact with the NRC staff, usually in the form of public meetings, and sometimes they call and ask questions, and we just answer the questions, or the on-site representatives come by and ask questions.

But we have interactions to make sure that when we submit something to the NRC that they understand that, and that we can discuss that in a public forum.

So we will continue to have those interactions, and I think as we submit these technical basis documents, in order to facilitate the NRC review of them, we will continue to schedule for those interactions, and they will probably increase.

We will probably do more and more of these interactions to make sure that everybody is on the same page. That they understand what we are submitting, and if we didn't submit something, that we could follow it up with additional submittals to make sure that information is available.

So I think that those interactions are very important, because when you are just working from the written page, you can only put so much information and write it down.

Sometimes what we think is obvious, the NRC staff either doesn't, or if they want to see that document. So even the obvious needs to be documented for the staff to be able to close these agreements.

I may have already covered this next slide on the organization of work. We develop technical basis documents for each of these bundles, and basically it is not so much the KTI agreements. It is just the way that the repository works.

There is another advantage to this bundling and these technical basis documents, and that when we describe the way that the repository works in the license application, this gives us a real headstart in putting that information together.

So it also gives the NRC staff a headstart in being able to review the description of the repository and how it will operate in the license application.

So these documents, while not absolutely a direct page to the license application, and a lot of the words in these documents will show up again in the application itself.

We will address the agreements within that context, and so the agreements aren't the driver. The safe operation of a repository is the driver. The agreements are just issues associated with our analysis of that operation.

And one thing that we have done -- and we were significantly behind, and I see that on the scheduled, too, on our submittal of KTI agreements before our reschedule.

And again part of that was budget and part of it was other reasons, and we have assigned a dedicated staff. We have a manager, Don Beckman, who is managing the KTI response process, and we have got dedicated staff, that we took them out of their main body of work.

They interact with the technical leads in these areas, but that was the key to being able to get these responses to the NRC in a more timely fashion.

This is a slide that Russ showed you earlier, and I just want to point out a couple of additional things on it. If you look at the left-hand part of the schedule, you will see that we went for a period -- mostly from October through July and August -- of not submitting very much agreements to the NRC, even though we had quite a few scheduled.

We have submitted a reschedule to the NRC in June of this year, and in that reschedule there were a significant number of agreements due in September and October. It was actually a huge bow waves. We had 39 agreements scheduled in September to submit to the NRC, and 23 in October.

September looks really bad on this chart since we only submitted seven, but all of the 39, plus some additional ones, were submitted by October 3rd. So we essentially met the schedule in September.

We were not so successful in October. We were about 13 agreements behind by the end of October, and we remain about 10 agreements behind. This week, we are hoping to get about 25 more agreements submitted to the NRC, and we are doing a thorough review.

I think that this bundling process is working, and I think that it does put things in a better perspective. We got a lot of very positive feedback from the NRC in the public meeting last week about this approach.

So I think that the approach is working, and we are not quite as far as ahead of the schedule that I would like to be, but it is working. Okay. Getting into high risk and low risk, we still have a couple of big bow ways coming in the months to come.

We are looking at a reschedule, and part of that reschedule, and part of that reason is that we would like to get as many of these agreements addressed completely by the summer of '04 as possible, okay?

All of them are not going to be possible, and I will give you a couple of reasons why. In this schedule though, some things that tend to stick out in people's minds when they see it is if you look in April of '05, there is two agreements that show up there, and in August of '05, there is one agreement that shows up there.

And the question that we typically get is why is it okay not to address that KTI agreement before the license application, and the answer is that it is not okay not to address it. The two agreements in April of '05 deal with the phase stability of Alloy 22, and some particular testing and analysis associated with that.

The one agreement in August of '05, the reason that we had it there is because there is some additional test work going on again about corrosion of Alloy 22 and titanium material that the drip shield will be made up of.

We have determined basically that we have enough information to do our technical analysis and safety evaluation of the corrosion resistance of Alloy 22 and titanium to be basis of a license application.

This additional ongoing test and analysis work is really more of a confirmatory nature, and so the schedule for these agreements is going to move up substantially to be right now no later than the fall of '04.

Other agreements that show up after September of '04,we are actually trying to accelerate that work as well, and with some success, and before the end of the year we will submit an updated schedule to the NRC, and as I have said, several of these agreements are moving to the left.

Two other points that I want to make on this chart, which is September of '05, there is three NRC high risk agreements, and that I am going to point out to you in the last six months or so here where the NRC high risk categories exist.

There is 3 out of those 10 in the September '04 time frame were high risk. We are going to be able to accelerate those and move them back into the summer or early fall.

There are eight high risk agreements per NRC's categorization in July of '04, and that is the bar that shows 25. Those eight, I believe all of them, or almost all of those eight, are dealing with our final TSPA model, TSPA LA.

So those eight agreements are probably not going to come in much earlier than that to the NRC because until we complete our TSPA modeling, the case that we are going to use for the license application, we will not be able to respond fully to those agreements.

So it is just a matter of completing the modeling work and the analysis before April to give a complete response to those agreements. I think on the next page, it gives you or tells you which bundles we have submitted to the NRC so far, and the dates that we submitted those bundles.

And the bundles so far, biosphere transport, unsaturated zone transport, and colloid transport, and separate into the drifts, water seepage into the drifts.

If you go to the next page, volcanic events since October of '03, and we didn't make it, but that was submitted early this month. We have two more packages that contain about 25 more agreements that we plan to submit hopefully this week, but if not this week, soon next week; in-drift chemical environment and waste package and drip shield corrosion.

Those are almost ready to go to the NRC and they are in the review process to go out the door. The next slide shows the other bundles and the dates that we plan to submit those other bundles according to our current schedule.

Again, we may accelerate some of these. So we are looking to do everything that we can to do that as long as we don't sacrifice the quality of the work.

The next slide is just a graph and the NRC staff actually came up with this graph, and everything except the second numerical column says agreement submitted to the NRC.

So if you will forget that column, and I think it is in blue. The rest of these columns are all mutually exclusive, and the list down in the first column, it is just the acronym that we use to describe the agreements.

For instance, the first one is container license source term. If you move to the right, and I will go down to the bottom, there is 293 total agreements. There is 64 of those agreements that have been submitted to the NRC and we are waiting for a response from them.

I am not complaining because they have got a lot very recently as you saw in those previous charts. Partial responses have been submitted on 21 of the agreements.

The NRC has asked for additional information that we have not provided yet on 27 others, and responses are remaining to be submitted on 101 agreements, and on 80 the NRC has agreed are complete. So to give you an idea of where we stand.

Okay. I am going to shift focus now and talk a little bit about the design. I am not going to go into much detail though, but I want to just point out a couple of features.

CHAIRMAN GARRICK: Before you shift there, it is sometimes very difficult to develop a real understanding of what is ahead of you on the basis of just a numerical evaluation of the agreements. Have you made any attempt to look at them in terms of their scope, and weight them in some fashion so that -- because there are some agreements that are much more complicated than dozens of other agreements combined.

MR. ZIEGLER: Well, actually we have a detailed schedule for every agreement, and we have been looking to accelerate those schedules. Sometimes the original schedules included more work than was necessary, such as some of those corrosion agreements that I showed you that are on our current schedule.

As far as an absolute risk ranking, the way that the NRC staff did, no, we have not done that. We did agree to go back and look at the NRC high risk rankings, and if we didn't consider them high risk, and to determine whether we also considered them relatively higher on the risk levels.

And if we don't, then to try and come up with an explanation of why we consider it that way differently than the NRC staff does. I guess one of the difficulties is this, and on how many of the actual agreements you have looked at.

You know, some of them sound very simple. I mean, most of them sound very simple, provide this additional information. But in many cases there is something behind that other than just provide that additional information.

So what we have found through our submittals is that even the ones that sound relatively simple, sometimes they are not.

CHAIRMAN GARRICK: Right. Right. Well, some of them certainly require -- some of them are just simply documentation, or a lot of them are documentation, but some of them require some real technical work.

MR. ZIEGLER: All of the technical work to resolve all of the agreements is in progress, and it is in our schedule and in our plans. In some of the areas here, some of these agreements are looking at things that typically would not be looked at until we were an applicant.

In other words, there are technical issues associated with the way that we do an analysis, and so in some of these our technical staff, the laboratory technical staff typically are the people doing this work, and believe that we have adequate or more than adequate information to address not just the agreement, but the inputs to the safety analysis.

You know, the topic of that agreement, and so we go back, and we make sure that our models are validated according to the quality assurance program, and all the requirements and criterions were in Supplement 3 to our Quality Assurance Program, which talked about the validation of models and data, and we have to make some judgments.

And sometimes there are some legitimate technical differences of opinion with the NRC technical staff, and we need to work through those. And what we have seen here with the KTI agreements is that process really has been started earlier than is typically done in a licensing proceeding because of various reasons about the law associated with the repository, and the NRC having to make some determinations of sufficiency leading into the site recommendations, and that is legitimate things to do early.

And what I would like to do is to get as many of these resolved before the license application as possible, whether they be high risk, or medium risk, or low risk, or whatever risk terminology that we use, because in order for the NRC to be able to do a 3 year review of a license application, which we are hoping we will be able to do, we want to facilitate their knowledge of the way that our safety analysis works. That is a long answer to a short question, but --

CHAIRMAN GARRICK: Joe, just for clarification, you are moving into design evolution now?

MR. ZIEGLER: Yes.

CHAIRMAN GARRICK: Now is that still in the 11:10 to 12:15 category that is on our program, or is that jumping into the repository design status?

MR. ZIEGLER: The same category. Paul Harrington will go into much more detail this afternoon.

CHAIRMAN GARRICK: Oh, okay. So we are still in the morning session?

MR. ZIEGLER: We are still in the morning session.

CHAIRMAN GARRICK: Okay.

MR. ZIEGLER: And we will go to that surface facility design here. I just wanted to make a few points, and I can answer some questions, and if we get into a lot of detail, I may have to defer to Paul.

But I just wanted to kind of present where we have been and where we are going, and what that means as a matter of change, or refinement, or evolution, or whatever terminology that you want to use.

At the time of the viability assessment, which was in the late 1998 or early '99 time frame, on the surface facilities, we were looking at one single large building. We were looking at wet handling of the commercial spent fuel, and we were looking at five individual transfer lines through that facility, where we could move different elements of fuel in the packaging in five different transfer lines.

At the time of the site recommendation, we were still looking at a single large building, and not quite as large. We were still looking at wet handling of the commercial spent fuel.

We had cut it down to three transfer lines because we were able to do a little bit of optimization of the through put even though it was kind of a preconceptual design. And we were looking at 5,000 metric tons of storage capacity, or what we call blending pools, within that facility.

And that was made necessary because of the high temperature and low temperature issues associated with the maximum temperature that would be reached in the subsurface repository after it was closed.

And in order to do that, we needed to be able to mix and match different fuel elements of different heat outputs so that we could even that up throughout the repository.

In the design that we are working on now for the license application, the same functions are basically there, but we have refined things and optimized some things more as far as operational facilities.

There are multiple buildings. We are looking at a dry transfer facility, and possibly two dry transfer facilities. Typically, almost identical. We are looking at a canister handling facility, which would be able only to handle canisterized materials.

So the DOE material we expect to come to Yucca Mountain will all be in canisters before it gets here. Right now we don't have a definite path forward for multi-purpose canisters, but this facility would be able to handle multi-purpose canisters.

We have not ruled that possibility out, okay? So if we are able to load commercial fuel into multi-purpose canisters, and then we run it through this canister handling facility, and the beauty of this facility is that it is a simpler operation.

It is clean, and there is no radioactive contamination at all, because we never handle bare spent nuclear fuel. In addition, we wet aside an area for a shielded canister transfer, and we are still considering that. We don't have the design on that done, but it is a relatively simple facility.

That if we could shield the canisters, or multi-purpose canisters with shield plugs in them, then we could go through a fairly simple operation to put those canisters in a waste package, and add a weld cell to the shielded canister transfer.

The beauty of having a shield plug in multi-purpose canisters is that we could do contact welding, and that simplifies the issues associated with remote welding. It is not that it is not possible or feasible, but it is a slow operation at best.

If we could do contact welding and contact examination of those welds, we could actually get a lot more through put through the process. So those are the types of things that we are looking at and the difference.

We are also looking at phase construction of these different facilities so that they are not all going to be available on day one. The next slide talks about the subsurface repository evolution, and again where we were at the time of the viability assessment there was very close drift spacing.

Drifts got to be 18 foot diameter drifts, and 92 foot spacing center to center between the drifts. The entire repository area would be above the boiling point of water for some period of time at the closure of the repository for a couple of thousand years at least.

It was on one single level, and there was minimal ventilation. We really weren't trying to keep the temperatures down at that point in time.

The site recommendation looked at a modified approach.

There was comments by external review bodies and others and so we modified our approach. And there was 266 foot drift spacing center to center, and the rock between the drifts, the emplacement drifts, would be kept below the boiling point of water.

At least half of the rock between the drifts would stay below the boiling point of water. So it sets that. If water were pushed away from the drift, that there was a place where it could drain in between down through the rock.

There were two levels, an upper emplacement level on the left, and a lower block on the right. A robust, forced ventilation system was built into the system as long as the repository was open, and we were seriously considering leaving the repository open longer and using natural ventilation, and with not much design effort, we could have natural ventilation circulation through the repository for quite a long time.

In our license application design, there has been optimization. The subsurface basically has been divided up into panels, and it facilitates development of part of the subsurface before other parts.

We still have the 266 foot drift spacing. We still have the sub-boiling temperatures, at least in a portion of the rock pillars that would provide drainage through that part of the pillar so that the water wouldn't congregate above the drifts and stay there during the period of higher temperatures.

It is on one level, and again we have the robust forced ventilation system as long as the repository is open. We are not taking credit in our current modeling for any natural ventilation. So that is not a factor that we are going to build into the license application or that we plan to.

Actually, this layout results in a little bit less excavation in the layout in the middle, but still gives us the same area in spacing, and that is just because of some optimization of the accesses.

If you go to the next slide, we will talk a little bit about the waste package design evolution. At the time of the viability assessment, we were looking at an outer barrier or an outer layer of the waste package being carbon steel.

A corrosion allowance barrier I think was the term that I think that we were using at the time. There was an inner barrier of the very corrosion resistant Alloy-22, and we were looking at a heat output limit, a maximum for each waste package of being about 18 kilowatts.

And in the site recommendation, we kind of flip-flopped the barriers, where the corrosion resistant barriers were Alloy 22, and stainless steel as the interstructural part of the waste package, and 11.8 kilowatt maximum power output per waste package, and again that was to levelize the heat load so that we could keep maximum temperatures in the subsurface below boiling in at least part of the drifts forever.

We extended the outer lid a little bit, and we changed the -- we have a split training collar, and the only reason that I mention that is because it is a change in the design that we have got now.

In the license application design, it is really functionally not any different as far as long term performance of the repository. It is still Alloy-22 on the outer barrier, and it is an inner-barrier of stainless steel with 11.8 kilowatt output maximum per waste package.

There is a flat outer lid, and we have done some optimization of that outer lid configuration. There is still three lids, but we have simplified the welding configurations because there were some issues about doing some deep penetration remote welding, and this is just a more efficient way to do things.

We also sped up throughput through the system, and we got a one-piece twist-on trunnion collar that will twist on the ends of the waste package. To summarize, we are completing the actions to achieve progress and address the longstanding management quality assurance issues that I mentioned, the data quality in models.

The NRC is monitoring our performance, and we are not quite where we need to be to be a licensee, but we are headed in the right direction. DOE still plans to submit a complete license application to the NRC in December of '04, and we are well on the way to do that.

We have some issues on the way as any large complex project does, and we have so far been able to successfully resolve those issues, and when we get behind schedule to work our way back on schedule.

An integrated approach is being used to address the KTI agreements, and this bundling approach. We provided responses to 75 agreements since September. There are going to be another 25 that hopefully go out this week.

The remaining agreements will all be addressed prior to license application submittal. The work, post-submittal of the application, we believe will be more confirmatory in nature, and ongoing test and analysis work will go on for the foreseeable future in the areas of -- and I don't see an end to corrosion testing ever until we close the repository.

And design is maturing towards the final basis for the license application. So as we move forward, we get more and more detail. So with that, I will open it up to questions.

CHAIRMAN GARRICK: Thank you. Mike.

VICE CHAIRMAN RYAN: Not right now. I will wait until the afternoon.

CHAIRMAN GARRICK: Okay. Jim, do you have any questions?

MR. CLARKE: Your design component, that is now 40 percent complete?

MR. ZIEGLER: Yes.

MR. CLARKE: That would include both surface and subsurface design?

MR. ZIEGLER: Surface, subsurface, and waste package. Now, let me explain.

MR. CLARKE: And the waste package?

MR. ZIEGLER: Forty percent. Now, 40 percent of the design level that is necessary to do an adequate safety analysis, which is the way that we read Part 63, and so it is 40 percent of that level of design.

MR. CLARKE: Okay.

CHAIRMAN GARRICK: Ruth.

DR. WEINER: On your risk granting slide, could you put that up.

MR. ZIEGLER: Yes.

DR. WEINER: Ont he aircraft crash, are you talking about the risk -- and I assume that this was risk ranking for the repository itself and not the surface facilities?

MR. ZIEGLER: No, no, no. Surface. There is no risk in the repository.

DR. WEINER: With the repository. Okay. Are you talking about the risk of the crash, the risk of a release, or risk to public health, or all of those, or some of those?

MR. ZIEGLER: It is a judgment factor, and if you look at the way that the NRC staff did their risk ranking, it was a combination of this. I would say it is a combination, but so far this is just a judgment factor, and that part of it is that we know that this has been a controversial licensing issue, another licensing proceeding such as at PFS.

So the amount of detail and information that is required to do this analysis we think gives us some licensing risk. So we will probably do more than maybe the regulations explicit call for just to make sure that we can get through the licensing process.

I think the NRC staff is also going to look at that very deliberately. As far as the risk to individuals, if you put the probability of the crash into the risk, the probability of an aircraft crash hitting the repository surface facilities is very low.

DR. WEINER: Well, that was my next question. When you are talking about risk on this chart, you are talking about risk to the licensing?

MR. ZIEGLER: It is risk to the licensing, but it is also in this particular instance is the regulations are pretty clear. You know, if something has a 1 in 10,000 chance of occurring over the period of operation of the surface facilities, and we have to consider it.

One of the elements of our design, and I didn't mention this, and Paul will go into it in more detail, is an aging area, such that certain parts of the spent fuel will be aged in surface containers.

When you look at the square footage of that area, along with the square footage of the other surface facilities, and then we look at the probability of an aircraft crash, it may or may not be -- and we are still trying to tweak the analysis. We are getting some updated information from the Air Force, the Air Force Base right next to us. And it may or may not be above or below 10 to the minus 6 per year.

DR. WEINER: So are you actually doing or have you performed a vulnerability analysis for your surface facilities?

MR. ZIEGLER: Consequence analysis, or just the probability?

DR. WEINER: A risk analysis.

MR. ZIEGLER: We have done the probability analysis. I mentioned in September that we completed at least a draft of the probability analysis of a crash into the surface facilities.

We are still looking at what the optimum area for the aging facility would be, and when we count the aging area in that probability, it is close to 10 to the minus 6. We have not done a consequence analysis except in the EIS of an actual crash into the surface facilities.

We don't think that the aging facility -- well, probably where we are going to go is that any aging facilities that we have there, we will probably design them to withstand an aircraft crash.

DR. WEINER: And you have submitted your probability analysis to the NRC?

MR. ZIEGLER: Yes, we have.

DR. WEINER: Okay. The other questions are kind of more general than this. How did your codes, your PA codes, compare to other performance assessment codes, like the performance assessment done for the waste isolation pilot plant, for example? Do you use qualified -- to what extent do you use already qualified codes in your performance assessment?

MR. ZIEGLER: To the extent that we can. A lot of the same people worked on that at Sandia and others, you know, with our project, are working on our codes as well.

One of the things is that I believe that the NRC regulatory process is more rigorous than anybody else's. So one of the issues has been not whether the code is qualified, but whether it is qualified consistently to our quality assurance program that has been accepted by the NRC.

So that while some of those codes may have been qualified at other places, sometimes that still presents a problem in the qualification of that code for our application. So to the extent that that qualification information exists, we are using it.

Sometimes we have to supplement that qualification activity quite often, but all of the codes that support the safety analysis will be qualified before we submit a license application.

DR. WEINER: And you will then be qualified to satisfy the NRC?

MR. ZIEGLER: Yes, to satisfy our quality assurance program and the Nuclear Regulatory Commission, yes.

DR. WEINER: Okay. And finally, and this is a short one, do you have public buy-in of the licensing support network?

MR. ZIEGLER: Public buy-in of the licensing support network? I am not sure that I understand the question.

DR. WEINER: Well, I have been away from

that whole area for quite a long time, more than a decade, but as I recall, the purpose, the original purpose of the licensing support network, which was then called the licensing support system, was to provide a record of public input other than DOE and the NRC to the licensing process.

And I just wondered if currently the way the licensing support network is configured, if you have had public buy-in, and public acceptance of that configuration.

MR. ZIEGLER: Okay. Let me tell you my understanding of LSN, and I am not an attorney, because every time we talk about LSN, I always want my attorneys to do the talking instead of me.

As I believe the regulations call for the licensing support network to basically be for discovery during the licensing proceedings. So those bodies that participate in the licensing proceedings have the licensing support network, and it was to facilitate that legal discovery process.

My understanding is that the Atomic Safety and Licensing Boards actually are the owners and the definers of what the licensing support network is, and not DOE. DOE, as other parties to the proceedings, must provide input to that system.

That said, there is something called the licensing support network advisory review panel that is chaired by Dan Graser, right, or by the NRC staff.

And we are a party to that, and the State of Nevada is a party to that, and other interested parties participate on that advisory review panel, and that advisory review panel has quite a bit of standing in defining the make-up and the content of the LSN.

So I guess I am begging off and saying that is an NRC responsibility. We participate as other stakeholders do.

DR. WEINER: And thank you for the explanation.

CHAIRMAN GARRICK: Joe, I wanted to ask you a couple of things. In your decision in your surface facility, they go to dry handling.

MR. ZIEGLER: Yes.

CHAIRMAN GARRICK: I can certainly appreciate when you have a high inventory of very aged fuel that this is a very rational approach, and that it makes for a lot easier handling activities.

On the other hand, if the repositories every catch up with the inventory of spent fuel, and the reactor sites decide that they want to get out of the on-site storage business completely, doesn't this impose a requirement on the generators downstream to be in the storage business more than perhaps they want to be?

MR. ZIEGLER: It might, but there are some options out of that, you know. One of the things would be if DOE could develop a reasonable multi-purpose canister to provide to the utilities, then it would facilitate our ability to handle it at the repository, and in our current configuration, we could handle those canisters without ever handling the bare fuel again.

Or we could put them in our aging area if there was a heat output issue with them. But it would either require an additional burden on the utilities, or an additional burden on us.

CHAIRMAN GARRICK: I guess part of the question is was there an evaluation made? Was there interaction with the generators on making that decision?

MR. ZIEGLER: I don't believe that there has been a lot of interaction with the utilities on that. There is some legal issues between us and the utilities.

CHAIRMAN GARRICK: Okay. One of the things that we are always looking for in these kinds of presentations on programs and program status is what are the real schedule controllers?

If you had to delineate your top 10 list of issues, and I am thinking that some of these issues are not so complicated, but may have a great deal of uncertainty associated with them because of budgeting and other issues.

Are we going to get any sense of what your top 4 or 5 of 10 list is as far as being in a position to give the license or give the NRC a good license application at the end of 2004?

MR. ZIEGLER: Okay. I'll try. It is off the top of my head, and I sort of tried to do that in what you see in this presentation. I personally think the biggest ones are resolving these quality assurance issues, and which in theory would be the simplest things to do, but in practice, we have had problems getting these issues resolved.

And particularly in the area of model development, which I think is coming along nicely now, and is very close to closure. The data qualification, particularly the old data sets, and in the software development.

They have been longstanding issues that this project has not yet totally resolved. But I think that there is an end in sight.

Technical issues. The KTI agreement and the process itself I think is one that we have to pay particular attention to, to make sure that we have addressed them adequately.

Basically, our models and the validation of our models should be adequate to deal with the questions that are the subject of the KTI agreements.

And this integration, the technical bases that we are doing, and not just how a repository works, but how these particular agreements fit into that structure, and this consolidation, it is truly an integration effort on our part.

I think that was one of our key issues, and I think that one is well in hand now, too. It probably hasn't been probably up until 6 or 8 months ago. Let me think if there are any technical issues.

CHAIRMAN GARRICK: Are there any major issues associated, say, in the near field with respect to source term issues that you see as very high on your list?

MR. ZIEGLER: I think certainly the end drift chemical environment, although if you have been following the NWTRB meetings or not, I think the issue of the maximum temperature subsurface.

Right now our application, we plan to go into our application with a repository for a period of time that will be above the boiling point of water. Okay. Not all the rock between the repository drifts.

I think that the NWTRB's recent letter, and you have seen our response to that letter, and we don't fully agree with the NWTRB, but that will be an issue that will probably remain with us that we will have to deal with, not just in that arena, but in the regulatory arena with the NRC and the licensing process.

So we are continuing to work on that area to better define the end-drift chemical environment that will exist, and how that might affect waste package corrosion.

I think that one of the keys to our analysis though is the probability of any of those extremely harsh environments existing, and enduring in a natural repository environment.

And there seems to be a difference of opinion between DOE and the NWTRB on that. That is what comes to mind. There is probably others with design. We were substantially behind where we wanted to be on the design effort, and so the work, just the physical work required to complete the level of design necessary to do an adequate safety analysis.

And then integrate the design work with the safety analysis work, and in an ideal situation, we would like to have 2 or 3 rounds of iteration of the design, the safety analysis, and if we tweak the design and do this minor change, will it avoid a potential safety issue.

And so we are having to do a lot of work in parallel. So, we are really going to be loaded pretty heavily come the spring and summer of next year trying to make sure that if that iteration happens that it is going to happen a little later in the process than what we wanted it do.

CHAIRMAN GARRICK: My final comment has to do with license application schedule uncertainty. We have all experienced in flying around the country what I call the airline schedule syndrome, delay syndrome, where they keep the monitors that is telling you that they are on time until 10 minutes before flight time, and then suddenly there is a several hours delay.

Is there an airline schedule delay syndrome associated with this project that we are going to observe? And maybe another way to ask it, I am a great believer in uncertainly analysis.

Is there any effort going on to quantify if you wish the uncertainty of the license application schedule?

MR. ZIEGLER: No, not to quantify it. We talk about it a lot, and we talk about our problems, and we have critical path meetings every two weeks that go into infinite detail.

You know, I think we are going to make it. I think that the work required, and I think I laid out the issues here to you today that are most of the things that could prevent that from happening that are in our control.

There are some things, of course, that are not in our control. If you look at the site recommendation schedule, which I think that was relatively optimistic, I don't think we made it, but I think we came within 6 or 8 months of that schedule.

And there were some external driving forces that kept us from meeting that schedule. So as far as the physical work activities, and the design activities, the safety analysis activities, I believe we are on track to make it.

One thing, and I will just point this out, is the way that we have built our schedules is that we have scheduled the safety analysis work to be done in the summer of next year.

If some of that work gets delayed, and if it gets delayed in a matter of months, a couple of months, there still is time to get the license application put together. I mean, the license application could be put together with holes in it, and that is not the way that we want to do it internally.

That is not the way that we want to do it and trying to fill those holes at the end, but there is a possibility, and there is some area there that if there are pieces, small pieces, that don't get complete in June of '04, that we could still recover if it gets done in July or August of '04, and still make the 12/04 license application date.

So while we don't show any contingency in our schedule right now, we were showing negative flow for a while in our monthly meetings that we do, and in our critical path.

That float in our schedule today is zero. That is not a good place to be. There is on contingency. But the way that we built our schedules for all the technical work to be done earlier, and to give us 6 months to actually the application itself nailed down in its final form.

So I believe that there is some time to

get there. I am fairly confident that unless some unknown factor comes in beyond our control, that the physical work to get this license in by 12/04 will be completed.

CHAIRMAN GARRICK: Very good. Are there any questions? Yes. Ruth.

DR. WEINER: Yes, one more quick one. I noticed on your KTI schedule that you have two agreement scheduled for January of 2005, and two for April of 2005, and one in August, and I understood you to say that those have to d with corrosion testing.

Could you expand on that a little bit? Are those confirmatory tests to confirm other corrosion tests so that when the corrosion KTIs are resolved that you are fairly confident that you can meet the licensing requirements?

So are those confirmatory or those just further tests, or what?

MR. ZIEGLER: Yes, they are absolutely confirmatory, and I think that I mentioned that we were going to move the schedule on those agreements up.

The testing will continue, but the testing really of a confirmatory nature, and the testing and analysis associated with those test results are more confirmatory.

We believe that we have an adequate basis based on the existing data and analyses to validate our models and to assure that the safety analysis meets all of the requirements.

So it is confirmatory, and those agreements we believe that we are going to move into the late summer or early call time frame as far as our submittal.

The agreements themselves didn't or aren't so specific that this particular testing has to be done. It is when we originally scheduled this work, or when we originally came up with the work that we were going to do to resolve the agreement, we believe now we went beyond what it requires to resolve those agreements. So it is entirely confirmatory in nature.

DR. WEINER: Thank you.

CHAIRMAN GARRICK: I think we have a question down there. Sher Bahadur.

MR. BAHADUR: Joe, I had a question on your Slide 20, when you talk about the evolution of the subsurface repository.

MR. ZIEGLER: Yes.

MR. BAHADUR: You mentioned that the DOE during the viability assessment considered single level, that turned to two levels in the recommendation phase, but then again came back to one level. Do you know that factors that led you to go from 1 to 2, and then back to 11 again?

MR. ZIEGLER: Well, I am going to look out and see if any of my zoologist friends are here. I know that Mark Board is going to be here tomorrow, and he may be able to address that better than I could. But, no, I personally do not.

MR. BAHADUR: Okay.

MR. ZIEGLER: Is there anybody out in the audience that can help? Paul Harrington said that he can address that this afternoon.

MR. BAHADUR: Okay.

CHAIRMAN GARRICK: Neil Coleman.

MR. COLEMAN: Neil Coleman, ACNW staff. Mr. Ziegler, there was an event in the last 36 hours that relates to your slide 9 under aircraft crashes. I noticed that the local morning news reported that an A-10 Warthog had crashed in the Nellis Range. The pilot fortunately survived.

MR. ZIEGLER: Yes.

MR. COLEMAN: They also had a report about this kind of aircraft type that -- and I don't know how accurate this is, but they said that nine had crashed in Southern Nevada.

But specifically about this one that just happened, could this require an update of your probablistic risk assessment for aircraft crashes?

MR. ZIEGLER: Well, I don't know if that particular event would, but we were in the process of doing that update anyway, and we are working with the Air Force on their future plans for flight activities.

Paul may be talking about this this afternoon, too. I know that the Air Force, and I know that we have been working on the no-fly zone around the repository, and actually the Air Force volunteered that.

So we will update the probability analysis of aircraft crashes before the license application, and we will use the latest available information int hat analysis.

CHAIRMAN GARRICK: Okay. I wanted while there was still some senior management of DOE here to at least express our appreciation to DOE for how they not only supported our meetings but especially our working group sessions.

As you know the working group sessions become a very valuable resource for nurturing our knowledge about some of the most important issues, and

DOE has been very cooperative in making resources available for those, as well as for the meetings, and we want to thank you for that.

MR. ZIEGLER: Thank you.

CHAIRMAN GARRICK: Are there any other questions at this point, which means that we are very, very much on schedule. And we will look forward to resuming our meeting at 1:30. And until then, we are adjourned.

(Whereupon, at 12:12 p.m., a luncheon recess was taken.)

A F T E R N O O N   S E S S I O N

(1:30 p.m.)

CHAIRMAN GARRICK: The meeting will come to order. We are now going to hear about repository design status, and the committee member that is going to take the lead in the discussion will be Mike Ryan.

VICE CHAIRMAN RYAN: Thank you, Mr. Chairman. We are going to hear some presentations this afternoon on various aspects of the design update in a little bit more detail than we heard this morning, I think, and to start us off, Paul Harrington will give an overview presentation, and perhaps introduce the topics and other speakers for the afternoon session.

We are going to have an initial discussion I think, and then a short break will interject between the first and the second presentations; and then we will go on from there after a short break. So, Paul, without further ado, let me ask you to lead us through this afternoon's session.

MR. HARRINGTON: Okay. I am Paul Harrington, and I am the DOE Systems Engineering Lead. And what we wanted to talk through with you today was the current status of the design, but also weave throughout it the results of the recent preclosure safety analysis that we have done.

That has been the first time that we have actually run the PSA process, and we had done an earlier assessment, but this one was the first time that we have actually run through the PSA as a quantitative result.

So that is woven throughout the discussion. I had actually planned on doing the presentation, all of it, myself. But obviously it is a very broad range of topics, and because of that I have four gentlemen here to help support and answer questions.

Dennis Richardson is the Bechtel FCIC preclosure safety analysis manager. Preston McDaniels is the BSE Surface Engineering Lead. Mark Board is the BSE subsurface engineering lead. And Mike Anderson is the BSE waste package lead.

And the bulk of the presentation is on the surface and that is where we have done the most work recently. It is really most subject to update, and then we will take a short break after that, and then do the waste package and subsurface after that.

Okay. We have gone ahead and done the preliminary PSA, and as I said, it is important to publish --

VICE CHAIRMAN RYAN: If you could just pull that microphone up a little bit so that everybody can be sure to hear you. Thank you.

MR. HARRINGTON: Okay. It is important to note though that that is certainly not the completed set of design that will be needed to support the license application. So the work that we are doing in the design side of the house from now until early next year is to add that additional detail to support the license application.

That means that we will need to rerun the preclosure safety analysis on that design update. The surface facilities, the most significant changes there are as a result of implementing some Cogema input that we have gotten, and also breaking it into a number of separate facilities.

I think the last briefing you had showed a series of buildings on the surface, but we have somewhat changed what goes on inside those buildings, and we will talk through that.

On the subsurface, the layout has changed somewhat, and we have made some changes in the ground control, ground support primarily. The waste package is really relatively unchanged. There is some detailed changes primarily in the closure head that we will go ahead and talk through.

The preclosure safety analysis approach to recap, we look at the internal and external events to identify what hazards may be that the facility has to withstand, and we will go ahead and do categorization analyses to look at the potential frequency of those event sequences.

And then we will do the consequence analyses to estimate the dose to both the public and the workers as a result of those event sequences, and then we have to do classification analyses that will identify which of those system structures and components, SSCs, are important to safety.

And then finally we are preparing something called a nuclear safety design basis document, and that captures the design requirements. There has been some confusion in the past as to what that document represents, and whether or not that is PSA directing the design organization to specific designs.

It's real intent is that it has captured the design basis that the design organization had used in their original design, and that was used by the preclosure safety analysis group so that that design basis won't be inadvertently changed. That is the point of that document.

The preliminary PSA was done based on April '03 design, and the results of that are going to be taken into consideration as we continue the design evolution to support the LA.

Primarily that identified certain components that are important to safety, and so the design organization will include the necessary redundancies and other features in the components during the detailed design of those components, and we will talk through a little later what those types of SSEs were that are ITS, and important to waste isolation also.

Again, we will need to redo the PSA prior to submitting the license application based on the conclusion of the LA design. We don't expect there to be significant differences though as a result of completing the design for LA and rerunning the PSA.

The kind of functions that the PSA looked at based in the April '03 design are really very similar and are going to be the same in the additional set of facilities.

I will talk a little later about what the PSA will need to pick up. This first version, for example, there was no canister handling facility, which will be something that will be added.

It also was on a smaller aging pad, and so the results of a larger aging pad will have to be incorporated into it. Looking at the surface facilities themselves, again, it picks up the design input from Cogema.

They have a lot of experience from operating the La Hague facility. Some portions of that are wet, and some portions of that are dry, in terms of fuel transfer.

We have adapted those design solutions for the Yucca Mountain facilities, and some of the recent changes in the surface facilities are the addition of a transportation cask for receipt facility with a buffer area.

That really comes out of -- and particularly the buffer area, comes out of the Cogema experience. They had a fairly standardized national transportation system.

So they were able to take transportation casks and their supporting appertances off of the national transportation conveyance, and put it on to a site conveyance, and use that effectively as staging prior to going into the waste transfer facilities themselves. We are adopting that concept also.

A canister handling facility. As Joe mentioned briefly, that is a facility that would allow transfer of sealed canisters from a transportation cask to a waste package, or to an on-site storage cask if we needed to send something out to the aging pad.

That could be built we think quicker than an entire dry handling facility, dry transfer facility, because it is simpler. It is a little bit smaller. We have also integrated the remediation capability that previously had been in a separate building, and into the dry transfer facility one, DTF-1.

There is a second dry transfer facility that would be built following DTF-1. Earlier that had been a larger building than DTF-1. It had a larger through put capacity, given the through put analyses that we have been doing, plus the addition of the canister handling facility.

It does not look like that there is a reason or a need to have the second DTF have a different through put capacity, having it be effectively a mirror of the first one simplifies design and construction also.

The processing is primarily dry now. There is a small pool for remediation of fuel assemblies or other items that might need that. Dr. Garrick, you had a question for Joe about the potential impacts of dry handling on utilities.

The standard contract that we have with the utilities defines several criteria. One of them is that standard fuel will be at least 5 years old. So we are designing our facility around 5 year old fuel.

We have also implemented some other parameters that we think are quite bounding for the types of fuel that the utilities would be generating in the future, and we will be using that as the basis for our facility design.

So we don't see that the change from a wet to a dry transfer capability inside of our facility would really have an impact on that standard fuel definition, or the ability of utilities to ship to the repository.

Also, we have gone back to a rail-based transportation for emplacement. The handling on the surface between the several buildings will be rail-based. Earlier, we were moving to a multiple-wheeled transporter that would take the waste packages below ground.

We have stepped away from that and gone

back to a rail-based system. We had moved away from the rail-based initially because of concerns of tight radius turnouts in the underground.

We have increased the radius of that, and that supported moving back to a rail-based system, and we are doing that.

On the site plan, the things to take away. This is the overall, and there is the subsurface area. This is the north construction ramp. That does not exist now. Right now the existing as you saw yesterday is the north ramp, down through the main and out the south ramp, with the ECRB across it.

These are the north portal facilities, and all the emplacement facilities would be located there. This also shows though a 19,000 MTHM worth of aging pads. That is in addition to the 1,000 that is local to the north portal.

Zooming in to the surface facilities, this is the fuel depot, visitors center, some of the admin type buildings. The transfer facilities are concentrated up here, and this is some of the support administration, warehousing and those sorts of things.

Going in a little bit closer to the North Portal plant is the rail line that comes in, and that is a storage yard for casks on rail cars, either inbound or out-bound, and there are a series of buildings through here.

The upper-most is for receipt of the empty waste packages. The one smaller one below it right here is the receipt of transportation casks. The one below that is not a building, per se. It is the buffer area.

That would be transportation casks that would have been removed from the national conveyance, and put on to the site conveyance, and the SRTC, site rail transfer cart. That would be an area to put those.

VICE CHAIRMAN RYAN: Paul, just a quick question to help frame this a little bit. Do you have a controlled area fence here or something that we could think about?

MR. HARRINGTON: Yes, that is the fence that goes around here, and is effectively the radiological controlled area.

VICE CHAIRMAN RYAN: Thanks.

MR. HARRINGTON: Working down the next side, this is the canister handling facility, and that is where canisters could be transferred from a transportation cask to a waste package, and the waste package is welded up and then sent underground directly from there.

The next building down is DTF-1, and on the bottom side of that is the integral remediation building. Below that is DTF-2, and below that is space set aside for future transfer facilities should through put needs warrant it at some time in the future.

Moving to the transportation cask receipt facility, we will walk through the individual buildings, the floor plans. This is a fairly straightforward building. Incoming waste packages come in on the top and side of the building.

Several of the bays have rail access, and so you can run a rail car in there. Several of the bays do not have that, and you would run trucks in there. And all of the bays have a rail coming out of the bottom that accesses this site rail transfer cart system.

So you would simply move the national conveyance into the upper end of that building, using an on-site locomotive. There would be an empty SRTC, a transfer cart, set in one of the other bays, and an overhead crane would pick the transportation cask off of the national conveyance, and put it on to the SRTC.

That may require that impact limiters be removed. If you physically could not lift it with the impact limiters on, they would have to be removed, and the transfer done, and then reinstall the impact limiters for the continuation of the move of that transportation cask over to the actual waste transfer buildings.

The next sketch is of the canister handling facility, and if there were a transportation cask that had disposal canisters in it, then it could come to this facility. That set of disposable canisters now includes the Navy canister.

Those are relatively large, on the order of 6 feet in diameter, by about 15 feet long. The Navy long is the heaviest canister that we would have. There are also several DOE canisters for high level waste, and spent nuclear fuel.

We will come later to that in our discussion to what those are. They are really unchanged from previous briefings that we have given. Okay. In here the SRTC would come in the entrance there, and there are a series of three welds here.

The waste package would be upended and taken off of the SRTC here, and then lowered into one of the transfer welds. The two welds that are adjacent to it to the left can accommodate either a waste package or a site storage canister.

And the waste then, this is a shielded transfer area, and the transportation casks would be opened, vented, purged, cooled, and the tops removed, and the transfer would be done by an overhead crane.

It would grapple on to the canister, pull it out of the transportation cask, translate over above whichever receptacle it was going into, and then be lowered into it.

After that was lowered in there, then the -- assuming there was a waste package, would be picked up out of its transfer weld and moved over and put into the closure cell there. In the closure cell is where the three lids would be installed, welded up, and a non-destructive examination would be done.

In the waste package discussion, we will go into more detail about what that actual closure detail looks like now. It is a little different and simpler than what we have had in the past. So after the welding, the inspections, the testing, are completed in there, then it would be taken out and moved over, and down-ended on a table here.

There is a transfer table at that point. Joe mentioned briefly that we had changed the mechanisms for lifting waste packages. Rather than having a split ring collar around them, and there will be more graphics later in the waste package, it is basically like a camera lens bayonet.

You can install it. It has several large threads if you will on it. You turn it about 60 degrees and it engages. It is a simpler mechanism, we think, than having to clamp and remotely bolt and remove individual bolts from the old style.

So those lifting collars would be removed and then the waste package would be sitting on the emplacement pallet at that point. The pallet would be picked with the waste package on it, and put on to the subsurface emplacement transporter, and moved into the shielding part of that transporter, and then be ready to be taken underground.

So functionally that is a fairly straightforward building. The transportation cask comes in, and put into a weld, and opened, and the canisters are transferred into either a waste package or a site storage cask, and then the waste package or storage casks are closed, sealed, and taken out the left-hand side of the building.

The direct transfer one facility and remediation combination is more complicated. The main through put, and I will give you a very quick overview, and then go back in more detail, waste packages come in either of two lines here.

And this area constitutes a transfer cell. Transportation casks and site storage casks come in this line, and they are fed to ports here or here. So the basic transfer mechanism happens right in that cell.

The waste packages, after they have been loaded at either that port or that port, are moved out into this gallery, and there are three closure cells here. That is the same as in the canister handling facility. That is where the lids are completed being installed, welding, testing, et cetera.

And then the waste packages are moved out into this area, and that is where they are down-ended, and the lifting collars are removed, and put into the subsurface emplacement transporter and taken out to the subsurface.

In a little more detail the incoming here, there is room there to remove the impact limiters, the personnel barriers, those sorts of things that are on the transportation cask during national transportation.

The two plugs there are for the transfer of waste into the waste package proper. There is also a small cell as part of that overall cell that has some capacity for lagged storage.

It is on the order of 48 PWR assemblies, 72 or so BWR assemblies, and 10 of the DOE SNF or HOW canisters. There is no storage capacity in there for the large Navy-type canisters, because there is no reason to store that. You would not bring it into the building to do a transfer unless you had a waste package there and available to do it.

But given that the capacities of the transportation casks, and the waste packages, are somewhat different, we may need to do some mixing and matching. So there is some capacity there in that small lag storage area to be able to either load fuel into that if you are unloading a transportation cask.

It is larger than the waste package, or pull from that as you are loading out a waste package. There was a very small capability for mixing and matching hotter and cooler fuels, but it is not near the inventory capacity that earlier designs of the facility had.

CHAIRMAN GARRICK: Okay. Is that going to handicap you in terms of having options for controlling the temperature of the fuel that is in place?

MR. HARRINGTON: It will make it somewhat more difficult to do that, simply because I won't have the wide variety of fuels to pull from. Practically speaking, it would be reasonable to expect though that many of the utilities would want to clear out much of their fresher hotter fuel first.

So to have planned the facility around an expectation that you were going to get a mix, and all it took was a little bit of inventory to really blend it well, was probably optimistic.

That is why we are now looking more at the aging pad. If we get a campaign of relatively fresh fuel, and 5 year old is the minimum for the standard contract, then conceivably we can put it out on the aging pad to continue to cool.

CHAIRMAN GARRICK: Is the 5 year requirement something that could change?

MR. HARRINGTON: At this point, I would not anticipate changing it.

CHAIRMAN GARRICK: I see. It seems kind of strange that generators would go along with it, because their idea is to get back to the old days when reprocessing was available, and they could get rid of the fuel in 90 days or something close to that.

MR. HARRINGTON: If we used up the

inventory that the utilities would have that was older than 5 years, we might revisit it. But there is a lot of inventory there that is older than 5 years.

CHAIRMAN GARRICK: Okay. Well, I know that there is, but sooner or later you should catch up, and that was the only question.

MR. HARRINGTON: If we ultimately get to that point, certainly we can revisit some of that. But not now. Okay. A little bit of lag storage right there. The loading takes place in those loading ports. These are the two transportation cask ports that would be used to do the transfer.

That is one fuel handling machine and crane assembly in there; the fuel handling machine for the individual fuel assemblies, and the cranes for the canisters.

Over here this gallery has room to stage several completed waste packages. At the point of transfer, we would put the inner stainless steel lid on to the waste package at that point. We would not have engaged the shear ring that will retain that lid in place, but at least the lid itself will be in there.

The movement from that cell over the closure cells, it will come out on a cart, and the crane would pick it up and move it over, and put it on to a different cart, and be rolled into the closure cells.

In the closure cell the shear ring, and spread ring, would be installed. There has actually been a mock-up of that fabricated up in Idaho. They have run it and they did it on the smallest diameter waste package sample that we are looking at and it worked.

It seemed to work well, and we saw the videos of that. Then the welding of the shear ring would take place. That is something that I will defer to the waste package discussion, because in there we have a good graphic of that.

After the closure and non-destructive examination of those welds, the testing for the guidance, then it is brought out on the trolley cart, and picked up by the crane, moved down, and put into this area.

And that is very similar to the back end of the canister handling building. The same types of equipment would do the down-ending, and do the lifting collar removal, and pick the waste package on its pallet, putting it into the shielded subsurface transporter, and it would be ready to go.

Now, this lower part of the building is the remediation section. There is a small pool available in the lower right-hand corner.

The intent is not to have any sort of storage there, but rather if there were actions that had to be done on a canister, on a fuel assembly, that you could better do with more direct access to it while it was under water, rather than having to do it remotely through manipulators, through video cameras, and that sort of thing. That could be done in that pool area.

Also, opening of non-disposable canisters happens down in that general area. There is certainly canisters out there now that are being used at the utilities that are not qualified, and have not been designed for disposal. So we would not be able to dispose of them as is.

So this design allows us to open those, and remove the fuel assemblies, put them into waste packages, and dispose of the fuel that way.

Site aging. In the EIS, we addressed that we could have as much as 40,000 metric tons of heavy metal capacity for aging. A year or so ago, we were looking primarily into 1,000 MTHM, and some of the through put analyses, the thermal analyses that we are doing, indicated that some additional amount beyond that 1,000 would be necessary.

So we are looking here at up to 20,000. It is a series of relatively identical modules, and as we conclude those thermal studies and through put studies, the final amount of aging that we believe necessary may change from this.

So the individual aging facilities are really all the same. This block has about a thousand metric tons capacity, and 20 percent there on the left is devoted to the new homes type canisters. They are in existence now, and a number of facilities have them.

We would need a facility that would be able to receive and continue aging them as need be prior to putting into waste packages for disposal. There are also a number of facilities that have the independent vertical, cylindrical, type of waste storage casks.

So, 80 percent of the capacity of an individual module is devoted to that stand alone canister type concept. We have not chosen a particular vendor for this. That is sometime down the road.

This is a concept for that, and we will

have to work out what the design parameters for those need to be. Joe mentioned earlier this morning that one of those design parameters may need to include aircraft crash resistance.

Phased implementation at the surface facility. That would give us the ability to have a higher chance of meeting a 20-10 initial operation. If you start small rather than building out the very large facilities that we have had in the past, we think that will improve the confidence of being able to do that and make that milestone.

The inclusion of the remediation integral with the processing and handling within the same facility we think is more efficient, rather than having it be a separate facility, and having potential problems with transfer of a fuel assembly, or possibly a cask or waste package and having an assembly stuck in it, and trying to get it from one building to another did not make much sense.

So inclusion of that capability into the one large structure we think makes a lot of sense. The adoption of lessons learned for DTF-2. If we find either from our own experience in DTF-1, or other international experience, that fundamentally there should be some changes made, we would have the ability to react to that, and accommodate that, in the design, and in the finalization of DTF-2.

I will restate though that the LA will address DTF-2. It is part of the facility design, and so we realize that we need to come in with a case that does include DTF-2 and its design. Let's see.

You see the construction sequence for surface facilities. In Phase I, that would include the transportation cask receipt facility, and also the canister handling facility, the dry transfer facility, and 6,000 MTHM worth of aging. That is the 1,000 local to the north portal, and one of the 5,000 MTHM modules slightly away from the north portal.

And some of the DOE facilities admin, and warehousing certainly will be necessary. Some of the ES&H support structures will be necessary. Phase II would come in after that, and include the second dry transfer facility, the balance of the aging, and the balance of the plan.

Let's shift over for a moment to the PSA results. There were no Category I or II external event sequences identified for the surface facilities. We looked at all the different external events that might happen, and none of them ended up falling into Category I or II event sequences.

We did identify two Category I internal event sequences, and those both dealt with drop and collision of commercial spent fuel assemblies in the DTF.

The reason for that is simply the sheer number of individual fuel assemblies that we are expecting to have to handle. The individual drop rate is very, very low, but the number of assemblies is high enough that it put it into that category one area.

There are 31 Category II internal event sequences for the cask, canister, and assembly handling, and again there are drops or collisions in the surface facilities, and not just the DTF. But because of the Category II picking up 10 to the minus 4 event sequences, there are some of those in the other waste handling facilities on the surface also.

For the 1,000 MTHM aging facility, there were no Category I or II event sequences. As that increases, we have to go back and revisit that with the greater number of handling events that go on there, plus the footprint that it takes up.

Likewise, the canister handling facility and that greater aging capacity was not part of the design in April, and so therefore it was not part of the PSA, the preliminary PSA results, but will certainly have to be rolled into the final LA PSA.

Dose consequences. The sum of the off-site doses from normal ops and the frequency weighted Category I event sequence doses are below the regulatory limits. The frequency weighted Category I events, we looked at the annual probability of the Category I event sequences, and added that to the off-site doses, and looked at the regulatory limits.

So of the worker doses from normal ops and the Category I event sequences are likewise below regulatory limits; and the Category II off-site doses also are.

Certainly as we redo the PSA based on the final LA, we have to revisit that, but that was the conclusion of the analysis on the April '03 design.

Classification analyses themselves. Those systems, structures, and components, that are credited for prevention or mitigation of Category I or Category II event sequences are important to safety. That is basically paraphrasing the NRC's definition.

In our parlance, we are classifying them as safety category, rather than our trying to draw a distinction between an important to safety, versus important to waste isolation. We just came up with the term safety category to include both of those.

Natural or engineered barriers that are important to meeting Part 63.113 performance objectives are important to waste isolation, and are also classified as a safety category.

SSCs that are not important to safety or to waste isolation we are classifying as a non-safety category. That is somewhat of a change from a power plant parlance, where we talk in terms of Q or non-Q, given that we have ITS and ITWI. SC is basically Q for us.

What are those SSCs that were classified as important to safety? Structures, the actual structures themselves, in which we handle the spent fuel assemblies, canisters, or casks, casks without their impact limiters, are important to safety. That is their consignment function that they play.

The important to safety subsystems and the cask receipt and return system conclude that a receipt of the cask itself, the preparation of it, and the cask buffer subsystems, the ITF systems in the dry transfer facilities, have the cask preparation, the waste package itself, the canister, this SNF and high-level waste transfer systems, again barriers and drops primarily.

And the other ITS systems include the transportation casks, the waste packages themselves, remediation system, and placement and retrieval system, and the aging system. Again, barriers and drops.

But those things that are barriers and that are important to avoid dropping or impacting the barriers, are those that graded out as important to safety. Let's shift over to the aircraft hazard evaluation.

VICE CHAIRMAN RYAN: Just a quick question before you leave that, and it is out of my own ignorance, and I apologize. But when you say system, you mean instrumentation and all the kinds of things that would provide information to operators and all of that as part of the system, or are you just referring to the mechanical handling systems?

MR. HARRINGTON: No, no, the systems include all the --

VICE CHAIRMAN RYAN: Okay. I just wanted to be sure that I understood that. Thanks.

MR. HARRINGTON: Now, we have done a couple of aircraft hazard evaluations over the last 2 years, and we looked at the hazards that were on the Nevada Test and Training Range, and also the Nevada

Test Site, and the commercial, general aviation, and military flights that are out in the Beatty corridor.

That is the name that we have given to the commercial aircraft flight path that is to the southwest of the corner of the test site. That is generally 8 miles or more away from the north portal area.

Our approach was to see if we could screen out impacts of aircraft based on probability, and we used a methodology that was similar to the NUREG-0800,a nd we made some minor modifications to that to deal with the north portal being in the middle of the test site, and in the middle of some of the military flights, rather than off of a flight path.

There were military flights that were not restricted to a flight path, and so we made an adjustment there to account for that. We got flight counts from the FAA in Las Angeles for the commercial traffic that was through there.

One of the comments that the NRC had in our technical exchange a month-and-a-half or so ago on the aircraft crash evaluations was that they wanted to see more, and that we needed to provide more information, and we are certainly taking that to heart.

We are getting more information, both from FAA and from the Air Force. We got flight counts from NTTR, and we have been looking at the crash rates by the type of aircraft. Some aircraft are more susceptible to crashing than other types are.

The initial study screened out that hazard for a 100 year operational period, and only 1,000 MTHM worth of aging pad. There was certainly a lot of discussion as to some of the bases for the conclusions that we had drawn in that.

We are working with the Air Force to get a better set of information to better support that sort of information. As we looked at increasing the aging pad, the ability to screen that out became very marginal, if even at all possible. But that was also based upon a 100 year duration.

If the aging pad would be emptied within 50 years, we thought it supportable, justifiable, to use a 50 year period for that though. Both of those are somewhat moot though because in the continuing interchanger that we have had with the Air Force, we found that they are significantly changing their access to the Nevada Test Site for their operations.

Previously, the test site, because of its testing operations, had been an area that the Air

Force could overfly, but they didn't actually conduct training missions over test site area.

There was only one permanent no-fly area on the test site, and that is over the device assembly facility, DAF. There were none on other parts of the test site. We had been looking at the Air Force flight historical data with the assumption based on the discussions with them that that would continue to be the case.

We are putting into place a more formal agreement with them for them to share upcoming changes, and we knew of some potential changes that might come from the introduction of the FA-22.

But in the discussions that we had with them, because of the change in the test site's mission, the Air Force is going to become more active over test site land. That will certainly have an effect on the probabilities that we had rolled into the analyses that we had to date.

So we need to go back and just reassess that whole process. As Joe said, and as I think I said once before, one of the results of that might be to impose crash resistance, at least upon the aging facility casks. We will just have to do that analysis and see what the results of them are.

Surface Facility ALAR, and worker safety issues. We are using a 500 millirem per year design goal for worker protection. The design guide items are the normal ALAR, time, distance, and shielding, to minimize the operations that might have to be done manually in radiation areas.

To improve the reliability of process equipment, and minimize the possibility that someone might have to actually access a radiation area to do equipment maintenance or repairs, and those sorts of things. Increase the distance, et cetera.

The sorts of things that we are doing are really to look at remote handlings for those high RAD areas. You will see operating galleries on those sketches that we walked through, and there is a lot of remote manipulator control available, and closed-circuit t.v. cameras, and operating windows, and local manipulators, and that sort of thing, to provide worker protection.

In that the Cogema experience at La Hague and elsewhere has really been very valuable. They have a lot of history operating a very large facility, and not just doing the sorts of things that we are doing, but also dual processing there.

So we are able to pick up a lot of that

sort of information. Okay. That is the end of the prepared remarks on the surface facility. We could take questions on that now, and then if you wanted to take a little break before we go on to the second part that would be fine.

VICE CHAIRMAN RYAN: Any general questions?

CHAIRMAN GARRICK: One of the lessons that we keep learning in some of nuclear operations, including the nuclear power field, is the issue of inadequate laydowns for repair, and inspection, and what have you. How much is maintenance inspection, and other activities associated with interruptions that could occur?

How much has that entered into your layout? It is very hard to see on these drawings?

MR. HARRINGTON: We have maintenance people just to make sure that their needs are adequately captured. We also have been doing some modeling using a couple of different programs -- Goldsim (phonetic) is one, and I don't remember what the other one is. Witness, right -- to model the through put through there to make sure that the activities that have to be done on the bolting of lids, and laydown functions, and pulling equipment off, is adequately modeled, and therefore captured in the design.

Preston, you have got the mike there if you want to elaborate on that, and if so, please do.

CHAIRMAN GARRICK: Please give you name.

MR. MCDANIELS: My name is Preston McDaniels, and I am with DOE. Other areas that we have been considering and we got included in the design are pulling a crane into a parked area, and shield it, and do maintenance.

We also have provisions in the design if a shield door fails, and we can do maintenance on it in a shielded environment. There are other activities that we are looking at potentially, remote change out of components where necessary in a cell where we do not normally have access.

So this is being considered and we are continuing to look at other constructibility and operability features that we need to build into the design to address the concern of what happens if, and our models also include the potential for varying ability of equipment to see how that affects through put.

Again, that may change the design requirements based on what availability the different equipment has.

CHAIRMAN GARRICK: Yes, I was going to ask if at the preclosure safety analysis, which you are calling PSA, which I wish you wouldn't. We have talked the NRC into changing it to PCSA to not be confused the international acronym of PSA, which tends to mean probablistic safety analysis.

But in the course of generating scenarios for the preclosure safety analysis, I would think you would look pretty close of incidents and accidents that you can get into, and what kind of recovery requirements are associated with those scenarios.

This has been a very valuable way to think out maintenance and repair requirements of other facilities, and I am curious if the PCSA people are working with the design people to make sure that you have the capability to respond to those kinds of events.

MR. RICHARDSON: Yes, that is a good question, John. This is Dennis Richardson --

CHAIRMAN GARRICK: How are you, Dennis? It has been a long time.

MR. RICHARDSON: Yes, and I am with the preclosure safety analysis, PSC, in Nevada. Yes, first of all, on industry experience. We certainly try to follow what is going on in industry. We follow -- I was just at a MOX meeting last week in Charlotte trying to get a feeling from them on what was going on there, and what they had to do.

We especially are utilizing our Cogema friends here in the contract to get their experience in France and at La Hague for the type of incidents and things that they have gone through.

And of course we bring the experience from the commercial nuclear industry in with this, too, with a number of people in our organization. One thing we tried to do was work obviously very closely with design day in and day out.

We try to walk through the hazards that we have analyzed to see if they think it is the same hazards, or if we have missed the boat somewhere, and have missed one, and in fact we are in the midst of doing that now.

We would document all that work to support our revised calculation in that, and probably the most important part of our work is that our going in strategy is to try to prevent as much stuff from happening as possible.

And so much of our design basis are for prevention, and the real key there is that we ask them to design something that is either impossible from their viewpoint, or very difficult to do, and there is where a lot of our dialogue and interactions take place obviously.

We try to make our job as easy as possible by preventing everything and not having anything to analyze. Of course, it can make their job very difficult.

CHAIRMAN GARRICK: Yes. Well, I was very curious about your ability to handle any kind of recovery operation, and the issue there is what kind of recovery operations are we talking about. I mean, that is something that you should be able to get out of your PCSA.

MR. RICHARDSON: Yes. We will be using obviously the credible event sequences that we are looking at, and also critical events that can happen in determining emergency operating procedures, and recovery operations that happen after the event to see what kind of equipment operator actions might be relied on to recover from whatever the abnormal event is.

CHAIRMAN GARRICK: Yes, okay. When did the north ramp come into being, and tell us again why?

MR. HARRINGTON: The new north ramp?

CHAIRMAN GARRICK: Yes.

MR. HARRINGTON: Oh, 2 years or so ago. Mark Board can answer that as far as when. The reason is constructibility of that additional set of emplacement drifts to the north of the existing -- of the north end of the north ramp.

CHAIRMAN GARRICK: Because it was not in the earlier designs as I recall.

MR. HARRINGTON: Right. It was as we started looking at the emplacement areas that our now marked as 3 and 4.

CHAIRMAN GARRICK: Are you saying that it is constructed motivated, and it is not operations motivated?

MR. HARRINGTON: Yes. In fact, we will go into more detail on that area in the next set.

CHAIRMAN GARRICK: Okay. All right.

VICE CHAIRMAN RYAN: I had must a couple of quick questions that follow directly to John's questions. And one goes back to the first thing that I asked, which is what is the radiological controlled area?

It is interesting that the whole fenced area is radiologically controlled, and that is counter to what a lot of facilities do. They tend to make radiological areas as small as possible.

Certainly security and so forth needs to be all fenced, and I understand that, but you raised the bar of health physics and monitoring, and all of that if you put it all in a radiologically controlled area.

So I appreciate any comment that you might share with me on that, and then the second is this question of automation, and you mentioned a little bit about it.

I am sure that there is a lot of detail that I don't have and have not seen, but when you raised automation, you raised the maintenance, and you raised the bar for repair and so forth.

So I think about both of those issues in terms of their radiological controls question. I would be happy to have any additional comments that you might have in those areas.

MR. HARRINGTON: Okay. Let's go to Slide 9.

VICE CHAIRMAN RYAN: Nine it is. We have a big one here, too.

MR. HARRINGTON: These are all buildings that will be involved in some manner in radiological waste handling, and the rail yard out here on the side. So what we are really looking at defining as a radiologically controlled area would encompass the rail yard and that set of buildings, and the aging pad.

It would exclude this set of buildings, and the other things, but because each of these buildings all have radiological material in them of some sort, either a canister transfer, or an individual fuel transfer, or the transfer of the transportation cask on to the site CAR, we are looking at just designing that entire area as the RCA.

VICE CHAIRMAN RYAN: I understood that is what you were doing, but it kind of implies, and again maybe you are not planning to do this, but if I am in building one, and I have an activity and I need to go to building two, do I change out and go to building two, and change back in?

Do I monitor and then go to building two? It makes that whole outdoor area part of the facility that needs a higher level of radiological monitoring than you might otherwise have.

MR. HARRINGTON: I just don't know your work flows well enough to know if I think that is reasonable or not.

VICE CHAIRMAN RYAN: Okay.

MR. HARRINGTON: Well, certainly if you want from one radiologically controlled area, a work area, to another, you would be exiting that one area, and having to sign out a RWP there, a radiation work permit, to go over to the other one and sign in on the new one.

But in terms of defining what is the overall radiologically controlled area, that is the broader area. We are not saying that whole area constitutes one RWP area.

VICE CHAIRMAN RYAN: No, I am not talking about RWPs. I am talking about exactly what you are saying, which is controlled area. The tendency in a lot of places that I am familiar with is to make them as small as possible so that the bar for monitoring is not as high, except where the work is going on. It is just something to think about.

MR. MCDANIELS: This is one of the areas that we have not fine-tuned yet. We are still looking at it right now, and obviously we have radiation and contamination zones in each one of the buildings that we are controlling access into. But your point is well taken, and that is an area we are looking into.

VICE CHAIRMAN RYAN: Just another example that comes from a slightly different perspective, but the rail yard, and especially the arrival yard. They arrive and it is a radiologically controlled area.

But they are at a siting somewhere in the middle of the country, or something, and it is not. There is a perception problem with that.

MR. MCDANIELS: Okay.

VICE CHAIRMAN RYAN: So how you define those areas I think needs very careful thought.

MR. HARRINGTON: And the second question had to do with the automation and the potential for increasing maintenance difficulties, and if you had a highly automated system.

MR. MCDANIELS: Again, in the cranes, for example, we are going to have a crane park area so that we can pull it out of the radiation zone and get it into area where we can do maintenance.

But obviously there are going to be areas that we are going to have to bring a component out, bag it out, sot hat we can get access to it, and change out.

So we are looking at remote change out of components where required, but it is an area again that we are looking into a lot more detail. We don't have a lot of the fine operating procedures and maintenance activities identified yet, but that is going to be one of the ongoing activities as you get further into the design.

VICE CHAIRMAN RYAN: One of us would be remiss if we didn't ask this question somewhere in this panel, and that is how much waste are you going to generate in all of the operational activities? And what will it be, Class A, B, C, or something else?

MR. MCDANIELS: We are hoping it will all be low level waste, classified as low level waste, suitable for disposal at a low level waste disposal facility.

The quantity, we have made some very rough estimates, and I don't have those numbers. We are obviously in a waste minimalization mode, and we are trying to minimize the quantity of low level waste we generate.

VICE CHAIRMAN RYAN: And don't get me wrong. I really appreciate the trade-off and waste generation maintenance, automation versus hands-on, worker dose. It is a complex algorithm. So I appreciate the task. But it is interesting to hear your views at this point. Thank you.

VICE CHAIRMAN RYAN: Ruth.

DR. WEINER: You mentioned that you did a surface facilities consequence analysis. How about a risk analysis?

MR. HARRINGTON: Dennis, I will let you answer that.

MR. RICHARDSON: Excuse me, but I didn't hear the very last part of your question.

DR. WEINER: You have done a consequence analysis for the surface facilities, the dose consequences.

MR. RICHARDSON: Yes.

DR. WEINER: How about a risk analysis? Have you contemplated that, or are you planning one?

MR. RICHARDSON: Well, in Part 63, we don't have per se a safety goal. So we in a sense are doing a probablistic risk assessment up to the point of where you might say combine all the Category II event sequences on the dose and everything.

That is not part of the regulation, and obviously that is something that you would do in a, let's say, Level II PRA. But in terms of the other elements of the instance of the PRA, we do each of those things.

We develop initiating events, and the event sequences from that. We do the frequency determination event sequences, and those that are within the Category I or Category II, we calculate the dose.

Now, on Category I event sequences, we do in a sense add those together per the regulation. But on the Category II, we look at the individual event sequences for compliance against the dose.

We don't have again a safety goal, per se, like a core melt limit, or early large release fraction, or anything like that. We look at the individual event sequences on that.

DR. WEINER: So basically you don't also report the risk as well as reporting the consequence?

MR. RICHARDSON: Not per se. But in terms of the strict or what we have to show for compliance with Part 63, that is not part of that.

DR. WEINER: The second question is that you have done a hazard assessment for aircraft crashes. How about a vulnerability assessment for your facilities?

MR. RICHARDSON: Well, are you getting into --

MR. HARRINGTON: Dennis, when we do speak, please announce yourself. As far as vulnerability assessment for the facility itself, and this is Paul Harrington again, no, we have not done a formal vulnerability assessment, if by that you mean a probability of penetration of the facility, for example?

DR. WEINER: And the consequences. I mean, how vulnerable are your facilities?

MR. HARRINGTON: Our first approach was to see if we could screen them out. As I said, initially we thought that we probably could address aircraft crash by a low probability, beyond Category II. With the change in Air Force flight patterns, we may well not be able to do that, and we will possibly have to get into consequence evaluations.

DR. WEINER: So you would be planning or possibly planning to do a vulnerability assessment of your surface facility?

MR. HARRINGTON: Yes.

DR. WEINER: In your staging areas where do rail cars sit if there is no immediate space for them to be off-loaded? Do you have a place where you can pile them up so to speak?

MR. HARRINGTON: Back on that Slide 9, the north portal plant, there was an area that is a rail car staging right here on the right side of this sketch.

DR. WEINER: And you think you can accommodate enough cars there?

MR. HARRINGTON: Yes.

DR. WEINER: So that you won't get backed up to the point where you can't get any through put?

MR. HARRINGTON: Right. Well, we also are responsible for transportation. The DOE is also responsible for transportation.

DR. WEINER: So you would stage that I would assume?

MR. HARRINGTON: Right.

DR. WEINER: How are you planning to handle the high level waste canisters?

MR. HARRINGTON: In the same manner as we talk about there. There are also sealed canisters, and they are 24 inches in diameter generally; and 10 and 15 feet long. The same overhead crane grapples on to them, and pick them out of the transportation cask, and put them either directly into the waste package, or into that little bit of lag storage area.

DR. WEINER: So they will be handled just like canister fuel?

MR. HARRINGTON: Right. Functionally, there is really no difference between any of the canisters.

DR. WEINER: Okay. Thanks.

CHAIRMAN GARRICK: Back to the question

for just a minute of recovery and maintenance, and what have you. In these scenarios that you considered were there any scenarios that would be greatly facilitated from a recovery sense by having hot cell capability, and how much hot cell capability if any do you intend to have?

MR. HARRINGTON: Well, define hot cell capability for me if you would. Do you mean additional capacity, or the ability to work via manipulators and windows?

CHAIRMAN GARRICK: Yes, by hot cell facility, I do mean where you have manipulators, and you can make repairs, and handle highly radioactive material safely.

MR. HARRINGTON: The remediation facility has that capability. It has the ability to do remediation both dry and wet.

CHAIRMAN GARRICK: Well, I was wondering whether this is where you were planning to do it, but you don't call out a hot cell specifically?

MR. HARRINGTON: No, not by that term. Let's see. Let's go to Slide 12, please. Preston, this area right here is the right area. That is a dry area. It is titled, DCP cutting and waste package remediation.

If we needed to do dry remediation, dry hot cell work if you will, that is the area that would happen, right in there. You have view points and manipulators from this work area here and that can be done there. That is a parallel capability if you will to the wet remediation capability there.

CHAIRMAN GARRICK: It is a little different than a real hot cell. Are these permanent manipulators that you are going to have in those locations, or are these equipment that you bring in on an as needed basis?

MR. HARRINGTON: Oh, there will be some permanent in there.

CHAIRMAN GARRICK: It will be permanent remote manipulators?

MR. HARRINGTON: Yes.

CHAIRMAN GARRICK: And what kind of shielding is -- what are you capable of handling there? What is the shielding of that particular room?

MR. HARRINGTON: Preston, you can talk to the shielding as far as what we are capable of handling.

CHAIRMAN GARRICK: Well, when I think of a hot cell, I think of high density windows, and high density concrete, and a real capability to handle essentially anything, and total remote manipulation capability, and I don't think that is what these are. But go ahead and tell me what they are.

MR. MCDANIELS: This is Preston McDaniels again. This would be a fully loaded waste package, which is our worst case shielding design basis. So there would be approximately 4 foot walls, and with viewing windows, shielded viewing windows, and remote manipulators.

And of course as we get into a specific remediation case, we may need to build special tools so that we would have the capability to bring in a special team in for remediation.

CHAIRMAN GARRICK: Primarily these are for production are they not? I mean, these rooms are going to be used routinely.

MR. MCDANIELS: For remediation only, and as well as the dry or dual purpose canister cutting and opening. But for remediation, it is on an as needed basis.

CHAIRMAN GARRICK: I see. Okay. All right.

VICE CHAIRMAN RYAN: Jim.

MR. CLARKE: Just a general question on the sequence. If I understand your intent, it is to build what you need to get started and then at a later date to expand at least two of the facilities. The subsurface construction is going to be phased as well?

MR. HARRINGTON: Yes, it is.

MR. CLARKE: And obviously those will dovetail to some extent?

MR. HARRINGTON: Yes.

MR. CLARKE: And do you expect the through put to increase with time as you --

MR. HARRINGTON: Yes, the through put requirements out of the Level I DOE requirements document are 400 metric tons of heavy metal the first year, and I think 600 the second, and 1,200, and 2,000, and 3,000. So it is a 5 year wrap-up to 3,000.

MR. CLARKE: Okay. So when do you expect Phase II; how many years after Phase I?

MR. HARRINGTON: I don't know that we have a schedule for that yet. I mean, there probably is, but I just am not the one who has it. Just simply some time to follow Phase I.

MR. CLARKE: Okay. I really just wanted to clarify my understanding of the sequence.

MR. HARRINGTON: Okay.

VICE CHAIRMAN RYAN: Any other questions?

Paul, perhaps this is a good time to take a break. I have 20 minutes of. Why don't we break until 5 minutes of 3:00, and reconvene with the other two presentations.

MR. HARRINGTON: Okay.

VICE CHAIRMAN RYAN: Thank you very much.

(Whereupon, at 2:40 p.m., the meeting was recessed and resumed at 2:55 p.m.)

VICE CHAIRMAN RYAN: Okay. Paul, we are in your capable hands once again. Please proceed.

MR. HARRINGTON: Okay. I was looking for my BSE support person.

VICE CHAIRMAN RYAN: Let me ask you to yank that microphone a little closer to you so that we can hear you better.

MR. HARRINGTON: Okay. For the subsurface facility, I will do the same thing that I did for the surface, and walk through what the facility is trying to accomplish and what it looks like now, and the changes recently, and then roll in the preclosure safety analysis results.

It is to accomplish several thermal goals, and one is the cladding temperature limitation of 360 C, and that is really a post-closure issue, with a preclosure ventilation. That should not be approached.

The preclosure drift wall temperature will be limited to 96 C, and postclosure drift wall temperature limit to 200 C. We do still want to allow for drainage of liquid phase water in the pillar between the adjacent emplacement drifts.

The ventilation system is still sized for 15 cubic meters per second per emplacement drift, and that would run for 50 years after the last emplacement.

That 15 cubic meters per second is on the order of 2 miles per hour, and just to give a sense as to what sort of a breeze might be down there. The waste packages are also emplaced a 10th of a meter end to end.

The changes recently to the subsurface design, we revised the panel layouts a little bit, and moved them to the north somewhat. Because of the waste package spacing being fixed at a 10th of a cubic meter, or a 10th of a meter end to end, we did not need as much emplacement drift spacing as the SR figure that Joe Ziegler had put up.

So that is why on the current designs that you are not seeing that fifth panel at the different elevation. Fixing the 10th of meter end to end says that you just don't need that much extra space.

It is there and it is available should we for whatever reason need to ultimately use that. It is not excluded for any reason, but it just is not necessary for the number of waste packages at that 10th of a meter end to end. So that is why it came off there.

The ground support, the ground control materials have changed. There is a graphic there later, but basically it is going from wire mesh and steel sets with some rock bolts, to a liner type in the emplacement drifts.

We went back to the rail systems as was mentioned earlier to move the waste package transporters from the surface to the subsurface emplacement drift openings.

The actual emplacement of the waste package inside the drift had not changed. That had had a rail system, an emplacement gantry transversed that rail system. None of that has changed.

We increased the radius of the turnouts at the emplacement drift openings to accommodate the longer wheel-based transporters. And the ventilation control doors. Our old graphics showed those doors basically at the end of the straight section of the emplacement drift.

They have been moved out to be adjacent to the perimeter main. So after you pass through those doors, and go through the turnout, there is no extra set of doors at the emplacement drift proper. They are at the loading dock.

Panel numbers show the proposed sequence. The first set, panel one, is right there. This again is the ESF tunnel down, and then back out the south. So there are eight emplacement drifts that would be taken off the main at that point, and we would need at least three of those to begin emplacement activities in 2010.

The second phase of that first panel would be the remainder of the eight drifts then, and then panel two has 17 drifts that excludes the contingency area down below there. Then panel three, east and west, and panel four, off on the west side.

The total emplacement length available is about 41 miles, or 65 kilometers. That contingency area there at the bottom represents about a 12 percent case for the 70,000 MTHM, and that is a little over 11,000 waste packages, with the tenth of a meter end-to-end spacing.

The first panel itself is again the eight drifts. It is about 4,100 meters worth of useable emplacement drift. It is about half int he lower lithophysal, and half in the middle non-lithophysal.

It gets ventilated with a supply coming down the north ramp, and there is an exhaust raised that would be taken off the back end of it; and a portion of it would be used for performance confirmation, with some very heavily instrumented tests for performance confirmation, and come off and go underneath adjacent to one of the emplacement drifts, with a PC axis drift, and then be able to instrument up into that one emplacement drift and adjacent rock areas.

The isometric of the emplacement drift itself, it shows the fabricated structural steel invert on the bottom,a nd it shows the emplacement gantry rails running alongside. It shows a series of different sized waste packages, each sitting on their emplacement pallets.

Generally the 21 BWRs and 44 BWRs are on the order of a meter-and-a-half in diameter. The widest ones are the co-disposal packages that have the one DOE SNF canister inside a ring of five; and DOE HLW, and that is a little over 2 meters.

And the Navy canisters are also about two meters in diameter. The drift shield that fits over the waste packages is a constant dimension. It simply is large enough to straddle all of the waste packages.

And so there will be varying clearance between the ID of the drip shield and the OD of the differing waste packages, rather than trying to make a drip shield that is varied in size. This is a simpler, and more straightforward design.

The entrance to the emplacement drift -- actually, let me go back to that for a moment. Back up one, please. This also reflects the shift from the rock bolts and steel sets, and wire mesh, to the perforated liner that runs down the length of the emplacement drifts.

So within the emplacement drifts themselves, it is a stainless steel perforated mesh liner, and stainless steel rock bolts holding it in place. The next slide, please.

Okay. This is the entrance of the emplacement drift, with the emplacement gantry running on its set of rails. These are the rails that come down from the surface facilities that are now rail based waste package transporter moves on.

This is the loading dock if you will. The gantry has the ability to come out on what is now a structural steel support set of members, and straddle the waste package, and pallet. It engages the sides of the pallet, and picks it up and moves it down the length of the emplacement drift.

That part of the operation is fundamentally unchanged from the last several years. It is still an electric-based locomotive for moving the emplacement transporter to and from the surface.

The invert, which is the fabricated steel invert segments, with an emplacement gantry crane rail on top, and this open area in the middle is where the pallets for the waste packages would sit.

There is a granular backfill installed there, crushed tuff compacted to provide a bearing surface for the pallets. They don't have to sit right on the cross-numbers of the invert material, but they can sit on that, or they can sit on the ballasted material.

And the invert itself is a steel structure, ballasted material, and it is carbon steel for the invert, and it supports the rail system, and the waste packages, and the drip shields.

The drip shields are actually not installed until the end of the preclosure period. So we have not changed that. The intent has been and continues to be that the waste packages sitting on the pallets are in the emplacement drifts through the preclosure period.

Then at the point at which we would do closure is when we would expect to bring in the drip shields, ballast material, crushed tuff, and an engineered barrier for diffusive potential. And also supports waste packages and drip shields.

Ground support. These are friction type rock bolts, 3 meters long, and the 3 millimeter thick perforated stainless steel plate, covering a 240 degree arc of that drift along the entire emplacement drift.

Bolts and sheeting made out of stainless for longevity, and we want to minimize the potential needing to access emplacement drifts to do any kind of maintenance, rock bolt maintenance, ground control maintenance, or anything else. We have moved to stainless steel components in there just to ensure their longevity.

CHAIRMAN GARRICK: Paul, you may have answered this, but is the ground support throughout always the same in the drifts?

MR. HARRINGTON: In the emplacement drifts, it is the same. But in the --

CHAIRMAN GARRICK: Whether you need it or not?

MR. HARRINGTON: -- other drifts, it is different, and we will get to that in the next slide.

CHAIRMAN GARRICK: I see. Okay.

MR. HARRINGTON: Throughout all the emplacement drifts, this is what it would be. The next one is the non-emplacement openings would use fully grouted rock bolts typically spaced within a meter-and-a-quarter.

Holding up welded wire fabric from spring line to spring line, or below if necessary to control reveling, and that is carbon steel material. Again, in the non-emplacement openings, we have accessibility for maintenance activities.

Turnouts and intersections, again fully grouted rock bolts and wire mesh, but inclusion of shotcrete, about a hundred millimeters thick, and lattice girders if necessary for those spans. The shafts for ventilation would have rock bolts and shotcrete or concrete.

The ventilation system is forced, and we have changed the ventilation design a little bit from VA to A. The intent now is that each of the emplacement drifts have access from one end, and the incoming air comes in that end also, and the perimeter drift on the other end of the emplacement drift is the exhaust main.

It used to be that we had much longer emplacement drifts, and we could do emplacement from either end with a central exhaust main. This is a little different. The emplacement would come from one end of the drift and exhaust is at the other end. That is the case in all of these.

So there are a series of supply shafts that feed the emplacement access mains, and there are a series of exhaust shafts that pull off the perimeter drift on the back end, which is the exhaust main now for each of the panels.

For the intakes, there are three shafts and three ramps. We use the ramps also -- north ramp, south ramp, and new north ramp -- for intake air supply.

The total intake airflow is about 1,700 cubic meters per second. That provides that 15 cubic meters per second per, with some leakage, and exhaust shafts, there are six of those shafts or raises, and note that is 17 cubic meters per second per drift.

Those are not standard CFMs, but they are actual so that the air is hotter, and it is expanded, but it is effectively the same mass flow rate.

Okay. The waste package transporter. This is very similar to what we have carried for the last several years, with the exception that we went back to the rail based system. A year ago, we had a series of wheels under there, and we were looking at running that on just a solid surface. It could be concrete and it could be steel.

But we have gone back to the rail based system. This has a platform that extends out from the shielded part of the transporter to provide access for the crane and the surface facilities, to lower the pallet and waste package on to that bed, and then gets retracted into the shielded part, and the shield doors close.

And the two locomotives, one on either end, move it underground. Then when it gets to the emplacement drift, one locomotive cuts off, and the other one backs it into the -- backs the transporter into the turnout, and the shield doors open, and the tongue extends, and the emplacement gantry comes, and straddles it, and picks the pick points on the pallet, and lifts, and moves down the length of the emplacement drift.

This item, this device, is about 350 tons with a waste package in it, and up to 65 unloaded. That is because of the shielding that is on it. It runs at 5 miles an hour maximum operating speed.

The manual and remote controls are through the transport locomotives. The emplacement gantry itself is really very similar to what it has been the last few years. It has four lifting hooks on it that engage the offset and the pallet so that we are not picking the waste package proper.

We are only handling the pallet that the waste package sits on. We have a series of wheels to move down and back through the emplacement drift, and operates at a smaller speed, 1.7 miles an hour maximum, and that is remote controlled.

And it has a bus bar for power pickup, and there will be some control mechanisms for that. Now, preclosure safety analysis results of that. There are no Category I or II event sequences in the subsurface facility.

The system structures and components that prevent Category I and II event sequences are important to safety though. What that means is that we are crediting performance of those components there at the bottom -- the waste package, and waste package transporter, and the emplacement gantry -- with providing the function that we are assigning to them.

Therefore, we are considering those because of the function that is assigned to them as being important to safety. But the event sequence, there are no event sequences that would involve failure of those, plus a drop and breach of the waste package, for example.

That is a beyond Category II sequence, but we are relying on those components to make that a beyond Category II event sequence, and that is why those components are classified as important to safety.

The next page is waste isolation. These items are important to meeting the 63.113 performance objectives. Now, on the Q list that we have prepared as a result of concluding this preliminary PSA, to be inclusive, we have included the important waste isolation components, barriers, features, as well as important to safety SSCs.

That way we would get an entire sense of those things that are important to the facility. The preclosure safety analysis though is not the vehicle that defines these as being important to waste isolation.

These came out of the total system

performance analysis, and the preclosure safety analysis folks picked that out of the TSPA analyses, and captured it in the Q list. So that we have the complete set of ITS and ITWI components listed in there.

But those include the subsurface facility itself, the drift inverts, the drip shields, the saturated zone between the repository and the accessible environment; and the unsaturated zone, the waste packages, the cladding for commercial and Naval fuel, and not for the DOE fuel.

The reason for that is we know that some of the DOE fuel is degraded, and cladding is not intact. We are not going to try and take credit for that.

Instead, the DOE fuel will be coming in robust canisters, and we will be crediting those canisters. And the waste form. The LARA and worker safety. The waste packages are not shielded. They are certainly robust, and they withstand the design bases events that we have assigned to them.

We have considered several times over the years whether or not we ought to provide shielding in the waste package proper, and have each time determined that that was not an appropriate trade-off.

Either of the result, and heavier waste packages, possibly more difficult to handle or recover from, or there would be more waste packages. Given that these are large heavy components, they have to be handled with robust mechanical systems anyway.

So we felt that we could do that reasonably remotely, as well as allowing contact access to the waste packages. So the waste packages are still unshielded, but as you have seen on the surface facilities, they is shielding, and there are remote controls for them.

And in the subsurface, they are transported in that shielded transporter, and that is providing a shielding mechanism, and also protection against rock falls and those sorts of things.

The drift turnouts reduce the dose and the access main, and they are not only a mechanism to get from one track to the emplacement drift, but the curvature of them and increasing that radius has provided additional rock mass there.

So that is providing shielding for workers and the access mains to the waste packages that are in the emplacement drifts. The ventilation control doors that are now out adjacent to the access mains are providing personnel access control.

There is also that we continue to maintain a differential ventilation pressure between the emplacement and the development side. We want to have the emplacement side at a lower pressure relative to the development side.

So that if there is any leakage of air from one area to another, it is going from where the development workers are to the emplacement side. Okay. That is the prepared remarks on the subsurface set, and before we go into waste package, I would want to take questions.

VICE CHAIRMAN RYAN: Sure. We can take questions that folks might have here. Ruth, do you want to start, please.

DR. WEINER: Sure. Could you go back to Slide 29, and I guess it is the replacement drift. What does that emplacement configuration do to the prospect of retrievability? I mean, how would you retrieve if you had to given that the drip shields won't be there.

I am assuming that the drip shields won't be there, but suppose that something happens to one of your containers. How would you retrieve one?

MR. HARRINGTON: In years past, we had considered having the capability of going in and picking an individual waste package from the middle of a string, and decided that was not a very good idea, because if you had component failure, it would be hard to recover from that.

So for the last several years the expectation has been to fill starting at the back of the emplacement drift, and then fill out to the access mouth of the drift.

That means that if you had to go retrieve a package, or all the packages, you would start retrieval from the mouth and work your way back to whichever package you were trying to get.

Isn't that making a lot of difficulty for yourself? I mean, wouldn't it have been -- I mean, I don't know because I am not an engineer, and I don't pretend to any engineering knowledge.

But wouldn't it have made retrievability more convenient, easier, if the emplacement were transversed to the rail direction rather than along it?

MR. HARRINGTON: There have been many different concepts of emplacement methodologies, and how you might orient it. Some of them are bore holes, or larger areas. This one we think gives us the best mix of construction costs.

This is a fairly straightforward tunnel boring machine access. It is a fairly straightforward set of mechanical features in there; the invert, the drift, and going to devices kind of like you were talking about, some of those were considered to be an individual bore hole off of the main gallery.

That is more complicated in many respects, and having to simply go in, and turn, and transverse, extract. If you had shielded packages, that may not be a problem. If you didn't, it would be a problem. This also is fairly conducive to ventilation.

The packages are sitting in a larger opening, and so you have that much greater surface area for heat to radiate to from the packages. If you went to the smaller holes, it is a lesser surface area, and you can see higher temperatures.

This really has been something that we have studied for a long time, and we kept coming back to this sort of --

DR. WEINER: I have a question, and I don't think you came on this sort of suddenly, or without a lot of thought. I am just concerned that as you pointed out, that if you have to retrieve a package, you have to pull out all the packages that are in front of it.

MR. HARRINGTON: Well, we think that is a lesser issue than some of the others that would have been introduced by other configurations.

DR. WEINER: Okay. The second question I have is that you are assuming I take it that the waste transporter and the emplacement gantry will never be involved in any kind of accidental fall?

MR. HARRINGTON: No, we are not assuming that.

DR. WEINER: Have you done a risk assessment for these?

MR. HARRINGTON: We have done probablistic analyses of the potential for drops, and the drop frequency of those. That's why those ended up being classified as ITS because we don't want them to drop.

We also are designing those devices so that they don't exceed the drop height that was defined as one of the design bases of the waste package.

DR. WEINER: So you are assuming that if they do drop, they are so designed so that they will not breach?

MR. HARRINGTON: We are having to look at the event sequence of a potential drop, which would involve having a failure of the emplacement gantry, for example, and also a breach of the waste package.

We would have to look at the probabilities of both of those, plus whatever else might enter into that particular event sequence, and the overall categorization of that, and that's why the potential for a drop and breach is less than 1 in 10 to the minus 4 based on the analyses that we did, and that is why it is not a Category II event.

But we are crediting the gantry for its ability not to drop, and we are crediting the waste package for its ability not to breach, and that's why those components end up being classified as important to safety, though they are not participants in an actual event sequence. We are relying on them to prevent the event sequence.

DR. WEINER: Okay. I guess that is all for now until I think of something else.

VICE CHAIRMAN RYAN: John.

CHAIRMAN GARRICK: Would you summarize once again the propulsion systems between the access drifts and the emplacement drifts?

MR. HARRINGTON: The which systems?

CHAIRMAN GARRICK: The power systems from moving this stuff around.

MR. HARRINGTON: Oh, in the access mains, the power to the locomotives is by overhead gantry, and that is current expectation. As far as the control system there, I would probably defer to Mark for that.

In the emplacement drifts there is a bus bar, I believe, running along there that the machine that the emplacement gantry would take its power from, and as far as the controls for that, there are several different technologies that we have looked at, including microwaves, leaky feeders, and I forget what the other one was.

And I don't know that we have actually made a decision on that. If I can have Mark Board talk to that a little more, please.

MR. BOARD: The decision on the control system for the gantry I don't believe has been finalized yet. As far as the transport of the waste package down the tunnel to the access main, there are two engines on it, one in the front and one behind, and the idea is to have those two prevent sort of a potential runaway of the waste package.

The one that could be decoupled on the front and in the switch thrown in the engine remotely back into the turnout, and there is a control system that will control when it docks into that docking bay that you saw right there and stop.

And then the bed plate that the waste package and pallet right on is remotely controlled after the shield doors are open to push the bed plate out on to the dock where the gantry will pick it up from that point on.

And from that point on the gantry is powered from a bus bar that runs down the invert of the drift.

CHAIRMAN GARRICK: Is there a reason that you went to an overhead system for the access drifts and a ground system for the emplacement drifts?

MR. BOARD: I am not sure of all of the reasoning behind that. I think the primary thing is that it is just simply a simpler system. It is well proven and it is out of the way from a construction standpoint. I guess the overall safety is the primary concern.

We have lots of room in the access mains, and it is something that is often used in underground in mining systems. I think that is the primary reason.

CHAIRMAN GARRICK: What is the life expectancy of the ground support system?

MR. BOARD: The total life expectancy I

can't exactly say. We were looking at -- the preclosure period that we are looking at right now is about a hundred year preclosure period, and we designed the system to be robust from an operational standpoint to easily last through that period of time.

I don't exactly know that we have determined ultimately how far we think that system would last, because once the system or repository closes, we are not counting on that ground support for anything.

CHAIRMAN GARRICK: Right.

MR. BOARD: We made it very robust also from the standpoint of requiring what we think is going to be minimal and no maintenance, and so it is kind of unconventional, the system that we are using, only from the standpoint that it is made out of stainless steel.

Every component that we have specified in there is in common use in the mining industry. It is just that we have sort of beefed the components up to hopefully make certain that we don't have to have worries about it.

CHAIRMAN GARRICK: Stainless steel, that sounds kind of extravagant.

MR. BOARD: Well, a hundred years is an

unusual requirement.

CHAIRMAN GARRICK: Right.

MR. BOARD: And stainless steel rock bolts are in standard use, and so lots of mines have high sulfite contents, which create acidic environments, and for example, both of these swellicks (phonetic) and split set type bolts, the same ones that you saw yesterday out there, are available in stainless steel off the shelf.

CHAIRMAN GARRICK: All right.

MR. BOARD: So they are a bit more expensive, but it is not outrageously more expensive.

CHAIRMAN GARRICK: Thank you.

VICE CHAIRMAN RYAN: Jim, do you have any questions?

MR. CLARKE: Just a couple of questions, Paul, and these are really more about operations than design, but they are inspired by design I guess. So the first one is a follow-up to the question that I asked just before the break.

And that is that as I understand it, you will be beginning a second phase of construction after the facility has opened, and at a time when the through put has been steadily increasing.

And I guess the point that I wanted to

make was that just adds another potential source of things that can go wrong, and you now have construction activities while you are receiving waste. And I wondered do your scenarios incorporate that?

MR. BOARD: The Coldsim (phonetic) and Witness modeling scenarios, or just the basic construction?

MR. CLARKE: Well, just the possibility of construction accidents and encounters with other vehicles.

MR. BOARD: In laying out the layout, and let's go back to Slide 27, please. The reason that this evolved over the last year or so was really to address construction and operations interfaces.

MR. CLARKE: And I am really thinking more about what is going on at the surface.

MR. BOARD: Okay.

MR. CLARKE: As you are building new or expanding existing surface facilities.

MR. HARRINGTON: Well, you will notice that the DTF-2 was offset from DTF-1, and there was a shielded corridor if you will between them. That sort of discussion is directly a result of -- or that sort of solution is a direct result of some of the operations concerns.

Some of the earlier facility layouts were focused on how can you optimally approach the north portal. But then when you looked at access to subsequent building construction, you found that you were constrained. So a lot of things have shifted around as a result of that.

That corridor is one thing where we see a recognition to provide an isolation between the operating DTF-1 facility and the DTF-2 facility to support the latter's construction as the former is operating.

So that is a mechanism to do it. It would also provide protected transfer of materials from DTF-2 to the remediation part of DTF-1, and that is why it is there.

But as we are doing the facility layouts, that is really one of the major considerations, is that given that not everything gets built and finished, and is operational on the same day, now do you then make sure that you are able to continue construction on the subsequent facilities.

The subsurface is really more straightforward than the surface, and it is repetition of emplacement drifts, and they lump them into panels.

MR. CLARKE: You're right. I was really

more concerned about the surface, and no additional activities going on, and other kinds of vehicles running around construction activities in the middle of an ongoing waste receiving operation.

MR. HARRINGTON: Right. I said earlier that the construction and -- well, I think I said operations and maintenance folks are involved with the design, so are the construction people, just for those sorts of constructibility issues.

MR. CLARKE: And my second question is related to Ruth's line of questioning, but a little more basic, and I may have missed something, but on Slide 36, the waste package transporter will have two locomotives associated with it.

MR. HARRINGTON: Yes.

MR. CLARKE: Manual and remote control operations; will there be people in those locomotives?

MR. HARRINGTON: Yes, there are.

MR. CLARKE: Okay.

MR. HARRINGTON: That is a shielded transporter, and so the operators in the locomotive cabs are protected.

MR. CLARKE: So you have two locomotives in case one of them has a problem; is that a factor as well?

MR. HARRINGTON: Yes.

MR. CLARKE: I guess I was wondering how you would retrieve the waste package transporter if you got halfway to your destination and something failed.

MR. HARRINGTON: You can access that. The waste package transporter, because it is shielded, you can have local personnel access. If it jumped the track or something, you could easily access it and jack it up, and get it back on track.

If you had a mechanical failure, you could have people access it hands-on to repair whatever it is.

MR. CLARKE: Okay. Thank you.

VICE CHAIRMAN RYAN: Sher.

MR. BAHADUR: Paul, on your Slide 29, when I look at this isometric diagram, I get the idea that the waste packages are stacked end to end on the transport rail system, and that they have been placed in a rock supported drift,a nd they also have a drip shield, which to me seems more like a genetic schematic.

Is there something that I am missing which is making it specific for Yucca Mountain or just a generic design?

MR. HARRINGTON: Well, that design is specific to Yucca Mountain, and it certainly takes into credit or into account the rock properties there. That is part of why we are looking at the ground control devices that we have assigned there.

As far as could you bore a hole and put materials somewhere else, yes. Mark, do you have something to add to that?

MR. BAHADUR: Well, what I heard was that these openings are going to have the rock support, whether we need it or not. So if that is true, then that does not make it specific to Yucca Mountain, and if we assume that the water is going to find its way, then you are going to use the drip shield.

So I am just trying to see as to what gives me the idea that after considering all of the factors of Yucca Mountain that this design has been finalized?

MR. HARRINGTON: Okay. I will answer from one perspective, and that is a maintenance issue. We want to have a very robust ground control mechanism that will minimize to the extent possible the need to potentially send people back into emplacement drifts having to do the unloading of packages if that were the case, or having to use remote tooling or something.

We want a very robust ground control mechanism. Mark, if you can talk to that.

MR. BOARD: Well, yes, I think it is -- well, I think the problem is that anytime that you look at any picture that it is difficult to see all the details that went into the design of that.

In our case, first of all, the ground support is very much specific to this project. We have done extensive calculations over the past year-and-a-half that were all aimed at examining what kind of ground support is specific and best for Yucca Mountain.

And, for example, the type of sheeting that we are using around the exterior is slotted to allow air circulation for drying the rock. The design of the slotting itself that we have is such that we can prevent even small rocks from falling off on the track.

The type of bolting that we are using and the spacing is specific to this rock type in this project. We are using the same ground support in both rock types that were in really more from a standardization point of view.

If you go to virtually any mine, I think you will find that in most places the same ground support is used on a regular basis to allow the mining crews to get good at installing something and using the same thing.

So we don't think that it is a good practice to change things based specifically on rock type. The invert design there has been done specifically for this project based on the waste package dimension and things.

The ballast that is placed in there, which we really have not talked much about, has been the compaction and the design of it has been such for utilizing the crushing of the tuff that we take from the tunnel boring machine, and take back underground.

The drip shield itself is very specific to this project and the design there, which I guess we will touch on a little bit later, has been very specific to this project. So I think that would be how I would answer that question.

VICE CHAIRMAN RYAN: Let me follow up just a bit on the design completeness and so forth, and I appreciate the fact that with graphical presentations like these drawings that it is difficult to understand some of the details, but I think about design as conceptual, preliminary, detailed, and final. Where are we, and particularly on these underground systems?

CHAIRMAN GARRICK: Or in the vanacular of the engineer-constructor world, conceptual Title I and Title II.

VICE CHAIRMAN RYAN: The percent complete, and I am trying to get a gauge as to where we are, because we have covered a lot of the conceptual details, but the rubber meets the road on the details.

MR. HARRINGTON: If I had to use one of those terms, I would use preliminary, but we agreed with the NRC that we would not use that, because that was in effect DOE terminology, especially the Title I and Title II terminology.

Instead, we will simply refer to this as the LA design, a design necessary to satisfy the requirements for the license application for construction authorization.

So we really have tried to stay away from referring to it as preliminary, versus conceptual, versus final.

VICE CHAIRMAN RYAN: That still leaves me confused. You know, I appreciate the schematic nature of these, but it is difficult to -- you know, I have spent a lot of time, for example, and again I am not a 10 year veteran of Yucca Mountain. So it is hard to probably educate me.

But we go from an overhead power trolley system to a bus bar system, and I am thinking, well, how does that transfer take place, and I don't see some of that detail.

And I just think about from my perspective safety and radiological control, and opportunity for mishaps, and if things were not to work exactly right, and then I think about, well, what stage is the design of these two transporters, and my mind turns to design construction and testing, and all of that, and I am just trying to think about where along the road of the process that these designs are.

MR. HARRINGTON: The focus that we are trying to hold is somewhat more detailed than the power plant preliminary safety analysIS report design. That was a two-step process, and this is a two-step process.

VICE CHAIRMAN RYAN: Okay.

MR. HARRINGTON: So in our mind that is the way we are interpreting Part 63 and the LARP when it says that you have to have a design. We will do that design. We have taken a number of different approaches in the past few years to try and clarify that to make sure that we don't provide less than what is expected.

We have talked in terms of percentages of design. I personally don't care for that because what is 40 percent. Is it a hundred percent of 40 percent of the stuff, or is it 40 percent of everything? Is it the rate of 40 percent?

That use of percentage is not real helpful. We have talked about PSARs versus FSARs, but each of us has a little different experience with what we saw in preliminary safety analysis reports versus the finals.

We bring a little bit of that to the table. So we have defined some matrices of specific products in the design organization that we expect to have done to support the license application. That is not to say that each of those things -- its drawings, its calcs, its analyses -- that they would be in the LA proper, but they would be completed to an extent necessary to support the license application.

A companion document with that was a text discussion of what degree of completion are those products to be. A piping and instrumentation diagram is not going to have vents and drains on it until you have done the physical layout to know where the high points and low points are.

But you certainly, and we believe that the NRC staff, will need to know what the components are, what the major pipes are, what the flow rates are, how this system operates. That is the kind of information, at least on the mechanical side, that we are expecting to provide.

Yes, that actually probably comes out of a 3-D model, but it looks like it might be a fairly simple discussion, with not much behind it. There is a lot of analytical information though that has been done that supports that.

They have done calculations on the rock mass properties, and on the strength of the rock, and on the types of ground control, and the thermal analyses that support it.

And the surface facilities, I showed you a series of sketches there, and they have done a fair amount of actual structural analysis of the concrete structures primarily.

They have done a lot of through put analysis, and they have Cogema, and Cogema has been on board for the better part of 9 months or so. They have all of their input in. We have redone the system description documents about a month ago, about the end of September.

And 33 or so of those came in, and revisiting and reclarifying the system requirements. So there is a lot of information that has been created to support these sorts of sketches, and we are trying to make sure that neither the NRC staff nor us are surprised when we go to deliver the license application with that set of material.

VICE CHAIRMAN RYAN: Thanks. That is a summary of what you have worked on with regard to these units and that is helpful. And I am again reminded of John's question about the airplane schedule.

So I am just trying to anticipate how much is left, and it is always a question that comes up when you hear what has been done. Thanks.

MR. HARRINGTON: Okay.

VICE CHAIRMAN RYAN: Any other questions or comments? All right. Let's go on to the waste package discussion then.

MR. HARRINGTON: Now, for the waste package, the design for the preclosure period, and analyzed for the post-closure period. So in that preclosure design, we are designing that such for each is beyond the category to prevent sequencing, that supports the preclosure safety analysis.

We will look at a series of event sequences. An object falls onto the waste package, and waste package drops, dynamic events, swingdowns, tipovers, vibratory ground motion, parametric fires.

There is a series of fires that are identified and will vary the parameters of those fires and make sure that the waste package doesn't breach. The preclosure design basis for rock fall. So that is the set of design bases for the waste package for the preclosure period.

For the post-closure, we will analyze its performance during the post-closure period. We have to look at a series of postulated events during that post-closure period that has the drip seal installed at that time.

Those support the model abstractions for TSPA, and look at damage from rock fall, and damage from seismic events, and distribution of weld flaws to provide potential and preferential pathways for early waste package failures, and stresses in the waste package, and base metal and weld areas.

We have done some mock-ups recently for the waste package, and in FY 2000 we fabricated a quarter-length test mock-up to validate the fabricability of that design, and performed stress measurements before and after welding of that mock-up, and demonstrated that we could actually use remote machine welding to do that.

There has been a lot of concern as to whether or not that might be a problem area in the surface through put issues, and the results of that mock-up was used in several of the developmental stages.

I mentioned earlier that we have now done a mock-up of the spread ring. This is for the revised stainless steel lid closure, rather than what earlier was a 4 inch open fresh weld to be made, and any projectable indications reworked remotely that did not seem like a high likelihood of success.

We have gone to effectively the same type of arrangement that the Navy has, where they main canister lid is retained by a shear ring, and call it a spread ring, and in 4 hours it is a single ring that you can see on the right there in that overlapped area right there.

And this machine basically closes the shear ring enough to allow insertion of it into the waste package end, and then that machine will force this end of that shear ring out, and engaging inside the groove in the waste package body, and that worked well.

And the developmental studies for the waste package gives us information, and rationale for the design, and any issues that might come up with fabrication, and that support analyses and model reports which are supportive of TSPA.

We have completed a series of studies already on weld flaw distribution, induction annealing, laser peening, et cetera, and there are several other studies that are planned for or are continuing this fiscal year now, this one that we just started.

Weld material and base metal variability studies, that was one of the items out of a KTI agreement; and laser peening and controlled plasticity burnishing corrosion study, and a fracture toughness study, and a welding interpass temperature study.

The prototyping of the waste package themselves, we want to demonstrate the fabrication process early enough in the design cycle that if there are changes that would be appropriate to make as a result of that, we can still do that.

So we are looking at prototyping so that we can make sure that they are fabricatable, and inspectable, and testable. We have to do NDE on them. Do the stress mitigation.

So they will be done to verify the closure processing systems, and also to support the handling; lifting, trunnion, collar, engagement exercise, and provide for operator training.

So we have planned for 15 waste package prototypes and that does not mean necessarily that there are 15 full-length ones. One of the things that we need to focus on is the making and inspecting of welds.

So of the waste package types are very similar. The Navy short is identical to Navy long, except for length. Those prototypes are looking at getting a contract cut by the end of this calendar year.

They would be produced over the next 6 years, and we expect to have bids in by July of '03. I'm sorry, to issue an RFP for them by July of '03. The 10 configurations there on the left are the same as have had for quite a few years now.

The change is both in the closure mechanism form, which is a slide or two later, and this lifting trunnion. This is the lifting trunnion. It has a pair of trunnions on the side there, and lifting collars is the right name for it.

There are three short threads if you will, like a bayonet lens on a camera is probably the best analogy that I can use. So you would insert that on to the end of the waste package, and give it about a 60 degree turn, and that would then be engaged on to the end of the waste package to support or to allow using that collar and trunnions then to pick the package into a vertical condition, vertical orientation, and handle it.

Recent changes to the waste package. The extended outer lid was replaced with a flat one. The induction annealing stress mitigation technique would be replaced by either laser peening or low-plasticity burnishing.

The middle lid was changed from a full penetration weld to a fillet weld, and that then allowed us to delete the stress mitigation step for that.

The inner lid became thinner, and the closure mechanism also changed from a full penetration weld to a spread ring. The split trunnion collar changed from the one piece like we talked about, and the gap between the inner stainless vessel and the outer Alloy-22 vessel was changed to better accommodate our expectations for a differential thermal expansion.

The closure details. The older design had a fabricated extended lid, and this was a full penetration weld out there. This is the support collar for the trunnion collar to be engaged on.

The middle lid had been full penetration, and the inner lid had been full penetration. So we have changed to a thinner inner-stainless steel with the shear ring.

So that was the tool that I showed you a moment ago that would engage that shear ring, and compress it enough to allow getting it down adjacent to the groove, and then allow the shearing to be extended back into that groove, and filler welds, and seal welds, would be made on the upper and lower interfaces of the shear ring to the body of the waste package, and to the inner lid.

And that middle lid, as a filler weld there, instead of the full pin, and the outer lid, goes to a much simpler design with a smaller, but still full penetration weld.

The drip shield design again analyzes for post-closure. The postulated events that can happen to it would include rock fall and vibratory ground motion, a seismic event.

There is a section of the drip shield, and the drip shields do not align directly with waste packages. They are a fixed length long and some of the waste packages are of varying length.

So the joint of a waste package doesn't necessarily line up with the joint of the drip shield segment. It is not important that they do so.

Now, these are changes that we are considering making to the drip shield. We have not yet adopted them, but one is to increase the distance from the bottom of the drip shield upper cover, the insider of the drip shield top if you will, to the top of the waste package.

That will allow additional deflection of the drip shield without contacting the waste package. Also, to increase the stiffness of the drip shield for bending loads, and to add some longitudinal stiffener beams along the axis between the bulkheads.

The materials of that are unchanged. They are still titanium grade. The preclosure safety analysis results. The waste package design considers both of the Category I and Category II event sequences as part of its design bases.

Because of that, inclusion of that as a

design basis, the robustness of the waste package, the breach of the waste package then we believe becomes beyond Category II.

That was part of the discussion that we have had with the NRC staff, both on the waste package and also on canisters, is might you have undetected flaws that would permit a breach that had not been accommodated in your design basis.

So we are looking at and have looked at what sorts of flaws might be undetectable, and what would the flaw distribution be, and so we think we will have an answer for that.

Classification. The waste package itself is important to safety, and the waste package and the drip shield are important to waste isolation because of the role that they both play in postclosure.

Again, because the drip shield isn't installed until the end of the preclosure period, it is not credited with any preclosure ITS performance.

In summary, we did the preliminary preclosure safety analysis and that was actually completed at the end of September based on the April '03 design status.

That indicated that we would be able to meet the regulatory performance objectives. We have identified SSCs that are in that design that would be important to safety, and engineered features which would be important to waste isolation.

We are working now to complete the design to support the license application. The PSA will need to be updated based upon that completed LA design, and we don't anticipate new event sequences.

So we believe that the LA would continue to be able to meet our regulatory performance objectives. Are there questions based on that?

VICE CHAIRMAN RYAN: John.

CHAIRMAN GARRICK: Given that the lid welds were considered one of the more likely pathways for moisture gaining access to the fuel, have these changes, development activities, and the consequence of the detail design, are they having an impact on what the license application performance assessment will look like?

MR. HARRINGTON: I would defer to Mike Anderson of BSE, the waste package design lead for BSE to answer that.

CHAIRMAN GARRICK: I am talking about the performance assessment more than the --

MR. HARRINGTON: Right.

CHAIRMAN GARRICK: Yeah, right.

MR. HARRINGTON: I don't do the performance assessments, and so I can't really --

CHAIRMAN GARRICK: Well, only because the lids were the most likely pathway for --

MR. HARRINGTON: You are talking postclosure TSPA, right?

CHAIRMAN GARRICK: Yes.

MR. HARRINGTON: Mike.

MR. ANDERSON: This is Mike Anderson, Waste Package Design for BSE. I, too, do not do the postclosure TSPA, but these changes are the result of a value engineering study that was conducted last fall, in which TSPA was a part of, and so they closely examined the bases for the --

CHAIRMAN GARRICK: I am having a little trouble picking you up.

MR. ANDERSON: Is that better?

CHAIRMAN GARRICK: Yes.

MR. ANDERSON: Let me start over again. Last fall, there was a value engineering study that was conducted on the waste package and particularly focused on the final closure and the feasibility of the induction annealing process.

And in conjunction with the folks from TSPA, they looked at what the real requirements were in terms of compressive layers, and weld microstructure, and how much time they had before it would become an issue and adversely affect TSPA predictions.

And as a result of that value engineering study, this recommendation came out. So in that recommendation, both low plasticity burnishing and laser peening were found to give adequate compressive depth to meet their long term performance goals.

CHAIRMAN GARRICK: Okay.

VICE CHAIRMAN RYAN: Ruth.

DR. WEINER: There is a question that I always wanted to ask. What is to prevent water from condensing on the inside of the drip shield, thereby sort of obviating the effect of the drip shield?

I mean, you are going to reach a certain humidity in the post-closure period, and given temperature differences, and so on, if water simply condenses from the air, it can condense as easily on the inside of the drip shield as it can on the outside. Am I missing something? What am I missing?

MR. ANDERSON: This is Mike Anderson again. The primary purpose of the drip shield to prevent direct adjective flow on to the waste package, and so it certainly has been postulated that what you say would occur.

But what you have then is water that comes in through the crack or the fracture network, and ends up in the invert, and finds it way underneath the drip shield and evaporates.

Now you have water that basically is distilled water that would condense on the inner surface of the drip shield and drip on to the waste package surface.

Now, there has been a lot of discussion about what salts and things like that, and dust is on the drip shield, and the interaction with that high purity water that would come from condensation.

But insofar as the purpose of the drip shield, it is the intersection of that adaptive flow and also interception of rocks that might fall from the roof of the drift.

DR. WEINER: So you are assuming that, first of all, that is a whole lot less likely to happen; and, secondly, if it does happen, that the water is of such purity that you don't have salt and other things enhancing corrosion. Am I correct in thinking that?

MR. ANDERSON: Well, it would be certainly be more pure than water directly coming from the roof of the drift directly on to the waste package. We are speedily getting out of my depth of knowledge on these things, and so I think I will just leave it at that.

VICE CHAIRMAN RYAN: Okay. Is there anybody else here who would want to talk to that? Okay.

DR. WEINER: Okay. The studies that you discussed on Slides 45 and 46, and you don't have to turn to them. But I was just wondering.

Are these modeling studies, or are you planning to do actual tests, and how are you dividing that up? Is everything going to be physically tested experimentally, or are some things simply going to be modeled? What is the division between the two?

MR. HARRINGTON: Both are them are in there, and --

DR. WEINER: Well, could you give me a little more detail on that?

MR. ANDERSON: Okay. You are talking about the ones that are on the bottom there, the 1, 2, 3, 4, 5, and 6 --

DR. WEINER: The whole group, yes.

MR. ANDERSON: Okay. That whole group, those are all actual tests that remain on hardware.

DR. WEINER: Okay.

MR. ANDERSON: The weld flaw distribution study is complete and documented, as is the induction annealing tests that were done. Laser peening, I think that there has been some work done there, and there is going to be additional work done as with controlled plasticity burnishing.

The residual stress measurement, those things have been done, and will continue to be done. And it says analyses there, and clearly you do some measurements, and you also do some predictions with numerical tools, and understand throughout the whole volume of the metal what is going on, and not just where you did the testing.

And then the neutron infarction analysis is a way to non-invasively understand what is going on, but those are all actual tests of hardware.

DR. WEINER: Okay. Thank you.

MR. CLARKE: Just one question, and again a follow-up to Ruth. Slide 51, if you could pull that up. Has this system been tested in the temperature range that you expected to see in the repository?

MR. HARRINGTON: You mean has it been physically tested already?

MR. CLARKE: Yes.

MR. HARRINGTON: I don't believe that we

have made a mock-up of the new. We had made a mock-up of the old, but the prototyping that I talked to you about --

MR. CLARKE: You had materials expanding, and contracting, and things of that nature.

MR. HARRINGTON: Well, that was one of the changes that I mentioned. I mentioned also was the change in the annular gap between the inner cylinder and the outer was to address that thermal expansion issue. So we have made physical mock-ups of the older design.

We have done testing and other things that Mike was talking about in that. We are shifting to this newer one and that is what we would expect to use as the basis for the prototyping that we hope to get started here fairly soon.

MR. CLARKE: And you would test that over the temperature sequence that you expect to realize in the repository?

MR. HARRINGTON: Oh, I don't know your temperature range before that, but I would assume so, sure.

MR. ANDERSON: This is Mike Anderson. I guess I would have to ask you -- you know, we have thermal expansion allowances in there and those are well known material properties. I guess one particular aspect of the thermal part of it --

MR. CLARKE: Well, I was just thinking of the waste package as a system with all the components in place, and then testing that over the anticipated temperature ranges in the sequence that you would expect to see the temperature changes.

Just how does it perform? Does it keep its integrity? I mean, whatever is the best measure of that.

MR. ANDERSON: I think if you think about it a little bit, the thermal and other challenges to the waste package in the drift are probably somewhat more benign than the actual manufacturing process and the final closure, because you have got large temperature differences, particularly in the final welding and things like that.

So in the prototype development process, we would hope to pick up any flaws in the design, in terms of mismatches, or differential expansion, and things like that.

MR. CLARKE: Just to make sure that you don't have something like an O-ring in your system. In other words, how is this whole system performing over that range.

MR. HARRINGTON: Well, there are no O-rings in there.

MR. CLARKE: I know that, and that was perhaps a bad analogy, but again just suggesting that the system be tested as a system over those temperatures.

MR. HARRINGTON: Okay. I understand.

VICE CHAIRMAN RYAN: Any other questions? Sher.

MR. BAHADUR: I would like to follow up the question on the drip shield that Dr. Weiner asked. The way that I understand it, the drip shield is to isolate your waste package from rock fall, and also from any water that may have strayed into the repository.

If in the postclosure time the rock fall makes a dent in the drip shield, and comes in contact with moisture, and with all that stress on it would it corrode, or is the presumption is that the drip shield material would not corrode?

MR. HARRINGTON: Well, I believe that there is a corrosion allowance in there for the drip shield. Mike.

MR. ANDERSON: This is Mike Anderson again. Certainly there is general corrosion that occurs in the drip shield, but when you have these localized stresses the TSPA abstraction will predict stress corrosion and cracking at those locations or some kind of accelerated corrosion and cracking.

My understanding is that they assume that because of the minerals in the water that those very fine cracks will plug up and prevent additional evective transport through the drip shield.

MR. BAHADUR: So if that is true then, would you consider a drip shield with an arch around the waste package, where your grabbing is actually in touch with the waste package? Because then perhaps you would be able to mobilize the strength a lot more than just making an arch around the waste package?

MR. ANDERSON: Well, one of the advantages of the drip shield is that it is decoupled from the waste package. So when it gets hit by a rock, there is no transmittal of any energy to the waste package.

And one important thing about the waste package Alloy 22 corrosion is that we have worked very hard to get a compressive stress in the outer millimeters of that, which will mitigate accelerated corrosion, whether it is stress corrosion cracking or some other form of corrosion.

So the longer that we can keep that

surface, those first few millimeters of the Alloy-22 in the as manufactured state, the greater resistance we have to to accelerated modes of corrosion.

VICE CHAIRMAN RYAN: Mike Lee, you had a question?

MR. LEE: Yes. I have two questions, Paul. First, in the last year, either at the last committee meeting here in Las Vegas, or in a subsequent meeting with the NRC staff and the DOE staff, there was talk of some development if you will of a kind of prototype facility, possibly off-site and outside of NTS, to work on the development of some of these waste handling systems?

What is the status of that, or is that still just kind of a concept?

MR. HARRINGTON: That is very conceptual at this point. It is not off the table, but it has not been determined whether or not to go ahead and pursue that.

MR. LEE: Okay. Thank you. And my second question is that once DOE submits the license application does the DOE have a position on the amount of site prep it needs to begin to undertake in advance of the receipt of the license application?

Has there been any thought about that, or is there just road running so to speak, or are you waiting until the license application is approved, and are you going to wait until that point to do prep work, or could you elaborate a little bit about that, please.

MR. HARRINGTON: There has been some discussion about what would be an appropriate set of work to ask permission to start prior to receipt of construction authorization.

But the last that I heard is that we are not yet to the point where we think it appropriate to come and propose any set of work.

MR. LEE: Okay. Thank you.

MR. HARRINGTON: Okay.

VICE CHAIRMAN RYAN: Anyone else have any questions or comments? I think we are just a little bit ahead of schedule, and so I would suggest that we take a short break. I have now about 4:15, and so why don't we make it about 4:25 and we will reassemble and start with our last formal presentation of the day, and then move into stakeholder interaction and comments. Thanks very much, Paul. Thanks for a great afternoon.

(Whereupon, at 4:15 p.m., the meeting was recessed and resumed at 4:30 p.m.)

CHAIRMAN GARRICK: Can we take our seats, please. At the last ACNW meeting the Committee heard a presentation from the NRC Staff and the Center for Nuclear Waste Regulatory Analysis on Drift degradation. This is a subject of considerable interest to the committee.

Unfortunately, our earth scientist was unable to attend this particular meeting, but we will do our best to represent some of the questions that he might have asked. At this time, we are going to hear from the DOE, and we wanted to wait until we heard that presentation before we wrote a report to the Commission.

And at the time of our discussion and our questions, Dr. Notaroja of the NRC staff will make a few comment, somewhat in the manner that you made, Mark, at our last meeting. So with that, let's proceed. And I guess that Mark Board is going to give the presentation; is that correct?

MR. BOARD: Yes.

CHAIRMAN GARRICK: Okay.

MR. BOARD: Just so Raj and I don't have a boxing match at the end. I think he outweighs me. Okay. I am going talk about the work that we have been doing on drift degradation and the rock mechanics aspects of drift degradation.

And just for those of you who were not here yesterday, we went underground and we discussed a lot of this stuff yesterday, and so unfortunately you are probably going to have to have a repeat of some of it.

But at any rate, we went underground and looked at the rock, and had a lot of discussion in this regard. What I would like to do today is give you sort of a broad overview presentation.

I don't have a lot of highly detailed technical slides and things in here because it was meant to be an overview presentation, but I can try to answer any of your questions.

First of all, I wanted to summarize for you what we think the general sources and mechanisms of mechanical degradation of the tunnels are; how we think it will degrade, and what the stress mechanisms are that cause that degradation.

I would like to review the geology and the layout of the repository and how it relates to the geology, because it has a direct impact on the significance of this mode of drift degradation.

I would like to review briefly the methodology that we have been using for simulation and prediction of drift degradation processes, and then finally I would like to give you a presentation of some of the results that we have, and drift degradation in particular to in situ stresses, thermal stresses, and seismic loading, and also time dependence changes in the rock mass.

As we go through it, in some cases I will do some contrasting between our approach -- that the NRC staff has been using, and the center staff has been using in analyzing these processes.

The first thing that I wanted to talk about was just about what the sources of mechanical degradation of the rock are. Mechanical degradation, I gave a little definition there. There is damage or yield in the rock mass that is induced around these or in any tunnel that is mined underground as a result of applied stresses or time dependent changes in the mechanical behavior of that material.

Damage here refers to in general propagation of fractures or new creation of new fracture surface due to yielding or failure of the rock mass. Now, underground, you can go into virtually any mine and you will find yielding or failure of rock masses that occurs around all tunnels.

It doesn't mean that the tunnels are

unstable. It simply means that they can locally yield and shift the stresses out to an area that the rock is confined, and it comes to equilibrium. So it is a natural process that occurs around most underground excavations and tunnels where the tunnel is deep enough, and the stresses are high enough to cause yield to the rock.

In our case, there are three primary sources for stress change that we are concerned with. The first is the in situ stress in the material itself, which I show here.

At Yucca Mountain the maximum stress in the rock itself which is due to gravitational load from the overburden is in the vertical direction, and the minimum principal stresses are in the horizontal direction.

And the vertical stress in general is about -- if you think in terms of metric units, it is about 7 megapascals, which is just simply due to the weight of the overlying rock.

And the minimum stress is about -- anywhere from about 3-1/2 megapascals, which is a ratio of about 2 to 1, to about 5 megapascals or so. So the minimum or the maximum stress ratio which controls the shearing stresses that develop in the rock is about 2 to 1.

Naturally when you have a maximum vertical stress component, the peak stress concentrations occur in the walls at the spring line or the center line at the top.

So in our case, when you walk underground at Yucca Mountain right now, the maximum stresses that occur are actually right at the spring lines of the tunnels.

In general, at Yucca Mountain right now, the rock stresses that occur here are not sufficient to cause yield of the material, and it is in an elastic state in general.

There are a couple of localized areas that we have observed some small yielding in the spring lines of the tunnels, and yesterday we went down through the ECRB, and when you pass through the the immediate intersection, or rather the transition from the middle lithophysal unit to a lower lithophysal unit, there is a transition zone in there where the lithophysal are large, and the rock is somewhat fractured or more fractured in there.

That is one spot locally where if you drill holes in the side wall here, you can see some minor yielding in the side wall that goes to the depth of perhaps a quarter of a meter or something, and you can actually see fractures that are forming parallel to the free surface, which is a typical type of yielding that you have.

That is about the only areas that we see, and I will describe the testing that we had done later. We drilled approximately 60 or 65 one-foot diameter diamond drill holes for collecting samples.

And they are large enough that you can actually stick your head in there and look at things, and we got a very, very good look, and we did those at various locations in the middle nonlithophysal and the lower lithophysal unit.

So we got a very good look at just what the conditions of yielding were in the side walls, because we drilled most of the holes directly into the spring lines. We also drilled some at different angles.

One thing that I will point out is the minimum stress, and when I say the maximum stress concentration occurs here, the minimum stress concentration occurs in the crown of the tunnel then, due to the fact that the minimum part of the stress is horizontal.

The second form of loading that we have to be concerned about is the thermal loading, and I just showed you a drawing on the side here, which is a prediction for a few different cases, three different cases of different thermal properties, just to illustrates what kind of temperature conditions that we are calculating at the walls of the tunnel.

This time period here is the preclosure time period, and when the rock mass is ventilated, a larger amount of the heat from the waste package is removed by the ventilation air, and so the temperatures are kept quite low. They are somewhere in the order of 45 to 65 degrees, depending on the conditions that you assume.

At closure when the ventilation is turned off, the temperature rises very rapidly, and within 20 years, it reaches its peak temperature at the drift wall, which is anywhere from 145 to 165 degrees centigrade.

Once it hits that peak temperature, the temperature slows drops off over time, returning back to pre-emplacement conditions after a long period of time.

I believe -- and I can't read from there, but I believe that the temperature remains at the drift wall remains above boiling for about a thousand years in the current scheme, is 1.45 kilowatts per meter thermal loading.

Thermal stresses are dependent upon the temperature change, as well as the Youngs (phonetic) modulist and thermal expansion coefficient of material. So the thermal stresses that we calculate follow directly this thermal profile that occurs here.

So the peak thermal stresses are actually occurring very early on in the system, and they then decay over as a function of time afterwards. The final types of loads that we are concerned with are seismic loads, and I show an example of one of the ground motions that have been supplied to us by the seismologist.

And this happens to be for 10 to the minus 4th annual exceedence frequency ground motion. We talked some about this yesterday, but as the seismic wave passes through the rock mass, it induces stress change in the rock mass.

Typically in most underground situations seismic stability of underground excavations is not an issue, because typically that is where it is most stable.

The peak accelerations, and peak particle velocities, are typically at the ground surface, and so that is where the area of greatest concern is. It is the same of course here, you know, that the accelerations and particle velocities are lower at depth than at the ground surface.

I will get into our seismic calculations a bit later. How do we use the rock fall that we calculate, or the drift degradation? All these thermal in situ and seismic stresses that I -- stress changes that I show up above here from those sources we are using to calculate stability of the tunnels on both emplacement and access drift tunnels.

But most of our effort has been in the post-closure area, and so we are mostly concerned about emplacement drifts, which are the 5-1/2 meter diameter tunnels.

We have been using these primarily to calculate rock fall, and change in shape and size of the tunnels as a function of time, and as a function of the load.

The types of things that we are calculating here, and let me get my glasses on here as I can't see the thing, but you can see it. The types of things that are calculating here are the particle size distribution of the rock that has actually failed and is falling from the roof.

And the total volume of that rock that actually falls off, and also we are concerned about the acceleration and velocity of those particles. So therefore we are calculating the energy content of that particle as it is ejected or falls from the rock, and in context the drip shield or the waste package, depending on whether it is a preclosure or a postclosure simulation.

The other thing that we are examining from a rock fall standpoint is time dependent change in rock mass strength, and how that affects the amount of material that fails and actually falls from the rock and bulks into the tunnel itself.

Now what we do with that, we are primarily feeding three different functions. The first thing we are doing is examining the mechanical effects of this rock that falls on the drip shield itself.

We are feeding to the drip shield folks the structural engineers repeating impact forces, and their velocities from accelerated particles, and where they impact the drip shield as a function of time or a function of a shaking event.

And we are also calculating what I have termed quasi-static load. In other words, it is the static load of the weight of the material that has fallen off and is resting on the drip shield itself.

Quasi-static from the standpoint that it changes as a function of time. Other areas -- and that is the primary area where we have been doing our calculations and feeds from our calcs, but we are also doing or looking at mechanical effects on the in-drift environment.

And in particular as the rock falls from the tunnel surface, and forms around the drip shield, we are concerned about the thermal effects of that insulating blanket on the waste package itself, and the temperature change that it and the drip shield undergoes.

And we are also feeding off the changes in drip shape and the size, as well as the fact that there is rock in the tunnel to seepage calculation folks to look at the impact that that has on seepage estimates into the tunnels as a function of time.

We went underground yesterday, and we showed you this picture, and we will just briefly go over it again. This is an east-west section through Yucca Mountain, looking to the north. This is west, and this is east, and this is the Solitario Canyon fault and this is the front scarp face there of Yucca Mountain that you can look out toward Crater Flat from.

The tunnels that currently lead in the north ramp comes from the east, and enters at a slight downward grade to intersect the repository units, which is the Topopah Spring formation, which is shown in green here on this picture.

And as we talked about yesterday, the Topopah Spring formation consists of four different distinct stratigraphic units within the flow that are based primarily on the degree of porosity of those units.

And when we have an upper and a lower lithophysal unit, and between them is the middle non-lithophysal unit, and below the lower lithophysal unit, which you didn't see yesterday, is the lower non-lithophysal unit.

The middle non and the lower non are very similar to one another. It is very difficult visually to see the difference between the two, at least for me, mineralogically and their fracture geometries.

The upper lith and the upper lith are different. The upper lith as you saw yesterday has lithophysal cavities that are relatively uniform in size and distribution, and that are on the order of maximum of about a decimeter in size.

The lower lithophysal unit has much more irregular lithophysal content, with larger lithophysals that can be irregular in shape. But the average size again there is slightly greater on average. It is somewhere around a decimeter on average, but we have sizes that are maximum and excess of one meter.

The area where the largest lithophysy and the poorest ground conditions I found is in a layer that is at the contact as I mentioned earlier between the middle non and lower lithophysal unit.

And the thickness of that contact layer is relatively thin. It is hard to judge it very specifically, but in thickness wise, it is probably about 10 meters in thickness, or something like that.

This slide I just wanted to show you the difference in behavior of these two materials. We treat them separately in our calculations because their behavior we feel is distinctly different, and it is primarily because of the structure that occurs in the rock.

The non-lithophysal rocks, which are shown in these top two frames here, their behavior is controlled primarily by the fractures that are in them. The intact rock itself between the fractures is quite strong and elastic as I mentioned yesterday.

The small core strength of the middle non-lithophysal unit, for example, for 1 inch samples, is over 200 megapascals, and one of the interesting features about this rock is that it is quite uniform in its constituent grain makeup so that the rock is very elastic.

We can raise the load on these rocks up to in excess of about 95 percent of their peak strength, and unload them, and there is very little histolysis or permanent deformation in them.

They fail in a brittle fashion on failure and uniaxial compression. The stress state that we have in the mountain, even from the thermal loading, is far below the strength of the intact material here, and so we are not quite so concerned about that.

It is more the stability effects of the jointing and fracturing in here. The fracturing is interesting in here. It is unlike what you might think of as a typical blocky rock mass, and that the fractures themselves are of a relatively short length, and they are in fact shorter than the diameter of the tunnel.

So as you look along a typical section, and I don't believe that I pointed this out to you yesterday, but you can typically trace fractures that start and end before they cross out of the tunnel itself.

Also the fractures often dead-end against another joint -- or in other words, we don't have a typical set of fractures that have very long trace lengths in them, and they are based on a regular interval, and is quite irregular in its cooling history.

There is four sets of joints in general; three sets, plus a random set, and two of them are subvertical sets, one northwest and southeast, and the other southwest and northeast. And there is one subhorizontal set that are called vapor face partings.

When you do have yielding in this type of material, it is typical that you see this sort of thing, and this is a photograph from the ECRB where we were yesterday.

Periodically if the joint orientations are correct, you form a wedge shaped thing, and they are relatively small wedges. They are typically less than a half-a-ton in size, and this is a tracing of one of those wedges.

In the ECRB itself, in the whole construction of it, all the wedges that were formed were either removed directly behind the tunnel boring machine, and most of them are removed by physically prying or barring the wedge out, because it was recognized by the mining people that it was potentially an unsafe condition for workers.

In fact, this is one of them because they put a plate over the top of it after it was barred out. In the lithophysal rock, behavior is controlled by porosity. I think one thing that we have come very strongly to the conclusion on is that the properties of the lithophysal rocks are porosity driven.

This is one of the panels that you perhaps saw at the site that we were standing at yesterday, and Dave Bush talked about this, but essentially these are lithophysal cavities that can be either roughly circular shaped or they can be much more complex shapes, like these star typed shapes that were influenced by the fractures, and gas flow, and expansion along the fractures in the rock when the lithophysy were formed.

Down here it shows one of our cores that we drilled out, the one foot diameter core, and this far away, it is hard to see. The core is wet, and you can see the fracture distribution in the core, and you can also see the lithophysy in the core.

If you look at what happens when you either mine this rock or drill it out, it is very clear to see that when this rock fails and rocks detach and fall away, they fail in small particle sizes.

I have never seen a particle size come out of the lower lithophysal unit that has been much bigger than about this sort of size, about fist size, or head size. That is about the maximum size that we think is possible to produce from this.

The repository rock units. I know that you guys have a lot of questions about this, and I am sure that you are going to ask more today about why we are locating the repository in the lower lith, as opposed to the middle non-lith, because it appears that it is more difficult to characterize that rock.

And I will wait on those questions and answer them when they come up, but just to show you that this is an overlay of the rock units on top of the subsurface layout that shows that about 80 percent of the emplacement drifts are within the lower lithophysal unit.

Yesterday when we went to Panel Number 1 was right here, and we were standing right there where the ECRB crosses, and we were in the middle lithophysal unit, which is green in this picture. It just so happens that the layout as we put it now, virtually all of the turnout to the large area excavations that we have are actually all in the middle lithophysal unit.

Very few are in the lower lithophysal unit. Mostly the emplacement drifts. There is a little bit of the upper lithophysal unit that occurs here on the eastern side of Panel Number 3.

Observations in existing tunnels. We talked about these yesterday, but we have two tunnel sizes, the ESF is 25 feet in diameter, which is the same size as the proposed access mains in the repository. and the ECRB drift that we are in is 5-1/2 meters in diameter or 16 feet, and that is slightly smaller, about a half-a-meter in diameter smaller than the proposed emplacement drift size.

But the two of those make a pretty good -- give you a pretty good feel for what the size of those excavations are going to be. They are 5 to 7 years old, and as we pointed out yesterday, there is only light ground support consisting of friction bolts and wire mesh in the roof.

Typically there is no support placed in the walls, particularly in the lower lithophysal unit.

As we saw yesterday, there is generally four bolts put across the roof, and in most cases there is very light wire mesh, which is just a typical sort of construction grade wire mesh.

You also noticed I'm sure that there was a lot of steel sets when we first entered, and I mentioned to a couple of you yesterday that we sort of I think got bit on the construction contract there.

It was very good for the contractor to put in steel sets from an economic standpoint, and I don't think we had very good control over how many steel sets he put in, and in fact we have measured load in a number of those, and we have not seen many cases where there is any load in anything down there.

In fact, those were pressed in place, and it is a very unusual way to put steel sets in there, and jacked in place, and you can see visually that there is no load on those sets at all.

So in many cases, or in my view at any rate, they are kind of a window dressing, and I wouldn't get too carried away with the fact that there are steel sets in there, because they are not indicative of what the rock quality is at those locations.

Right now -- and I have talked to

everybody out there, all the miners and everyone. Well, first of all, we have got deformation measurements that are made with x-insometers (phonetic) and closure pins that are done on a regular basis.

And in particular their measurements are made after every earthquake that occurs in the area, and all the excavations show that they have reached a stable equilibrium. In other words the deformations have dequilibrated right after mining, and they dequilibrate as a function of time.

As far as I can tell talking to everyone, no one is knowledgeable of any observed rock fall that has occurred in those tunnels since they were excavated, and some of the people working there have worked there the entire time.

The one minor spaulding that I showed you yesterday from the drift scale test, which was done specifically because of a thermal overdrive test that was done, is one of the few things that we have actually observed in any kind of spaulding or rock fall that has occurred.

To my knowledge there has never been the necessity to go back and maintain any drift support or reapply new ground support. I could be wrong on that, but I have not heard that.

CHAIRMAN GARRICK: Mark, what would you expect to happen in a thousand years?

MR. BOARD: I will get there. We are going to show that. But first what I wanted to do was to tell you how we have approached the problem, because this as you all know calculates or attempts to estimate how rock is going to behave around tunnels for thousands of years. It is not standard practice in the industry.

We have excavations that are subway tunnels, and other tunnels that are being used currently that have been used for hundreds of years. But for thousands of years, or tens of thousands of years, it obviously is not standard practice to worry about that kind of thing.

So we are in new territory in making these estimates, particularly in hard rocks. In soft rocks, like salt, and I know that most of you have been involved probably back in the salt program and things, but it is a bit different situation there because people can generate creek curves and calculate with at least -- well, I would say at least with a domale salt anyway. I don't know about bedded salt, because it is a bit different animal.

But in domale salt, there is some expectation that you can make extrapolations of what those creek curves will do over time. In hard rocks, however, it is a new territory. Not many people have been too concerned about this.

There is not a great wealth of information. Because of that, we felt that it was necessary to try and understand how this rock behaves from a basic mechanics level.

And this chart, I hope that you can read it in your document. I will just go through the top bar up here, but this is sort of the strategy that we set up initially to try and gain confidence in our understanding of how both lithophysal and non-lithophysal rock behaves.

And as we pointed out a few weeks ago in Washington, and I am sure that Raj will talk about here later, our approach is different than what you saw, and that we are not relying on empirical estimates from mining practice or from tunneling practice to try and make estimates of things that are occurring for thousands of years.

We felt that the only approach that was going to produce reasonable results that we could back up would be if we could start from a very basic level and work our way forward.

What this plot shows is actually something that we have done over the last few years, where we started with detailed field characterization of the rock mass.

We felt that we absolutely had to start with a very good understanding of the basic geology and the structure that existed in the rock mass, because that is what controls the properties.

And so we have spent a lot of time going over the detailed structural analysis of the fracturing and the jointing in both rock units, and in particular in the lithophysal units doing detailed mapping of the lithophysy, and how it is shaped, and its size, and its porosity, its distribution through the mass, trying to understand its variability within the tunnels that we have access to.

The lower lithophysal unit is in the upper lith, and can be observed in both ECRB and in the ESF. We didn't see the ESF yesterday because it is way down in the south end there, but it is observable in both of those.

We have taken a lot of time to map those and statistically try to describe that work, and I won't go over that again because Dave Bush talked about that yesterday.

What we have done then is that realizing that the lithophysal rock, that the two important features for the porosity in the lithophysal rock, and the fracturing in the non-lithophysal rock, we tried to set up a program to try and understand those two structural features and how they affect rock mass properties.

And we did two things in the lithophysal rock. We sampled large cores in which we had at least 5 lithophysy across a diameter. We felt that was reasonable enough to begin to start seeing the impact of lithophysal porosity on strength.

We sampled those through quite a extensive drilling program that was done. I would say that we drilled about 65 holes, and we did laboratory testing on those at Sandia Labs.

At the same time, we knew full well, and as I discussed yesterday, that we could not do a typical statistical testing program as you would on metals, or perhaps hard rocks, with no structuring them.

And to fully understand the impact of lithophysal variation, we felt that we had to calibrate a numerical model or some sort of simulation tool that was capable of physically representing those holes in the material and how they affected its strength properties and the variability.

So at the same time that we started the lab testing, we started a calibration program using two different numerical approaches, one in terms of a micromechanical model, which is the PSC code it is called, and I will show you some examples in a minute.

And the other one is a program called a UDEC, which is a discontinuum program, and they both sort of predict the same thing, but we wanted two methods to be able to use to examine the problem.

So we originally calibrated and tested that code against the laboratory results. Then we went to the next physical scale up, which was the field scale, and we did in situ compression tests on that material which were partially successful.

A couple of the tests that we did were successful, one not quite so successful, and then we examined the results of those tests with the model that we calibrated as a validation exercise.

We then used that model, which we felt we had some confidence in, and actually quite a bit of confidence in its predictability, and asked the question how much do these properties vary, the physical and mechanical response, when I start to extrapolate with that program over all the conditions that I can't test.

In other words, we are using it almost like a laboratory tool, a laboratory simulation tool, where we took the actual panel maps that Dave showed you yesterday that were created here, and used those as input to the numerical model, and examined just how much variability we had in response for realistic conditions of lithophysal characteristics.

And we used that to try and establish what range of variability we needed to use for design purposes. Once we had that, then we went ahead and we did a whole series of parametric examinations of how this rock behaves when you apply stresses to it, and those are in situ, thermal, and seismic stresses.

And those were done as a series of parametric analyses, where we used bounding ranges of properties that we determined from the laboratory testing and the extrapolations that we did.

First of all, the non-lithophysal rock mass. I had mentioned to you that we did a lot of examination of fracture mapping. In the ESF, every fracture -- and we did not discuss this yesterday, but in the ESF and the ECRB, every fracture with a trace length greater than one meter, it was actually recorded.

It's dip direction, and its surface variability, in standard terms that are used in the geotechnical description area. Every one of those fractures was described, and we have an enormous database.

I think the entire database is about 35,000 observations, but we have been using a subset of that, which is I believe about 10,000 observations. And we have used that to develop a statistical or stochastic model of the fracturing. It is hard to see what it going on here because there are so many fractures in there.

But we have used a program called FracMan, which is a common program used, particularly in the oil industry, where they actually generate synthetic fracture geometries, or rock mass geometries, to try and estimate fluid flow and uptake oil, oil pumping rates from fractured rock masses.

We used that as a tool to generate a synthetic rock mass that is a cube, a hundred meters on a side. So we said let's take the data that we have, and statistically generate our own rock mass that we can tunnel inside and run simulations from.

The other part of this picture is the property surface properties of the joints. We did a lot of testing at Sandia years ago using a technique called rotary shear testing. There is a little bit of a question about the validity of that, although we get pretty much the same results as we did here.

And we actually sampled in those large bore holes that you saw yesterday, we sampled all the major joint types that we have, and we did large scale direct shear tests at the U.S. Bureau of Reclamation on these joints.

And these are very large. It is the largest direct shear testing machine that I am aware of, and we determined their shear behavior there to get properties.

For the lithophysal rock, this shows one of our one foot by two foot diameter samples at Sandia Labs in a large testing frame. We did compressing testing on these cores, and we found basically that the testing that we were doing here confirms the results of testing that was done in 1985 from cores also from the lithophysal rock from Busted Butte, which is next door here.

In '85, before there was any tunnel there, the same rock units outcropped at Busted Butte, and they went up into a quarry, and took samples from it, and we found that we were getting the same correlations with porosity and rock strength.

Here it just simply shows a uniaxial compressive strength versus the lithophysal porosity. At zero percent porosity, the rock strength is about 70 megapascals for these large samples.

So we see this logorhythamic decrease in strength as a function of lithophysal porosity. The only thing that I wanted to point out there is that from Dave Bush's results that he showed you yesterday, where he mapped the porosity and the intervals going up the ECRB, most of the cases that we have in the ECRB are from situations where the lithophysal porosity varies between 10 and 20 percent.

And 90 percent of the intervals that we have mapped in that tunnel haver porosities of 20 percent or less. So in other words, what I am trying to say is that the majority, the large majority of porosity that we see in the ECRB is less than 20 percent, and it averages somewhere close to 15 percent by volume.

This is important later, because what we did is we did a bounding analysis, where we calculated estimated properties that went anywhere from zero percent lithophysal porosity, all the way up to 30 percent.

And we ran calculations across that entire range, but I want to point out to you that the mean condition that you looked at yesterday, the stability that you were viewing yesterday, was typically based on a porosity level of somewhere around 10 to 15 percent, in that range.

Let me just go back one second. I'm sorry, but I just wanted to point out again that for design purposes, what we did is we took the mechanical properties, and we subdivided these ranges, these properties up into a series of ranges that covered the entire range of observations underground, and we divided this into five different categories of strength.

And we can then relate that to the categories that we actually see underground of the percentage. So that is how we make a correlation between this and what you actually observed underground, okay?

I wanted to briefly show you what we did then to generate rock properties to try and understand the range of variability to lithophysal rocks. We used this numerical approach that I had mentioned, a discontinuum of numerical models.

This particular one is called the particle flow code, and it was developed by a Peter Condel, and it essentially models the rock as a series of bonded particles, and it is in quite common use in the rock mechanics area now.

We felt that it was an ideal tool for us to try and understand how a lithophysal rock behaved. What we did is that we started off first by calibrating this model against non-lithophysal rock, which I show here.

And I thought that the easiest thing would be to understand this is to show you a little movie of what one of these tests looks like. You are seeing a numerically generated test. This is a stress strain curve, and this is a rock sample composed of about 10,000 bonded particles.

Remember how I told you how elastic it was. You got right up to the peak stress before any failure starts. What you are seeing here is that these fractures are actually 10 cell bond breakages between particles that coalesced to form overall shearing fractures, bifurcating shearing fractures in the material, which is exactly what we see when we test these rocks.

We get a highly elastic response to a peak strength, which then falls off in a brittle reaction, post-peak reaction. You can go ahead and run it again. It goes very quick.

What we did is that we calibrated this first against the medullas of the material, and the peak strength, and we observed the failure mechanisms that occurred, and compared it to the actual samples.

And we found that we could reproduce the failure mode quite nicely in the material. Then what we did is that once we had calibrated the bond properties of the material, we then applied it to lithophysal rock here, and this is a case where I am showing you 26 percent lithophysal porosity in round holes.

Now, these two plots that I just showed you are to the same scale, the last one and this one. The stress strain behavior that you see, this is stress versus strain, and it is being compressed in uniaxial compression from the ends.

You see a much different behavior. First of all, the peak load drops by almost an order of magnitude with these samples, and you get an elastic plastic response, in which the material behaves in a non-brittle fashion after failure.

The mechanism of failure that we found when you start adding porosity to this sample is that it is very simple. You get extensional fractures, which are shown here between lithophysal and holes, and once these extensional fractures form, it essentially unloads an area and causes the load to shun off to an area where you have a solid bridge.

And as you increase the porosity, you decrease this bridge length, and it naturally decreases the strength and decreases the medullas of the material. And we found that really without any fudging at all that we could reproduce the same sort of behavior. If you want to go back to the original slide that we had.

We could reproduce -- this is the same plot that you saw earlier, a uniaxial compressive strength, versus void porosity or lithophysal porosity. We found that we could account quite nicely for this logorithmic decrease in strength just by the fact that you are adding holes to the material.

What we did then is that we started modeling real porosity variations with the various shape lithophysy, and we found out that we could account for the range of property variation that roughly we were seeing in the laboratory, and in the field scale results.

So that is how we accounted for the effect of lithophysal porosity. The next thing we did is that we encapsulated this behavior into a drift scale model.

It would be very nice if we could use that PSC model to model the entire drift, but unfortunately the computer resources would have to be enormous, and we felt though that we could encapsulate that same behavior in a larger discontinuum model, and that we calibrated in the same fashion as the PSC model, and that is what I am showing very roughly here.

We used this program called UDEC, and that is subdivided into small grains again as the other one with bonded particles between those grains, and we can reproduce exactly the same kind of behavior that we saw before.

This model, however, is capable of simulating fracture underload in rockfall, and what you are seeing here is a tunnel with a drip shield in it, and some rock piled on time of it.

We can take samples out of that, and test them, and make certain that it behaves in the same way as the PSC and the laboratory material behavior did.

Okay. Some of our results from our

calculations. This shows rock fall calculations under seismic load. First of all, I would point out that in non-lithophysal rock, there is no rock failure in our estimations from in situ stresses or from thermal loading over the -- with the rock properties as they are now.

The rock remains elastic because it is quite strong. We also don't get joint slip behavior or joint failure under those conditions, and that is exactly what we observed int he drift scale test. There were no block fallouts that occurred in that test either.

What we did here was that we took our model that I showed you earlier, our 100 meters on a side model, excavated tunnels from it, and put it in a drip shield, and we excavated enough tunnels to where we felt that we had a reasonable statistical variability of the rock properties.

We took that model, called 3-DEC, and we subjected it to seismic shaking from the ground motions that we received from the seismologist. What we found out was what I have summarized down below for the case of a 5 times 10 to the minus 4, which is a preclosure motion.

And 1 times 10 to the minus 6, and 1 times

10 to the minus 7 motions, which are both postclosure motions. As I mentioned, the 10 to the minus 6 and 10 to the minus 7 ground motions were quite enormous that were given to us there.

The 10 to the minus 6 motion has an acceleration of about 5G, and as I mentioned yesterday, I don't believe that the -- we certainly don't feel that those motions, which were produced using a PSHA process, which is used for power plant design, that those motions are physically realizable.

The strains that they produce actually cause free field rock failure, which as I mentioned yesterday, we did not observe anywhere underground, especially in the lithophysal rock, and we feel that would be obvious when we mined into it, that those conditions would have occurred in the last 12 million years, and we don't see anything of this sort.

We also have had a number of outside reviews of the seismology, and I believe it is uniform that people feel that we are extremely conservative. So I just want to make that point, because it bears on what you are going to see from the lithophysal rock.

Even with these motions, what we find out is the prediction from the non-lithophysal rock, is that we actually get fairly moderate rock fall. We produce a mean block size of less than half-a-ton.

And it falls off quite dramatically as a function of tonnage, and so that the maximum overall worst block I suppose if you want to look at it that way that we have produced, which falls from a maximum height, was 14 tons.

And that was for one of the postclosure motions. This information and the location of where the impacts occur on the drip shield, are fed directly to the drip shield design function.

In the lithophysal rock, I illustrate two things that we did here. One is that we looked at just standard in situ loading conditions for all the bounding studies that we did for these different rock mass quality, five different rock mass strength categories that I told you earlier.

We compared those predictions to what we see underground right now, and we feel that we have a model that seems to predict for the mid-range category, which is what we think represents best the average rock conditions that predicts that material behavior quite well.

Under thermal conditions, what happens for this thermal loading. We find that we get actually quite a small yield. It is hard to see, and I apologize for this slide, but these are stress projectories around the excavations due to thermal loading.

And where it is white on each spring line, that is where the rock has actually yielded and unloaded. That level of damage is at the spring line where the stresses are maximum is less than a half-a-meter in depth.

So in other words, we are expecting from the peak thermal loading to occur that we actually get minor, quite minor spaulding of the rock mass or minor yielding.

One of the reasons for that is that the medullas of this material is quite low, and so it does not build up high thermal stresses. But we by the way validated this very model that you are looking at against the drift scale test.

Only instead of putting in properties of lithophysal rock at these contacts, we put it in properties of the non-lithophysal rock, and we found out that we were able to reproduce the spaulding mechanism that you saw yesterday quite nicely, again without fudging any properties of the material, but just what we produced from our calibration against the size and strength effect for those rocks.

What happens when you shake this thing with a large close-closure ground motion is that we get a collapse of these excavations for the 10 to the minus 6 and 10 to the minus 7 ground motions.

This picture I think was actually the one that was shown to you a couple of weeks ago, and that is why I reshow it here. When you shake these, the ground under those very large ground peak particle velocity motions, you actually cause the failure of this material due to induced stresses, and it fails and drops, and bolts into the excavation opening.

The rock particles are quite small. We feel that they are on the order of -- like I said earlier, about 10 centimeters on the side. That information is fed off again to the drip shield design folks again for the non-lithophysal rock. They are treating those two things differently again, and in the TSPA calculations, we are treating them differently as well.

Time dependent degradation. I think probably the greatest -- and I would guess disagreement if we have one with the staff from the center, is in the area of time dependent degradation.

And that is how quickly in the absence of these very large motions that we are talking about, will these excavations actually fail and collapse. I want to make a couple of points here that I did yesterday, I believe, and that is that time dependency estimation of hard rocks has not been extensively studied.

So we are kind of in an area here where I think we are plowing new ground. I want to point out that the complete collapse of tunnels is not inevitable. I think that the impression that has been given is that it is an inevitable fact that these tunnels will completely collapse, and it is not necessarily true.

And I back that up by my next statement here that many tunnels in natural excavations, and not tunnels, but natural excavations, can stand for millions of years without collapse.

And I suppose for me, as I mentioned yesterday, one of the prime things that we can look at are these very large lithophysy that have been undergoing a static fatigue test due to the overburden load for 12 million years.

And there is no evidence of any fracturing or disturbance that has been created past the initial cooling fracture stage in the material. In fact, we have done a PSC model which we have used to generate what we think are time dependent strength curves for this material.

And we have actually used that to back analyze lithophysy, and we get agreement with what we see underground. Some other things are caves and slopes. If it was obvious that these things had to collapse, we wouldn't see vertically standing slopes like we do, and we also wouldn't see caves that reach equilibrium that have been there for many millions of years with an arched roof.

What typically happens when something fails is that it doesn't have the bulk to stop the failure. You can form a stable elliptical arch to the material, and if the time dependency of the material is slow enough, it can actually stop its failure process.

We differ from what the approach was that you saw earlier in the use of this stand up time curve, and I discussed that yesterday. So I won't go into that again, but we feel that the use of empirically related tunneling classification schemes that were made for personnel safety considerations are not applicable in trying to predict thousands of years of failure.

What we did here is that the degradation rate is a stress corrosion process, in which you have microcrack growth under the presence of moisture and stress. So you have to have a stress data in the rock mass in humidity and moisture conditions that are significant enough to cause strength degradation in microcrack growth in that rock for time dependency to occur.

We are using currently static fatigue testing, which is the standard form of material tests to estimate time to failure. You can also think of them as a creep test if you want, although what we do is raise the rock sample up to a given percentage of its given compressive strength and hold that stress constant for given periods of time.

Now, the data that we had in the past, the preliminary data that we have been using was for short time periods. There is no question about it. However, the creep or the time dependency in this material, the tuff is very small.

And we have been attempting to use additional bounding calculations with other materials that are better known, like granite. We know for a fact that this tuff has a lower time dependency than granite does because it is a uniform mineral structure, as opposed to the non-hydrogenous fracture or grain makeup of granite.

The URL in Canada has generated a very large database of time dependency static fatigue measurements for granite. So the first thing we did was that we said, okay, we have got more granite data than tuff. What if this material was granite, and we know that it is going to behave in a faster failure mode than tuff, and let's use that and see what happens.

Well, we use that to begin with, and then we took the small amount of data that we do have, and estimated stress corrosion behavior for that, and then ran our models with that, and we are trying to gain confidence as we go.

We are currently -- we have a very large static fatigue testing program going on at New England Research right now to generate more data for us, both for non-lithophysal rocks and on large cores of lithophysal rocks at the U.S. Bureau of Reclamation.

But we think that we actually have enough information right now to make some reasonable estimates of what the time dependency would look like, and I am just simply showing you two cases.

One is for the lowest quality lower lithophysal rock, and these are simulations that we have made with the same model that you saw earlier, but with time dependency attached to the strength properties of the material, where we actually reduce its friction and its cohesion, and tensile strength as a function of time. This is for 10,000 years of --

CHAIRMAN GARRICK: Mark, I can see now that we made a mistake in calling for that last break. Would you be able to wrap up in about 5 minutes?

MR. BOARD: You bet.

CHAIRMAN GARRICK: Let me just go over this. If you look at the maximum amount of failure that we expect right now in what we are predicting in the lowest and the highest quality, we predict that it is going to take a much longer time period to see substantial failure than what you saw earlier, which was that essentially when the ground support fails that the whole drift is going to collapse.

We do not believe that that is the case. We believe that it is a much longer time frame, and that the amount of failure that is going to occur is going to occur in a slow dependency process, in which primarily the rock that yields during the thermal stressing will simply be knocked out by small scale seismic events that will occur.

And you will see that this sort of a thing developing over time. On the next slide, what we have done from a conservative standpoint is simply calculate the load that material, if we assumed complete collapse would occur, on the drip shield, and how that load would develop.

You saw this same plot two weeks ago from our calculations, and the one difference that we have, and I believe the big difference that we have with the center's calculation, is that we are trying to use mechanistically based models to calculate load on the drip shield, where you get significant arching of the load that occurs around the drip shield, instead of these highly conservative piping mechanisms, where we assume that the rock packs together quite nicely over time.

We feel that the load distribution on the drip shield was actually much smaller, and I am just comparing here these analytical methods, which are the type of thing that the center has been using, versus what we think are more mechanistically based calculations that we are using for load.

So we get different loads, and I think the main difference is that we get different loads on the drip shield, and they occur much later in time than what the center is doing.

And does this have a significant impact on the design? I guess the only thing that I would say is that if you assume that these things happen very early on, and you affect the seepage, you can affect the seepage to the drift and the temperature distribution on the waste package.

So, yes, it may be significant. I really don't know because we have not run the things, or I haves not seen any runs where we have taken it all the way through the TSPA model, but I think it is significant in the differences in results that we are getting. So I will leave it at that. Thanks.

CHAIRMAN GARRICK: Thank you. Ruth, do you have any quick questions?

DR. WEINER: I would like to hear Dr. Nataroja's response if that is okay before I ask my questions.

CHAIRMAN GARRICK: Okay. Yes. Jim, do you have any questions?

MR. CLARKE: Just a real quick one, Mark. The premise that the compressive strength is a decrease in function of porosity made a lot of sense to me when you explained it, and it is very pronounced in the mathematical model predictions, but it does not seem to come through as well in the experimental data.

Am I missing something?

MR. BOARD: No, I think that slide, the only thing that I didn't show was that was only for lithophysal porosities of 10 percent or greater. If you extend that picture to the left-hand side, where the porosities drop, it is algorithmically related and it very rapidly drops over the first 10 to 15 percent, and then it sort of stays relatively constant thereafter.

The thing that makes it important in what we are doing is that most of the rock porosity that we are dealing with is on that left-hand side of the screen, where it drops fairly rapidly. So it does have a reasonably pronounced --

MR. CLARKE: I was referring to Slide 11, where the data seem to be not nearly as dramatic as the model.

MR. BOARD: Yes, that is what I was referring to, too. If you look at the -- and unfortunately it probably was not a very good slide to put in. This slide is cut off here at 10 percent lithophysal porosity, and I don't drop it down below that.

What you found out is that when you go to the left on here there is a very pronounced drop here that levels off at about or between 15 and 20 percent. The only thing that I am pointing out is that most of our rock mass that we are dealing with is down in this range, where it is doing this kind of thing.

And unfortunately I cut it off to show the higher porosity levels, but it is a significant --

MR. CLARKE: Now that you point that out on the model predictions, that is where the major difference is. If we could just go to the next slide.

MR. BOARD: And what you can see here is where it rapidly increases here, and we are dealing primarily in this range of the material, as opposed to this range out here, although our calculations as I mentioned, we did it over the entire range here to try and see what the impact of that was.

I think the bottom line worst case is that under seismic load, that if you get very poor rock quality out in here, the tunnel under those very large loads completely collapse, and that is what we are using as our worst case analysis for feed to the drip shield people.

And I think that it is highly worst case analysis because of the size of the motions and using those porous rock properties. But at any rate, we did it over the entire range, which you find out that if you do the calculations at this low range, even for that 10 to the minus 6 motion, you still get a collapse, because the motion is so large.

So it was a bit of a moot point when it comes to the seismic thing with those large motions.

MR. CLARKE: Thank you.

CHAIRMAN GARRICK: Mike.

VICE CHAIRMAN RYAN: No.

CHAIRMAN GARRICK: The only comment that I wanted to make was that I can see more clearly the impact that this work has on design. I noticed that Abe Van Luik is in the audience, and I was wondering if somebody would care to make a comment on what the impact of this work is on the performance assessment.

DR. VAN LUIK: Dave Van Luik, DOE. The impact on performance assessment unfortunately isn't available yet. These are some of the feeds into the performance assessment model that have been put in on a trial basis.

They seem to be very important to long term performance, but we have not finished a complete package yet to look at all aspects of the post-closure case.

So there is really nothing available to say from that this is really important or not. The preliminary calculations show that it has an impact.

CHAIRMAN GARRICK: My intuition would be that the major impact would be on the uncertainty in the analysis, more than perhaps any significant change in the central tendency parameters.

DR, VAN LUIK: Yes, I would probably agree with that, but I would like to see the results later next summer.

CHAIRMAN GARRICK: That's good. Okay. Thanks, Abe. Did you have a quick question?

DR. WEINER: I did.

DR. WEINER: This is basically going back to your Slide 5, I guess. Why wasn't the repository horizon located more in non-lithophysal rock?

MR. BOARD: Well, there is an easy answer to that I think.

DR. WEINER: That's good.

MR. BOARD: First of all, from a mechanistic standpoint, I am not certain that it makes -- well, I don't believe myself after doing all these calculations that it makes much difference in which unit the repository is located from a final standpoint, okay? I will make that statement right now.

It makes it a little more difficult to do the calculations, and we have had to go through a lot of work to try and estimate what the properties are, but in the end result, I guess that is what we will determine from the final performance calculations that you asked about a second ago.

But the reason why it is in there is simple. If you look at Yucca Mountain, these beds are dipping off to the east in general, between a 10 and 20 degree general slope.

The area that the repository is placed is bounded by the Solitario Canyon Fault on the west, and the Bow Ridge Fault on the east essentially. And if you go to locate the repository, which we wanted as much as possible to make a single plane within that.

The thickest unit that we have is the lower lithophysal unit. So if the repository is a single plane, the majority of it will naturally be in the lower lithophysal unit.

Now, of course, we took into account many, many factors that we got, and a lot of it was from the seepage folks and other people about staying so far away from the PTM boundary, and all this kind of stuff.

We had took all of that into account, and you try to make a single plane of the repository, and you found out just naturally that most of it falls within the lower lithophysal unit.

We could have a multiple level repository, which is what we showed before. There were two planes. The current one was about like this, and the other -- well, it is actually off it. It is like this, and the other one is kind of off the page here going like this, and the previous design that you showed.

There is nothing -- I don't believe there is anything theoretically that limits you to making as many levels as you want, except that it becomes more complicated from a mining and a ventilation standpoint, and a transportation standpoint.

The only thing that I would point out is that the middle lithophysal unit, if you look on here, is the thinnest of those units. It is about 40 meters thick. Dave, is that correct? It's about 40 meters.

DR. VAN LUIK: Thirty meters.

MR. BOARD: Thirty meters. If you take the horizonal projection on that thing, and with that dip of 30 meters the lateral extent is not very large. I don't know what it is, but about a hundred meters or something like that on that direction.

So all of our emplacement drifts right now are about 600 meters in length averaging. So we would cut the emplacement drift size down, and we would have a multiple level repository.

We looked at all those options earlier on, but we felt all-in-all that the best alternative was to go with a single level from a construction end standpoint. So that is really why it ended up the way that it was.

CHAIRMAN GARRICK: Okay. Raj, did you want to make a comment? Please give the recorder the benefit of your full name and affiliation.

MR. NATAROJA: Thank you. I am Mysome Nataroja from the NRC staff. Would you please put the Number 9 slide up, please. Obviously this is not for me to come here and rebut what Mark entered, because this meeting is for Mark to present his views to the ACNW.

We have already made our views known, but I just wanted to make a couple of observations. We have been discussing with DOE the geomechanics related issues for nearly 10 years, and we have a number of disagreements to start with, but eventually after numerous interactions, DOE came up with this particular approach.

You can also add to the horizontal access, it not only improves information as you go further to the right, but it also makes it more difficult to go from the left-hand side to the right-hand side.

So the difficulty starts when you look at the -- I cannot read that from this distance, and so I will -- well, when you go to extrapolate from the limited range of geological conditions to the actual conditions, and to make predictions of the time dependent behavior for 10,000 years, I think that is really where the problem comes in.

But we have actually endorsed this particular approach and I don't think that we have any problem or major issues with the DOE approach, although we have yet to review the official AMR and the degradation. I believe it is ready to be submitted to the NRC.

And once we have that, we will be able to review that and give our official position on that. But in the meantime, I think that we have no problem with the -- no major issues with the characterization, and as for the amount of work that is going on, and the type of work that is going on, and we also believe that the characterization will continue even as you excavate the defined placement of waste.

So new information will be gathered as we construct the repository, which will all be factored into the final analysis. Secondly, as for the modeling is concerned, I believe -- and I believe that the center agrees with us, that the approach is reasonable, that DOE's approach is reasonable, and that using all of the right kind of models, especially the particle flow code, which is a very powerful code to be used to do some of the things that Mark explained, and I think that the results that are shown for reproducing in the laboratory gives us a lot of confidence that it can be used for extrapolating some of the repository conditions.

The next thing is that a lot of progress has been done going from almost no data to some data in the actual repository horizon, and not only in the laboratory, but in large samples and so in situ testing.

But having said that, the one thing that I would like to bring up here is that we are looking at (inaudible) activity, which is such a low probability even, but we take it seriously and take it to the consequence to see what the consequences are.

It is a low probability, but a high consequence type of situation; whereas, the drift degradation is probably the opposite. It will probably have a low consequence, but it is a high probability in our view, compared to the case activities, which is 10 to the minus 6, and 10 to the minus 8.

Drift degradation and drift collapses is probably one in some cases. I a not going to say that all the repository would be collapsed in a hundred years or 200 years, or any such predictions. But during the licensing hearing some experts will claim that it is going to degrade fast, and some other experts might give their opinion saying that it will take a long time.

It will be left to the licensing board to make a decision on what exactly is going to happen. So it will be a futile exercise in my view to try to argue who is right, and what kind of a built-in factor is to be used, and what will be the exact load that is going to come on the drip shield or the waste package, and so forth.

Instead, I think that you have to look at the whole range of conditions that are possible, including some drifts being stable for a long time, and many drifts having been degraded completely within the period of 10,000 years.

And we have to look at its impact using

performance assessment, and I think the right question was asked by the Chairman. He asked what happens in a thousand years, and that is the question that will be asked at the licensing hearing.

I do not think that there is any one methodology or one model, or one test method, that can be used to make the prediction accurately. So there will be uncertainty, and taking that uncertainty into account, how are we going to make the case.

So I think that the next step would be to look at these possibilities and look at what happens to the seepage, and what happens to the load on the drip shield, and what happens to the potential possible transfer of load if the drip shield collapses on top of the waste package and so forth.

And what are the implications of temperature distribution in the (inaudible) as a result of possible drift collapse. So my opinion is that the next step has to be taken, and it has to be taken all the way through the performance assessment.

And a demonstration has to be made that even the consequences are still within acceptable limits, and I think that is probably what our opinion will continue to be, even after we review the AMR, although some details are to be worked out on the actual post-closure seismic loads and other things. I thank you for this opportunity.

CHAIRMAN GARRICK: Thank you very much, Raj. There is a great deal of interest in this talk, and we could go on for a long time, but we have already invaded some of the time that we have allocated for interaction with stakeholders.

It has become somewhat of a practice for the committee to try and meet in Nevada once a year and to each day that we are here to allow a certain amount of time for citizens or whomever to make comments, and we are going to do that now.

We have received requests from two people to make comments. We urge the commentors to limit their time and generally we try to follow the practice of around 5 minutes or less for making any remarks.

There may be extenuating circumstances and to allow for more time, but that is the practice that we like to follow. The two people we have heard from are Dr. Jacob Paz, and Ralph McCracken. So let's go in that order. Please tell the recorder your full name and your affiliation.

DR. PAZ: My name is Jacob Paz of Environmental Services, Incorporated, and I would like to address the committee on the issue of assessment of (inaudible). I have provided you with some professional literature, which I will send you more. I would like you to review it, and make an appropriate recommendation to the NRC on this issue.

First of all, we have to look at what are the (inaudible) in Nye County, and we have two issues here. One is from the Nevada Test Site, and one is the contamination from radionuclide, and mixtures, and the second is the proposed high nuclear waste repository at Yucca Mountain, which probably contain heavy metal, particularly chromium and nickel, and various other nuclides.

And this is the major source of contaminants. The second issue, which is a relatively new issues, is the bystander effect, and the term applies to a phenomenon when unirradiated cells, near dose irradiated cells, exhibit a response similar induced by the irradiation, such as (inaudible) genesis, chromosome operation, (inaudible) cell deaths, and possible cancer.

And the bystander effects has been observed in one heat of one particle after two (inaudible). And it is also observed after 35 generations in (inaudible) culture. This is just an example to show you an apothesis of a bystander effect of other particles, and I am not sure if it is one heat, and you are going to see on the let, particularly the red cell, is damaged by (inaudible), and normal (inaudible) which are (inaudible) cell death.

And there is a magnitude of difference, about 400 or 500 times. One of the papers which you have already submitted is (inaudible), which very clearly stated that low level chemicals and their radiation present in the natural environment can also induce (inaudible) instability in cell and also involved in the bystander effect, and in general instability, we are talking about chromosome operation, and possible cancer.

I gave you a recent paper which was from the EPA, and to summarize it, it is stated that the exposure to lower level of radiation and chemicals may enhance the cancer potency, and particularly in Yucca Mountain it is a very serious issue.

There are several potentials, and one is transportation, and second, during construction, interactions between the silicon and radian, and possible aeronautic (inaudible) in the literature would surely increase the placidity, and carcinogen and chromosome operation.

The public at large, what is the real risk, is unknown, and there is an issue, and this has not been discussed at all at the final environmental statement. It might be an issue.

And here is the summarized occupational protection (inaudible) during construction, and what is the real health risk to the public is unknown. This topic should have been discussed in the final environmental impact statement.

And finally the risk assessment conflicts with nature, and the current risk assessment, which is based upon single chemical or single radionuclide, is scientifically inadequate, and should be addressed by original research.

I have a debate with Yucca Mountain, and I will continue this debate, and I provided a publication which summarizes all these issues. Thank you.

CHAIRMAN GARRICK: Thank you. Mr. McCracken.

MR. MCCRACKEN: Thank you. What brought me here today was primarily the enclosure that was in your packet yesterday regarding the Anagosta Valley Bus Tour.

But since I am here and saw a little of

this, I have got 2 or 3 very brief comments on what I have seen here today, and what I observed in the tunnels with you yesterday.

It is very easy to -- and an old sales technique is that if something is wrong, talk about it a lot and then move on to how it doesn't make any difference.

And I think that you were subjected to some of that yesterday. They gave these pores in the rocks a very fancy name, lithophysy, and the bottom line is that there is a whole bunch of pores in that mountain that you are busy drilling holes through, and connecting those pores.

And just keep that in mind when you are looking at all of this, that you have got a porous mountain, a leaky mountain, that you are trying to store something for a very long term in.

One of the questions that I have not heard answered is how did that chlorine atom that was fairly rare in this world until the atomic testing in the South Pacific, how did it in less than 60 years get into the center of this mountain?

Chlorine 36, how did it get into the middle of this mountain? Why was it found when they were boring these tunnels and testing the sides of the walls, and it is water carried. It just didn't happen there.

I ask you to keep those things in mind, that somehow this mountain is a lot wetter, or has been a lot wetter, or can be a lot wetter than it is right now.

Okay. Enough on that. Do you happen to have that package from yesterday with you? No? Okay. We will take it from the top then. The kind of appendix that was added to the package that you were presented with was actually written in 1991. It was published in 2000. Well, in 1999 is when it was written.

It was published some 26 months later. It was written in August of '99, and was completed, and it was published in October of 2001. So, 26 months later.

Obviously, the data has described the community, and it changes over two years, and then by putting a cover sheet and a date on it, I think that it was meant to be presented to you as how things are today.

Well, things have changed radically in some areas of the valley since this package was put together. One thing in particular that jumps out in my mind is that there is on the last page there, where it talks about wells in operation. There is 130 wells.

Well, I made a 2 minute call to the Southern Nevada Office of the State Water Engineer, and he says, oh, no, there is close to 400 domestic wells and probably another 150 or so permitted wells.

There is -- and in here it talks about 200 days of growing. Well, that is not so. We have closer to 270 growing days per year. We are limited in the months of December, January, and February. Those are the months where you really can't grow anything here.

We also have the dairy that is present now, and things have changed since 1999. We have approximately -- I talked to the manager of the dairy today, and we have 8,600 milking head, and the dairy alone farms 2,000 acres.

In this fact sheet, you are presented with the fact that there are probably 2,000 acres that are farmable. Well, the dairy does not do all the farming in the valley.

The one ranch that you visited yesterday with some size to it, the TNT Ranch, he says that he has got 900 tillable acres with water rights, and the

TNT Ranch does not sublet any of their fields to the dairy.

What I would like you to do is to consider asking for some more recent data, in terms of particularly the physical characteristics of the cultural aspects of the Anagosta Valley when you consider that into the rest of your decisions.

So I hope that you understand what I am trying to say, is that you have got some old information being presented currently. I am looking at my sheet here, and some of these comments are a little bit out of order, but I hope you will bear with me.

I checked with our local well driller. They have drilled 22 wells alone this year, and they have another five under contract before the end of December.

I think Mark was talking about caves. Well, most of the caves that I have run into in terms of just watching t.v. and being educated, and so on, most caves, and the formation of caves, are water related.

And the coarsing of the water wears away the soft stuff and leaves the hard stuff, and of course your caves tend to last for a long time. But also what is a long time and what is a short time, and what is a medium time.

And in his presentations I did not get any sense of what he considered a short term. Is it 1 year, or 5 years, or 10 years, a hundred years, a thousand years? What is medium time, and what is a short time, and what is a long time. It is just near term and short term. What does that mean?

And without being delineated, I am not confident that you are thinking the same thing that he is thinking when he says long term and short term, and that kind of terminology. Thank you for your time.

CHAIRMAN GARRICK: Thank you. Any other comments? Would anybody like to make a point? Yes?

DR. PAZ: Just one more point about the elevated temperature effect. First of all, for how many years are you going to see 200 degrees centigrade elevated temperature. Second, how it will affect the zero life matrix, and when it is cooler, and will it increase the fractures in the long term.

This is a very important question because it will affect the absorption of the metals and the radionuclides, and the last is that there should be a full large scale study on the impact of (inaudible) absorption of heavy metals and radionuclides, and high temperature and low temperature. That's all.

CHAIRMAN GARRICK: Thank you. Oh, yes. Judy.

MS. TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force. I just have two things. I think that you need to request from DOE that you get an absolute answer on the aircraft thing.

That is something that is important to Nevadans, because we all know people if we have been here a while, and we live in Las Vegas, we know people who work at Nellis, and we know about people and pilots that are involved at Nellis talk about things that go on there, and some of the surprising and rather scary stuff.

But I think that you need to know whether or not the Air Force did indeed declare a no-fly zone, or has volunteered to do so, or if in fact their activities are going to be increasing, and making things worse.

On the one hand, we heard that it may be something that may be less risky, and on the other hand, it may be more risky. The other thing that I would like to find, and I have asked for this before, but I have never gotten it, was what the performance confirmation program is.

There was a site investigation program, a site research program that ended with a site recommendation. There was also supposed to be a performance confirmation program that was laid out. What we are seeing now is that there seems to be a basket.

And when things don't get done in time or the schedule gets in the way, they get called, and there is just a new label put on it, and it is confirmation work.

And that should have been defined beforehand and it is should be defined now, and not just a basket that is a catch-all for stuff that didn't fit.

CHAIRMAN GARRICK: Thank you. I think that there was a comment over here somewhere. Okay. Well, this has been a very constructive day in my opinion, and I am sure in the committee's opinion, and we have a long day tomorrow to look forward to, and with that, I think we will adjourn.

(Whereupon, at 6:10 p.m., the meeting was adjourned, to reconvene at 8:30 a.m., on Thursday, November 20, 2003.)