UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

WINTER MEETING

Wednesday

February 16, 2011

Marriott Suites Convention Center
325 Convention Center Drive
Las Vegas, Nevada 89109
Lake Mead/Red Rock Salons

NWTRB BOARD MEMBERS PRESENT

Dr. Mark D. Abkowitz
Dr. William Howard Arnold
Dr. Thure E. Cerling
Dr. David J. Duquette
Dr. B. John Garrick, Chairman, NWTRB
Dr. George M. Hornberger
Dr. Ronald M. Latanision
Dr. Andrew C. Kadak
Dr. Ali Mosleh
Dr. William M. Murphy
Dr. Henry Petroski

CONSULTANTS

Lake Barrett, Independent Consultant
George Dials, B&W Technical Services Group
Christopher Kouts, Independent Consultant

NWTRB SENIOR PROFESSIONAL STAFF

Bruce E. Kirstein
Gene W. Rowe
Carl Di Bella
Douglas Rigby
Daniel S. Metlay

NWTRB STAFF

Nigel Mote, Executive Director
Karyn D. Severson, Director External Affairs
Joyce M. Dory, Director of Administration
Linda Coultry, Meeting Planner

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Each panel member has been invited to make an opening Presentation and to address the following questions:

1. What technical advances were made during the development of the Yucca Mountain program that would be applicable in developing future programs for management of spent nuclear fuel and high-level waste in the United States?

2. What scientific research, or technical development work, should be undertaken now, or in the near term, to support future development of a repository for disposal of spent nuclear fuel and high-level waste?

3. How did different managerial approaches and changes in management approaches during the development of the Yucca Mountain program influence the technical design, planned operations and logistics?

4. What actions were taken to build public trust and confidence in scientific and technical activities and results? Which of these actions should be repeated for future repository programs and which should not? What, if anything, could have been done better?

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P R O C E E D I N G S

8:30 a.m.

GARRICK: Good morning. I want to welcome you all to this meeting of the U.S. Nuclear Waste Technical Review Board. It's been a while since we've been in Las Vegas. In fact, it was June 2009. We always enjoy coming here, so we're delighted to share this time with you.

Now, as you can see from the agenda that was out on the table, we have a very busy day ahead of us. And, we have a mix of panels and presentations who will discuss a variety of what we think will be very interesting topics.

Much of the meeting agenda will be a continuation of a meeting we had actually in Dulles, Virginia in October of last year on basically what's been learned about geologic disposal. I expect that we will find the discussion today equally interesting. We plan to write a report, and we have written a report that's in the review process, on lessons learned, and we expect to publish that report in the next few months--actually few weeks.

Because we have such a busy schedule, I think we're going to break today from the tradition of introducing the individual Board members. You can see us all in this V-shared alignment here. We're all here. There's a couple out right now because of a conference call, but we have 100 percent attendance. We have name tags. And, we have our

staff back against the wall there, and they also have name tags. So, I think we'll allow that to be the basis of our introduction today.

For those of you who are interested in determining what the affiliations are, we have this information on the table as you enter the room.

Speaking of the Board's role, some of you may be wondering what the Board's focus has been since the Yucca Mountain project was shut down. The short answer is that because the Board's statutory mission is to evaluate the technical validity of all DOE activities related to implementing the Nuclear Waste Policy Act, we have refocused our ongoing peer review on current DOE activities related to DOE responsibilities under the Nuclear Waste Policy Act.

For example, in the fiscal year 2011, DOE proposed increasing funding for research and development related to alternative strategies for managing the back-end of the fuel cycle. Accordingly, these activities have become part of the Board's ongoing peer review. In addition, the Board continues its evaluation of DOE activities related to managing DOE-owned spent nuclear fuel and high-level radioactive waste, which I collectively call high activity waste.

Other activities that the Board has undertaken are preparation of a White Paper on the technical implication of

long-term storage, dry storage, and the development of a PC based tool we call NUWASTE that is designed to allow us to evaluate different fuel cycle initiatives that DOE may consider. Copies of the extended dry storage report are available on the back table, and a report on NUWASTE will be coming out in the next few days.

In addition, we are working on an update, an extension of a report we prepared a little over a year ago on programs being developed in other countries for managing high-activity waste. And, as I mentioned earlier, we are also preparing a technical lessons learned report that attempts to capture important elements of the technical work to date at Yucca Mountain and elsewhere.

Now, let's turn to today's meeting. For more than two decades now, developing a repository at Yucca Mountain was DOE's primary activity related to implementing the Waste Act. And, consequently, DOE's efforts in this area were the focus of the Board's ongoing technical review.

Although the alternative fuel cycle strategies that DOE is now considering include recycle of uranium and plutonium, introduction of fast reactors, and other reactor designs, as well as more esoteric concepts, such as accelerator-driven transmutation reactors, the Board believes that regardless of what strategy or strategies are adopted, a deep geologic repository for the permanent disposal of high-

activity waste will ultimately be necessary.

With that as context, we will begin today by hearing from Monica Regalbuto, who is Deputy Assistant Secretary for Fuel Cycle Technologies in DOE's Office of Nuclear Energy. Monica will discuss DOE's ongoing fuel-cycle technology activities. Then, we'll hear from Bill Boyle, Director of DOE-NE's Office of Used Fuel Disposition. Bill has appeared before the Board many times. Bill will talk about DOE's research and development activities for used nuclear fuel disposition, which include storage, transportation and disposal. Both of these topics are of interest to the Board because they pertain to our mandate to review DOE's implementation of the Nuclear Waste Policy Act--in this case, the technical aspects of the back-end of the nuclear fuel cycle.

We will then continue our discussion from our October meeting with the objective of obtaining as much information and input as possible on experiences gained during the Yucca Mountain Project that are considered important when moving forward with geologic disposal.

To begin, I will moderate a panel of past directors and managers. The panel members are Lake Barrett, who as OCRWM acting director may have directed the program for a longer cumulative time than any other individual; Chris Kouts, who also served as acting director of OCRWM, among

other positions; and George Dials, who was the general manager for TRW Environmental Systems--the management and operations contractor for the Yucca Mountain project.

George was also manager of DOE Carlsbad office in charge of the Waste Isolation Pilot Plant. I had an opportunity to interact with George during that assignment when I was a member or chairman of the National Academy of Science, Waste Isolation Pilot Plant Committee. I look forward to renewing our acquaintance and to what George has to say.

John Bartlett was invited and is unable to be here, a former director of DOE-RW in the 1990 to 1993 time frame. John has prepared a statement for us that will be made part of the record, and that statement is out on the table as well.

Following lunch, we will hear from Andrew Sowder on the Electric Power Research Institute’s review of geologic disposal options for used fuel and high-level radioactive waste, again, from a lessons learned perspective. The Board is always interested in hearing what other organizations think are the important lessons learned. After this, we will hear from Sandia National Laboratories on the subject of Deep Borehole Disposal. This method for disposing of spent fuel is one of the many options that has been considered. It has recently been looked at again for use in the United States.

There are two aspects of deep borehole disposal we'll hear about. First, Technical Concept and Performance Assessment, and, then, Programmatic Benefits and Pilot Demonstration Path Forward. Pat Brady and Andrew Orrell, who are both from Sandia National Laboratories, will be making the presentations and will answer questions from the Board.

Finally, on our last panel, moderated by Board member Andy Kadak, we have invited Ernie Hardin of Sandia National Laboratories to present a Sandia study entitled *Geologic Disposal Options in the US.* Ernie will present the study, and he will be joined by Andrew Orrell in a discussion of the technical aspects of the geological options. Even though the technical aspects of geologic disposal are the Board's focus, we understand that other aspects, which potentially may affect the technical program, must be considered when re-evaluating geological locations for a repository. So, we have invited Hank Jenkins-Smith from the University of Oklahoma to discuss public acceptance and related issues to help broaden our understanding in that important area. We look forward to his presentation.

A tradition we would never forego is devoting the final segment of our meeting to public comment. Public comments are always an important part of our meeting because they help us measure how well we're doing our job. If you would like to make a comment during this final session of the

afternoon, please enter your name on the sheet at the back of the room. There are people there to assist you. We have an attendance sheet there as well that we would like everybody to sign. If you prefer, remarks and other material can be submitted in writing and will be made part of the meeting record. These statements will be posted on our website along with the transcripts and presentations from the meeting.

Now, sometimes we are asked whether it is appropriate to pose questions during the course of the presentations. We kind of have a convention about that. First, Board members will ask questions. Then, time permitting, staff members will ask their questions. And, beyond that, members of the public are welcome to ask their questions. Frankly, we rarely get past the staff. We rarely give them an adequate amount of time. However, there is another mechanism that would allow you to question our speakers. If you write down your question and submit them to a member of the Board staff, they will see to it that the appropriate Board member gets the question, and we will do our best to provide an answer.

Now, there’s one disclaimer here that’s important. In these meetings, we Board members like to freely exchange our views, express our views and opinions, and we want to continue to operate in that open and free manner. We ask that you realize that these comments are not necessarily the

positions of the Board. So, any opinions you hear or infer from a Board member's questions or comments are not necessarily Board positions.

As usual, to minimize--this was timed well--as usual, to minimize interruption, we ask that you all turn off your cell phones, including me, I have mine here, so I'll do that right now. So, we do ask you to put them on at least the silent mode. If you are going to speak to us or use one of the microphones, be sure to identify yourself, your affiliation, and speak clearly into the microphone, because sometimes the pick-ups are not always perfect, and we need your name and affiliation, because we need completeness in our transcript.

With these preliminaries out of the way, I'm going to ask Monica Regalbuto to start us off this morning. Monica?

REGALBUTO: Thank you.

Good morning. I would like to thank the Board for the opportunity to present to you the current activities that we have in the Fuel Cycle Technologies of the Department of Energy.

In April of 2010, the Department of Energy issued a research and development road map. We have brought copies of the road map, and there's on the table in the back. There's additional ones here. If we run out of copies, we have a

website. If you don't have access to a website, you can put your name and address, and we'll be happy to mail you as many copies as you will desire.

In the road map, we spell out the main objective for the Department of Energy, which is to support the national imperatives for clean energy, economic prosperity and national security. We all want an integrated approach, which I will discuss in a few minutes, and we also address a transformation of programs moving into a more science based type of approach.

The main objectives are pretty much support for different areas. The first area supports the fleet of current reactors where the development of technologies and solutions are set up to improve the reliability, sustain the safety and extend the life of the current reactor fleet.

The second objective focuses on new reactor development, and that is in the process of improving affordability to enable nuclear energy to meet Administration's energy security and climate change goals.

The third one, which is the focus of this presentation, is to develop sustainable nuclear fuel cycles. And, we do all three of these objectives by understanding and minimizing the risk of nuclear proliferation and terrorism.

I'm going to briefly show to you how the Department of Energy is organized. We are under the leadership of Dr.

Peter Lyons. He's currently our Acting Assistant Secretary of the Department of Energy-Nuclear Energy. And, we basically are divided into two areas. The area over here on the left-hand side is the business and operations, and the area on the right-hand side here is where the research and development happens. We basically break that into two components, fuel cycle, R&D, and then nuclear reactor technologies. Today, I'm just going to focus on this area. Both fuel cycle, R&D and the reactor technologies are supported by a large program that we have called the University Program, and that is direct research related to these two areas.

In addition, both the fuel cycle technologies and the reactor technologies support the international program, which is driven by R&D needs, but also by policy and different missions that the United States Government has, not only necessarily the Department of Energy.

So, today, we will discuss with you these three areas, and this is the Office of Systems and Engineering. The next one is the Office of Fuel Cycle Development. And, then, the last one is the Office of Used Nuclear Fuel Disposition, which Bill Boyle will address today. So, I will cover these three areas, and then Bill will go into detail here more.

So, basically, on Fuel Cycle Technologies, what we

really do is we support decision-makers, and we do that by developing a suite of options for the management of used fuel. We demonstrate technologies to support commercialization by 2050, with the understanding that not all technologies come into the table at the same technology rate and level. So, some technologies will be ready earlier, and some technologies will be ready much later. You know, that is spelled out in the R&D roadmap.

What constitutes a sustainable fuel cycle is we focus in a number of areas that are key, and that is improve uranium resources, we maximize energy generation, we minimize waste generation, we improve safety, protection of the environment, limit proliferation risk, and they have to be economically viable.

We focus on mainly three fuel cycle options, and that is the once through. The once through is a traditional open cycle in the United States, where there is no recycling or conditioning of used fuel. The second is called the modified open cycle, and that option is where we have very limited fuel conditioning and reprocessing, but there is no recycle of the material, in general. And, full recycling is where multiple reprocessing steps and transmutation of actinides occur, which is the traditional, you know, full form of fuel cycle. Yes?

KADAK: Monica, could you explain Number 2 again? It’s

not clear what that is.

REGALBUTO: Yes. Number 2 focuses more of mechanical separations, for example, KANDU type reactors will be one, where you reuse the material, put it back in the fuel, but you don't go to the extent of doing reprocessing or a chemical separation or a prior chemical separation. So, it's very limited. It's a subset of the second one.

KADAK: But, not reprocessing at all?

REGALBUTO: No reprocessing. It's more a mechanical separation or reuse. Reuse of the fuel as is without separating the actinides and the fissions products. So, you can grind the material, prefabricate, maybe get rid of some of the fission products by, you know, by oxidation, for example, in the front end. But, there is no big recycling facility associated with this.

KADAK: Is this good for PWRs or BWRs.

REGALBUTO: That is what the current program is doing, is looking at alternatives, but it's mainly focused on light water reactors.

KADAK: Thank you.

REGALBUTO: You know, the current fleet of reactors. It's not focused on new advanced reactors. So, it's a subset, like I said, of one, but it is usually shown separate. In the new budget items that you will see for next year, it has become a subset now because we recognized that

the majority of people think of it as either open or closed. It's partially open, if you want to call it, but it's not MOX, for example.

KADAK: Okay.

REGALBUTO: Okay, as I mentioned, in the Fuel Cycle Technologies, we break up into three different areas. The first area is the Office of System Engineering and Integration. And, the objective of this work is really to inform Fuel Cycle R&D programmatic decisions, strategic formulation, policy development. We have a number of drivers, requirements, you know, technical requirements is one, policies is another one, and stakeholder input is another one.

So, the system approach, what it does is evaluate different options in which we can address this area and come out with a proposed number of alternatives. Those alternatives help us narrow it down to decide where the R&D dollars are being spent. We have a fixed budget, you know, which about is $155 million for FY 12. FY 11 has not been determined. And, we can only spend money in several areas, so what we do with the system study is we down select where is that area, and we identify the gaps where we need to spend, and make that investment. It also goes back into, you know, as we come out with new knowledge in here, we go back and reassess the alternatives that we have.

So, the integration analysis office pretty much evaluates alternatives, evaluates gaps, disconnects, places where we should not continue to invest, different options for deployment, dynamics of the systems, and basically informs our R&D program.

In our R&D Program, we basically divide our sections into four areas, and, you know, maybe the graphic is a little better, so you see how the system analysis approach is informing how to do this work. We have four different areas, and I'll talk a little bit about each of them.

We have Materials Protection and Accountability, which is really supporting all of the three different areas. We have Separations and Waste Forms. We have the Used Fuel Disposition, which you will hear next, and we have Fuels Transmutation. Currently, our focus is more science based. It's a goal oriented research, and we develop options for the current commercial fuel cycle management strategy.

And, I'm going to give you some highlights on each of the areas, and then Bill will give you more depth of the Used Fuel Disposition. So, for Separations and Waste Form, you really have two main challenges. I mean, there are many challenges, but the two critical challenges are we have to minimize the waste generated from the fuel cycle, and we also have to recover fuel resources, either be from natural materials, or from used fuel in an economic manner.

We have a development path for each of these areas, and we have outcomes, and I just brought you some examples because they're really broad. For Separations, for example, we are currently focusing on more fundamental understanding of separation processes, and listed are two examples. For example, thermodynamic properties and microstructural and corrosion mechanisms.

Why are we going back to more fundamental understanding is we do have commercial technologies that can do recycling. If we are to understand how these technologies can be better tailored to reduce secondary waste, also to achieve the correct separations that we have, then we are doing a leap step forward. Otherwise, it's an incremental improvement on current commercial facilities.

The outcome is advanced separations technologies, meaning alternatives to the current commercial facilities that exist worldwide, and robust waste forms that minimize the exposure to the public, protection of the environment. And, also, we combine all of our current R&D with predictive methods, which means that we have a large computational support initiative that works together with the experimental information coming out of these programs and tries to do more predictions. And, in general, it feeds back to the systems studies, because one of the things that we have observed, and I think many of you also have observed, is in the long run, a

system study is also useful based on the quality of the information that is fed. So, when we constantly validate the quality of information that is going back to the system study through our experimental programs, we end up with a better product, and with an answer that is more meaningful.

For transmutation of fuels, we're basically focusing on the current challenges, which is really improve the fuel cycle options in terms of, again, waste management and resource utilization. We are looking at developing fuels that have variable compositions. This is advanced reactor concepts. Also, because these fuels will have different compositions and a variety of actinides may be present, we need to also concentrate on fuel fabrication, which is not straightforward, as is done in LWR or even in MOX.

Our path forward is also looking at an R&D point of view from a more fundamental point of view. We are trying to understand how do we come out with a microstructural form that is the result of that, so less of a trial and error and more of a science based, looking at grain scale, nano implementations, transporting the different phases, and so on.

Reliable fuel fabrication is really a show stopper when one tries to close the fuel cycle, because if we do not have a way to reliably make the fuel which is consistent, and we can handle the materials, we really do not have a closed

cycle, or any cycle for that event.

The outcomes are advanced fuel forms and predictive models, which again help us guide our research and also inform the system studies.

The last area I'm going to cover, and the Used Fuel Disposition will be covered by Bill, is the Materials Protection, Accounting, and Control Technologies, which we use the acronym MPACT, and many of you may have seen that before. And, you really have the challenges that as we move forward in the fuel cycle and develop advanced nuclear systems, we have to rethink how we do material accountability. And, that is mainly because now you have, as the fuel cycle becomes more robust and you have mixed streams, it becomes a challenge in terms of do we need to develop new instrumentations so we can account for the different impurities or different signals that may have struck, for example, a pure stream, it's easier to monitor a pure stream than it is to monitor a mixed one. So, we can do it, but we want to do it economically. We want to also do it online, so we have real time data.

And, we move into a preventive approach, knowing exactly what comes in versus taking a graph sample and waiting three days until we do a destructive analysis and come back with the answer. So, that's what we call the next generation of instrumentation, high sensitivity, new sensors,

and new materials. And, also, the way that we understand the data that is coming out of those sensors in real time and use a more probabilistic and uncertainty analysis.

If you are familiar with Rokkasho Mura, which is the recycling plant in Japan, it is a dump of information that comes out of all these different instruments, and is really very difficult for one person or two people to really look at all the data that comes at the same time. So, we are getting to the point that we have more information than we have the ability to process. And, the outcome is, again, real time and also models that help us to manage this data.

And, just a couple of highlights on our University Program. Our University Program really has a couple of missions, of course, is to conduct R&D, but it's really to increase the infrastructure that we have available to us to conduct this type of work. And, we also are very committed to provide the next generation of nuclear professionals. We do that by providing resources to support the nuclear energy research and development. And, this is not only done at a nuclear engineering department, for example, it's done in a chemistry department, it's done in a chemical engineering department, materials science. It's done at different parts of the universities to support this area.

This supports direct research. Basically, the universities, some of them have their own funds, and we guide

them in how to use their funds. Some of it's work that we contract because they have the right equipment and the right expertise to do so. We also try to improve the infrastructure available to the universities. Sometimes, it's buying equipment that is in the benefit of the country to house in a university setup. And, we also have a fellowship and scholarship grant for students. It is a critical part of our work, and basically we support them with about 20 percent of our budget that goes directly to university funded research.

Concluding remarks, I hope that I have shown to you, and if you'd like to read more in detail, I invite you to take a copy of this report. If you want to comment, especially for the panel members, on our R&D roadmap, this is a leading document, so we welcome any comments or suggestions that you have for our next generation of our roadmap. R&D roadmaps change, and we take into account everybody's feedback.

For the Fuel Cycle R&D, research and development programs, our programs are goal oriented. You know, we have the closing of the fuel cycle in mind, and we also have the current needs of the reactors that we have to address. It is more of a science based program that we currently have than it has been in the past. Our job is to develop and assess technical options, to provide informed decisions, and our

research is really focused on improvements of the once through, modified open, which is a subset of the closed fuel cycle programs.

With that, I will entertain any questions.

GARRICK: Thank you. Thank you. Howard?

ARNOLD: Howard Arnold, Board.

I have the same question that Andy did. I don't understand the modified open, so maybe if you gave me an example or two, I could understand it better.

REGALBUTO: Yes. For example, there are cases in which, you know, the fuel still has enough fissile energy content, but is not desirable to separate the actinides from the rest of the fission products. You have to have the right kind of reactor for that. Not all the reactors can do that. A KANDU type reactor, for example, is one example, where you can take the fuel, you can grind it, you can release the fission products at the grinding state and capture them. Not all the fission products will come out. And, then, you remake the fuel and put it back in the same reactor. But, you have never done a completely raw dissolution and then start separating actinides and refabricating, for example, true oxide fuel. It's still the same uranium oxide with whatever plutonium has built up to the first cycle. So, it's more of a KANDU type concept.

And, the challenge that was set up out there in

this call was can people think about other options that do not require taking away the actinides from the rest of the matrix. So, keep the matrix intact, and come out with clever ideas to do this. So, this is only, it's been out for about eight months, and there are some proposals and we're in the process of evaluating if this is even a commercially feasible idea.

ARNOLD: But, you would contemplate actually deconstructing a used PWR fuel assembly?

REGALBUTO: Yes, mechanically deconstruct it and reassemble it, yes, sir.

ARNOLD: Okay, thank you.

GARRICK: Mark?

ABKOWITZ: Abkowitz, Board.

Monica, this is certainly a very structured and organized approach. I, for one, appreciate the thought process that's going into this.

I've got a couple of questions. The first one is do you have a time frame in mind for when some of the work you're talking about here would be accomplished. Is this a two, three year activity, ten, fifteen year activity? What's the expectations?

REGALBUTO: Unfortunately, I wanted to bring to you the implementation plans, but they are not publicly available yet. So, as soon as they're available, I'll be happy to send

the Board a copy. They're in the process of being reviewed. We have four implementation plans, and each of the implementation plans supports each of the R&D areas. And, there, you can see the insertion points. When does one technology become ready to, you know, fulfill the--you know, 2050 is really the end of mission, and so you have to go back to build and construct anything for the next ten years. So that brings us back to what do we need to do today? What do we need to accomplish in five? What do we need to be ready by ten. Some ideas might be wonderful, but, you know, we don't have the money to continue R&D for 50 years, for example.

So, in the implementation plan, we do spell out all these points. Two of them were ready. We have four. So, I couldn't bring them to you because they're not public documents, and we are going to make them public. We had a workshop with industry last week, and we asked for their feedback to see what is a realistic expectation. So, we're in the process of rolling up the feedback that they provided to us, and I will be more than happy to provide that information to the Board as soon as it becomes available.

ABKOWITZ: Thank you. I have sort of a follow-up question, and that has to do with what kind of conversation is taking place within the Department in terms of juggling the potential for some of these concepts whose implementation

is out in the horizon decades, at least, with the amount of spent nuclear fuel that is accumulating and would be anticipated to continue to accumulate if we depend on nuclear energy at any scale relative to how we depend on it today? It seems to me that we have to approach this in a very continuous manner, and need to be grounded in the fact that today, it is what it is and will be what it is for a while, and we have to reconcile how that inserts into some of these ideas that are being kicked around.

REGALBUTO: Yes, and I think what I showed you is more of a closed fuel cycle approach, but there was one box that I did not describe, which was the used fuel disposition. Now, Bill will address that area, and he will talk about what are we planning to do now that, you know, we have to look at options for used fuel disposition with the understanding that we continuously accumulate. So, yes, that is part of the R&D roadmap. I just didn't talk about it because it's the subject of Bill's presentation.

ABKOWITZ: Thank you.

GARRICK: Ron, Ali, and then Henry.

LATANISION: Latanision, Board.

This is a follow-up to the question that Dr. Abkowitz just asked. And, I would just preface it by saying that I think the long-term character of what you described is important in terms of nuclear electric generation in the

United States. But, I do have some questions on the budget. Can you tell me, if we go to Slide 4, what the budget distribution is among those boxes that you've highlighted, first of all? And, then, secondly, can you tell me what fraction of the budget is directed towards--

REGALBUTO: Oh, okay, I see your point.

LATANISION: Right. And, then, secondly, the question from a manpower point of view, the budget that's directed towards university student programs, NEUP?

REGALBUTO: Yes. And, in your packets, you may have backup material. I'm not sure if you were given the backup material or not. That should be Slide 15. No? Okay.

Jeff, could you provide to them Slide 15 and 16 on the backup material? I believe this is information that we have made available in the past to the Board. Unfortunately, this is 2011, and that is a budget that has not been approved. But, we certainly know the percentages are pretty clear in here.

So, for the fuel cycle R&D in 2011, the request is $191 million. And, if you look at the line that spells University, you will see there is a $35 million allocation for University Programs. For example, Used Fuel Disposition is $23 million, and we will give you copies of that.

LATANISION: Yes, that's precisely what I was looking for. I'm just curious, how much of that, for example, in

terms of University Programs, how much of that $35 million has been distributed? Do you know offhand?

REGALBUTO: Okay, there was a call, and, you know, continued resolution has caused an impact to our University Programs.

LATANISION: What's been spent?

REGALBUTO: So, what has been spent is the current programs that exist, and, you know, when you form the university, you don't form them on one year, even though our budgets are spelled out in one year.

LATANISION: I'm glad to hear you say that.

REGALBUTO: You know, I mean, we all went to grad school and we know that we need at least four years for a Ph.D., and Andy will not issue us one if we wouldn't serve at least four years. So, the majority of this money is allocated in a three or four year process. So, when you look at this number, you have mortgages already with the promissory notes of people that you funded two years ago, three years ago and four years ago. So, it's a ramp area.

The first priority is to continue those funded because the other people are currently in the program. We had a call and we received a large number of proposals, many of them very, very good, and we have put that distribution on hold because we have not been given our budget for FY 11, so I don't know really how much money we have to distribute at

this point. But, we are very sensitive to the fact that the master's program is a minimum of two years, a Ph.D. program is a minimum of four, and the role of the university is to educate. So, you know, it's in the best interest of all of us to approach it that way.

GARRICK: Is there a way to break this out a little differently? For example, in terms of how much of this money is analysis, how much of this money is laboratory work, how much of the money is--

REGALBUTO: I could certainly provide that information to you. I don't have it in hand right now, but we do have, I mean, you can probably see that this is a computer generated flow sheet. We have a really good accountancy system, and we can generate reports by university, by national lab, by location, by area. I'll be more than happy to provide that to you.

GARRICK: I'd be very interested in the activity, how much of this is kind of in the paper category, how much is in the development category.

REGALBUTO: Yes. Yes.

GARRICK: How much is in the pilot plan?

REGALBUTO: Right. So, we can break it down, for example, by experimental program, by facilities, by what we call reports.

GARRICK: Right.

REGALBUTO: And, so on. But, the information as we have, we just have to generate the report that benefits the Board, and we'll take that as an action item.

GARRICK: Okay, thank you. Ali?

MOSLEH: Mosleh, Board.

Slide 5, you have listed a number of mission objective program objectives. Looking at that, some of those depend on what kind of power generation mix we have, what kind of reactor technology you're envisioning. Is any of the new concepts or things that are currently being discussed, such as a small modular reactor, part of the mix that you're considering when you're looking at that?

REGALBUTO: Yes. And, you know, this is the title. Unfortunately, it's only for Fuel Cycle Technologies. If we go to Slide Number 4, please, you will see that we also have another area here, which is Reactor Technologies, and then we have what we call the Integration Part. What you describe about SMRs is in this area, and then we have the combined, you know, we have to gel everything together. Today, I only presented to you this area, so I didn't cover SMRs. SMRs will be here. But, if the Board is interested, perhaps in your next meeting, John Kelly can come give you a briefing on that area, if you all are interested.

MOSLEH: I was wondering what, concerning the implications of those designs in your--

REGALBUTO: Yes, and that comes in part of the--if we could go to Slide 7, please? If you're looking here, Requirements, right, for example, if we move forward with SMRs and that becomes a very viable option, when the system study analysis was done, SMRs is considered as one of the options. And, so, as we go back in time, perhaps the option with SMRs might become a more dominant option that we need to go in there, and that is certainly part of this exercise. It is not frozen in time, because, you know, a fuel cycle is a dynamic process.

MOSLEH: That's what you meant by the systems dynamics?

REGALBUTO: Yes, by the systems dynamics. Unfortunately, sometimes we only see data reported as a steady state in 100 years, but they don't tell you what it takes to get from zero to 100 years, because it's not like the reactors disappear overnight and new reactors come in. So, it's a phased approach where you have transition technologies going along, and sometimes you see reports and they don't capture, they just tell you a steady state in 100 years. Well, the reality is that a fuel cycle never reaches steady state. That is part of the recognition to that.

So, that's why we have this iterative loop, because we may do the study, and, you know, other people may do a study and base it on different assumptions, the conclusions may be different and we have to decide what are the different

assumptions that were being done, or are the assumptions correct, or did we miss something, and we have to continue doing it. So, what we do is we generate the tool, but that tool is only a mechanism that allows us to really predict continuously and self-police ourselves, if you want to call it.

MOSLEH: Thank you.

GARRICK: Henry?

PETROSKI: Petroski of the Board.

You used the term science based in a couple of places.

REGALBUTO: Yes.

PETROSKI: Could you elaborate on exactly what you mean by science based?

REGALBUTO: Okay. Science based in not as science based as the office of science, you know, it is more discovery. It really is more of an approach that is less trial and error. So, for example, if you're doing fuel fabrication and you realize that a batch of samples, you know, is pretty brittle and it doesn't meet the requirements, but you have another set that is good, you want to try to understand what are the qualities that make that batch good, in addition to saying this is a good candidate. So, you go a little step further in there.

If you develop a solid extraction molecule, for

example, then you want to ask, okay, not only we have one, this is good, it's also coming on and saying okay, what were the attributes that make that material successful. And, then, maybe you can develop an improvement to that. That's more our science based for us.

PETROSKI: So, is it fair to say that it's more applied science than basic science?

REGALBUTO: Yes, sir, it is applied science.

GARRICK: Okay, Bill?

MURPHY: This is Bill Murphy of the Board.

You heard in John Garrick's introductory remarks a conclusion that the Board has come to that one way or another, geologic disposal of nuclear waste will be necessary. And, it seems in contrast, you use the term "full recycle" and "closed fuel cycle." Do you realistically anticipate there's a fuel cycle that does not involve geologic disposal of wastes?

REGALBUTO: Okay, when we use the word "fuel recycle," it doesn't mean that everything gets recycled. It means the material that has a fissile value, and there are a lot of materials when you account for the spent fuel that do not have fissile value. NE has always recognize that no matter what fuel cycle we select, the need for a repository will always be there.

MURPHY: So, full recycle means--

REGALBUTO: Full recycle means fissile content. From a value point of view, it's what's still valuable is any material that still has residual fissile energy content.

MURPHY: So, how does that contrast with the concept of a closed fuel cycle?

REGALBUTO: A closed fuel cycle basically--are you asking between partial recycle and fuel recycle, or are you asking open cycle?

MURPHY: Well, I'm confused. It seems to me to be a conflict between the notion of the necessity of geologic disposal and a closed fuel cycle, which would seem to imply that everything gets recycled.

REGALBUTO: No, in a closed fuel cycle, you would still have high-level waste that would go into the repository, many containing tracers of fissile material that no longer have energy content, and of course the collection of fission products that will be generated in each of the passes as you go along the reactor.

MURPHY: So, the closed cycle includes a geologic repository?

REGALBUTO: Absolutely. And, also, even in a closed cycle scenario, there may be materials that you may choose not to recycle. So, you would still have a partial amount of spent fuel that would have to be disposed. You know, it's a value approach. At one point it's economic to recycle some,

it may not be all, and you still have to dispose of spent fuel in some fashion, and you still have to dispose of the secondary waste generated from a closed fuel cycle, of which some is high-level waste. So, the need for a repository, and I don't want to give you the impression that in a closed fuel cycle you don't need a repository, no, you will always need a repository. And, that is a reality of the system.

MURPHY: Thank you.

GARRICK: Andy?

KADAK: Yes, Kadak, Board.

You said this is a goal oriented program, and I'm trying to understand the goal.

REGALBUTO: Yes, the goal is a sustainable fuel cycle by 2050, with the understanding that--

KADAK: That we all love you and everything.

REGALBUTO: Yes, with the understanding that this argument just came out in April.

KADAK: Can we get a little more specific?

REGALBUTO: Yes. It is recognized that part of the goals will be changed after the Blue Ribbon Commission issues its recommendations. So, this document will be revised when the Blue Ribbon issues its recommendations. We are looking forward to those recommendations in the report in July, and definitely looking forward to the final report in February. It is a stop point for us to re-evaluate our options at that

point. So, the current goal is what you see, and I clearly agree with you that it's a little undefined, but we need to wait for the Blue Ribbon recommendations to put more definition into this.

KADAK: Okay. And, you also know that the Blue Ribbon Commission is not a technical body?

REGALBUTO: Correct.

KADAK: And, you are a very technical person, you've done chemical separations for many years.

REGALBUTO: You're outing me.

KADAK: Pardon?

REGALBUTO: You're outing me on my chemical separation background.

KADAK: No, I'm not. I'm just reflecting on your technical accomplishments.

REGALBUTO: Thank you.

KADAK: But, you know this business better than most about separations options. Do you see anything dramatically new coming out of this science based research that will greatly alter the direction?

REGALBUTO: What we're trying to do is use our budget to the best way. So, for example, the system analysis tool, once we have the tool, we can run it with whatever different requirements, policies, and so on comes out. So, the tool itself, the money that we're spending developing the tool, is

money well spent because we can use it after Blue Ribbon, and I know they're not going to issue technical recommendations, they're going to issue more guidance, but as that guidance goes into our R&D, that's money that we developed in this tool.

In the separations and fuel cycles area, we're concentrating on understanding the fundamental mechanisms that really drive any separations. I mean, you can go by changes in compositions, sizes of molecules, and so on and so forth, so that knowledge doesn't get thrown away just because, you know, we change an approach. That is still the driving forces for a mechanism. The failure of fuel is still the same, you know, there's brittle material, there's corrosion, and so on and so forth. So, when we design these processes, we're keeping it to the areas that there is a continuum on them, and then there will be the area that will be evolving as we move along, because that is driven by policy, not by science for us. So, we have to make sure that we have a core that continuously improves knowledge, and then the one that responds to policy needs.

GARRICK: Okay. Well, thank you very much, Monica.

REGALBUTO: Thank you. I appreciate the time.

GARRICK: Bill?

BOYLE: Thank you for the opportunity. As Chairman Garrick mentioned earlier, I've made a number of

presentations through the years to the Board and members of the audience, but it was always as a member of the Staff of the Office of Civilian Radioactive Waste Management. And, as you can see, I'm now representing the Office of Nuclear Energy.

So, because of that change, my presentation in part is a little bit different than Monica's, in that I will also focus somewhat on the people, because I felt that through the years, both the Board, the Staff, and many members of the audience certainly got to know the Office of Civilian Radioactive Waste Management, including the people, who was responsible for what. And, so, I will spend some time focusing on that as well, not just the technical work that we do, because this is the Nuclear Waste Technical Review Board, and the disposition part is disposing of the waste.

So, I would expect in the years to come, there will be a lot of interactions between my group within NE, and I'm sure the Board will have interactions with other parts of the Department of Energy, but it was because of the probability of many interactions that I was going to focus somewhat on the who of our work as well.

As Monica said, she spoke about all of Nuclear Energy's fuel cycle responsibilities, and I'm just going to speak about one part of it, the disposition part, which, you know, disposition equals storage, transportation, and

disposal.

This is the slide that Monica presented, except I've highlighted in red Objective Number 3, because that's where my group fits in. As she said, one and two are related to reactors, and this is the part where used fuel disposition fits in as part of the nuclear fuel cycle.

And, this is another slide that Monica shows. And, again, to emphasize some of the people, my group is NE-53 down there at the bottom in green. And, we report up to Monica for Fuel Cycle Technologies.

Okay, now it's back to the what of what do we do. You can all read this, and I will shorten it a bit, but our main goal is to identify alternatives, and conduct research and development in those three main areas down at the bottom, storage, transportation, and disposal.

Now, I will have a couple slides on the who. This one shows only Department of Energy staff members, and it's really how we have divided ourselves up from a human relations point of view. There is roughly 21 of us, I believe, and we needed to divide up into some way in terms of we needed to have multiple supervisors. And, so, we divided it up this way between Engineered and Natural. And, the reason we did that was take criticality, for example, that's of interest in both storage, transportation, and disposal. If we had rearranged ourselves in those lines, storage,

transportation, and disposal, arguably, we might have needed a criticality person in each, and we didn't have that much money, nor that many people.

So, we have set ourselves up to be matrixed out. We do have somebody who understands criticality and is responsible for it, and that person will work on storage, as necessary, transportation, as necessary, and disposal, as necessary. Corrosion is another example. In the seismic activity, you have to account for that in both storage and disposal. So, this is why we set ourselves up from a human relations point of view to be able to have the staff matrixed out.

Now, some or all of the people on this slide are in the room. Jeff Williams is the Deputy, and he's in the front row over there. I know he's made presentations to the Board through the years. I see Tim Gunter in the room, and he's the Engineered Systems team leader. I don't know if Ned Larson is in the room, and I didn't see a hand go up.

So, that previous slide was focused only on the Department of Energy organization and staff. As is typical in the Department of Energy, the bulk of the day to day detailed work is done by the national laboratories, and so this slide has some national lab staff as well.

In terms of how and who, we get our work done, it's shown here, and it was also shown in the backup slide, we

have four control accounts in the Used Fuel Disposition area, Management and Integration, International and External, Transportation and Storage, and Disposal. And, in that backup material that was given to you for the $23,800,000-something, the bulk of that is really is Disposal, about twice as much in Disposal as in Transportation and Storage, and the listed amounts for the other, the Management and Integration and the Interactions Groups.

We have an overall campaign, we get all the work done in the construct of a campaign. And, in Monica's presentation, she lumped some of the campaigns together. I think we actually, in Fuel Cycle, we have about a Used Fuel as just one of them, and we only have one campaign in Used Fuel. We could have alternatively set it up such that we had a Storage campaign, a Transportation Campaign, and a Disposal campaign, but this was the organization that existed when I came over to Used Fuel Disposition, which was September 26th of last year. And, all the federal staff actually came over, with the shut-down of the Office of Civilian Radioactive Waste Management. We've only been involved in Nuclear Energy since September 26th, and this was the setup that existed then, and it's worked quite well.

Ned Larson, who is not here today, he's the federal program manager, and his laboratory counterpart is Peter Swift, and Peter is in the room, he's back there. And,

underneath them, again, there's these four control accounts, each of which has a federal manager. Jeff Williams has the first two, Ned, who is not here, has Transportation and Storage, and Tim Gunter, who I introduced, is the federal manager for Disposal. And each one of these control accounts has a lead laboratory manager, lab control account manager. For the first two, Management and Integration and International and External, it's Mark Nutt of Argonne National Laboratory. For Transportation and Storage, it's Ken Sorenson of Sandia National Laboratories. And, for Disposal, it's Kevin McMahon of Sandia National Laboratories. I don't believe any of those three are in the room today.

Now, back to the what. These next two slides, again, you can read them, and I will summarize them, if you will, starting with the near-term objectives. The first, most important part, is provide technical expertise to inform policy and decision-making. You know, as the U.S. moves forward with considering different fuel cycles, each of which produces its own different wastes on the back end, our job is to provide the needed technical expertise to inform policy and decision-making.

These next two bullets can be summarized as working at today, what do we know and what do we not know? It's identify the data gaps, because what with the stopping of Yucca Mountain in the budget and the shut-down of the Office

of Civilian Radioactive Waste Management, we have everything is available to us. You know, we're not focused on a geology, a site, a solution. It's where other countries are and where the U.S. was a while ago, so we have to ask ourselves for each of the concepts we're looking at, you know, what do we know, and what do we think we need to know.

GARRICK: The middle two bullets imply that you're really analyzing the Yucca Mountain experience in some level of detail, among other things, among other experiences?

BOYLE: Well, I would say it factors into, both on the federal side and the lab side, many of the people that are now in Used Fuel Disposition, actually worked on Yucca Mountain. And, so just as humans, they can't help but bring their experience with them.

GARRICK: Well, that sounds kind of fuzzy. I'm thinking of there were very tangible specific advancements made in analysis technique, in flow models, in rock mechanics, in all kinds of things associated with the one activity that we say we've got to go forward with, and that's a high-activity waste repository. So, there's the most concentrated effort of the last 20 or 30 years of technology. I hope that what this means is that you're really taking a look at that, and that you're being able to reassure the citizens that that $10 to $13 billion didn't go completely to waste.

BOYLE: Yes, and I would say it all depends somewhat,

like for example, it all depends on what particular geology or concept we're looking at. For example, if we're looking at granitic rocks or, you know, mined geologic repository in granitic rocks, in granites or fractured, or we're looking at borehole disposal in a fractured brittle rock, I agree with you 100 percent that the first place we should look is what models were we using at Yucca Mountain.

Now, salt is a different story. The scientists, we would in that case, turn to the people at WIPP or the Germans, who have more experience there.

So, it all depends upon the problem. And, again, back to my first part of the answer, I think that naturally comes, for many aspects of the problem, because the people came over. Like, we still have Lawrence Berkeley National Lab involved. They develop TOUGH as a code. That would be the first tool they would probably look at in their toolbox. So, I think yes, depending upon the problem. But, there are other problems, like for example, since it's wide open again, we don't have a site, there were certain things we never looked at at Yucca Mountain or beyond the FEP stage, if we screened them out, like glaciation that the Swedes and Fins look at, and the Canadians, we really never did at Yucca Mountain, other than we represented it as wetter climates in the future. But, we didn't have to ever worry about loading.

So, there are certain areas that aren't

transferable from Yucca Mountain. And, in that case, we look out, well, what have others done in this area, much like the Germans and WIPP, for experience, and so on.

GARRICK: I'm thinking of a lot of things. I'm thinking of what did we learn from the project that tells us about how we can design and develop a better specification, for example, for site characterization. I think that one of the things the Board kept hearing about, if we had only known this, we would have done this, et cetera, et cetera. Well, we have a tremendous experience base here with respect to at least understanding some principles that should be applied with respect to being able to relate the results to the supporting evidence, of which the site characterization is one of the most critical inputs.

BOYLE: Yes, and I'm sure we'll hear some other input on that this afternoon from Lake Barrett and George Dials and Chris Kouts, and others. But, my own is is one valuable lesson to be learned is in site characterization, you would want to spend your money on the things that are important. Well, you don't necessarily know a priori what's important. You know, you've got to go get data, create some sort of model that provides insights into what's important. So, it becomes a bit cyclical and iterative in terms of you refine your models, you get more insights, you then decide to study this.

To the extent that you can make that iterative process faster and cheaper, but nevertheless robust, I think that's an important lesson to be learned because the sooner you find out that although some things of interest to some scientist, but it's not really important to the performance, when you can stop it, you can save a lot of money.

And, the last bullet deals with, and of course we will have to develop models to analyze our systems. And, the next slide, believe it or not, is the long-term objectives are really pretty much the same, in that we're going to continue to develop our understanding. That's what the first two bullets deal with. And, the last one is, and we will develop our models more, all in this time frame that's a little bit further out.

And, the last two slides deal with the third and fourth control accounts I showed, which is where the bulk of the money is, not only the bulk of the money, it's where the technical work is largely done.

And, in Storage and Transportation, that first sub-bullet, conceptual evaluations, what we're looking at there is how do you develop data to justify 100 years of storage, 200, 300 years. You know, what do you want to measure? How do you want to measure it? Where do you want to measure it? Does a facility exist today? Do we need to build something new? Does half a facility exist today? So, we have people

working on these concept evaluations, looking at alternatives in terms of what do we think we need to know, and what do we need to measure, and where could we do it, and what do we have to build?

The R&D opportunities task for Storage and Transportation, that's looking at, well, what do we do today? Where are there any areas in which we think we need more information?

Security and Transportation are very similar. They both go on today, so we're looking at what do we know today and where do people think they need to know more? And, specifically, issues that come up with respect to Transportation and Storage is the increasing burn-up of the fuel, and what will happen after extended storage when you then go to transport it. What state will it be in? And, it's very similar, in my mind, to the issue you face with a repository, in that the time frames involved, you know, repository is thousands, ten thousand years, out to a million, storage is shorter, but it's still multiple life times. What kind of tests can you do in a shorter time frame that nevertheless supply meaningful insights.

And, the last slide deals with the Disposal Research. It's, for now, if you will, and again this started a year or two ago, for now, we're looking at some specific rock types that I would say it's fair enough to say look

around the world and what rock types have people considered for waste repositories. Salt, we're looking at salt. Granites, we're looking at granites. Fractured rock, well, we did that, all granites are fractured anyway. Shale, Belgium and France are looking at shales, so we will as well.

So, we're looking at the standard candidates, and added to it, borehole disposal, which is actually somewhat independent of rock type, but not entirely. You can't put a borehole in pore enough rock. You know, you can't do it economically. But, we're also looking at that as an option. And, so, for these different media, we are looking at well, what do we know and where do we need to add to it. And, again, as I've mentioned, some of what we know has been generated by other countries, you know, because we here in the U.S. for the last two decades, we're looking at one concept, and now we have other concepts to look at, and that relates to the second sub-bullet.

We were considering specific included FEPs at Yucca Mountain, and now because we don't have a site, we don't have fixed geology, we have to consider other FEPs, glaciation being an example again. And, because we don't have a specific site and a specific design, what we mean by generic there is we need to ask ourselves for those rock types and those concepts do we have models that have enough modules built into them to allow the right sorts of physics and

chemistry to be evaluated. And, so, now we're developing those models. With the end result being that sometime we could inform policy and decision-makers that well, if you considered a repository in this rock type or that rock type, here's what it might cost you, here's what the performance might be.

In these last two sub-bullets, I'll try and describe those. This is where we really flange up to the rest of fuel cycle. As Chairman Garrick mentioned, the Department, specifically the Office of Nuclear Energy, is looking at these other concepts, fast reactors, he said esoteric ones such as transmutation, and things like that. So, people can develop all these different alternatives, each of which has its various pluses and minuses in terms of constructing them, operating them, but also in terms of what do they spit out the back end in terms of waste.

This gets back to Bill Murphy's question of Monica, that each of those alternatives will produce different amounts, different types of waste. Each type will have different amounts and different characteristics. And, each of those waste types and amounts will need some sort of disposal. So, you have to consider the whole system, not just the disposal of the high-level wastes. It wouldn't make much sense necessarily to choose a system that seemed to produce lesser amounts of high-level waste, but just

voluminous amounts of greater than Class C or low-level waste. By the time you put pencil to paper, you might find out that that was a disadvantage to option, even though it might have produced less high-level waste.

So, we, in these last two bullets, that's what we're looking at. For what do these alternatives upstream, the different types of reactors, and the different fuel types, what do they spit out the back end, how much do they spit out, and what might we have to do to dispose of them? And, that is my last slide.

GARRICK: Okay, Howard?

ARNOLD: Howard Arnold, Board.

It seems to me one of the important outputs from the previous program was the TSPA analysis.

BOYLE: Correct.

ARNOLD: I think a tremendous job was done there. Looking on Slide 5, you have the Engineered Systems and Natural Systems, and those bullets underneath. Who is keeping alive the TSPA and getting it ready for whatever is chosen next?

BOYLE: Well, it's easier to find on the next slide. It's--well, go back one slide. Again, this slide was a human resources slide. That responsibility, just by choice and the people involved, we put under Ned Larson. Now, I'll go to the next slide. Those activities would fall in here.

ARNOLD: Do you think you could bring it back alive, the TSPA model?

BOYLE: Yes.

ARNOLD: Okay.

GARRICK: David?

DUQUETTE: Duquette, Board.

I don't envy you your job, because I'm not sure what you do. It' just seems to me that this Board has been exposed to lots and lots of different disposal concepts, and that it's very difficult to have a generic concept of anything. Let me address the EBS because that's mostly where I'd be coming from.

We know that each of the rock formations that have been looked at by other countries, as well as our own in the Seventies and Eighties, would come up with a different concept for an EBS type of engineering. I guess what I'm asking is is how you do a generic study of what an EBS might be without knowing almost anything about rock formations, except for what we know about other nations' rock formations and our own early investigations?

And, the second part of that question is something that I think is missing in your program, and maybe there's some other connections someplace, is we know that each type of disposal process, whether it be in shale or rock or clay, or anything else, has a price tag attached to it, and I don't

see anything in your program that's going to be able to advise any kind of a policy-making group as to what these things are going to cost. For example, if I go to granite, is it going to be ten times as much as clay?

We do have the option in this country of probably more options than almost any other country in terms of the formations that we can look at, because of the size of the nation and the different geological structures. So, my question will be are you just a stable of people waiting for someone to come up with a concept someplace that you can then address? In the meantime, are you looking at options? And, my second part of the question is how are you going to address the economics of the whole process?

BOYLE: We're not just waiting for somebody to give us an option. Although I didn't say it earlier, another way of rephrasing your question is in order to do analysis, you have to analyze something. And, a lot of people don't like that word generic, and I guess I've grown--I didn't coin it--but I've grown accustomed to it. In those activities where we're looking at whether it's the system or the natural or the engineered system, people either already have or are in the process of or have plans to analyze something, they've got to bite the bullet and say okay, for the purposes of this analysis, it's going to be a borehole of this with a waste package of that.

Now, the problem with doing it that way is you did an analysis of that, and if you want something else, you've either got to get insights into the something else from the one you did, or you've got to do another analysis. But, yes, people are making those choices to analyze something. And, I'm not saying we know that what we're analyzing today is going to be the thing chosen, but we do have to make some choices to have some results.

And, the money factors in as well, because back to the discussion of each of those alternatives, you know, different reactors, different fuel types spit out these different wastes and different amounts, and the cost of disposing is different for each of the different types and amounts. So, that is part of our work in concert with our colleagues and the rest of NE to look at. But, the money doesn't necessarily factor into every analysis we're doing today, but we do realize that if we're to provide credible input to the policy and decision-makers, that ultimately, the cost is part of that. Because, for all we know, policy-makers might actually choose something that's more expensive because it provides some other benefit, you know, greater protection, or something or other.

GARRICK: Ali?

MOSLEH: Bill, on your near-term campaign objectives, the ones that refer to development of comprehensive

understanding, the two bullets in the middle on Slide 7, what would be the work product of that activity? Is it going to be a series of reports?

BOYLE: Yeah, it would be, and I'm pretty sure what I'm about to say is true, I think our work plans for this year were given to the Staff members? Yeah, Jeff Williams gave them to Carl DiBella. And, all those work plans, you know, the plans we have with the national labs under Peter as the National Technical Director, it lists all the reports, and there's quite a few of them. I actually think it's maybe, you know, because again the way DOE does project management, as others do, you know, there's Level 1 milestones, Level 2 milestones, Level 3 and Level 4 milestones. I think we have one Level 1 milestone, that's on storage R&D opportunities. We have four or five Level 2 milestones. Tens and tens of Level 3s, and even more of Level 4s.

So, yes, generally, the output--and, back to a question, I forget who asked it, what's the division of money, it was asked of Monica, testing versus analysis and reports. The bulk of our money right now, but not all of it, is in analysis and reports, not testing.

And, when you see the 14 plus million, I think it is, for disposal, yeah, $14,562,000, the bulk of that is on analysis and reports, labor, if you will, not as much on testing, although there is some testing.

MOSLEH: And, then, on the disposal research, who's doing that work, you know, the ones that you've listed?

BOYLE: Pardon me?

MOSLEH: The list of research areas, generic evaluations, who's doing that work? 10, Slide 10.

BOYLE: The generic disposal system level modeling?

MOSLEH: Yes.

BOYLE: The people I interact with are Peter, Ned and Tim, but I believe Cliff Hanson is one of the people. Peter, do you--

SWIFT: Peter Swift, Sandia.

For each of these activities, it is a multi-lab effort, and the lab teams are people you're familiar with, people at Lawrence Livermore, Lawrence Berkeley, Los Alamos, Sandia, and labs that you have not had as much work interacting with through the RW Program, the NE labs, Idaho, PNL, Savannah River, Oak Ridge. So, for example, take inventory and low-level waste disposition, our leads for that activity are Savannah River National Laboratory at Savannah River.

The generic modeling activities, the leads for them are at Sandia. The work is at the appropriate labs, for example, Natural System, we have Los Alamos working on far field saturated transport. We have Lawrence Berkeley lab working on thermal processes and chemical processes in the

near field. Does that answer it?

MOSLEH: Yes. Depending on the area, some of the expertise are outside this county, do you interact with them?

BOYLE: Well, we did have the one slide of international interactions, which I'll take a minute to answer that. Again, because as a country, we were focused on a specific site, specific design, and that sort of thing, OCRWM and the labs that worked for us, we certainly had interactions with the international community, but because of some aspects of the unsaturated versus saturated, and that sort of thing, one could argue we didn't have as much commonality, I'll use Finland and Sweden as an example, we didn't have copper waste packages, they did. But, now that we as a country have said no, it's all wide open again, we actually will probably have more international interactions. Like, for example, using copper packages again, to the extent that we consider them, it would be natural for us to interact with Finland and Sweden because they're so far along. So, we do have the one control account with International, and we do interact with other countries, and we're looking to do more.

GARRICK: Ron?

LATANISION: Latanision, Board.

I think you're hearing the questions from Howard and from Dave, a theme that I think probably is on the mind of a lot of people in this room, and that would be is it

implicit or maybe explicit in the mission of the Fuel Cycles Technology Group to preserve or maintain the technical infrastructure to ultimately deal with waste disposal, is that part of what your mission is?

BOYLE: I would answer that yes, the Department of Justice has actually made that statement to the Circuit Court of Appeals. You know, if you go back and you read the various filings and the lawsuits, the government does recognize it has an obligation to dispose of this material, and it is well aware of that obligation and will take care of it, and is maintaining the corporate technical ability to do it. It's just that it's not the former choice.

LATANISION: I mean, obviously, the staffing has changed dramatically since OCRWM has disappeared. So, is the concept then to maintain the leadership positions with the thought that ultimately, when the need arises, you will draw on the national labs to staff this, or what's the vision?

BOYLE: Well, my take on it is DOE, you know, is the government entity with the contracts with the national labs, and that's typically how DOE gets its day to day technical detailed work done. As long as DOE has this responsibility, I'm sure the labs will be involved.

LATANISION: Thank you.

GARRICK: Mark, Andy and Thure. Mark?

ABKOWITZ: Abkowitz, Board.

I'm interested in learning more detail than what you've given us in these slides. And, my question I guess is similar to the conversation that I had with Monica in which there's an implementation plan behind what she talked about that provides much more detail about what you are really doing, and I think is the level of detail the Board would need to try to understand how specific initiatives are being carried out, who's carrying them out, what they're trying to accomplish, when they're trying to accomplish it, how it integrates with other cohorts in their own group and across groups, et cetera, et cetera. Does such a document exist in your program?

BOYLE: Oh, yes, it's one of the four.

ABKOWITZ: Okay. So, this implementation plan is essentially the--has all of the information that the Board would be looking for to properly examine how this part of NE is expecting to function?

BOYLE: I don't know about all. That's the only thing I'm hesitating at. With the roadmap, the implementation plans, the annual work plans we gave, supplemented by future meetings like this, like, for example, when Peter mentioned those last two bullets I talked about, the low-level waste and inventory where I described, you know, it's all these different waste streams, different amounts, and that sort of thing, done by Savannah River, I would encourage the Board to

ask for a discussion of that. It's a fascinating topic. So, it's all those things together. But, when the implementation plans become available, that will help. If you have annual work plans, which I will say right now that absent an over-arching document like an implementation plan, there's a lot of detail there and you may get lost in the detail, but the detail is there in the work plans.

ABKOWITZ: Okay, thank you. We'll take our chances on the getting lost part. I'd like to point out that Monica did indicate that drafts exist of all of those documents. I'd like to remind you that the Board has access to pre-decisional material, and, so, we'd like to see that as soon as possible.

BOYLE: Yeah, I'm aware of that, and, so--

GARRICK: Okay, Andy?

KADAK: Kadak, Board.

I would like to second Mark's comment. I think our role is to review your research plans to see if they're focused, if they're going in the right direction. And, this kind of presentation hardly does that for us, honestly. So, as soon as you can have those plans available, that would be very important for our mission.

The other thing, have you seen the Board's report on interim storage?

BOYLE: The executive summary, yes, if that's it. The

one that's ten or twelve pages, that's the one I looked at, the one that came out in December, as I recall.

KADAK: Yes. We have a very extensive report on the technical needs for dry cast--

BOYLE: Sure.

KADAK: --for interim storage--

BOYLE: Right.

KADAK: --for up to over 100 years. And, I would suggest that as a--what we're trying to see is whether you're reading some of these documents and seeing if your research is linked to anything that's going on.

BOYLE: I won't put John Kessler on the spot, but he's in the audience. In the storage area that we, the Office of Nuclear Energy, NE-53, participates, I believe the acronym is, everybody calls it ESCP, E-S-C-P. And, we participate, Nuclear Regulatory Commission participates, EPRI participates, industry participates. Yes, our people, when your executive summary report came out, Ken Sorenson, I know that right there, the lab control account manager, he's read it. I've read it.

KADAK: I'm not talking about the executive summary. I'm talking about the technical content.

BOYLE: Oh, I'm sure he has. I've read the executive summary, and I'm sure that our people have--I think we're pretty plugged in. And, John, if I'm not mistaken, I believe

other countries are plugged into the extended storage cooperative program as well.

KADAK: Okay. Well, John is not a DOE employee, as best I remember.

BOYLE: No, but is this under your organization?

KESSLER: John Kessler, Electric Power Research Institute.

We do have what we call the--it's been dubbed the ESCP program, Extended Storage Collaboration Program. The idea is to essentially collect up and get everybody who is doing work all across the world on extended storage issues together to share information. At the last ESCP program meeting we had in December, we had a nice presentation on the TRB work that was done. We also had some presentation done by a guy that's in Bill's organization on some of the GAP analysis that's been done. What do we need to know to extend storage out to a longer period of time. We're working with the Japanese, the Germans, the Spanish, et cetera, because this is a worldwide problem, the need to store for a very long time. U.S. isn't unique by any means. Lots of other countries don't have disposal yet either, and they're looking at very long-term storage.

KADAK: And, the DOE is integrating all that information in its program plan?

BOYLE: We're aware of that, yes.

KADAK: That wasn’t a yes or a no. Could I ask you a question about, you say one of your missions is disposal, Mr. Gunter--

GARRICK: If he told you no, would it make any difference?

KADAK: No. But, with Mr. Gunter, I’m just trying to see when do you think, since everybody recognizes that we need a repository, when do you think we might actually see one?

BOYLE: I don’t know.

KADAK: You don’t know. Okay, that’s a good answer. Well, I’d like to direct you to--I mean, I feel like I’m in déjà vu land. 1957, we’re back to well, gosh, we need studies of this, we need studies of that. Can you give us some assurance that some progress will be made on any of these issues? Because I’m seeing we’re going back to basic science. We’re going back to trying to figure out whether what we know about geology is real. Give us a sense of any progress that you see being made here on this disposal program.

BOYLE: Here is my--let me pull up a slide here. Our objective, me, Monica, Peter, the people we work with, is to provide technical expertise to inform others, most of whom are probably not in this room, you know, that we will, the work we’re doing, the science and the engineering on the

disposal concepts now will produce inputs to others, you know, that we don't even have the BRC draft report out yet, but the work we're doing now, the intent is to use that work to provide inputs to those who will make the policies and will make the decisions so that we can move forward on some path. With your frustration that we're seemingly back to 1957 or back to selecting sites in the Seventies and Eighties, as somebody mentioned, that wasn't done by NE-53 or NE-5, you know, that's the circumstance in which we find ourselves, that's what it is.

GARRICK: Bill, let me try to characterize this a little differently, what Andy I think is getting at, with the focus on a repository or geologic disposal, which there's world unanimous agreement that that's the way to go. And, so, once you have reached such a conclusion, it seems to me that things can get very targeted in terms of what we do. And, is one of the things that's coming out of this process, and I haven't seen it yet, is specific recommendations about something like site selection, for example, site characterization, something that really is a tangible product that is a precursor step to an actual site selection process? Is it a team within DOE that's saying here's what we've learned about what constitutes a well designed repository? We're going to translate that information into some sort of a specification. That would be a product. That would be

something that would be enormously beneficial.

It seems to me that there's such a fear here of talking about Yucca Mountain that not much is getting done, and we're frustrated by the fact that there is a lot of technologies, particularly in the last two decades, that has been developed in the interest of building a repository, which everybody agrees that we need it and it should be done. It's going to have to be done. Okay, well, let's see if we can develop a plan, an engineering plan that clearly manifests itself as something that would provide real roadmap for the next move, something that really gives a sense of achievement. The studies and providing technical information, this sounds very clinical and just as if what you're really doing is just developing an information base. And, that's what makes it sound like it's thirty years behind the times. We have advanced tremendously across the globe in how to solve this problem. And, yet, it's not being manifested.

BOYLE: Well, I'm sorry for that. But, to me, it's back to Professor Duquette's question that some of the specifications and specificity you're looking for are site dependent and concept dependent.

GARRICK: You can tell us how to do a site selection process, and I don't see that coming out of this.

BOYLE: Yeah, but from my point of view, maybe it was

Professor Duquette or Professor--it was Professor Duquette, site selection in the United States, because we are blessed, if you will, with such a big country, it isn't really a technical problem at all, in my mind. I mean, poor Belgium, even they found a site. It's only 50 percent bigger in surface area than Clark County, Nevada. We've got 50 states. You can probably throw darts at a geologic map of the United States and find a technically acceptable site.

As you will hear from Professor Jenkins-Smith later today, I think the challenges are more on the societal and, you know, political ends, and related to that is my reading of the Nuclear Waste Policy Act is they wanted to make it very process oriented to try and let everybody know that they had a fair shake. There were certainly technical aspects to it, and the great bitterness of many people in Nevada with the amendment is because the process was short-circuited. I think a lot of the activities we're doing here is in the interest of doing our work systematically, with an open transparent process that will provide information to decision-makers, so that we don't repeat what some view as the mistakes of the past.

GARRICK: I'll close my comment on this. But, it sort of reminds me several years ago, I was talking to a senator about why this nation has never had a rational energy policy, and his response was a very interesting one, he says, "That's

because the technical community has never gotten their act together to tell us what should be the basis for such a policy." You know, we keep talking about developing information for the policy-makers. The policy-makers don't know what's going on. We have got to provide information that allows them some decision options that has constant benefits and risks associated with them, different options. We can't just keep giving them books and books and volumes and volumes of technical data that has no direction.

BOYLE: I think we're doing what you mentioned that they are interested in, both the benefits and the cost of these different options.

GARRICK: Well, that's good.

BOYLE: We just can't do that overnight. I can't do it in my 30 minutes here.

GARRICK: That's good. That was one of my questions. Is out of this going to come some specific recommendations, some information that says oh, this is very useful, and it is anchored to the experience base, and it is contemporary in the sense that they have fully accounted for everything that we've learned so far? Anyway, I've talked enough.

Thure, you had a--oh, okay, yeah.

KADAK: So, just to conclude my question, are you guys going to develop a new siting strategy as part of the disposal group there for how to site a new repository?

BOYLE: I myself, we're not doing that right now. Ultimately, we probably will. But, I don't want to pre-judge the Blue Ribbon Commission. I don't know what they're going to say.

KADAK: I'm asking you as DOE, who is responsible for a disposal of nuclear waste, are you and DOE, as John said, going to be recommending a new siting strategy for disposal of nuclear waste?

BOYLE: I'm sure eventually, but it's not in our activities--

KADAK: Not in the plan at this time?

BOYLE: Not in this fiscal year.

KADAK: Okay. So, that's why we have to review the research.

BOYLE: John?

HERCZEG: John Herczeg, DOE. I'm Monica's Deputy.

Just a partial answer to your question here is that we're going through a phase right now of making sure we have all the information cataloged and available so we have not lost all of the detailed work that's been done. Point number one. Point number two, the people yes, have been dispersed, but yes, they can be resurrected. And, I would try to categorize this time period we're in right now as a recess period. And, that recess period is over when the BRC gives us the marching orders.

And, trying to delve down and say you should be looking at this or looking at that, while that's good advice, it may not be the direction the BRC is going to recommend. So, we've got to use our precious dollars, which is roughly $40 million, very carefully to make sure we don't lose that precious information.

KADAK: But, they too are also an advisory body. They're not your bosses. So, you keep saying they're going to run your program.

HERCZEG: But, they have to give--they're a very august body. You have to realize that. Those guys--

KADAK: What are we, chump change?

HERCZEG: You've seen their meetings. They're not going to pull any punches. What they say is going to be politically correct. They're not going to hide anything.

KADAK: Okay, thank you.

GARRICK: Thure?

CERLING: Cerling, Board.

I just wanted to return to the long-term storage issue because it seems that since we no longer have a repository, we have long-term storage prospects in many, many places, and it's also our experience in the last ten years that we've seen certainly global temperatures and local temperatures that are very different than long-term temperatures, and so I was just wondering what your group is

doing to understand our increased confidence in 50, 100, 500, and 1000 year events, which we know take on a much greater importance for long-term storage than the shorter-term storage?

BOYLE: Obviously, that certainly factors into the much longer time frames of repositories, but I'm not aware, and that's just--I just don't know whether or not our storage activities are looking out 100 years, 200 years, and what effect might climate change have on extended storage. I don't know that we're looking at it. It just might be that it's one of those things that we're not yet, but we could. I certainly heard your question.

GARRICK: Okay, we can take a question from the Staff. Yes?

ROWE: Rowe, Staff.

I think most people agree that any path forward is several years away. Has DOE got any program underway right now that is looking at how to implement whatever decision is made 20 years from now, 10 years from now, whatever, how to make implementing that process easier?

BOYLE: Well, these implementation plans, when they're finally publicly released do have more details of the steps we need to--

ROWE: No, what can we do today, we're going to be storing fuel for a long time, I think, is there any way that

we can make that storage, like right now, everyone is storing stuff in canisters, and basically no matter if you're going to go through a repository or reprocessing plant, you're going to have to pop open that can. Is anyone looking at how you could make what we're doing today more flexible, so independent of what the path forward is, it would be easier to implement?

BOYLE: There's two ways of answering that. The first is back to these alternatives that Chairman Garrick mentioned in his introductory remarks, the different types of reactors and that sort of thing, and eventually, they do produce different waste types, and as part of our analyses, we do look at that. That's one part of the answer.

The other part of the answer is for what's being done today by the utilities. If you remember, I think it was perhaps at a Board meeting in November 2008, it was probably at the Sun Coast where Dave Zabransky spoke, what's done with storage today by the utilities, and the ultimate responsibility of the government, that's subject to a contract. The utilities do what they need to do, or want to do, and the government eventually has to do what it needs to do. But, if where you're getting is are we, DOE, interacting with the utilities today to tell them oh, don't put it in your storage, you know, we want you to put it in smaller storage containers so that we can utilize borehole disposal,

no.

GARRICK: Okay, well, we are up to our break time, and I think we'd better try our best to stay on our schedule.

Bill, I hope we weren't too rough on you. We appreciate your--

BOYLE: Used to it.

GARRICK: We'll take a break. Thank you.

(Whereupon, a recess was taken.)

GARRICK: Okay, we'll come to order.

We now continue the Board's quest for trying to get as much information and insights as possible as to what has been learned about geologic disposal and a permanent solution to the management of high-activity wastes.

We are very fortunate that we have been able to put together what I think is going to be an outstanding discussion. The panel represents a tremendous amount of experience in being in the trenches in trying to implement a solution to this problem. And, so, I think we'll just jump right into it. Each of them is planning to give a few opening remarks, and then they will function as a panel with questions from the Board.

So, with that, we'll start with Lake Barrett.

BARRETT: Thank you, Mr. Chairman.

It's a pleasure to be here before the Board to reminisce a little bit and go down memory lane, but my main

focus is to look toward the future. But, I think there are lessons that we can learn from the past that will help this country through its difficult times at the moment for a better future for all of us.

As I tried to address your four questions on the plane last night as I flew out here, I kind of came across the continuum of several points. So, what I'd like to try to do is put down sort of four major lessons learned, and then go specifically into the questions that you asked in the agenda.

The first point I would like to make as far as the lessons learned, I think the country has to have continuity and durability of a national and policy process. The nation back in 1982 passed the Nuclear Waste Policy Act, and in the preamble to the Nuclear Waste Policy Act, it talks about the past 30 years of failure of getting on with geologic repository. That was written in 1982. I was kind of surprised again to see that. But, I mean, that's how they felt in '82. I feel a bit that way today.

But, the process was established in the Nuclear Waste Policy Act, and that was a technical and a political process. I think it was a little idealistic. It took some damaging hits back in 1986 with the second repository, and the '87 amendments that everybody knows about. But, basically, it's functioned reasonably well until recently.

The key scientific and technical work for a repository was done back in the 2002 time period. Chris Kouts was the lead person for that, working for me at the time, and did a tremendous job of bringing together all the pieces, and his lessons learned points will be very pertinent to where we are today.

But, at that time, the technical work was done. It was nine years ago, two days ago, on Valentine's Day when the Secretary made his recommendation to the President. And, then, under the Act, we started a political process, where the governor had the right to disapprove the site. Governor Guinn at the time did disapprove the site, and the site was disapproved for political state acceptance reasons, unless the Congress, both Houses in Congress overrode it. It was overridden in bipartisan votes, and the process continued on to the licensing. The license application was submitted. NRC Staff questions were answered by the DOE. Yes, there were delays, but the process got done, and the Staff was ready to issue their draft safety evaluation report, like this past fall. However, it was stopped.

But, right now, Secretary Chu and Chairman Yasko are basically substituting their personal judgments as to what they think the law requires. That now is before the courts, and I believe the courts will decide on that over the next several months. And, it is my hope that Yucca Mountain

will be restored and the next licensing will continue.

The Blue Ribbon Commission, as you all know, is looking for better ways. I think that's a healthy thing to do, and look forward to what answers that they have. But, I think it was in the discussion here this morning, is there is no escaping that there is going to be some high-activity waste, in the Chairman's words, that are going to need to be disposed of. So, I believe that it's important that we move on.

As I mentioned lawsuits, there's another lawsuit that was filed yesterday by the states of New York, Vermont and Connecticut challenging the NRC's Waste Confidence Rule, which I think is important technically, and there's an intercession here, with what you're about, is where the challenge is, what is the technical and the process basis for the NRC saying that it's satisfactory to leave fuel for 60 years after the end of life in the plant, which would be a total of 120 years, assuming a 60 year life extension.

Your report that you issued I think brings up a lot of the issues that need to be addressed, and I believe that will get, over the next two years through the court process, I think they will examine that. And, also, the basis for the NRC's December 23rd, which in Nuclear Waste Policy Act, two days before Christmas is normal time to release these things, where they said that they have confidence that a repository

will be available when necessary. What is the basis for that remark? But, anyway, that will go forward.

The key lessons learned to me is the nation needs to have a policy, and unless there's a technical reason to change that policy, which there has been none for Yucca Mountain, the Secretary has not said he has any basis of a technical aspect of Yucca Mountain termination, stick with it. If you want to change it, change it by law. It shouldn't be jerked all around on election cycles.

The second point I would like to talk about is whoever the implementing organization is, in the past, it's been DOE, it ought to be empowered by the nation to do its job, and not get whipsawed on election cycles, or through instable budgets that go up and down. Whoever does it, and I hope it's not the DOE in the future, I hope it's a fed corp or a private/public partnership arrangement, needs to be empowered to do it.

The third point I'd like to make is I think we need continuity of the management team. Ward Sprout talked about this very well before the Blue Ribbon Commission, having it within DOE where the director is changed on the political cycle, or can't get confirmed, is not the way to get it done. To me, it is a formula for failure. I personally was probably the longest serving director, and I wasn't qualified to be it. I was never duly anointed by the Congress. But, I

served for five secretaries, well over a dozen under-secretaries and deputy secretaries, and it made it very hard for us to have stability in the team to move forward. But, I'm so proud of what we were able to accomplish through the good works of George when he was running TRB, and Chris and all the others, and Bill, and I don't want to name names because everybody was a great team.

The fourth point I would like to make generically is it's critical to maintain a supportive local and state host relationship. That is probably the biggest failure that I felt we had with the Yucca experience. First, I want to compliment the Nye County and some local governments. I think we had an excellent relationship with them. Nye County was strong, independent, had their own science program, and did a good job. And, I think that's a good model of a partnership arrangement. I think the WIPP folks in New Mexico have done an outstanding job, and that's another example of a very good situation.

In the case of the State of Nevada, the '87 amendment really poisoned the well. And, the history of DOE was never going to be able to bring that back into a win/win situation, especially when it started getting into the Presidential politics starting in around 2000, then it became an election football, and then you're really doomed as far as what's going to happen from a public point of view.

I'm very optimistic for the future, though. I believe that it should be taken out into a public/private host relationship partnership. I think a lot of things can be done with private industry in coordination and a joint venture with the host. There are many different models for that, and it can go forward. Maybe it will be other states, maybe it will be Nevada in the future, but I think there are tremendous opportunities for the host state and the federal government, you know, as well as we go forward.

Now, turning specifically to the questions that you asked about, the first one was what technical advances are applicable for the future? One point I would like to discuss on that is what I would call an integration of incompatible cultures that are absolutely necessary to bring about a successful repository program. The incompatible cultures basically are state of the art earth scientists, state of the art underground construction and mining, and nuclear engineering. These groups have to work together as a seamless team. They have to work together in an open and transparent environment in a highly regulated nuclear regulatory licensing cultural environment.

Now, the Nuclear Regulatory Commission culture is something that is not a natural understood thing, especially to some of the advanced state of the art earth science world. The nuclear culture of the NRC is an evolution of Admiral

Rickover's very first nuclear submarine culture. I worked in that as a young engineer when I first came out of school. That does not mesh well with state of the art scientists. But, it is crucial that that get pulled together. So, this cultural adaptation and teamwork I found was a major challenge through Yucca Mountain. I think we got it together, but it was a constant management challenge at all times. So, I would put that down as a lesson learned, and I think many things by getting people to work together, like dry drilling, where we got the scientists who said we don't want to be putting water in and ruining the data we get back, and we developed dry drilling. So, that was an example of an integration of this in the past.

Another thing as far as where I think we didn't do as well as we would like to have was the earth science repository people generally don't get too enthusiastic about understanding about why the utilities put fuel in ten ton cans that have to be opened up, and things like that. Whereas, the reactor people that necessarily understand thermal constraints and issues that are in a repository. But, one of the things the teams have to do for a future repository is to integrate those cultures.

The second point you asked about what technical work should be done now? We look back at Yucca Mountain, there are definite phases you have to follow. First, you

have to have regulations as to how safe is safe enough. You're going to have to go through a siting process. You've got to do the exploration. You've got to bring that to closure. And, you have to do licensing, and then you have to build it. That's a natural cycle for any repository going forward.

I believe that the system needs to have more systems integration in the broader sense. We know what the point is. We need a functioning repository as soon as practicable that is safe and publicly and politically acceptable. Where are we now? We have no site. We're a little bit of deer in the headlights because of the politics, where the big giant elephants and big giant donkeys are stomping around, you've got to kind of duck. Okay? I felt very sorry for Bill up here today, but he's a good soldier. But, that's the world he lives in. I don't have that world anymore, so I can say it like it is. But, we have to look at where are we today? There's 65,000 tons of spent fuel out there. We're making 2000 tons of it a year, and most of it is being put today in dry canisters that have ten tons of fuel in it. Okay, put in 200 ton casks on site. We're making 100 of these cans every year, and there's 1200 cans out there today. We've got to bridge from there today to tomorrow's repository.

Now, I noticed just for example, you're going to be

talking about boreholes in salt this afternoon. Boreholes is idealistically a wonderful thing. The practicality of it from a systems engineering point of view, I think that dog don't hunt. Okay? Ten ton cans don't fit down 20 centimeter holes too well for a couple of miles down. Now, I will use, for example, the 100 canisters the Navy has. These are the biggest canisters, so I'll use it as an example. They are seven feet in diameter. I kind of know what's in those cans. But, you turn those things into small cans, is a big piece of business. It can be done. We put a man on the moon and we have submarines that run 30 years without refueling, so I know they can take those cans open. But, I'm telling you as an American citizen, I don't think that's where my tax money ought to be spent. So, those are the kind of issues I think that DOE has to have a systems engineering point of view, and you and the Board, who has always looked at these things like that, need to maybe focus on as an example.

Salt, there are some real challenges with salt. WIPP is a wonderful site, and salt is a wonderful medium for sealing the repository. But, there are a few issues, like how do you lower 200 ton packages down a 2000 foot shaft. Well, maybe you want to make a ramp. Is a ramp really going to fit into salt, does it fit? Okay, is it going to make it that deep? How much land do you need? Sealing salt to keep water out, we all know that's very important, ask the Germans

on the Asse intermediate-level repository.

But, nonetheless, technical work on these things are very valuable. I don't know the details of DOE's program. I hope they are looking at these as generic topical reports. One thing we had back that was similar in the Nineties, we were looking at interim storage facilities, the follow-on to the old MRS, Monitored Retrievable Storage. We were not allowed to talk about sites because of political constraints. But, we did some valuable generic work. Chris was the lead on one of those, was developed how to do dry transfer at a reactor site if we had to. So, we did make some useful technical things. We actually prototyped one at Idaho. So, there are pieces of very meaningful work that Bill can be doing today, and I believe he's doing some of those. But, you have to kind of look to make this applied science to get ready to help the nation find a repository site which is clear.

There are some regulatory issues that I would hope DOE can be proactive with, or maybe you can get the system to be proactive with, are regulatory requirements. For a generic repository, what is the period of performance? Is it a million years like Yucca Mountain? Is it 10,000 years like WIPP? Is it maybe a thousand years as the NAS 1990 rethinking report would imply. We have to deal with that. What are the retrievability reversibility requirements for

salt? Does it matter if you put fuel in salt? Is 50 years enough? Should it be longer? But, these are issues you need, I believe, the nation needs to look at generically in a meaningful way so when the political green light comes to go find a real site, the nation can move forward much more promptly than it has in the past.

You also asked about management approaches and how it influenced things. I believe when I was there, we had a team together that valued best available technology being an important part of our program. We evaluated in the viability assessment in 1998, certain things should we add or not add. We looked at drip shields and said add drip shields. We looked at Richard's barriers and said no, the cost benefit for Richard's barriers wasn't really going to do. But, we were constantly in this management balance of balancing betterments, I'll use that. You know, when is enough enough? When does better become the enemy of good? And, making these fundamental choices based on the facts before us at that time, based on the budgets available. I believe gathering up some technical tools to be able to promptly do those as we move down toward a repository site, I think is an important lesson.

Management team needs to be prepared to do what I call battlefield triage. When bad things happen, like we had 40 percent budget cuts and Chris had to wash the ball in his

tenure when he was acting director, when bad things happen, as Murphy's law says, are we prepared to deal with those? Are you zeroing out or cutting out the least important functions and preserving the heart and the vital functions? We made these decisions back in the late Nineties when basically we had to sacrifice a lot of the preclosure engineering and concentrate on the post-closure to do the site recommendation aspect of things. That came back and bit the program after I left, and the license application got delayed from 2004. But, you need to be prepared for a management team to do that.

And, the last, and let me try to finish up, is trust and confidence in the technical programs. I believe that trust and confidence with the State of Nevada was doomed with the '87 amendment. I think the State public relations machinery was extremely effective of turning any molehill into a mountain, any hiccup into darned near fatal pneumonia, on anything that DOE did. DOE, I felt our hands were tied behind our backs and we were just kicked around in the trust and confidence and public relations point of view in that sort of environment.

We did some thing. I think the tours of the Yucca Mountain where people could go out and talk to the scientists was one of the better things we did, and it was effective, and I think would have made a difference, but also the State

of Nevada understood that, and Harry Reid, you know, prohibited us from doing it from the budget to run any tours by putting that budget amendment in place on that, which was very unfortunate.

We did international peer reviews, and spent a lot of energy and time on that. I don't think we got any credit for that from a trust and confidence point of view. We were the most open and transparent program I think in everyone's existence as far as a public program is concerned. We made an extra effort to get that information out quickly. When we had the Chlorine 36 situation, it was a matter of days we got that out to everybody. We felt that was extremely important.

And, I can't kind of end without talking about you all on the TRB. I believe in the aggregate, although you did some good things, your predecessors did, whether you were on the Board back then. In the net, I believe you negatively contributed to trust and confidence. I know the creation of you in '87 was to provide trust and confidence for people in Nevada. But, I think what happened is in your constructive criticism aspect of things, that was taken and the negative was amplified. The positives things you did was lost and never amplified because you don't speak up, or you speak down, you speak the facts as you write your reports. But, it's how they get used in the future. In the future, if we had had a state public partnership type arrangement, a joint

venture arrangement with a willing host state, and a partnership where the state has authority, board of directors are there based on the governor's appointment, and a strong and sternal regulator like the NRC or the EPA could be, I don't see any real role for TRB as far as trust and confidence would be under that arrangement in the future.

So, let me finish there. I've talked more than I ever expected I would. So, we can do questions whenever you're ready. Thank you very much.

GARRICK: Thank you. Thank you very much. I think we'll continue with the comments, and then open it up for questions. George?

DIALS: I was just reading--I'm George Dials, I'm with Babcock and Wilcox Technical Services Group. But, in the past--you know, I feel like I'm between a rock and a hard place here. In the past, I was a member of the Senior Executive Service, and created and ran the Carlsbad Area Office for five and a half years, responsible for licensing the WIPP site. Subsequently, I was the M&O contract manager for TRW during the last two years of its contract, and had the responsibility for delivering the site selection report that was in fact accepted by the Department, submitted to the President, and then ultimately approved by the Congress. So, I had a role in saying yes, Yucca Mountain is the place, and let's get on with it. You know, I really felt we were going

to get on with it, too. It shows you I missed a bit of that social political aspect.

I have degrees from MIT in both nuclear engineering and political science, done at the same time. Through the advice of my mentor and a man who had a great influence on my life, David Rose, who to my knowledge coined the term, it's the first time I heard it anyway, sociotechnological problems. In fact, he taught a course called sociotechnological problems and solutions. It was in that course that I got very interested, as he was, in nuclear waste disposal and repository programs.

Interestingly enough, and this is like back to the future in the presentation I've heard this morning, interestingly enough, at one time the programs were combined, that is, the issue of dealing with the transuranic waste and high-level waste, and all the waste was sort of looked at in a holistic way as one problem, let's solve it. And, sometime during that period, and they started about sixty years ago thinking about this, that's sort of the scale of sociotechnological problems. Just to give you an analogy, you know, when the fork was invented, it took about 50 or 60 years for the English really to accept the use of the fork. They thought it was an instrument of the devil when it was first invented, because it sort of looked like the devil's fork. Henry the Eighth never did use a fork, by the way.

Elizabeth finally approved the use of forks. It's a sociotechnological problem and a solution.

And, we're not much different from that. We view sociotechnological problems in much the same time scale. It takes 50 or 60 or 70 years for major developments really to take effect and be universally accepted. And, if you go back and look at the history of repository programs internationally, you will find those time frames are sort of the ones that are in effect.

At some point during the program, it was actually decided because of the very long half lives of the transuranics or the actinides, to split up the program, the one dealing with the transuranic wastes, because after all, who can contemplate doing modeling and demonstrate the ability to create a repository to safeguard the biosphere, and that is the health and safety of the public from transuranic waste for hundreds of thousands of years, and thus, separate out the program so we can really deal with the fission products, which are ten thousands of years. Of course, later, the regulatory programs were I think inappropriately redefined so that actually WIPP, you did the tens of thousands, hundred thousands of years modeling and documentation that you could keep the material out of the biosphere, and then for Yucca Mountain, it evolved to a million years, which wasn't credible to the public. And, I

don’t think it’s very credible to many of us, but that’s the right regulatory framework.

So, we ended up with two programs that were organized and structured very differently, and one went forward, much to the surprise of everyone, that is, the one with the longer half life material, to a successful conclusion. That is, WIPP did get licensed, is operating, has been operating safely for over ten years, has broad public acceptance in the region where it’s operating. And, in fact, that community was recently before the Blue Ribbon Commission, and I was recently before the Blue Ribbon Commission also talking to them about what their report might be, that community was up in front of the Blue Ribbon Commission arguing for an expansion of the mission of that facility.

So, the first lessons learned for me, as I look not only at our programs in the United States, but look at the programs around the world that are being successful, you have to have a well informed very active, proactive in fact, accepting population in the region where you’re going to have a repository.

You would think that would be easier in the United States because of our diversity and the strength of local communities and local political base than in most other countries, because we have such an expanse of land such as

diversity of choices, and we have a lot of sites, as has already been said by the technical folks. We have a lot of potential sites. So, that's the first lesson learned, if you're dealing with this kind of problem.

You have to have a transparent regulatory program. You have to have one in which the regulator, the scientists, and the public, and all the stakeholders--and, the public, by the way, do have a great deal of influence on the politicians who represent them. We often forget that, but it's true. In our case at WIPP, we had a bipartisan effort, we had both Senators Domenici and Bingaman, republican and democrat, very supportive, one much more active and demanding and assertive, as Lake can remind us all, that's Senator Domenici than Jeff Bingaman, but they were both very supportive and understood the science technology, and reviewed the materials, and had staffs that were very supportive.

On the other hand, we had representatives that were sometimes recalcitrant and appeared to be opposed to it, like at that time, Congressman Richardson. I will remind you it was Congressman Richardson who ultimately supported the WIPP Land Withdraw Amendments Act, and got it through his committee, that allowed for an accelerated EPA review and certification of the project. So, he too responded to the influence of the people, and what was needed for the country.

So, those sort of go in hand in hand, and in a

transparent process, you do get the people in a position where they're informed and influential enough and proactive enough that they influence the political outcomes. That didn't happen in Nevada. It didn't happen on Yucca Mountain. We worked hard at it.

I remember when I was working for Lake as the M&O contractor, we had lots of opportunity to interact with Senator Reid, and even though he and I had something very much in common, he was a boxer in college and growing up, and I was a boxer, and I remember fighting little bantam weights like him, you know, you get him back in the corner and they quit swinging. But, we had a great relationship. But, something happened in that relationship where we never could get back to him and get him to understand the national need, or accept the national need for the repository, nor could we get those who were influencing him in the public sufficiently informed and willing to support that. And, ultimately, it got us to where we are. As Lake said, a perfectly good pinnacle site that could have achieved the mission we had formulated for it, was politically rejected, and has been politically rejected.

My view from interactions with the Blue Ribbon Commission is that that's not likely to be turned around. I testified before them on February the 1st. We spent a lot of time talking about the next subject I'd like to talk about,

and that's the organizational construct for what happens next with the repository program. And, by the way, this is my cover slide, Random Thoughts of a Nuclear Trash Man, just to tell you I was trying to explain to my mother, who was a coal miner's wife in Appalachia, what I did when I was at WIPP, and she actually visited the site and got to go underground, and we had those mining machines. She was about 70-some years old, and thought all mines were dark and black like coal mines. She was amazed it was white down there. I couldn't explain to her about transuranic waste, and so forth, but she finally did understand I was a nuclear trash man. And, she thought well, that's a good job, son, you just do it well.

Let me have the next slide. This came to it because we really need, and we had some discussion this morning, you know, we're confusing ourselves now. We're confusing ourselves about what a closed fuel cycle is, and we've played with the word so much, and English is such an imprecise language, it's easy to confuse ourselves. Well, this is a diagram I sort of liked about closing the fuel cycle. You know, it's a pretty nice graphic. I didn't make it up. I borrowed it from somebody. And, I'm all of a sudden involved in--we just won a contract, my company has, to take over the DUF-6 deconversion facilities, and I'm going to run that project for a little bit, or start it up at

least, and get it going for a couple years.

But, we need to go back and look at this as a holistic problem. We need to close the fuel cycle. And, to me, closing the fuel cycle has these components in it, but it's never completely closed. We don't get to use everything that's in the cycle. You know, there is some waste, and we're ultimately going to do something we should be doing with all waste, that is, minimize the waste product. And, then we do have to have a disposal. So, we have to have a repository. I agree with everyone in that regard. And, we need one that will dispose of this high-level waste, for whatever length of time we determine is regulatorily necessary to convince a skeptical public that we're protecting their wellbeing from whatever site we pick.

But, we need reprocessing, too, and we seem to be afraid to talk about reprocessing. And, I made this comment before the Blue Ribbon Commission, and one of the Commissioners was saying it's not economical. I said, "No, that's because we quit working on it back in 1970-something." Now, most processes that we quit working on in 1970 really, using our creativity and ingenuity in the United States to solve these problems and make them more efficient, most of them we left back there aren't too economical today, and this one isn't. That doesn't mean it can't be. And, we don't need to have a repository where we take most of the fissile

material that's in slightly used fuel, and it's only slightly used--all of you who are in the nuclear engineering arena know it's only slightly used, most of the fissile material is still there--is irrational.

We say well, we've got so much uranium, it's not economical to deal with that. Well, we've got so much uranium right now perhaps, but if we have the nuclear renaissance in our country, coupled with the nuclear renaissance that's coming in the rest of the growing world, we're going to need all the fissile material we can get. So, throwing away most of it, slightly used fuel, is irrational. So, we need a closed fuel cycle.

Then, we need interim storage. We have de facto interim storage in many places across the country, I think about 70 sites right now today. We have de facto interim used fuel storage at all the reactor sites. I recently visited the Sequoia Plant with the CEO of TVA, and they were having some difficulty because they had outages and they've got to refuel, and stuff, and they were having to shuttle fuel canisters around out of the pool, out to dry storage, because they're getting constipated, they don't have any place to put it. They never designed their facilities and never sited their plants to have interim storage. We need to go to interim storage.

In fact, one of my recommendations, Lake and Chris,

if I could get these former OCRWM guys to get with me, we could start a group to do this, is let's make Yucca Mountain the first Monitored Retrievable Storage facility in the country. It would be a great use for it, particularly since we designed it with several billions of dollars of titanium drip shields so we could protect the canisters anyway. It would be a good use for it.

Peer reviews. Lake mentioned peer reviews. I know Yucca Mountain, and I was involved in some of these, we did great peer reviews. We got no credit for it ever, I don't think, the international peer reviews particularly. Contrary to that at WIPP, we did eight substantial peer reviews, National Academy of Sciences reviews. John, you were involved in some of these with the WIPP panel, the National Academy. Peter Swift and Mike Voegel and the other folks at Sandia Lab, lead a lot of these.

We did one international peer review that was the first of a kind. It was a joint OECD, NEA and IAEA joint international peer review. We got a lot of credit for that. They did a special report about it. They bragged about it. We bragged about it. EPA was our regulator, a little different from Yucca Mountain, but EPA bragged about it. And, EPA was involved, it was transparent, they were engaged, they participated, they observed all the peer reviews. And, the peer reviews were significant in giving confidence to the

regulator that when they were certifying that WIPP was going to be able to perform under the regulatory requirements, maintain its integrity for the 10,000 year requirement, that they were confident that they would be supported by the scientific and technical community on an international basis. It's really important. It was important to the outcome of that certification process.

The Blue Ribbon Commission I think is going to have a lot to say about an organizational construct for a repository program going forward. They will agree with all of us that we need a repository. I agree very strongly with Lake Barrett, and we didn't talk about this before. I'm glad you said it. We need a private federal corporation. That could be akin to TVA, or there have been some other private federal type corporate structures, to do this.

I believe it was Einstein who said, "Doing the same old thing and expecting different results is insanity." Giving this back to DOE with the structure they've had before, tying it to both the political time scales, that is, we're changing Congresses every two years, administration change every two years, not every four really, putting it on the annual budget cycle when the money has already been contributed by us, the taxpayers, to pay for this solution is insanity. We need a private federal corp to do this. And, there's some really smart people looking at that structure

that are going to be advising the Blue Ribbon Commission.

I was thinking last night, and my wife, Pamela, is here with me and she suffered through all this nuclear waste trash man stuff, and it's her birthday, I have to tell you, so thank you, John, you got me out here to Las Vegas, I could bring her out for her birthday.

GARRICK: My pleasure.

DIALS: Thank you. She's suffered through that before. I've been here when it was her birthday, and she wasn't with me. So, we watched the Westminster Dog Show last night, and it was great. They picked the world's greatest dog temporarily, it's the Scottish Deer Hound, for those of you who didn't see it, not the prettiest dog I've ever seen, but it reminded me of a cartoon my father-in-law had, it was a nuclear engineer, he worked for United Engineers, he finally retired early when Seabrook got shut down, and he said well, I'm just going to let--he had this cartoon that said, "Let the bastards freeze with the dog." We're not going to do that, though, we're going to open a repository, because I like another cartoon he had, it was Rex, the mutt, the world's greatest dog, and the caption said right under him, he's got all the ribbons, and stuff, "He caught his own tail."

Let's catch our own tail and move out and get on with this repository program. We need it. The nation

expects it. The public demands that we who know how to do this, solve this problem, and we are technically competent and capable to do it. And, Bill, I know you're doing some work in these programs that will protect and safeguard this science and technology at the national labs, where we have the ability to go forward and do this.

I'll be happy to answer any questions later.

GARRICK: Okay.

DIALS: Excuse me, one final thing. I have some comments that have bulletized lessons learned that I've learned from the three sort of programs I've been involved in. If you have any questions about any of that, I'll be happy to answer them.

GARRICK: Okay. Chris?

KOUTS: Would you mind if I stood over here?

GARRICK: No, fine.

KOUTS: I'm used to being here when I'm talking. And, I will say that I didn't collaborate with George or Lake on my presentation. So, if you see similarities, it's purely coincidental I'm sure.

The last time I was before the Board was, I believe, on September 23, 2009. I was almost in a position like Bill Boyle was, where I had the straightjacket on, and I knew the parameters about what I could say and what I couldn't say, and I didn't want something to be in the press

the next day, or whatever, so someone would come down and day what the hell did you do yesterday. So, I have great affection for Dr. Boyle, and many of the people in this room who worked for me over the years, and who I have worked with over the years, and it's good to see them, and it's good to see that they're gainfully employed.

So, moving right along, I was going to go through a history lesson, what I call the Office of Civilian Radioactive Waste Management 101. I'm not going to belabor it, but again, it was created by Public Law 97-425. I'm sure you all have committed that to heart. It was passed on January 7, 1983, and was terminated by the Obama Administration. I put a question mark there because I don't think that that necessarily, the jury is out still on that specifically. So, we'll see what happens.

We did a heck of a lot of evaluation of repository sites. Back in 1984, we recommended five to President Reagan. He approved three in 1986. We were directed by Congress in 1987 to characterize only Yucca Mountain. Subsequently, we had a site recommendation on Valentine's Day 2002, and we submitted a license application on June 3, 2008. And, that license application is still pending with the NRC.

MRS, you're all familiar with that, this is where I really start with the program back in 1985. We submitted a proposal to Congress in '86, it was delayed a year because

the State of Tennessee sued us and said we didn't have the authority to submit it to Congress. So, it took us a year to get to the Supreme Court who denied cert. We finally were able to submit it in 1986, and that was subsequently rejected by the creator of the internet, Mr. Gore and his fellow senator from Tennessee, Senator Sasser, and they basically revoked that siting and basically put some conditions on an MRS that made it absolutely ridiculous for the Department to proceed with it. So, I won't belabor that, but it was kind of an interesting history, and I lived most of it.

Major program challenges. Well, the controversial nature of the activities, that's pretty straightforward.

Radioactive waste fear factor, Fear Factor is no longer on TV, but, you know, it sounded good when I wrote this.

Extraordinary time frame requirements. What the National Academy did to the program, and how the courts interpreted it, et cetera, et cetera, created some really significant challenges for us.

Siting is obvious.

I struggled with transportation because I was head of transportation. I don't think technically transportation is a problem, but certainly when you're going to be moving these materials across all the states in the country, it's going to be a challenging experience.

Communication, trust and confidence, obvious issues that the program struggled with and did fairly well with over, you know, toward the end of its existence.

First-of-a-kind nature of many activities. Yes.

Political intervention. That's been talked about a great deal. It happened at all levels. It got down to the day to day operations of the program, which I think was extremely unfortunate.

Changing leadership. You know, I did a quick analysis, since I worked for all of the six politically appointed directors in my time in the program, and basically, we had permanent directors, or political directors for about 55 percent of the time. So, 45 percent of the time that the program existed, we didn't have a political appointee in place. And, what that means, since Lake knows it very well and I know it very well, yes, you can operate the program on a day to day basis, but in terms of interacting with the Hill, people have you in a straightjacket and a collar and so forth, you don't have the flexibility to go to the Hill and talk to people, explain to them situations, and so forth. It's a much different situation when there's a political in place.

Being part of the federal bureaucracy, many many challenges associated with that, and you probably see where I'm going to be headed in some of my perspectives. But,

hiring was a problem. For us to get services within the program, I mean, we paid for billets in the Office of General Counsel. We paid for billets in Procurement. We paid for billets in the CFO's office, the Office of Environment, and even though we were paying for the people, their support was not what I would have liked it to have been, or anybody in the program would have liked it to have been.

Final challenge was funding. This is more did we get the money that we needed to do what we needed to do. And, I will go back to my last few years in the program where we were cut $100 million in successive years, and yet we found a way to do a lot of the things. We cut out things, obviously, but I think there's a lesson here, certainly a strong lesson, a powerful lesson that I learned about federal programs, and that when you really get down to it and you don't have money, you find creative ways to do things. And, when you get to some of my recommendations, you will see where I fall down, too. I think yes, you need funding, but also you don't need tremendous amounts of funding. And, I think certainly my experience has been you can do a lot more with a lot less than people might anticipate.

Okay, let's talk about applicable technical advances. This is somewhat of a schizophrenic discussion because on one hand, you look at it with an eye are we starting Yucca Mountain back up? Are the courts going to

direct the Department that they didn't have the authority to do that? And, if I could just talk about that for a minute. Reading some of the pleadings in the cases, I find it instructive and amusing to see that the attorneys for many years who told us that the Nuclear Waste Policy Act took precedence over the Department of Energy's Organization Act and over the Atomic Energy Act, those same lawyers are now arguing that those acts take precedence over the Nuclear Waste Policy Act. So, I think there's a commentary in there about lawyers, but I don't want to go there. Thank goodness I'm not one and neither are my sons. But, I think that is instructive.

Anyway, getting back to applicable technical advances. Some were media specific. Certainly dry drilling technology was I think an advance made that was very unique to this program, and I think could be of potential use in the future.

The RBM cutters that we used, if there's going to be a TBM sometime in the future, they were primarily constructed for tuff. In fact, it was the University of Colorado, or one of those, I think it was Colorado University that helped us with the actual development of that.

Non media-specific advances. I think burn-up credit, the burn-up credit work that we did, although it focused on actinides, and we haven't really gotten to much

into fission products, I think that's certainly applicable.

TSPA, I think Total System Performance Assessment, the work that we did certainly has a lot of applicability no matter where you're headed in the future.

Our scientific methods, Lake referred to a little while ago, quality assurance, getting scientists to understand the need to document. We had some hiccups with the USGS, but I think we were getting to the point where people really began to understand nuclear quality assurance and bought into it. And, I think that there were a lot of lessons learned there, and hopefully, they won't be lost.

A lot of the design work we did for spent fuel handling, I think is applicable. We did the DTS. We also did that topical safety analysis report. We also did the centralized interim storage facility that you withdrew from the NRC, Lake, because we didn't have money to support it, but those kinds of topical safety analysis reports which are generic and have very wide earthquake ranges and weather ranges and tornado force ranges, and so forth, can be useful in subsequent activities.

Finally, a lot of the research and storage demonstrations that we did up at Idaho I think still have applicability.

Needed research and development. Before I get into that, I will say that with our nation facing $14 trillion

deficits, I think you have to be very suspect about the need to do research, and I am sensitive to the fact that there are people who are funded to do this work. But, from my own perspective, until we have a little bit more definition in the policy and know where we're headed as a nation, which policy path, I struggle with the need to spend tremendous amounts of money in this area, although I do believe that we ought to keep the core team that exists in these areas still together and hopefully there will be a spring board into whatever new policy path that we have.

My sense is generic research on potential repository geologic media is probably not useful until we really know whether or not we're looking for new geologic media.

One of the things that people haven't mentioned, we've done a lot of work on storage of spent fuel, but there are higher burn-up fuels coming out, and if you really understand the license application, we looked at a limited range of spent fuel that could go into a repository, with the anticipation that we would be able to address higher burn-up fuels in the future. That kind of research could be helpful, but again, that's helpful downstream.

This is kind of a personal experience for me. Over the past year, I've done some consulting work, and when I really go back and I try to find information about the

program, it's kind of hard to find. And, you would be surprised what documentation is out there. There are, for instance, the program annual reports, which we hated to do, okay, and basically got out for the previous fiscal year. We barely made it the previous fiscal year, got it out of the building and out of OMB. But, those are helpful. Many of the TRB reports have been helpful because at least they document what happened in any specific year and what types of activities and what kind of oversight the Board looked at in areas. Those kinds of things are helpful.

However, when you try to figure out what really happened and try to piece it together, there isn't anything out there that really kind of puts it all together. So, maybe this is someone who struggled over the past year and tried to really find documentation for the program. I think in my concluding remarks, you'll see where this also has play, but I think we have to understand what happened with Yucca Mountain, and for those who work on future activities, people really need to understand what occurred.

Another thing, and I cheered to hear that maybe NE is already doing this, but when I left, most of the materials were being turned over to the Office of Legacy Management. For those of you who use the LSM, you probably know that it's not the most user friendly system in the world. I think an easily accessible library of past technical reports again

could be useful, and perhaps web based, and so forth, so people could have access to them.

Going on to management approaches and changes, lead lab, if there is a program and you are using national laboratories, I think what we found is that having a lead lab seemed to have certain advantages. But, that's to be determined.

I do believe that you really need to maintain a relatively small core program staff. I think if any of you have read the book, "The Tipping Point," you know that when organizations really get over about a 200 person organization, they get kind of unwieldy. And, that's why I would say that whatever program goes forward, whether it's a fed corp, whether it's whatever, I think the core program staff need to be relatively small.

Again, this wasn't rehearsed with Lake or George, but I do think the program needs to be removed from the federal bureaucracy.

I think program funding has to be accessible and timely. There were many attempts of this over the years, reclassifying receipts from the mandatory to the discretionary side of the ledger, and although people say you can do that administratively at OMB, and OMB will tell you no, that Congress has to do that, you go to Congress and they say no, OMB can do that, and you get this, nobody really

wants to do it. And, that's because people are using the money for other purposes and not for the intended purposes of this program. So, at the very least, the funding stream that comes into the federal government, which is anywhere between $750 and $800 million a year, really needs to be dedicated to the organization who's doing this work.

Leadership stability. Political appointees, besides the fact it takes them a long time to get confirmed because of senate holds, and so forth, it really argues against having leadership stability within the program, and my sense is you probably need director terms, maybe they're five years, maybe they're seven years, but it needs to be not appointed by the President. It needs to be appointed by a separate board perhaps and without any political influence.

Let's talk about actions for building trust and confidence. Let me go back for a second because there's a point I wanted to make at the end of this slide.

One of the things that struck me, and I think it was in the 2006-2006 time frame, and this was about four years after we went through the site recommendation and we spent a lot of time educating people on the Hill, one of the problems that this program suffered from was that there were long periods of time where Congress just paid attention to this program through the budget process.

Basically, if you go back to the Eighties, you will

see that we had a nomination of sites in ’84, the President acting in ’86. Congress was involved in a lot of things. ’87, the amendments act. But, really, the next formal check-in for Congress was the site recommendation, which was twelve years later.

My sense is is whatever program goes forward, there needs to be some kind of check-in point with Congress, maybe it’s every five years, maybe it’s four years, or whatever, where people have to understand what’s being done, and you have to get some acknowledgement that you need to proceed. Because, without that, you have people who have no clue about what this program is.

And, the example I’ll give you is I went up about three or four years after the site recommendation, and I was doing program briefings, and at that time, the Bush Administration was pushing legislation and I was briefing on the submission--not the submission, but the contents of that legislation, and the turnover in staff on the Senate side, on the House side was amazing to me. These people, yeah, they had some notional idea that Yucca Mountain existed. Many thought that waste was already in the ground. You know, there was just no understanding of the program.

So, I think there needs to be some kind of check-in point where the program has to go up and brief, where there has to be some acknowledgement that yes, the program needs to

continue on its current path. Without that, I think that you run the risk of running into the same situation we ran with Yucca Mountain. People step out, a lot of information comes in, people don't understand it. They would throw up their hands and say I don't care. And, I think there has to be, if there's going to be Congressional involvement, and we can talk about that too, there has to be a cyclical point where Congress has to know what's going on and basically say yes, continue with it.

Going on to my final couple of slides, trust and confidence, I think program transparency, I think the program did a good job of that over its lifetime. I think it got a lot easier with the web to make documents available. When we were in the Eighties, basically we used to send massive documents out to people and wait for letters to come in for comments. I think it got a lot easier when the worldwide web came and after Al Gore basically created it. It was a great help to the program for trust and confidence.

I think that the program should be insulated from political intervention, from the budget process and day to day operations. I definitely think Congress should approve facility siting, but they should only intervene through an act of legislation, and not through the budget process.

And, I think we need stable program leadership. That's certainly something that I believe would help.

Other thoughts. In the near term, the courts will determine the next steps. There's oral argument on March 22nd in Washington, which I think will be interesting.

And, I think the ultimate question is is the nation really serious about this issue. And, if they are serious, comprehensive legislation, if people are interested, takes about three years to develop. And, anything that comes out of the Blue Ribbon Commission, and I heard people say well, we're going to wait for that, Blue Ribbon Commission is going to issue a report, and it's going to be a flawed report. And, you can ask me why, is because how can you do an evaluation of the policy without really looking at what the country has been doing for the past 25 years.

I mean, that's a personal opinion, but I think it may have some interesting things in it, and I'm sure there are people working on it, and God bless them, and I'm very happy they're doing it, and I'm sure they feel very empowered, but the bottom line is you have a major flaw. And, again, it was created for a political reason, and people are going to look at it as a political construct.

There may be some interesting information in it, but again, unless they decide to ignore their charter, they're going to have a whole--if I could just give you an analogy? Let's say the President wakes up one day and says, "I want a new star map. I want a map of the heavens, and I'm

going to create a Presidential Commission to do this." And, he hires a bunch of people who are not astronomers to go do this. And, he says, "And the only thing you can do is you can't look over here. You leave this quadrant out. But, I want the best star map that you can possibly make." Now, when that star map is done, how credible do you think that star map is going to be? Anyway, food for thought.

In any new construct, the federal liability needs to be addressed, and how that happens will be, I think, a challenging thing. If you to a fed corp, or if you go to a private entity, there's going to have to be some federal oversight, because ultimately, the liability is growing. And, if the federal government is going to give the authority to implement the program to another entity, the federal government needs to have some assurance that progress is being made, and so forth. So, that issue is going to be a little sticky and it's going to be challenging.

My concluding thoughts. Future philosopher once said that "logic clearly dictates that the needs of the many outweigh the needs of the few, or the one." If you want to know where that's from, it's from the "Wrath of Khan," which was one of my favorite Star Trek movies. But, ultimately, this is going to be an unpopular program. I think there are going to be people unhappy with it. But, ultimately, again, a decision has to be made, and it's for the needs of the

many.

And, George Santayana said something similar, “Those that fail to learn from history, are doomed to repeat it.” I think we really need to understand where we were, what we did in order to make sure that it doesn’t happen again.

And, in closing, I will say that my last all hands, and there were several people here in the program who were present for it, where I more or less explained what my perspective was and what was going to happen, which is one of the reasons I retired from federal service, the program did not fail. I think that we had many dedicated people who worked very hard in order to implement a very challenging piece of legislation and a very challenging enterprise.

However, politics failed the nation. I was going to put “again” but we want to focus on the subject. Anyway, those are my remarks, and I’ll be happy to answer any questions.

GARRICK: Okay, thank you. Thank you very much.

Okay, let’s open it up to questions. Ron?

LATANISION: Latanision, Board.

George, I’d like to hear a little bit more about your experience at WIPP on two points. One, your comment about an informed supportive population. What was done in New Mexico that wasn’t done in Nevada? Point one. Why don’t

we take that, and I have a follow-up question.

DIALS: That's a great question, and it's one I'm really proud of. One of the things we did very early, and I got to go in and create the Carlsbad area office, and it was fundamentally different from Yucca Mountain because running the program was my job, and I ran it from Carlsbad. And, Dr. Garrick will tell you the interactions were really focused on Carlsbad and what was going on with our management team. It wasn't in Washington.

I reported to Assistant Secretary Grumley at the time when I first went there. I reported directly to Hazel O'Leary, and we were in direct communications most weeks. The good news about that is all the political interference was being run there, and I was running the program, and I had direct outreach with my lead labs, Sandia National Lab was a scientific advisor, I think we really designated them the lead lab ultimately. I required each of the labs to move, to have an office in Carlsbad, so we really focused the program.

As far as the community and the state were concerned, the leadership of the program was in New Mexico not in Washington, and that was the case. And, it was very, very beneficial and helpful. We published early on, I think it was in April of '94, I got there in like November of '93, by April of '94, we published a schedule called the Disposal Decision Plan. It was eight and a half by eleven, tri-fold,

and I was looking for one, I couldn’t find one, to pull it out, and I have a black and white one, was in some of the comments, the diagram material I brought to look at, but it was revised only four times in five and a half years in terms of the schedule.

But, on that Disposal Decision Plan, eight and a half by eleven, tri-fold that I used to brief all the Congressional folks who came, all the local leaders, anybody I met, sort of your elevator speech, it had the schedule for every public interaction was scheduled on that document, and all the peer reviews were scheduled, and the major scientific activities, or the goals or deliverables were identified as to date, like the performance assessment activities were identified. So, we went to the extraordinary efforts to make it a transparent process. So, the scientific evaluations were listed, the regulatory interactions were listed, the peer reviews were listed, and the public comment periods were listed, and in that time period, we had 47 public hearings on various aspects of the program. And, the opponents and the proponents were actively informed and equally informed about when they were going to occur and their ability to participate.

As you might imagine, the greatest opposition against WIPP were those people who seemed to be inversely proportional to the distance from the site. So, it was in

mostly Santa Fe and Albuquerque, which were the opposition groups, and they're still there. They're still opposing some of the activities of WIPP. But, we decided also to open an office in Santa Fe, just two blocks from their office, so we had equal access to the public. If the public wanted to come to our office or their office, they had to walk by one to get to the other almost. A very engaged outreach.

Out reports, all the documents were provided, and the public were encouraged and allowed to participate. We had a lot of hearings, and I think over time, it was very productive because we got a lot of people who were finally getting the message in a sense is if you're truly worried about this, for example, I can remember a meeting in Santa Fe where we had a lot of the Pueblos, the Northern Pueblos, come in attendance and speak. And, if you were at Santa Del Fonso Pueblo, for example, which is the one that has territory that bounds Los Alamos National Lab, it became obvious to them that really, the risk to them was more apparent to leave the material where it is on North Mesa than it was to move it and put it in a hole in the ground in a salt formation at WIPP.

So, over time, people became informed enough to be able to take an informed decision and position on it.

LATANISION: Did you track the public attitude in terms of polling or any of that?

DIALS: We did. In fact, one of your participants

today, Hank Jenkins-Smith, was one of the polling contractors we used. He was at the University of New Mexico--no, he's still at University of Oklahoma, he had some affiliation at the time. So, we did that as well. We had a lot of outreach with the scientific and technical communities. I mentioned we did seven peer reviews, the seven national peer reviews, and the one international review, and those were open for observation to the public. The reports went out to the public.

We did a piece on the science, and I meant to bring this up, and I know Peter Swift and Andrew Orrell and the other guys suffered through this process a bit when I was running WIPP. When I first got there, we had 116 separate scientific and technical evaluation programs going on, and we didn't have that much money at the time. Our budget was $180 million a year, or something of that, to do everything. So, we created a process, it was a prioritization process, sort of a ranking process on the importance of those programs. And, Peter, you might remember this, I think we went from 116 different sort of projects to eight major groupings of projects, and that's where we spent the money.

We focused the science on those things that were absolutely important to demonstrating the performance of the repository, and meeting the regulatory criteria. And, that helped us a great deal because it really focused not only the

attention of our scientific contractors and the national labs, but it also focused the attention of the opposition groups in a sense, because those are the things they started worrying about and paying attention to. That was critical to our ability to have this open and transparent process.

LATANISION: One follow-up question. You also mentioned--actually all three of you have mentioned moving any subsequent project out of the federal bureaucracy. And, you talked in particular about a private federal construct.

DIALS: Right.

LATANISION: What would be the characteristics? Where would the funding come from?

DIALS: Well, the funding would come from the Nuclear Waste Fund that we're all paying into already. I mean, it's an IOU. The money is not there.

ARNOLD: It's in that lock box. Welcome to Social Security.

DIALS: Well, and others, but that's the logical source of the funds, and there's substantial funding available to accomplish this task. I've been spending some time in Tennessee. I'm an Army nuke, unlike Navy nukes, you know, Navy nukes deal with all this sort of very deliberate conduct of odd stuff that get things to go through water, propulsion systems. Army nukes deal with weapon systems, so it's probabilistic siting and calculations about what you need to

take out certain parts. So, as an Army nuke, I think you go through the probabilistic assessment of how much money we need to do this job, and you will find out that the waste fund is more than enough if we had a private fed corp, like the TVA or something like that.

LATANISION: So, you would not look to any taxpayer money in order to do this?

DIALS: Well, just the rate payer money.

LATANISION: Rate payer money, yes. I understand, okay.

GARRICK: Howard?

ARNOLD: Howard Arnold, Board.

I'm going to ask you to comment on another aspect of public confidence. If I look at Southeastern New Mexico and the chosen sites in Sweden and Finland, I see another element which is a--there's something in it for the locals. That's, I think, a key element in getting the kind of support you're getting. If you look at Southeast New Mexico, you've got WIPP and you've got the new enrichment plant, and they're major drivers in the economy of that area. Whereas, if you look here in Nevada, you've got enormous Las Vegas, and the amount of economic benefit to this area of the Yucca Mountain project is very minor compared to what you've got in New Mexico, and also in Sweden and Finland both. Those are sites where there are nuclear facilities, and the people see the actual benefit of this thing in terms of jobs and economic

growth.

So, my recommendation would be that we add that to the list of things that are part of future public acceptance. Pick a site where this thing is going to be economically a great benefit.

DIALS: I think that's very true, and it's played out obviously in a place like Carlsbad because near the potash industry, which has had a bit of re-invigoration the last few years, had gone through a very difficult time. So, there were a lot of mining experienced workers available in the area, too, so having a repository fit an immediate need. You know, that's one of the things you often hear. They should benefit. Education programs should certainly benefit job creation, people and families have an opportunity to stay in the area.

BARRETT: I believe you can--we never got to do any negotiations really with the State of Nevada. I mean, the politics was just so difficult. There was such a litmus test here in Nevada, it just couldn't be done. I believe you can look forward with other states potentially, as Governor Martinez in New Mexico said, I believe you can put together a win/win situation. The national need for facilities is great. Interim storage, I think we need a bridging facility if we have a far out repository. And, I think there's huge benefits available for a state that can make a difference at

the state level. I mean, when the need is great, the price can be high. Things in the university system for the state, the state could have the highest caliber scientific nuclear safety infrastructure, and many things can be done business-wise. So, I believe there's hundreds of millions of dollars available. I'm talking about partnership, mutual benefits for infrastructure that would benefit all parties. So, I'm very optimistic that such arrangements can be done in a state in the future.

KOUTS: Just if I could supplement their comments? I'm sure the Board is aware that the payments equal to taxes that were given to Nye County were a major portion of their budget on an annual basis. So, I think in terms of providing financial benefits to the situs county, the problem was doing that under the constraints that it had, since we had no formal C&C agreement with the state. But, Nye County certainly needed that money on an annual basis, and they're struggling right now because that pipeline has been cut off.

ARNOLD: But, your opposition came from here.

KOUTS: Well, correct. And, what you're really talking about is an agreement with a host state, because the political structure of the state needs to engage and want to engage. In Nevada, you know, that was something that had been tried many, many times and just didn't go anywhere. The state was adamantly against it.

ARNOLD: So, you've got to start from that standpoint, not get into it later.

BARRETT: The state is critical. I believe that's one of the key lessons, and I think the BRC fully understands that as well.

KOUTS: Well, let's put it this way. The state is critical in the current construct that we currently have.

DIALS: The experience at WIPP was that the region began the effort, actually, and the state came on later. I think you could do it either way, but you certainly have to have a proactive voluntary region that wants this thing to happen. And, then, they do benefit substantially, the City of Carlsbad benefited substantially from all the involvement there, as is that region now.

And, I think--and, I had a hand in, I ran the LES project, it's now renamed Urinco, Inc., but I selected that site down there because I had lived there and I knew about the site, and when we had a failed siting operation going in Tennessee, got to make the decision to pick a new site, I went to one where I knew there would be a receptive host community. So, that's going to happen, and right across the border in Texas, you have the Waste Control Specialist Operation. I was the president of that group when we got our license application in. That whole region is now a proactive accepting region for nuclear industrial projects.

ARNOLD: That ought to be the starting point.

DIALS: So, I think going to a WIPP-2, and I have a bias a little bit towards salt. I spent a lot of time in the salt operation. I did my thesis on repositories in Europe, so the salt mines in Germany were the most progressive at the time. I think you would save time, and this is my personal view, if you would look at a WIPP-2 type operation for either disposing of the high-level military waste, and it's going to be vitrified through the processes that are in existence out at Hanford and Savannah River, and take care of that part of the problem, and certainly look at an opportunity for a repository siting in a salt formation. It doesn't have to be right at WIPP. There's a lot of salt, as you know. But, it would save you a lot of time because of all the information we have, the characterization of the geologic structure, the performance assessments that have been done by Sandia and others of radionuclide transport in salt, and it would save a lot of time in going to some other geologic structure, my opinion.

GARRICK: Andy?

KADAK: Kadak, Board.

I was struck by I guess you all said take it out of DOE, give it some federal private partnership. But, I wonder what is the advantage of having the federal involvement in any way? Because you bring in all the federal bureaucracy

problems and you take away, you don't allow, it sounds like, the incentive of the private corporation to accomplish the task. So, can you kind of explain why you think you need the feds, you know, especially if after the site is closed, or whatever, how many years in the future, the government could sort of take over the land? I mean, they could own the land, for example, if that's the kind of partnership you're talking about? I don't know, could you kind of elaborate on that for one moment?

BARRETT: I can start. I think there are many different constructs that you can look at from a management sense. One of them that was started back in the Sixties was the New York State Energy Research and Development Authority. That was West Valley. This was back when West Valley, in the State of New York, felt that this was a good industry for the future. The land was state, it was owned by the State of New York. Okay? And, it was contracted by the best and brightest of private industry at that time for the reprocessing plant. It was built and it operated. Now, it didn't operate very long for a various set of reasons, but the management structure was one that that could work on.

So, I think there are many models like that. You can do the TVA model. I think there needs to be a partnership with the host state and the local community and private industry, who can work and implement it under

contract with, say, DOE. I mean, this could start under the existing law. Private fuel storage, which was interim storage in Utah, which is politically blocked at the moment, and has an NRC license for storage, they, for example, would like to have had a contract from DOE to start the process and work as a contractor to store the fuel to help DOE with its obligation. We were never able to do that because of politics, basically, but I mean there are very many models where you could do this.

I think in the aggregate, and I worked as a fed for 27 years, private industry almost as much, but you're better off, all things considered, to move it out into a private public partnership. But, the land could go back to the state. Low-level waste sites are an example of how you can do that, in Texas and other places as well. So, I think there are various public private partnerships that could work quite well for this.

KOUTS: The only challenge I see in that construct is trying to figure out a way to address the government's liability under the contracts. Because if this entity is being contracted for by the government in order to perform under the contracts, the government has to have some oversight responsibility in terms of making sure that this organization is doing the right thing and not creating a greater liability for the federal government. So, that's to

me the biggest challenge, the construct, whether it's something that Lake suggested, or whatever, I think can work, but that's really the wrinkle that I think a lot of people are going to have to think hard about, and what kind of construct is going to be that oversight in order to deal with the contract.

KADAK: Just a comment about the TVA. The TVA is put up as a model organization. But, if TVA ever had to pay back the bonds, they'd go broke. Okay? So, let's kind of not throw that one around too much.

DIALS: Well, that's true, but the--well, the nation is broke already. Let me say something about it. I think it's sort of a societal or psychological part of this because when you're talking about such long-term risk, and we're saying we're going to protect you and future generations on a national basis for long-term risks, I think there's some comfort level for the people, particularly in our country, we do value our national institutions, and have some view that we will have some long-term survival. So, having some sort of overlay of federal or national responsibility ultimately for the site, makes some sense from a psychological standpoint. That is a comfort standpoint for the public.

KADAK: Let me ask another question relative to regulation. You were apparently able to be successful with EPA in siting WIPP. Do you have any views as to who should

be the regulator for a waste repository?

DIALS: Well, I think NRC is a perfectly good regulator, and they've got the educated and the type of scientific and technical folks you need to make determinations. I do think that the--they were adversely impacted by what I view, and this is a personal opinion, sort of a rational result of the National Academy of Science study that ended up with a million year performance time frame.

You know, we can run the computers, and it may say well, the model can give you a number out there, and we think that's--but, the public looks at that and says you've got to be kidding, Jack, we can't even predict weather for next week. You know, you can't predict what's going to happen in political campaigns. Our predictive abilities are not persuasive, in other words, with the public. You've got to get it into a range where they can say yeah, I can buy that.

KADAK: I'm talking more about the regulatory process. Going through the EPA process is quite different than the NRC process, and I'm just wondering what your views are about the two. Or maybe Lake has a comment.

DIALS: You know, I've been through, I've worked with both processes. It was interesting in the EPA, the EPA process became a much more of an interactive process because the EPA, and Dr. Garrick was very involved in this, he had a lot of time with his committee and with the scientists at

Sandia, were very much in a learning process about regulating this industry.

GARRICK: The thing it sort of reminded me of is how the regulatory agencies work in Europe. They interact a great deal more with the licensee, and the EPA did that. They were very visible. They attended meetings, informal meetings. They worked with analysts on both sides, and they demonstrated a great deal of technical humility. They knew that they had a disadvantage, and that they didn't have the infrastructure of NRC in terms of nuclear experience, but they offset that by the studiousness with which they engaged themselves in the process. And, they really did work hard to understand all the issues, including the issues that our committee was raising. So, it was a very kind of inspiring relationship.

But, I would agree with George it's a little bit apples and oranges, you can't really compare the two in terms of who may or may not be the better regulator for this particular application. I think the NRC has the full capability to do it. But that was a unique experience and an extremely successful one, and didn't have the adjudicatory baggage that was inherent in the NRC. It just seemed to allow and be an environment into which people were more relaxed and working together in solving a problem. I think that was a tremendous advantage.

DIALS: John, as a West Point guy, I can take a shot at my Navy nuke friends that said, you know, there were many fewer Navy nukes in the EPA regulatory thing than there are in NRC.

KOUTS: If I could just make one point? There are two parts to the regulatory scheme. One is setting the standards. The other is oversight of the standards and the licensing. I would argue very strongly that what we have now is the worst of both worlds, which is we have one agency creating the standards, another agency interpreting them, and basically licensing the site.

What I would strongly recommend, and, you know, I'm certainly to either EPA or NRC doing it, but they should do both. They should issue the standard, because basically it will be homegrown within that organization, they will understand how it's going to be interpreted, and so forth. And, they will issue that regulation with an understanding of how it will be implemented, as opposed to having one federal agency basically issue it, another federal agency interpret it, where you get into all kinds of different situations with it. It needs to be done by the same organization regardless.

BARRETT: Let me reinforce that, absolutely what Chris said is true, and George did too, as well. But, they are culturally very different organizations. The EPA is more policy. They are a legislative type hearing process. It is

not really run by the engineers and the lawyers at all. The NRC is an adjudicatory process. It is really the process of licensing, is run by the lawyers, it is staffed by nuclear engineers.

The strength in NRC kind of started off with reactors and machinery and that sort of thing. And, the EPA was more, well, what are we going to do with toxic wastes and those sorts of things, and risk analysis. So, they are very different culturally. Chris is absolutely right. We have the worst of both at Yucca. We had the EPA philosophically, best available technology set a standard, applied by rigid engineers, and in an adjudicatory, lawyer driven process. It was the worst of both. If I had to pick one and go, I think they're both good organizations, and certainly capable of doing it. But, you don't want to mix them.

GARRICK: We have another Board member that wants to raise a question. But, I have a question that's related to what we're talking about, and I've had it in my mind through many Board meetings, and I can't think of a better group to ask than this one.

And, it has to do with the implications of the Amendment, the Amended Act of 1987. And, there's some people, and I might even be one of those, that believe that the Amendment to the Nuclear Waste Policy Act, the 1987 Amendment, was what really derailed the project, because it

transformed it from a rather systematic problem that was being handled in the context of a decision analysis problem where you have options, and suddenly now it was not.

And, I would like to hear a comment from each of you about that, and whether or not you believe that this was a step backwards rather than the step forward that it was intended to be.

BARRETT: I'll start with that one. It was a huge step backwards as far as the relationship with the State of Nevada.

GARRICK: Yes.

BARRICK: If the country could have held with the state's disapproval and a decision in 2002, as was really decided, we'd be okay. But, nobody expected that little weak Nevada of 1987 would have the majority leader who had the power to control who the president was, as it was believed in the last election cycle. So, what happened was it shouldn't have been such a driver, but it became a huge driver in the emotions of the situation.

I think when I said the Nuclear Waste Policy Act was a little too idealistic, back in '82, people thought site characterization and the level of risk people would expect was not what it turned out to be in 2002. I mean, the public and the TRB and the NRC and the EPA expected almost perfection and absolute zero risk almost from a repository.

Back in ’82, it was a billion dollar, 60 million, or something. Site characterization was put a shaft down and a few small experiments and get on with it in a couple years, not a $5 billion operation that had to have triple belts and suspenders and almost perfection and nuclear quality assurance, et cetera. It’s that cost that drove it so high, and to be unbearable and unsustainable.

If you look at the three sites, the Hanford, Death Smith and Yucca Mountain, my personal opinion is when it was all said and done, if we had gone through with it, Yucca still would have come out on top for many technical reasons.

So, as Congress short-circuited it, it was probably the dead right call. Okay? It was probably the right call to make, but the repercussions of it, due to the next 15 years, it was fatal.

GARRICK: Yeah.

DIALS: I agree that I think that really made it more difficult to get to the repository opening stage on Yucca Mountain, because you enabled the opposition to always hang fear on the idea that we’re being forced to do it because it’s so dangerous that nobody else would voluntarily do it. We have interesting and sometimes irrational responses to personal risk in our society and we all do it every day.

You can think about if you’re looking at a new automobile, the kind of automobile you want to buy, and you

may be one of those who goes and checks out all the latest safety things and which scored highest and what's got the best air bags, and so forth. But, given all that information, if you were told that you had to buy this specific vehicle because that's just the way it's going to be, regardless of your fear about the risk, you would be very reluctant to do it psychologically.

And, I think that's what happened in this case, and it enabled those who argued that this was dangerous for Las Vegas, and that's where all the people are in Nevada, to really have the upper hand in that argument, and contributed to the ultimate failure to win over public acceptance.

GARRICK: I think another way to ask that question would have been to get your opinion of where we would be now, and would we be in the same position, had we not had the Amendment Act?

KOUTS: Well, I'm glad you asked it that way, Dr. Garrick, because let's play it forward, let's assume that the '87 Amendments never happened, and we carried forth site characterization efforts at Hanford and at Death Smith, Texas and at Yucca Mountain. And, let's say we get to 2002 and the Secretary of Energy recommends Yucca Mountain, and the State of Nevada says no, and we have the same political structure in place today. I would submit to you that we could have ended up exactly where we are today, even following three

sites going forward. Because I think whatever state, if their mindset is hell no, and if they have the political willpower and the political power to do it, it's could potentially happen again.

So, what I would submit to you is yeah, looking back, maybe. Looking at how we look at it now, yes. But, we'll never know the other path because we may have ended up exactly where we are today.

DIALS: One of the things I would add, that would give you, Chris, an opportunity to enter into negotiations, which were never done in Nevada. Say, well, we're going to up the ante with what you get, and we talked about the benefit to the region, there's substantial benefits that can accrue to a region for taking on this repository program. And, we were not as specific as perhaps we could have been, although Nevada knew that there were certain things coming, and would certainly come to go along with this. But, it wasn't enough and there was no real negotiations about it because the positions had been taken early before it was eminent. And, there was no other group contending for the opportunity because we had foreclosed all of them. So, it was a this is it or nothing. So, I think that would have affected it, Chris.

KOUTS: I have great respect for George. It's a theoretical discussion.

BARRETT: A third opinion on it. I think we would have ended up in the same place. Okay? Because I don't think you would have ever gone in and spent $4 billion characterizing each site. And, it we had done it, for example, and spent all that money through the budget, then you would have come out, each site would have pros and cons, and each governor would probably say, you know, my site is not the right site because of, say, transportation, or this or that. So, you would never end up with closure.

Now, maybe we could have had a negotiation with Nevada, and maybe not. You know, I don't know. Nobody is ever going to know the answer to that. So, it's hard, we just don't know. But, I don't think you could have gotten there because I don't think the country would have spent $12 billion, if the other sites got done like Yucca Mountain, got analyzed. And, I don't think TRBs, and others, would allow anything less than that.

GARRICK: There is one thing very clear. If we did not have that Amendment, we would not be here.

BARRETT: Maybe not. There would have been an NRC or somebody else demanding almost the same. I mean, the NRC requirements, the EPA requirements are very restrictive, and if you look at it from a national perspective, in my view, I feel very badly that we spend billions of dollars to deal with miniscule, almost non-existent risks in society, and

spend billions of dollars to prevent a statistical death maybe a million years into the future, whereas, we could use that money for our schools, our hospitals, or whatever it is today.

I think we are ill-serving the American people by spending billions of dollars on things that are really of such low risk relative to other things we accept due to the psychology of a nuclear death that we'll spend billions to deal with, but a roadside death, or when the ambulance comes to get somebody with a heart attack, maybe it's $50,000 is a death. That is, to me, the imbalance in society in nuclear.

GARRICK: Okay. David?

DUQUETTE: Duquette, Board.

I'm going to argue that the three of you are trying to put together a horse by a committee, and you're going to end up with the same camel that most of us end up with in trying to put together a federal state industry organization.

I recognize that the federal government has made an agreement with the utilities that they would dispose of the waste at some point. But, like all laws, that can change. I mean, the other camel I'm talking about is USPS, for example, the U.S. Postal Service operates sort of as a private organization. It doesn't do it very well.

What if we turned it over to industry? What if we took the Nuclear Waste Fund and turned it over to a group,

say EPRI, or somebody like that, that's an industry group that is responsible for that? That's what has happened in Sweden, pretty much in France and Finland. The utilities are responsible for the waste that they generate, and the governments in those cases basically simply make sure that it's a safe operation and one that's going to serve the public. Would that be a reasonable model for us to go to? A complete change in how we approach it. But, would it be a model that we could go to?

BARRETT: Let me start with that one, and Chris will probably add to it, his views.

If we're starting from scratch, that's what I would do. But, we didn't start from scratch. And, the Constitution has a Taking Clause. DOE has a contract with the utilities, and this is contract law, not legislative control. Okay? And, the utilities, in '82, were smart by saying you know, I'll give you the money, but I don't trust you will ever deliver. I want contract protections under the Taking Clause.

So, you cannot, as Chris mentioned earlier, this federal liability of $16 billion, and growing at a half a billion dollars a year, has got to be reconciled with going forward. And, you can't pretend it doesn't exist. So, even if the Congress just can't change the law and say good, now, you do it, whatever model, the SKB model of Sweden, you know,

you take it over, someone has got to deal with that $16 billion, and growing, liability.

It can be dealt with various ways, but you can't just change the law under the Taking Clause of the Constitution, unless you don't believe in the Constitution, and most do.

KOUTS: If I could just supplement what Lake says. It is a contract, and if you look at the Windstar litigation, Congress can't pass a law and say the contract doesn't exist anymore. So, the only way to get rid of the contract is if both parties agree that the contract is dissolved.

DUQUETTE: Of course. There's no question of that. It's contract law, and contracts are changed on a daily basis everywhere in the world.

KOUTS: But, it takes two parties to do that. It takes both sides of it. And, the question then would be are both sides willing, and it's not one contract holder, there are like 77 contract holders, so, you're not dealing with a single mindset. You're dealing with people thinking about what's good for their own organization, whether it's a corporation or whether or not it's a--but anyway, there has to be total agreement among those 70-some odd entities to abolish the contract. That will be very challenging.

And, right now, as you know, the federal government is locked in litigation on that, and it's not the liability,

it's because the contract says that the federal government was supposed to begin taking these materials by January 31, 1998. Courts have ruled basically that the government is in partial default. And, all the lawsuits now are not about who's at fault, the lawsuits are about how much money the individual contract holder gets because of the Department's delay up until the point of trial.

So, it's all about damages, it's all about money, and the question is are people going to want to get off that gravy train and go to a new construct. And, what I would submit to you is from what I've seen, personal experience in court, I don't think a lot of people are going to want to get off that gravy train. There are already some contracts that have been settled, and they get continual payments. Now, why would they not want to do that and go to some other construct where they don't know what they're going to get.

So, what I'm suggesting to you is that it's a Gordian knot kind of issue, and it's going to continue until some entity performs and begins to take spent fuel, and that liability can be reduced.

DIALS: I think it would change if there were some way to do the alchemy here that was once thought of, and you can turn the crud into gold. And, whoever takes title to the material will ultimately own the fissile material that's in it, and we say long-term, there's likely to be tremendous

value to that if we have the nuclear renaissance worldwide that we're talking about. And, that could provide some incentive for an approach that you suggest, where a corporation would come in and deal with it.

If we were to start over, that would be an ideal thing. I have a great deal of confidence in the ability of American industry to solve problems and deliver value. But, it is complicated by this case, but I do think it has to do with a value judgment at some point about what the material is worth and who would like to have title to it. And, I don't think it will be resolved in the near-term, but if you go to a process of interim storage facilities, for example, one idea that could exist is the utilities could be enticed by private interim storage facilities to transfer title, if some interim storage facility were courageous enough to do it, a corporation. And, that means we've got to have an ability to recycle and reprocess.

So, that's part of this holistic view that's missing now as we look at the overall fuel cycle. And, with the status of the cycle now, I think Chris and Lake are right. The utilities would be very reluctant to give up that contractual obligation the government has to take the material.

GARRICK: Two more questions from the Board. One from Bill Murphy and then Ron.

MURPHY: This is Bill Murphy of the Board.

First of all, I would like to say that I'm very appreciative of this discussion. It's been really enlightening for me to have this Panel address the Board. So, I appreciate that.

My first question is why was peer review useful in WIPP and not useful at Yucca Mountain? Was it perhaps because peer reviews at Yucca Mountain were critical, as the TRB has been at times?

BARRETT: I started that one, I guess. I'll speak to Yucca Mountain.

They were positive peer reviews, and we did the NEA, IEA because George told us how good it was at WIPP, and that's what we did at Yucca Mountain, and they were very positive. What happened, what my comment on that was it didn't affect the trust and confidence of the technical work, which was the question that you all had asked. So, no, it didn't have a big thing. It was valuable to do. I would do it again. But, we didn't get credit for it.

MURPHY: Why?

BARRETT: Because it didn't--it was a good news story and within the State of Nevada, the airways were basically controlled by, and the papers, by folks who felt this was a terrible injustice, and they were not going to basically publish favorable information about Yucca Mountain. Any

hiccup and negative, it would be all over the place.

So, the answer is it was the demeanor of the state was not about to talk about the positive things at Yucca Mountain. So, it didn't work here. New Mexico was a different environment.

DIALS: Well, some of the peer reviews were negative. I mean, we had problems to resolve as a result of the peer reviews. But, the results of going through the process were improved programs, and we resolved some of the issues, whether it was actinide solubility, or some other issues people were worried about, we had to do more research and more technical work on.

Our regulator participated as an observer and were involved in the peer review. So, it gave them some confidence. And, I'm not sure the NRC would be involved in a peer review. So, the EPA regulators were involved in the peer review, so they got confidence also that we were really working the problems, and the results were scientifically credible.

Andrew, you were involved. Andrew Orrell was with Sandia National Lab, and was involved in a lot of these things and might have a comment to add. They suffered through a lot of these peer reviews, but they were very important in terms of our effort to get the support we needed for the program.

GARRICK: I think there was one other thing that very much distinguishes WIPP from Yucca Mountain, and that is the stability and genuineness that was provided by having a chief scientist throughout pretty much the whole project. Wendell Weart did a marvelous job. He was a great communicator.

And, I think the other element that existed on WIPP that never has existed on Yucca Mountain is it had continuity in its National Academy of Science Committee throughout the whole process. And, they worked extremely well, from the standpoint of the technical element. So, the organizational makeup was just much more friendly, had much greater continuity.

MURPHY: This is Bill Murphy again. I have one additional question. And, it's somewhat a spin on the question that John Garrick posed about the effects of the Amendments Act. And, I think we learned from the WIPP experience and from the Yucca Mountain experience that site characterization is really a pretty hard job, and problems will be discovered that need serious work to resolve them.

And, this is rather glib, but in my view, my personal view, one of the important lessons learned from the Yucca Mountain experience is that it was a mistake to select the site before the site characterization had come to a conclusion, because there still remained hard problems that hadn't been resolved.

BARRETT: What Congress said was characterize this only one site. They didn't say this is the site. They said DOE can go forward and characterize only one site, and if it is safe, proceed. So, as we went through that over the many, 15 years, between '87 and 2002, if we felt scientifically the site was not there, I had the authority and a couple times I had to use it in the political world, was that I could report to Congress that this site is not suitable. So, that was there. It was not forced on that this was the site no matter what.

So, the science still controlled it, and the science still was supreme. And, the reason I say what happened politically, was that while we're developing EPA standards, there was one EPA standard that some little over zealous folks within EPA, it was science could never show, you basically would have to show every cubic meter of rock was below the EPA standard. You couldn't do it. But, I said if that's the standard, I will go report to Congress in the morning that this site is unsuitable. Okay? Because no science, you could never prove it. Then, EPA went back and said well, wait a minute, we don't want to go there. But, I mean, science still was supreme, even though after the '87 Amendments, in my opinion. Then was the siting, when science was done, then the political process.

DIALS: But, I think our report, I submitted the site

selection report, it should have been the site affirmation report, not selection. The site had been selected. We just submitted a report that said yeah, given all the stuff we have to do through characterization, the site will meet the objective. But, it had already been sited.

KOUTS: This is an excellent example about why I think you need a comprehensive history of the Yucca Mountain program, because there's so much more to the story in answering your question than Lake or George just said. I mean, the initial standard was a release based standard. It wasn't a dose based standard. It was remanded because of the ground water requirements. Congress directed the Energy Policy Act of 1992 that a site specific standard for Yucca Mountain be developed, and that's where we got a dose based standard.

Now, getting back to Dr. Garrick's question, if we had the horse race and the three repositories, would we have had three separate standards for three separate sites, and so forth? Again, I think your question, and many of the questions here of the Board, really, in order for the knowledge of what the program went through, and all the issues that it addressed, that's why you need that comprehensive history, so people really understand. Because if you're just dealing with a notional understanding about well, why did they do this, or why did they do that, you

never really get to understanding how to go forward and construct something that will work in the future, if indeed that's where we're going.

GARRICK: Okay. Quickly, Ron?

LATANISION: I'll pass.

GARRICK: No? This has been an excellent session, and we really do appreciate the three of you being willing to take off your straightjackets--

KOUTS: I got rid of mine last January.

BARRETT: Mine was nine years ago.

GARRICK: --and share it with us. We appreciate, as we appreciated all the presentations this morning. They've been a little bit unfair, but still you held up very well.

All right, we will recess until 1:45.

(Whereupon, the lunch recess was taken.)

AFTERNOON SESSION

GARRICK: Okay, let's come to order. Is Andrew Sowder here? Andrew is going to talk to us about Electric Power Research Institute review of geologic disposal, or disposal options for used fuel and high-level radioactive waste.

You have the floor.

SOWDER: Well, first of all, I wanted to start off by thanking the Board and the Staff for the opportunity to share our perspective on geologic disposal, lessons learned.

As Chairman Garrick indicated, the title of the talk is EPRI Review of Geologic Disposal and a focus here is on lessons learned. I'm Andrew Sowder, and I am with Electric Power Research Institute. And, I also want to express EPRI's appreciation of the Board's confidence in suggesting EPRI of running the program. But, I'm not quite sure how I feel about that suggestion added to my role.

So, quickly, just the contents of the talk. I wanted to provide you with a brief overview of really the context for our review, and remind folks who may not be familiar with EPRI our role, which has been over the course of several decades in geologic disposal studies, especially performance assessment. And, introduce our geologic disposal review series that was published in 2010, and given that this is after lunch, and I know many of you will be fighting the urge to fall asleep, I will focus this talk on two core

principles for moving ahead with a new geologic disposal program in the U.S., informed by previous experiences. But, also, I can't resist adding a few additional observations and lessons learned, in parting, before writing a brief overview summary.

So, I don't need to really go into too much about why we're here. Clearly, with the Department of Energy's license application in June of 2008, followed by the termination of that program in 2009 and end of NRC review last year, along with the 2010 empanelment of the Blue Ribbon Commission, we, as others, I think felt that it was imperative to attempt to capture some of the key points, lessons learned, experiences from the past 20, 30, 40, 50, 60 years of geologic disposal research and programs.

And, a brief word about EPRI. We are an independent non-profit research institute. We conduct research on behalf of our members, which are the electric utilities. We're kind of agnostic on where the electrons come from, but a lot of our utilities do use nuclear energy to produce those electrons. And, we currently encompass all the nuclear utilities in the United States, as well as a sizeable fraction around the world. So, we are international in scope. But, we were chartered for public benefit, we are a non-profit. Essentially, we're here to keep the lights on, so to speak.

So, in terms of EPRI's role in geologic disposal, I'll focus quickly on our performance assessment experience. Again, I have only been at EPRI for three years, but certainly our role has dated back 20 years or more. We were among those demonstrating early on the utility of total system performance assessments for grappling with the complexity associated with geologic disposal, particularly compliance over long time frames.

And, throughout these past two decades, we have been able to provide independent, technical defensible assessments of Yucca Mountain performance. Again, we feel we are in a unique position, as we were able to develop and maintain our own independent capabilities throughout this time frame.

And, just to kind of illustrate the long history of total system performance development, and really, I think the role of peer review was raised at several points with regard to Yucca Mountain, about it not being maybe as effective, but in many regards, it has been effective at least from our point of view. We felt like our work paralleled that of the Department of Energy's and Nuclear Regulatory Commission, and at several points along this leap frog effect of developing the performance assessment methodologies, that we were able to inform the process and make meaningful contributions, as well as us learning from the Department of Energy and others

doing the same.

The last bullet there, EPRI all along I think has been a vociferous champion of the concept of reasonable expectation. You may have stringent standards and regulations, but one of the saving graces was this philosophy of reasonable expectation embodied in both 40 CFR 197, as well as the generic standards of 40 CFR 191. And, I will touch on that more later.

But, kind of as a quick advertisement, my year last year was spent putting together what turned into a four volume set of surveying and reviewing the history, as well as current and planned geologic programs, and aspects of those programs. Volume I addresses the aspects of siting associated with the Nuclear Waste Policy Act, up until the 1987 Amendment. Volume II is associated with reviewing the regulatory set, both the environmental standards and the Nuclear Regulatory Commission's regulations associated with geologic disposal. Volume III is a fairly hefty review of international repository programs, focused on, again, a limited number of countries, but with the view towards trying to capture a number of the key aspects and experienced base that now exist.

In many regards, the international community has now caught up and is passing the United States in the area of geologic disposal. And, certainly, there is much to learn

from that experience. Of course, transferring those lessons also comes with a lot of caveats, and there are some limitations on how much you can apply the international experience to that of the U.S.

But, today, again for the sake of brevity, I will focus on lessons learned. The point of this volume was to take the meat of these first three reports, which were meant more as neutral technical observations, and distill them down into some more useful points in terms of take-home messages.

KADAK: Did you say these are publicly available?

SOWDER: Oh, I'm sorry. And, I will provide the websites at the end of this. Yes. One thing that we have strived to do in our used fuel and high-level waste program is make virtually all of our reports publicly available from the start. Because, again, in fitting with our role and our mission as a non-profit for the public good, these more strategic type documents are seen best in the public arena. So, these, and many others, at the end of the talk, they're in the packets. I provide a short bibliography of other relevant reports we have produced over the years.

But, thank you for that. That's an important reminder.

So, in lessons learned, this is pretty much how we focused or organized our lessons learned. Nothing surprising here. Again, EPRI is a technical organization. We do not

delve into policy. That's for others to decide. But, we are about performing technically credible work and presenting those results, and letting them stand on their own merits.

The first bullet there was included because it's very clear that we are not starting from a clean slate on geologic disposal. You have over five decades of work behind us. There is an international consensus that geologic disposal is the preferred and safe method for dealing with long-term isolation of used fuel, high-level waste from the geosphere.

Now, geologic disposal encompasses both mined as well as other options, such as deep borehole, but, certainly revisiting once again space based disposal. How many people have heard of a rocket blowing up on the launch pad? If you have, it's probably not a good option right now. Sub-seabed, technically credible, but from the standpoint of international conventions and law, again, that has been examined in the past.

Again, in the interest of keeping you awake, I will focus on two core principles. These are what I saw as recurring themes, at least in our review, that seemed to serve to inform maybe a path forward for the next geologic disposal program. And, I think one of the messages here is that in spite of the challenges and the problems with the Yucca Mountain program, the long history, there is much to

learn and actually to start from with what we have with respect to the Yucca Mountain program, at least in terms of the generic aspects such as regulatory compliance, regulation, that sort of thing.

So, the first theme is the kind of the eternal need to anticipate and address uncertainty. Again, this shouldn't be an earth shattering concept. But, from our standpoint, the inclusion of the reasonable expectation concept in the EPA standards does provide a sound basis for performance evaluation and compliance.

Given that, there is explicit recognition in those standards that absolute scientific proof is unattainable, particularly as you move out in time.

Reasonable expectation recognizes that many of the uncertainties increase significantly with time. Some don't. Some increase over the matter of a course of days and weeks, for example. Human behavior, for instance, is one that I think most people agree is something that you can't get a handle on no matter what the time frame, other than a period of institutional control.

Reasonable expectation allows you to focus on those risk-significant features, events, and processes, or FEPs. And, again, in terms of how we looked at performance evaluation, reasonable expectation drives you towards best estimate rather than worst case scenarios and also worst case

assumptions and data.

A second key aspect, and some of this was brought out in the 1990 National Academy Board, BRWM position on Rethinking High-Level Radioactive Waste Disposal, is from the start, however, a flexible adaptive approach is really needed to anticipate the inevitable surprises, that’s how it was put, and I think it’s a good word, as siting progresses from here, ignorance, not in the pejorative sense, but as you move in your siting activities from ignorance to uncertainty to knowledge.

And, you know, when you’re first approaching site screening and selection, you may not even recognize what you don’t know in terms of, in the words of a famous uncertainty expert who now has a book out and is on tour, you start off with your unknown unknowns, and then you move through your known unknowns, and hopefully, you get to the point where you have your known knowns.

So, in that regard, starting up front, acknowledging the fact that you may end up in a place ten years from now that doesn’t look like where you started with with regards to your site assumptions and your conceptual models, would certainly overcome some of the challenges faced when the need for course corrections occur. Again, changing your assumptions and conceptual models doesn’t mean that your process failed. It just means you’ve learned something.

The second general theme is the value and need to treat the geologic repository as a system. And, again, this has again become pretty much now a universal approach, but it wasn't always so. By treating the repository as a system, it allows you to focus on the appropriate endpoints driving the system towards protection of human health and safety, not becoming distracted with the performance of, say, individual components of that system, whether they be in a natural barrier system or the engineered barrier.

Again, by treating the system holistically, it does allow you to identify the risk-significant FEPs, features, events, processes, that you might not otherwise be able to do if you're treating each substantive component in a siloed fashion. And, finally, again, this approach really allows you to optimize your system for safety and robustness.

So, the underlying concept here, or take-home, is the ultimate performance of your repository is driven by the combination of your natural and engineered barriers working in concert, providing you with safety margins through the existence of that defense in depth.

So, now, putting out those two key concepts, what I liked about doing that was these two seem to drive a number of other choices in terms of how you might organize your new program. And, again, a lot of this may sound like it reflects a lot of the previous program. Well, that's because

there are parts to retain. We are not starting from scratch, from a clean slate, or there's no need to throw the baby out with the bath water.

So, some of the aspects of a new program that fall out of these two basic principles or themes is how you do your regulation. Again, I indicated risk or dose based, all-pathways approach. I'll get into this in more detail in the following slides.

The use of performance, total system performance assessment methods as your means of measuring performance and compliance over long time frames. These drive how you do your site screening, selection and characterization, and allow you to evaluate your features, events and processes in the context of the system performance. Again, rather than unduly focusing on one aspect of your site, say, hydrology, becoming too enamored with the hydrology where you may miss or under-estimate other important contributions to performance.

And, finally, recognizing that your repository design is in fact tailored to your site, and that to a large extent, that design can be adapted within certain margins to optimize your performance and to make up for some surprises as they come along.

So, in terms of the all-important regulatory framework, again, a quick review of the international scene,

you do see this trend towards risk-based regulation, nothing like and also a departure from cumulate release limits, those sorts of things. The trend is towards risk-based approaches.

And, along those lines, separate containment requirements, subsystem performance requirements, separate ground water pathway requirements, even if they are seen as programmatically desirable by some organizations, end up being really redundant and they're really contrary to the all pathways approach. They are not needed, and in the end, they actually can end up being detrimental to your ability to optimize. Again, by focusing on one subsystem, you may end up hurting your overall performance of your repository.

Another interesting thing, or important fact to point out is that the most evolved U.S. regulations strictly apply only to Yucca Mountain, the site at Yucca Mountain, Nevada. And, so, the licensing of any other geologic repository currently reverts back to the generic, and I put in in parentheses obsolete, 40 CFR 191 and 10 CFR 60. But, I think it is widely recognized that these really don't need to be revised or a new set of regulations promulgated.

The last point here is that we do have some positive data points on regulation of geologic disposal, and that is the EPA certification of WIPP, that it can provide a model for the utility and application of generic standards in terms of how it was done. However, again, the lessons from

WIPP must be considered with caution because the applicability of WIPP, the WIPP certification process for TRU waste does not necessarily translate to disposal of commercial used fuel and also high-level waste.

So, the take-home here is that existing standards and regulations, the framework we have, actually provides a useful basis to start from for promulgating or developing a simpler risk-based all pathways approach. We don't need revolution, we don't need people in the streets here, we just need informed evolution.

Next, a critical component of the regulations, and really the whole program, is over what period you need to demonstrate compliance and performance of your system. Extension of the Yucca Mountain compliance period to one million years resulted from the EPA's response and how they decided to respond to a very narrow court ruling. That court ruling was tied to a legal finding regarding the consistency of those standards with the National Academy of Sciences report, as mandated by the Energy Policy Act of 1992. But, it was not driven by a finding of inadequate protection. So, that's an important to keep in mind.

If you want to look abroad for examples, well, that may be of less use, but in general international regulatory systems encompass the range from 10,000 to one million years, or beyond. So, take your pick there. But, one important and

I think useful feature of the international regime is that there is a growing consensus that as you go out in time beyond that 10,000 year time frame, there is a need for an increasing qualitative treatment for far distant time periods.

Now, in a 2005 report, EPRI prepared some recommendations as to how you might implement a meaningful and reasonable regulatory framework going out beyond 10,000 years. And, in the end, the final 40 CFR 197 was fairly consistent with the recommendations in our report, in which quantitative performance limits were retained for one million years, but in other countries, you have phased regulatory approaches where you move to more qualitative assessments, more of a safety evaluation, safety analysis past 10,000 years, or so.

So, the take-home message from here is regulation of a high-level waste repository other than at Yucca Mountain could in fact revert to a 10,000 year quantitative compliance period.

How do you demonstrate compliance? Well, again, as pointed out earlier, the development of Total Systems Performance Assessment really provides a principal tool, an enduring tool, for demonstrating repository safety over long time frames, whether that be 1,000, 10,000 or beyond.

However, it’s important to recognize there is a

fundamental difference between performing your modeling to demonstrate regulatory compliance, and support regulatory confidence, and, running the models and expecting them to actually predict the future. Those are two very different activities, and the purpose of the TSPA methods I think, no matter who's running them, is for the former, that is, demonstrating regulatory compliance and adding to your safety case, adding to your regulatory confidence.

Throughout all this, your TSPA is of little use if you then use the tool in an over conservative manner, piling conservatism upon conservatism. Really, the usefulness, utility of the TSPA is best realized when you apply it again in this context of reasonable expectation. Again, tying my themes here together deliberately because I do think it does provide a useful theme for moving ahead.

I couldn't resist including our latest evaluation of Yucca Mountain performance under nominal plus a seismic scenario, just to kind of indicate that based on EPRI's work, and others, Yucca Mountain itself has a site, performed with substantial margin over the time frame demanded by the regulation.

In terms of site screening, selection, and characterization, I think there's a lot of interest in learning a lot from the international scene in terms of what's the best approach, how should we proceed. We now see

Finland, Sweden reasonably close to actually achieving licensing of their facilities for construction. However, of course, what works in one country is really highly dependent on those factors in that country. And, I call attention to the one obvious thing, is that in the United States, we have state governments and they do play an important unique role in policy and politics. And, so, that needs to be definitely factored in. So, there really is no single best approach. Nominative, top down, works in some areas and volunteer approaches work in other countries.

One universal lesson that may be gained from the history of Yucca Mountain from the Nuclear Waste Policy Act process is that overly restrictive siting criteria should be avoided initially in your screening process, because you run the risk of possibly eliminating suitable sites, and distracting from evaluating the most risk-significant aspects. Again, focusing on favorable hydrologic conditions that may later turn out not to be the case. Focusing on ground water travel times, or setting cumulative and fractional release limits.

Ultimately, the goal of our geologic repository program is to identify and develop an adequately safe site, good enough is good enough.

And, so, kind of the take-home here is a best site really neither exists nor is necessary. And, that the

successful siting experiences do not necessarily translate to other nations.

One of the compelling lessons, though, from the international perspective is you immediately realize that all nations seriously pursuing geologic disposal expect to successful site one, regardless of their size, their geology, their diversity of geology, the population, the population density, et cetera.

And, so, in the U.S., we are again blessed with a continental nation with geologic diversity. We have all the geologies under consideration in other countries, so this is an obvious lesson learned. I heard it raised earlier that we have no shortage of candidate sites from a technical perspective.

Along with the site selection, again, looking at the system as a whole and risk informing that process, your site selection cannot be totally divorced from your repository design, because a repository design--ultimately repository performance is determined by both natural and engineered barriers working together. And, the existence of multiple barriers provides you with margin to this defense in depth principle.

And, the one possible benefit from the U.S. now being back to square one in its repository program is we now can benefit from the international experience. The

collective international experience offers a number of repository design concepts off the shelf, if you will, that are suited for a wide range of environments, geologies, you know, again for each geology, you may have vastly different repository designs, and also requirements. For example, the need or design for reversibility or retrievability.

Also, another trend is the development of new alternative repository designs that provide greater flexibility and adaptability for integration into fuel cycles. These would be ones that are hybrids between storage, with the option to dispose.

So, the take-home here is that having the flexible repository design allows for some degree of course correction, should again those surprises and repository characterizations occur. Again, this is not a failure of your process. This is just what happens when you learn more about a site. And, it's a benefit from having the ability to mitigate some of those, some, not necessarily all, but some of those deficiencies.

So, now, moving on, one parting comment or lesson that I wanted to point out, and I think it's been reflected here is the common mischaracterization that Yucca Mountain was selected without any technical basis. It's clear that the selection of Yucca Mountain occurred in an abridged Nuclear Waste Policy Act process, and, again, to the

detriment probably of the overall program. But, there was a process in place, and Yucca Mountain was a top site determined in the composite ranking in a technically based multiattribute utility analysis.

Now, that MUA process, that was criticized as being deficient, as could any process be criticized. But, there was a process in place. And, again, the figure here just indicates the long history of the process leading to the down-selection of Yucca Mountain, starting in 1957, going through various restarts, down-selection from nine acceptable sites, to five, to three, and then the ultimate abridgement of the process with the Amendment of the Nuclear Waste Policy Act.

Another comment that has not really been addressed today is the need to distinguish between your technical and your legal or other repository capacity matrix. There is a big difference between what your repository system could potentially hold versus what it's been advertised as being able to hold. Legal or regulatory limits are established for many reasons, non-technical reasons. In the case of Yucca Mountain, this was tied to the status of the siting of a second repository. I believe after the second repository was licensed for construction, or perhaps after going operational, then that 70,000 metric ton limit would be lifted.

However, I think one detrimental aspect of this focus on this legal limit was that you began to see fuel cycle options being sold on the basis of the limits of Yucca Mountain. From EPRI's perspective, and again, we did some work on modeling the technical limits of Yucca Mountain and the rock block there, we found that the site could contain at least four times the legal limit, and possibly expandable up to nine times that limit, with changes in repository design, configuration, et cetera. DOE, in its Congressionally mandated second repository report, came to a similar conclusion.

So, finally, and perhaps a self-serving role, but we certainly, EPRI, as an independent entity conducting research, we certainly feel that peer review and independent input into the process are really vital for a credible program. And, again, we count ourselves amongst the Nuclear Waste Technical Review Board, this Board, the National Academy of Sciences, for better or for worse on some of their reports, as well as the International Peer Community, among being a vital and really a constructive part of informing the process, and providing that credibility.

However, technical merits of a program only go so far, and so it would be naïve for me to not recognize that non-technical issues, the social, political, economic dimensions, can and really typically do over-shadow the

technical merits of a repository program.

So, in summary, the objective of a repository program that should inform and be kept in mind throughout the development of the process and execution, is that the objective is ultimately an adequately safe not a best site. Because, again, “the perfect is the enemy of the good here.”

The nature of the siting process, given this progression from not even being able to bound your uncertainties through understanding your uncertainties through knowledge, really calls for an up front acknowledgement of the fact that, you know, surprises will happen. And, many programs around the world have moved to a more flexible, adaptable, phased approach. Canada, for example.

Another key nugget here is the importance of treating the repository as a system because out of this falls many other usual attributes of a meaningful and implementable repository program. And, that is, you know, what really matters is the protection of the human receptor downstream, no matter what pathway contributed to the risk. The all pathways, risk-based approach is really preferable.

You do have tools for demonstrating compliance. The Total System Performance Assessment approach remains a valuable tool for doing that. Risk-informing your evaluation of your features, events, processes in screening site

selection and characterization is another useful outcome of looking at your system as a whole. Focusing your resources on where they need to be focused, and, finally, having the ability to tailor your repository design to complement non-fatal site deficiencies.

Also, the value and importance of independent technical peer-review, credibility of the program overall. But, again, recognizing that all the technical credibility in the world, well, it's a necessary but not sufficient condition for a successful program.

So, with that, here are our reports. Again, I've only touched on the surface here, touched very few of the actual details, and these reports, they are publicly available and, again, contact me if you have any questions. We also have put out a long string of technical reports as well as our contribution to the process informing the public debate.

So, with that, I thank you again.

GARRICK: Thank you. Thank you, Andrew. Andy?

KADAK: Andrew, I've got a question relative to your adaptable approach. Are you basically endorsing the National Academy of Sciences "One step at a time" approach, or do you have something different in mind?

SOWDER: That statement was more of just a generic statement about acknowledging the role of uncertainty, and

the nature of uncertainty, how it changes through time. But, certainly, what the National Academy, the report I'm most familiar with, or the opinion I'm most familiar with is the, "Rethinking high-level waste disposal."

KADAK: Well, they wrote another one called, "One step at a time," which is a little bit more prescriptive than I think what you're talking about.

SOWDER: Right. Right.

KADAK: Okay. The next question is can you just give us a quick feel for why your numbers are so much lower than the DOE's numbers on the TSPA? What is it that was different in your model than their model? And, clearly, you couldn't do it to the level of complexity that they did.

SOWDER: Right.

KADAK: And, the reason we're asking is that if there is a future TSPA done somewhere, the complexity of the TSPA that DOE did perhaps obscured its real findings. And, just could you share with us just some of the highlights of the difference, because I know you looked at it?

SOWDER: Well, in terms of some of the key scenarios, including this one, is some of this is driven by the seismic results. I think certainly our evaluation of the seismic processes were less conservative than those of the Department of Energy, in terms of effects of rock fall on the performance of the waste packages, et cetera. Other things

built in, in terms of dose from key nuclides, such as Neptunium 237, for example, we screened out colloid transport, for example, based on, again, on a systems approach looking at the event tree that would have to happen in order for the colloidal contributions to be significant. Your probabilities fall off into dust.

KADAK: Okay, that's good.

SOWDER: Yeah, and I'll state right here, you know, EPRI is not the licensee in this case, and so as I mentioned, we took--a lot of this comes in terms of how you parameterize best estimates versus moving towards perhaps more pessimistic selections for your values of parameters.

KADAK: Okay, thanks.

ARNOLD: Right down the corner of the chart there, reasonable expectations.

SOWDER: Right.

GARRICK: Bill, one more question?

MURPHY: This is Bill Murphy of the Board.

I have two questions. The first is do you think--pardon?

GARRICK: Go ahead. One more two-part question.

MURPHY: Do you think that there are certain phenomena from a geologic perspective that are more predictable on a million year time scale, such as perhaps seismicity or even colloid stability?

SOWDER: Off the top of my head, I don't think I can get specific, but there are probably some features and events that become less uncertain, or more certain over time. You know, the fact that over a certain time frame, you're going to have glaciation in some regions, you know, that's a known fact in some areas.

MURPHY: Okay. And, my second question applies to this figure, and I see Uranium 238 and its daughter, or sub-granddaughter, 234 and Thorium 230 and Radium 226, all relatively predominant, those contributors. These are not related to fission at all. This is all coming from just the Uranium content of the system. And, in natural systems that contain Radium on time scales like this, the predominant dose comes from Radon, which is the largest dose that people receive under natural conditions. Why isn't Radon in your graph here?

KESSLER: It goes up rather than out.

SOWDER: In terms of, again, the receptor here is that 18 kilometers downstream, in terms of the exposure pathways followed, your Radon is going to off-gas. And, in terms of, I think if you looked at the actual concentrations you're looking at, I don't think--you're not going to get a significant dose. And, that's certainly something that you can look at, but can be screened out in terms of the impact.

MURPHY: Thank you.

GARRICK: Okay, thank you, Andrew. We're running a little close to our schedule, so I think we're going to have to terminate the discussion.

Our next discussion is on Deep Borehole Disposal, and that's going to be handled by a couple of people we heard from in the past, Pat Brady and Andrew Orrell. Pat?

BRADY: Lake Barrett stepped out a little while ago, so he did my introduction for me. This is "the dog that won't hunt" description of deep borehole disposal. And, it actually is useful and I don't mean to be glib here because if this country is to move towards a phased modular approach for the disposal of high-level waste, like deep boreholes, we have to make a distinction between what deep borehole disposal entails compared to the traditional mined geologic repositories.

This represents work that's been done at Sandia by myself, Bill Arnold, and Jim Krumhansl. We have worked side by side with our collaborators at MIT, Mike Driscoll and Richard Lester, who pioneered this and have worked on it for the last two or three decades.

This time last year, we were getting ready for a workshop in Washington, D.C. that was attended by a lot of the international people from Sweden and the U.K., and two members of the Board came as well. That was Bill Murphy and Dave Diodato. Whereas they could not speak and represent the

Board officially, they were there with their comments, and their very presence assured that the importance of technical peer review was held at the top of everybody's mind. So, it's an honor to be here with you all today.

Now, first of all, let me describe what a deep borehole entails. Essentially, it's five kilometer deep--well, this is our reference design--a five kilometer deep borehole using existing oil and gas technology. The waste disposal zone is ideally in crystalline rock, typically a granite. The waste disposal zone goes from a five kilometer depth to three kilometers depth. So, you've got two kilometers in which to stack waste.

You will see some pictures here showing how far down that is. There's the bentonite on the outside. The waste package is really not a package at all. It's nothing more than traditional drilling casing that has, in the reference design, it has two fuel assemblies stacked, and the ends are sealed, and it's placed down the borehole. And, you can get roughly 400 of those in one borehole. That's roughly 110 metric tons. You can do the math. That says that to cover 70,000 metric tons at Yucca Mountain, you would need about 600 boreholes. Roughly six for every nuclear power plant in this country.

The reasons why deep boreholes are perceived to be safe and require less site characterization than, for

example, Yucca Mountain or WIPP, it's a combination of hydrological and geochemical factors. Hydrologically, there is a density stratification of the water. As you go down with depth, the solid content of the water goes up. The deep boreholes that have been drilled in the former Soviet Union, in Germany, they typically point to silinities on the order of 4 molar. So, that density stratification causes a resistance for subsequent vertical transport.

The other geochemical driving force for low doses when you do PA's for deep boreholes is that these are very reducing conditions. Typically, there's free hydrogen. Most of the actinides are in their lower valent states. There is one notable exception I'll get to towards the end.

On the less technical side, the attractions for deep boreholes, there's about four of them. First of all, I don't have the map here, but there's a map in one of our reports showing the area of the United States that is underlain by crystalline rock, which is two to three kilometers deep. That is our target. A large fraction of this country has crystalline rock very nearby. So, you don't have to look far to find a place to put deep boreholes.

Secondly, it requires not vast technical improvements, that is, we don't need--well, essentially, these boreholes are done routinely in the oil and gas industry, and, so, our approach has been to where we can,

take advantage of existing oil and gas technology.

The human intrusion scenario is rather extreme, to the point of being non-existent in this case. And, lastly, as Andrew Orrell will point out after I'm done, it's relatively inexpensive. We've done some early calculations that we're refining right now suggesting it would be substantially cheaper to dispose of nuclear waste in deep boreholes than in a mined geologic repository.

Now, when we first started off on this, we took advantage of the work done by the Swedes and by the British, and did something they did not do, which is do a performance assessment. And, when we did it, we came up with one single radionuclide of concern, that's Iodine 129, and I will cover why that is in just a moment. But, even with the most conservative assumptions, we ended up with iodide doses that were typically about nine to ten orders of magnitude below the regulatory limit.

So, what I'm going to do in my next five minutes is talk about what we're doing in the meantime, as we work towards doing a pilot for deep borehole disposal.

One of the take-home messages here is that there are some truths we cannot arrive at just by doing calculations. We actually have to demonstrate them, and show that this is truly a viable concept.

So, I'm going to spend about four slides just

quickly running through some of the recent thermal hydrologic modeling. The thermal mechanical modeling is going to be very fast because I don't know a whole lot about thermal mechanical linkages. We'll linger a bit longer on radionuclides solubilities and sorption, which I do know more about. And, then, I will tell you a little bit more about some of the iodide sorbants we're developing, as well as how one might achieve retrievability here.

This is Bill Arnold's work. Basically, we start off, the reason we do the thermal hydrological models are to establish how far apart the boreholes have to be so that they don't see each. Typically, the borehole temperatures go up 30, 40 degrees above the ambient. That gets higher if they get very close. We'd like to know how close they can come before the temperatures start to build upon each other.

Now, here's some of the results from Bill. This is sort of spent fuel assemblage. There's a 200 meter spacing and 100 meter spacing. Essentially, there's a temperature peak in about two to eight years. Like I said before, it only goes up about 20 or 30 degrees. These things, you really don't see them. They don't see each other. You can put them fairly close together, within 100 meters, it doesn't change the thermal profile a whole lot. What this means is if the country were decide to go down to boreholes and put them all in a single field, it wouldn't have to be that

large.

KADAK: How old is the fuel that you're disposing in these boreholes?

BRADY: I don't know exactly for this one. The first time we did it, we took the Yucca Mountain inventory and aged it to 2117.

KADAK: 2117. So, it's very, very old fuel.

BRADY: Yes.

KADAK: Okay. I just want to be sure we understand that.

BRADY: It goes higher if you use like the high-level waste, we did some of the French fuels as well, and you can get it up, it never really clears about 170, though.

The important point here is that, and what Bill has done here is he's taken the temperatures and converted them into a vertical water velocity. That is, when you look at how quickly water, and presumably radionuclides can move, the only way that you can get the radionuclides up to the surface rapidly is straight up the borehole. And, the thermal pulse basically expands the water. You end up with a vertical driving force. And, what this slide shows here is that depending on the hydraulic conductivity that you choose in the borehole and in the disturbed rock zone around it, you're typically talking about vertical velocities of about a millimeter per year. Keep in mind that the thermal pulse

lasts for 100, 200 years tops. So, we're talking about vertical movement on that order.

So, that's one of the inputs into the PA calculation. If you've seen the earlier reports, you will see that these specific discharges are about an order of magnitude lower than the earlier conservative ones we did. So, as we get into this further, the vertical velocity is actually dropping.

The next thing he's going to do is explicitly couple in the thermal haline stratification, and those numbers will drop further.

Okay, skip the mechanical part. I'm short for time. Let me go to the solubility and sorption. For the PA, you anchor the concentrations of the radionuclides by solubilities inside of the spent fuel. Now, those numbers can vary. For example, look at technetium. Well, technetium is kind of the poster child here. It's typically very low because it's insoluble in reducing conditions. But, the range of values is very, very large because we really don't know what the solubility limiting phases are going to be.

Now, at Yucca Mountain when we calculated the solubilities of something like uranium, we had to assume that the fuel in an oxidizing environment was going to completely dissolve. Everything that was in the fuel was going to go into a water rich environment and then possibly come back

down. As, for example, thorium would drop out, it would be a hydrated amorphous phase.

Under reducing conditions in a borehole, there's not a whole lot of driving force for the spent fuel to dissolve in the first place. And, that depends on how much uranium is around in the ambient fluids to begin with. So, it's harder to say with great confidence that it's going to be the amorphous hydrated forms that establish the solubility. There's a chance, there's a possibility that it might be the oxides. We put them both up here for the actinides.

Let me point out, though, it really doesn't matter in the PA. These things never make it out of the granite. The only things that do make it out of the granite are things which we cannot assure there's a solubility limiting solid. Let me point these out, because it identifies some of the uncertainties that we'll have to grapple with on boreholes.

Carbon 14, well, you'd like to think that calcite will form and limit that. But, bicarbonate levels are all over the map when you look at what's coming out of the deep boreholes that have been drilled before. Cesium, that's easy, there's nothing that it's going to form a solid with. It's a long-shot. Iodide might combine with some of the metals, but that's more than a long-shot. And, so, we've had to deal with that separately. Radium and strontium, well,

you can't just assume they're going to form carbonates, because we don't know how much carbonate is there. We would love to know what the bicarbonate levels are at these depths.

By the same token, we would love to know what the levels of sulfides are at those depths. Chances are there won't be sulfates there because of the reducing conditions to form radium sulfate or strontium sulfate. But, that's on our wish list. We'd like to know carbonate levels and sulfide levels.

If you look down at the bottom here, these are sorption kd's taken from a compilation by McKinley and Scholtis maybe 15 years ago where they looked at these were kd's they compared from a lot of the international repository programs. They're all over the map. The important thing to remember about them in an order of magnitude sense is that for carbon and iodide, the kd's are effectively zero. Iodide, and this is what causes the iodide to be our primary dose driver in the PA for the deep boreholes, and so one of the focuses of our research has been to develop ways to stop the iodide from coming out.

And, I can't show the slides here because it's patent protected, but we've been looking at basically developing bentonites, which we've been able to construct, that will give us kd's on the order of 20 to 100, which effectively erases our iodide does. We don't know exactly

how it works yet, but it's encouraging, and the fact that we're going to have bentonite in the annulus and in the seals above it, it give us a way to target lowering our dose.

The other thing we're looking at is the seals. Obviously, if the only transport pathway of concern is vertical, those seals have to perform really well. We're looking at the best combinations of just regular bentonite and the chemically doped bentonites to give us defense in depth, to prevent and protect the iodide moving forward.

So, before I wrap this up and hand the baton over to Andrew, let me put in a plug for--well, I told you what we do know. Let me tell you the stuff we don't know, the things that we really have to demonstrate.

I mentioned the carbonate and the sulfide. We need that just to refine the thermodynamic models. Keep in mind, though, that for the things whose solubility are affected by those, it's not like they're going to show up in the PA. But, we would like to know what the solubility limiting solids are.

But, if you think about doing a borehole, a bigger concern is what happens if you get a canister stuck? What happens if a decision is made to retrieve the spent fuel or the other waste that you've put down in the bottom? These are things that we can propose ideas for, but they're things that we actually must test. We would like to have a pilot.

We would like to have a pilot where we fail. We want to have a pilot where we get things stuck and have to pull them back out. We'd like to have a pilot where we have to retrieve a waste.

I'll close by pointing out that a lot of people say that boreholes will never work because you cannot assure retrievability. Sure, you can. One way to do it is to, if you have to pull a canister out of the bottom, you don't pull it out, you rublize it using existing drilling techniques, and you solution mine it down a straw. This is how we got the uranium in the first place.

Now, drawing this up on a sketch is one thing. Proving it in real life is another, and that's one of the objectives for our pilots. And, with that, I will close.

ORRELL: Let me first make a correction to the question about the aging of the fuels. For thermal calculations, we used 25 years from the date of discharge, the same as we do for the Yucca Mountain license application, or PWR assemblies. So, it was quite hot actually. And, then, on top of that, we also did thermal calculations for the French glass waste, which was even hotter. And, the conclusion is still the same. There's very, very little thermal impact, if you will, primarily because the granite and the ground water make such a great heat sink. So, I just wanted to clarify it was not 2117, it's 25 years.

KADAK: Okay, since you brought it up, we also did some studies, not for spent fuel, but for glass waste, French style two kilowatt packages, and we got much higher numbers, to the point where, in fact, there was a concern that we would be melting the glass again because of the poor conductivity, if you will, of the host rock because we didn't really know what the conductivities were. So, it's a variable and a very important variable.

So, you know, we've talked about this before. I would very much like to see some of those calculations about the temperatures and the assumptions you're making about air gaps, the casings, and so on and so forth, and the size of the waste package.

ORRELL: Agreed. Right. And, I will talk about some of our collaborations in a moment, yes.

KADAK: Okay.

ORRELL: So, as an adjunct to Dr. Brady's discussion on the technical issues regarding deep borehole disposal, I plan to discuss the programmatic rationale for why this disposal concept is of particular interest, the benefits that it may provide, and possibly a path forward to realize its implementation.

So, why the interest in deep borehole disposal? For me personally, it was developed essentially as a lessons learned in working on several repository programs, and

realizing where the majority of the time and effort that was spent on site characterization and performance assessment. I was intrigued by the work of Mike Driscoll and Dick Lester at MIT and Fergus Gibb in the UK.

So, several years ago, I assembled a small team of researchers and charged them to complement the work at MIT, and to look specifically at the safety case that could be made for deep borehole disposal. In that effort, we also identified a number of lines of arguments for why the deep borehole disposal concept should receive serious attention. What we desire in all repositories, regardless of the geology, is a very high confidence in the isolation performance of the repository over very long time frames, and achievable at reasonable cost.

All traditional mined repositories present some unique challenges that are a consequence of their location, being only a few hundred meters below the surface. Traditional mined repositories are tightly coupled to the surface biosphere effects, which complicates the process of understanding the effects of the biosphere on the repository, and the effects of the repository on the biosphere. This coupling between the surface phenomenon and the underground disposal environment, which invariably complicates the safety case and the assessment of performance, and may result in expensive accommodations, is manifested in sometimes unending

debates and controversy, which can ultimately erode public confidence.

For example, on Yucca Mountain, we spent huge amounts of time and money on those very interactions between the surface and disposal environment involving infiltration, effects on UZ geochemistry, the effects on waste package corrosion, and the ultimate effects on the projected dose. And, we all anticipated that those effects would be the focus of the licensing hearings.

In Sweden, similar issues are arising over sea level rise and glaciation effects on the rock mechanics of the repository, and the potential impact on the integrity of the heavily relied upon engineered barrier system.

Regarding the desire for high confidence isolation and reasonable cost, deep borehole disposal concepts appear to provide such benefit. The multi-kilometer depth of deep borehole disposal more effectively decouples the repository from the bi-directional biosphere effects and, thus, makes the process of assuring high competence performance and safety perhaps somewhat easier. I believe this is also the reason for a similar interest in salt repository, as salt in appropriate settings is thought to offer near complete waste isolation.

This intrinsic isolation capability is what makes deep borehole an intriguing disposal concept. In contrast to

most mined repositories, I believe the smaller number of features, events, and processes that would require inclusion in a deep borehole PA could reduce the time and cost of the site characterization and for developing a high confidence safety case and licensing basis.

Consider, for example, the potential for debates over future climate change and the effects on infiltration, corrosion, et cetera, especially if performance assessment periods remain on the order of 100,000 to a million years. With deep borehole disposal, many such phenomena could be screened out based on a lack of consequence. In essence, deep borehole disposal could be faster and cheaper to implement and with better higher confidence in isolation.

For many, traditional mined repositories seem deep or deep enough especially when you are personally underground. But, for many others, it is difficult to fully appreciate the distances involved in either traditional mined repositories or deep boreholes. This graphic is simply to help grasp the difference between traditional mined repository depth of a few hundreds of meters, and the multi-kilometer depths anticipated for keep borehole disposal.

The red line is from the location of this meeting at the top to the airport terminal, which is just about five kilometers straight along Paradise Road. If you got out to walk it, you'd be below the depth of most mined repositories

before you got to the end of the golf course right next door. That would be the yellow line there. The yellow line similarly is from the intersection of the Sahara and the strip, just below the Stratosphere Tower, to the MGM Grand at Tropicana, and the strip is about five kilometers long.

For height, when you leave today, take a look at the Stratosphere Tower as the tallest object by far in the Las Vegas horizon. It is 350 meters tall, about the depth of Yucca Mountain, and a bit more than half the depth of WIPP. Then, consider in a five kilometer disposal concept, it would take 14 and a little more Stratospheres to make five kilometers, and eight and a half of those would be used for the plugging and sealing zones alone.

Let’s talk about benefits. These are labeled as asserted benefits because I recognize that all repository concepts are though perfect before they are actually implemented. When something hasn’t been tried, there is no shortage of positive qualities, such as those listed here. I won’t read each one. You are free to ask about any. But, there are a couple I would like to emphasize in the next couple of slides. One, feasibility and cost and, two, multi-repository issues.

On cost and feasibility, data from enhanced geothermal drilling estimates suggests an emplacement ready deep borehole of sufficient diameter and depth might be about

$20 million. Let's simply add another $20 million for operations, sealing, et cetera, for a total of $40 million per hole. For the U.S., that would be about 38 billion, that's billion with a "B", for the entire U.S. inventory anticipated through the year of 2030, or so.

Let's double that again just for government uncertainty, and you get $76 billion. Still $20 billion less than the last Yucca Mountain life cycle cost estimate for the same inventory of about 120 to 130,000 metric tons.

Dry rod consolidation demonstrated at Idaho in the 1980's could conceivably double the utility of each hole, or conversely reduce the cost of each hole by reducing the needed diameter. But, the value engineering of this idea has not yet been completed.

As importantly, for nations with small inventories, such as Mexico, the linear scale cost and the relatively low initial cost make it ideal for programs that can't afford a significant portion of their GDP to fund a traditional multi-decade mined repository program.

On the issue of multiple repositories, the potential for deep boreholes has some potential advantage over mined repositories. Crystalline basement rocks are relatively common at sufficient depths, and this gives us lots of technical siting options, and makes the idea of regional repositories perhaps just slightly more conceivable.

Based on my personal experience in repository programs, I worry about the simultaneous pursuit of two mined repositories, especially if they were to occur in different geologies.

These are two plots of the performance of the same clay repository loaded with spent fuel on the left and high-level waste on the right. Now, imagine if these were two different repositories located in two different geologies, but with the same inventory. Even though both exceeded the performance criteria, imagine the contentions and protests that would be raised about one repository being “safer” than the other. We believe that deep borehole disposal fields may not only have a very low dose projection, but they may also be very comparable from field to field if the expected uniformity of basement conditions holds true.

So, what might we do if we wanted to move from concept to realization? The European Union had recently formed the Implementing Geologic Disposal Technology Platform, and it provides a model for how we might move towards a deep borehole disposal pilot demonstration. In 2006, the European Council decreed that there should be an emphasis placed on implementation oriented R&D activities of all remaining key aspects of the deep geologic disposal of spent fuel and long-lived radioactive waste.

Prior to formal organization, an executive working

group of interested implementers and R&D stakeholders worked to define the technology platform and vision report specific to the challenges of disposal in Europe. The waste implementing organizations across Europe initiated the Implementing Geologic Disposal Technology Platform to "foster, to promote, and to accelerate the implementation of geologic disposal."

The mission of the IGD-TP is to support confidence building in the safety and implementation of deep geologic disposal solutions. They are now in the process of finalizing the strategic research agenda, and will soon begin implementation of that agenda.

I fully acknowledge that deep borehole disposal is still a concept that could spend easily another 20 years in academic consideration. However, given the technical, programmatic, and political developments of the past two decades, I will suggest that the time has come to move from concept consideration to full-scale pilot demonstration, if for no other reason than to fully vet the promise or the pitfalls of the disposal concept. The IGD platform may also provide a model for doing this.

The conclusions. The point here is not that deep borehole disposal is the best or only solution for geologic disposal. The point is that the concept holds such a significant promise that it warrants consideration of an

effort to accelerate its pilot demonstration, and to vet its true feasibility and viability.

As the concept has merit for the U.S., perhaps to address regional equity issues to Mexico to effect complete disposition of its small inventory and avoid long-term stewardship storage, and to Canada as well, with 2.8 million CANDU fuel bundles in lots and lots of granite, given this, it may be worth considering a multi-national collaborative effort similar to the EU technology platform for implementing geologic disposal. I am not suggesting a multi-national repository, however.

Lastly, as a concept which could yield patentable technology that would have direct and indirect applications, such as with enhanced geothermal, industry RD&D participation is conceivable, and could be a precursor to alternative waste management models such as Fed Corp. The role of the Department of Energy could well be to stimulate a cost-sharing program between the drilling and waste management industry implementers and the government and its cadre of researchers who could accelerate the RD&D process, and thereby create another option for the U.S. Government to meet its outstanding obligations.

I think that’s it. So, now I think Pat and I are happy to answer any questions.

GARRICK: Okay, Ron?

LATANISION: Latanision, Board.

I haven't heard any conversation about the mechanical loads on the canisters. Am I correct in assuming that the bottom-most canister supports all the ones above it? I am?

BRADY: You case it down to the bottom, you cement the base of the casing, but yes, then you're stacking the canisters on top of each other. We did calculations early on to suggest that they would not squash, and Mike Driscoll did the same thing, using a canister of cast iron.

LATANISION: So, 5000 meters is based on an estimate of what the mechanical properties of the canister would be with a load of however many--

BRADY: Two kilometers worth of canisters on top of it, yes.

LATANISION: Okay.

BRADY: So, the bottom one sees--

LATANISION: I'm glad to know you've done that. I was wondering about it. But, there is a metallurgical phenomenon called micro plastic yielding, and what this means is that if you have a mechanical metallurgical structure with a sustained load on it for very long periods of time, even though the loads may be below the ostensible yield point, there may be micro plastic yielding. A classic example is in spring steels. So, I'm just wondering whether you have

thought about such phenomena in such an application?

BRADY: The quick answer is no. But, you have to keep in mind that if the micro plastic failure doesn't occur before--if it occurs after we've emplaced the seals, it doesn't affect the performance, because we took no credit for those canisters. I mean, it would be good if they lasted thousands of years.

LATANISION: Yes. You mean, if it were to crush, it doesn't matter?

ORRELL: No consequence.

BRADY: No consequence.

ORRELL: We take no credit for the canister to begin with. All we have to do is get it to the bottom hole. I'm sorry, essentially, there's no consequence. If we get it to the bottom of the hole, we seal the shaft essentially. Then, we don't take any credit for the canister, we don't take credit for the cladding. It does whatever it wants. That's the whole point of why could we do this faster, cheaper, better? Because most of the issues that we would be concerned with near-surface, we can screen out because the consequences are none.

LATANISION: Okay.

GARRICK: David?

DUQUETTE: Duquette, Board.

Have you assessed the current sites of the reactors

to see if it would be possible to set up a disposal field directly at the reactors?

ORRELL: No.

DUQUETTE: Because it would obviously eliminate the transportation problem of moving stuff around.

ORRELL: No.

DUQUETTE: Why not?

ORRELL: Money.

DUQUETTE: Your money or money that it would take to--

ORRELL: No, wanting to keep earning money. I'm sorry, I couldn't read this. No.

DUQUETTE: Is it in your concept at all that the disposal fields, for the most part, would be at reactor sites. If you only need six boreholes per reactor, it seems to me that that would be logical.

ORRELL: The thought did occur to us. We did consider the idea of regional, the advantages of that. We did not go to the specific siting of individual power plants themselves. It was thought through in terms of the idea that each state, for instance, could perhaps take care of its own burden as opposed to each power plant, if you will. But, we have not done, primarily because of not having the charge and the funding, to look specifically at those kind of things.

GARRICK: Yes, Ali?

MOSLEH: So, you listed the benefits and advantages.

But, what are the disadvantages or the potential problems with this method?

ORRELL: Well, the one that's often mentioned is retrievability. And, what we think now is that these people are beginning to rethink that issue of retrievability. Pat mentioned that there might be ways to retrieve the material if you so desired. But, it would be a formidable undertaking. But, what we think is changing is the idea of we shouldn't try to even dispose of it unless we really do want it to be permanently disposed. In other words, there's no reason or thought to have it retrievable. So, we tend to look at it now more as an issue of for the purposes of safeguard and security, non-proliferation of material, the fact that it's difficult to retrieve is fabulous, it's a positive.

Other disadvantages are as with all repositories, you have this problem of once you get into it a certain distance, you know, you've started to construct or build, or whatever, you have this problem of well, now you want to make it work. Right? What we would hope is is that the individual cost of each of these holes, if you were to find conditions that were for some reason unacceptable, predefined conditions that were unacceptable, you could actually just walk away from it and not really greatly alter your program by $20 or $30 million.

We have reason to believe things like deep water off-shore drilling that comes up dry is only about $100 million as an industry idea. So, other disadvantages are it hasn't been proven. It's easy for us to say that we can drill a hole of sufficient diameter five kilometers down, but we need to find that. That's the main reason why we think that we could continue to wonder about this academically, but we think that for the relatively small cost, and something that industry might be involved in participating in, it's worth going to a pilot to see if we can fully vet those issues. What are those disadvantages?

GARRICK: What is the prospect of a pilot?

ORRELL: Right now?

GARRICK: Yes.

ORRELL: Zero. I mean, there's no particular effort at this moment. This is simply a concept at this moment. So, there's no particular effort to engage industry or other countries in this concept.

GARRICK: Is there a campaign going on?

ORRELL: Just what you saw here. I mean, just to tweak it wildly, the Laguna Verde plant in Mexico is very rapidly approaching its spent fuel pool capacity, and it is now thinking through how it's going to move its spent fuel into dry cask storage. For the U.S., that's not a great thing, we're not really keen on the idea of them having dry cask

storage for various reasons. They may serve as a great pilot opportunity to simply go straight from the pool, straight into permanent disposal. They've got plenty of favorable geology, and we could do it under the auspices of the non-proliferation program as opposed to the waste management program.

GARRICK: Yes.

MURPHY: This is Bill Murphy of the Board.

I'm curious about the extent to which you've evaluated the heterogeneity of the basement. I've done a little work looking at water chemistries in cratons, and there's a lot of heterogeneity, and I've looked at core from the Swedish repository site and the Finish repository site, the latter which is often called granite, but it's not granite at all, it's kind of a migmatite or a metamorphic rock. So, I can anticipate that there's quite a lot of heterogeneity.

And, following on that, it may not make a difference, as you point out, however, what kinds of heterogeneity could you discover once you got down five kilometers that would make the system look bad?

BRADY: Well, Bill, you're absolutely right. There's going to be heterogeneity down there, and that's not an area that geologists spend a lot of time looking at. And, so, the solution is the one you put your finger on. We want to

establish a set of criteria ahead of time before drilling, go/no go criteria. For example, if you encounter geo-pressure zones, that would be one that would disqualify a site. Lord knows, you might encounter uranium ore body.

But, I think the primary one we would worry about would be substantial vertical fluid flow, the possibility of oil and gas resources, areas that we once thought were radiologically inert like tight shales are now an economic boon, that's the kind of thing we would like to avoid. So, we started down that path. We haven't finished it. I think those are the two big ticket ones. Also, unexpected hydro-geothermal activity would be a third, and then we'd fill in from there.

ORRELL: This brings up one less explicitly defined advantage. We think it might be possible to predefine the conditions that are acceptable, as opposed to site characterization, and then trying to find out if it's acceptable, et cetera. We think we could probably do enough up front work to define a broad set of conditions, thermal/chemical conditions that would say if it meets this, you're going to get the order of magnitude performance that you expect.

No more characterization is done, other than what you drill for the hole itself. You don't have to characterize the entire field. And, that may result in an

approach similar to the combined operating license mentality that we use today. Is it possible? I don't know. Is it conceivable? Certainly.

GARRICK: Two quick questions. One from Andy and one from George.

KADAK: Could you take a minute and describe the hole, size of the hole, and how big you have to drill it to get to the minimum diameter that you need for the five kilometer depth?

BRADY: I can tell you the bottom one better than the top one. Originally, we started off with the bottom hole diameter being 17 inches. That would allow you to get the cases with a fuel assembly in it. Now, Andrew mentioned the consolidation scheme.

KADAK: Is that doable with today's technology?

BRADY: I'm getting to why we're moving towards--right now, we're looking at about 11 inches. With today's technology, that's at the outer edge of what they could do. Talk to the oil men and they will say yeah, we can do it, it will take a little extra, which that's not defined. But, what we find is, and we're having the folks doing the cost calculation, once we get down to about 10 inches, 10 to 11 inches, that's within their existing operating environment. So, yes, that's doable, and the costs drop proportionally.

KADAK: And, the fuel assembly, cross-sectional

diameter?

BRADY: No, that's where you take off the spacers and you pack--

KADAK: Consolidate the fuel?

BRADY: Yes.

KADAK: Okay.

GARRICK: George?

HORNBERGER: Yes, actually a follow-on to that. I was curious about the technology for getting this down the hole. You're unpacking the fuel, you're repacking it, you're hooking it to a cable. How heavy is it? The oil and gas people don't usually drop things down in the hole that weighs a few tons.

BRADY: Well, our calculations say that each hole has about 300 metric tons in it. About half of it is--five kilometers of casing is about 150 tons. It's about 110 tons for two kilometers worth of spent fuel assemblies, and when we talked to the oil and gas people, they say oh, yeah, we can actually carry all of that, which was a surprise to us.

GARRICK: Thank you. Thank you very much.

It's now time for our 15 minute break.

(Whereupon, a brief recess was taken.)

GARRICK: As I indicated earlier, my colleague, Andy Kadak, will be moderating this panel. And, so, I will turn over the time to Andy.

KADAK: Okay, thank you, John. This panel we've organized as a special panel looking at possible ways to figure out how to do some site selection, assuming we're going for a next repository. And, Dr. Hardin and his colleagues have written a paper on the topic, which will be presented at a conference I think next month, Ernie, if I'm not mistaken.

And, unfortunately, one of our speakers couldn't fly out of Oklahoma, or someplace. So, he is now on the line. He will listen to our panel. And, then, he has a presentation which you will also hear and see. Okay? So, we're going to try to make up for the fact that he's not here. And, then, we will open it up for a dialogue with all the panelists, including Andrew Orrell, who is here somewhere.

Okay, so let me introduce Ernie Hardin. He is from Sandia National Laboratory.

HARDIN: I'm here representing the men and women, scientists and engineers at Sandia who have been working on deep geologic disposal for 30 plus years, and I'm here to tell you that the USA really does have many geologic settings suitable for disposal.

We say this with substantial confidence that we can demonstrate compliance with regulatory standards such as those that we have worked with in the past. And, because we

have done and are in the process of doing generic work to address the potential for compliance in these different media with different disposal concepts.

We're going to talk about rock types, including salt, shale--I use that term loosely, it's clays or shale and granite, and that's another loose term, which in this context could mean any massive competent rock type. And, we will also hit on the deep borehole disposal concept, which you now know a lot about. And, we have media-specific disposal concepts that we'll talk about as well.

Some general considerations for siting. The host medium depth, unit thickness. Generally radionuclide migration occurs in a vertical direction. Uniformity and structure. These are attributes that bear upon the effort of characterization and the complexity of safety analysis. Seismicity, seismically quiet conditions favor design and operations, and in post-closure performance as well.

And, I have to point out here also that this is an important point that the starting point for a screening exercise, such as we're going to contemplate here, is the regulatory frame work, and whether site suitability criteria exist in the regulations.

So, these are some general attributes of the geologic setting that would be desirable for siting. Hydraulic conductivity, 10 to the minus 12 meters per second.

This is a number that is typical for the shales that are under consideration in Europe, also for clay buffer materials. And, sometimes they do better than this, but this is a nice round number.

In addition, we would like to have a medium such as salt or a plastic clay which is capable of self-sealing, whereby our excavations would close naturally. And, we think that in the low permeability medium, this would re-establish diffusion dominated transport. Also, we would like to see reducing chemical conditions in the host rock.

This is a little map taken from an earlier report done by Bush, et al. By the way, I give the references for these maps on the back page of the backup materials for the power point. But, this is outcrops of granite, granite taken to mean crystalline rock.

The USA did have an R&D and siting program for crystalline rock until the 1980's, the second repository program. A look at granite going forward would probably include fractured and unfractured, saturated and unsaturated conditions, although the fractured unsaturated would probably give us a set of conditions most resembling those that have been used in Scandinavia. And, we have optimism that we could find a suitable site, given international progress.

This is a map of shale provinces shown by age. So, Cenozoic, Mesozoic, Paleozoic and so on. Generally, the

induration or the lithic character of the shale will increase with its age. So, the softest most plastic shales would be the youngest. Those are shown here in blue. Gulf Coast goes back approximately 100 million years in age. But, there are other large shale basins available in the Continental U.S.

The U.S. also had an active shale repository R&D program in the 1970's and '80's, which included some laboratory and in situ scale thermomechanical tests. And, here again, our confidence is strong because of international progress and particularly the French program at the Bure locality.

And, here's a map of salt deposits, which I'm sure some of you have seen. It shows both vetted and domile salt. The domile salt is in the cross-hatched areas. Again, the salt basins tend to look geographically similar to the shales because they are in fact similar depositional environments.

The U.S. has supported significant investigations in salt in the past. Project Salt Vault done in Western Kansas, Avery Island, Louisiana, and of course WIPP, where some limited thermal testing had been done. And, currently, international interest in salt disposal is high, particularly in Germany.

This is a map of depth to basement, which we take then as a surrogate of the general suitability of certain terrains for deep borehole disposal where you need to find

the basement within a range of approximately three kilometers of the surface, or less. And, here, we see that most of the Continental U.S. could be investigated for suitability of deep borehole disposal.

This is, again, for crystalline basement rock, that may be preferred, but in my view, not necessarily required to implement the deep borehole disposal. And, we have some interesting possibilities there.

Now, to talk about disposal concepts. We use the term, I'd like to define it, it consists of a waste stream, a geologic setting, and a concept of operations for the repository. And, in addition, the disposal concept then brings in the--I'm back to a regulatory frame work, and any siting criteria that makes the site suitability criteria.

So, again, when we go to screen areas for potential suitability, we're looking at not only the geoscientific attributes of the geology, but also we're considering the disposal concept itself and what we would build there.

So, I have some slides here that review disposal concepts. They were prepared for a somewhat more general audience. I don't need to fill in your understanding of the KBS-3 concept either vertical or horizontal, as shown here.

In clay or shale, there are sort of pre-conceptual concepts out there being investigated in France, Switzerland, Belgium and even in the USA, we at Sandia have analyzed a

configuration in the last year or so. And, these differ mainly in respect to the emplacement mode, whether it's borehole or in-drift and possibly in measures taken to address ground control, such as Belgium has taken in the plastic clay at Mol. So, a little bit different design, same emplacement mode.

This is a reference configuration for a mined repository in salt. This is a report about two years old that was compiled by some folks at Sandia and Savannah River, I believe. It's based on WIPP experience.

In this configuration, the waste packages shown here and here would be placed on the floor of dedicated alcoves, and covered with crushed salt that would heat and be subject to re-consolidation, and ultimately, the entire repository excavation would close due to crete of the roof floor and walls of the opening.

And, this is the well worn figure of the deep borehole concept.

This table compares them. I don't have time to go into all the details here and the thought process that went into the table. But, suffice to say that in salt, we have high thermal conductivity. We have practically impermeable conditions. At the same time, we have potential for dissolution.

Now, if you move over to shale, we have potentially

very low permeability, which is good. We have sorption potential here. But, resistance to heat is somewhat lower than it is in other media.

For granite, if it's fractured, it's going to be permeable, and that means that in all likelihood, some engineered barrier system is going to be required.

In the deep borehole concept, what we're really relying on here I think is low permeability in situ.

So, moving along, when you read technical in these slides, I'd like you to read geoscientific. I don't want to slight any of the social scientists in the room. These are, you know, we anticipate that the siting game probably will change as we revisit policy issues that were debated earlier in the twentieth century.

We recognize that we are going to have to have a regulatory frame work before we can move out with a technical evaluation of factors affecting suitability. But, I think at this point, we can say that the U.S. has multiple, technically promising geologic disposal options, and I'm going to try to make that point here by showing you some example screening data.

These maps come from GIS files. They come from the USGS by way of the National Atlas website. So, these are basically available to anyone to download off the internet. And, I'll show a set of layers and build up a base map, and

then overlay the geology figures that we just saw on that, and talk about those.

This is the extent of the southern advance of the Illinoian and late Wisconsin glacial cycles. This is not a necessary criterion for siting. Clearly, the Scandinavian programs are dealing with the likelihood of glaciation. But, it's a factor that we might want to consider.

After that, I've added a plot from the same GIS database of recent volcanoes. Now, I haven't seen a map of probabilistic volcanic hazards. I'm not sure one exists. We did a map on assessment, which would be a map like product for Yucca Mountain, but for a limited region. So, this will have to do for this particular exercise. The volcanoes shown here are in the legend on the right. So, they are broken down into very recent, kind of recent, and Holocene, and then there's an uncertain category.

After that, we can add the occurrence of faults or fault zones. You will see a different character here between western and eastern. Well, that's because there's more uncertainty in the east, and the seismic characteristics of the crust are different. This green zone is an area of growth faults, which has been identified as a zone by the USGS. Some of them are quite old, and they are the faults that occur seaward dipping as the thick sediments consolidate.

After this, we could add seismicity, so this is a plot of historic seismicity. These are felt earthquakes using Mercalli scale, pretty intuitive here.

After this, we can add a map of seismic hazard. This particular map is the horizontal peak ground acceleration, with 10 percent probability in 50 years. The colors represent, they're shown in the legend here, fractions of G. Somebody pointed out to me that the blue color and the gray is not in the legend because we sort of sub-sampled the original data. But, they are less than 10 percent.

So, there's the base map. And, if we overlay the granite map on this, you know, you can see that even given the relatively limited occurrence of surficial granite in the area, that there are still sub-regions with apparently promising characteristics.

Now, you know, I'm going to give you some caveats on this later, but it's important to realize that there are limitations in any such exercise on the scale of the data, and how it's presented, and what it's based on.

If we overlay the shale map, now you can see that there are rather large areas in the Great Plains and the Gulf Coast that might be investigated further.

And, if you look at the occurrence of salt, you can draw a similar conclusion, since the deposition environments look rather similar. So, we conclude from this that if

there's ever reason to suspect, we will be successful in the future screening exercise.

And, this is the caveat slide. It's important when we use geographic data for studies like this, that we represent all important aspects of the system performance. There are many other types of data that should be, and will be, brought into this exercise when we officially undertake it. The advantage of geologic diversity within the Continental U.S. is great, but remember, it couples to the disposal concept. And, so, we're in a sense screening on attributes that affect the performance of both the natural and the engineered barriers. It's not purely a geohydrologic screening exercise.

Data resolution is important. By the way, this USGS database is excellent, but it will be limited. You will get down to the scale of a state or a county where the underlying data support needs work. And, so, I expect we'll be in that situation.

The uncertainty on the data, since these maps are all composited from multiple sources, some care should be given to how you understand and take account of the uncertainty in different parts of a map.

With all that said, the U.S. already has siting experience. Ken Skipper with USGS is here and reminded me earlier in the day that they were closely involved with DOE's

siting program prior to 1988. We have experience from Sweden and France where they have done a progressive phased screening process. It wasn't all successful, but there are lessons to be learned there.

We recognize that in its implementation, that this exercise will be phased, and it will involve transparent decision making, stakeholder review and consultation.

So, to conclude, the U.S. does indeed have multiple, technically promising geologic disposal options. The geography is coupled with the disposal concept. We expect that there will be a new waste management policy that will strongly affect how these screening, siting and suitability evaluations are performed, and that to do that, we're going to have to have a regulatory frame work in place.

KADAK: Okay, thank you very much. I just want to say that when I was organizing this panel, a lot of the stuff that you saw here was not in Ernie's paper, so he did a lot of extra work in doing these overlays, which I want to thank you personally for doing. It's very helpful and very informative. And, the USGS, of course.

I think I would like to now, if I can, Bill, plug in Professor Jenkins-Smith. He's going to give us a different perspective on the siting, not necessarily the technical, but the sociopolitical side. I heard him testifying before the Blue Ribbon Commission about a month,

or so, ago and I thought he made some very important and compelling points about the siting process.

So, Hank, are you there? Hank, can you hear me?

JENKINS-SMITH: Yes, I can hear you.

KADAK: Okay, you're coming in well, and just let us know when you want us to change the slide.

JENKINS-SMITH: Fantastic. Will do. And, I appreciate being able to attend at a distance here. The fog in Oklahoma this morning was unbelievable, and I regret not being there in person.

What I'm going to describe today is some work that's been done jointly by the University of Oklahoma and Sandia National Labs, trying to understand the evolution of the American public's understanding of nuclear energy.

I'm sorry, I'm getting quite a lot of backfeed there.

KADAK: You're getting feedback?

JENKINS-SMITH: Yes. Sorry about that. Actually, you know what I'm going to do, is pull out my ear phones, and that way, I won't hear feedback.

Okay, this project has been going on for some time. If you would move to the next slide, I'll review what I'm going to identify here. I'm going to start with a brief discussion about public beliefs concerning used nuclear fuel, and then focus on preferences as they exist currently for

alternative strategies for managing used nuclear fuel.

There are some issues having to do with policy design and facility design that I want to address that might be of importance for your consideration. And, finally, I want to get to the question of proximity as we begin dealing with regional location of facilities which this issue will loom large.

Next, go to the next slide, please.

The project is taking on something rather tough here. We're trying to measure the views of average Americans on a complex policy issue that involves a lot of technical issues, that involves terms and levels of understanding that, frankly, are not of great import to most people in their ordinary lives, and to try to measure these beliefs in a systematic way that gives you some reflection of the likely response to the public to a real siting case presents some interesting challenges.

This project does this in a time series fashion in which every year in the late spring, we do the large nationwide survey that attempts to get at people's understanding of the nuclear issues from a variety of different dimensions. In 2011, our chief focus was on perceptions of nuclear waste issues, nuclear disposal, nuclear materials management more generally.

We employ a mixed mode approach to survey data

collection. In current times, it's difficult to find a single way of talking to the American public that gives you a representative sample. We use a mix of telephone surveys and internet surveys, both of which are designed to generate a cross-section of the public, but they do tap different strata of American society. Our view is that using a mixed mode approach is much more likely to tap the real views of the public than would be a peer design of any kind.

We do have a system that gets very high responses from the public, both in the internet version and in the phone version. And, I could bore you with the details of that. But, the issue that's really challenging is trying to present issues that are very complex and have very different perspectives associated with them in a way that is representative of what people perceive when they watch the news, hear policy debates, and engage in discussions with their neighbors.

The result of this is we have to present these kinds of questions in a way that captures the different arguments that are mounted by proponents, opponents, people with different levels of concern, different levels of background.

And, as you will see, the design requires a rather lengthy survey. Our respondents, on average, spend about a half an hour talking to us each time we do one of these

surveys. And, we interview several thousand people every year for this, so it's a rather extensive process.

Go to the next slide, please.

We provide first a bit of background on what people currently perceive to be going on with spent nuclear fuel. We ask what they believe is currently being done with spent nuclear fuel in the United States, and we provide them with four options, including the materials stored on site, shipped to Yucca Mountain, sent to regional repositories, or reprocessed and reused. And, we randomly provide those answers.

And, as you can see, over time, since 2006, there's been quite a mix of responses. Back in 2006, we had a plurality thinking that Yucca Mountain was operating and doing just fine. And, only recently has there been an increase in the perception that on-site storage is in fact the mode that's being employed.

And, what this tells you is that there's a real mixed sense of what it is that's happening with spent nuclear fuel in the United States. There's a dawning awareness that we are accumulating spent fuel on site at nuclear power plants, and perhaps a growing recognition that we don't have an operating facility at Yucca Mountain.

Tap it again to bring in the bottom frame, please.

When we ask people these questions, after we get

their initial responses of what they believe, we inform them that currently, we are storing the bulk of used nuclear fuel on site or near site at over 100 reactors across the country. And, then, we ask to the best of their knowledge, whether they believe nuclear fuel is being stored above ground at any power plants in their state. Only 12 percent of our respondents were able to correctly answer this question, and that's less than we would have expected by random chance. And, so, there really is, at this point, a soft understanding of the problem, of the nature of the issue.

Now, in the background here is another problem, which is that people perceive nuclear waste to be a very frightening material, which half of the public essentially believes that spent nuclear fuel can accidentally explode like a nuclear bomb. Nearly two out of three who venture an opinion would say that even if the dose was the same, the exposure to man made materials, or the radiation from man made materials is greater, is more toxic than that from naturally occurring radiation. So, there is a background level of risk that comes from the popular media, the history of nuclear weapons testing, and elsewhere, that has not gone away.

Over time, the chief change that we see with perceptions of things nuclear is a growing appreciation that nuclear energy does afford a way of providing secure domestic

supplies of energy, that it is a stable and secure form of production that isn't dependent on the weather, and that those factors have lead to a growing sense that there's valuable in nuclear energy.

But, you have to keep in mind that in the larger public, there are substantial misperceptions of the nature of the material. There's a real sense of potential catastrophe associated with the management of it. And, so, at present, the perceived benefits outweigh the risks, but those risks are not trivial in the public mind. And, any major event globally with respect to nuclear materials, of course, will resonate with those underlying perceptions of risk.

That's basically all I want to say about the background of public beliefs about nuclear materials and nuclear energy.

Let's move on to the next slide. What I'd like to do now is turn to the question of preferences concerning current and alternative used nuclear fuel policy options.

Slide 6 provides a set of the introductory questions we asked about storage. We've been asking now since 1996 what people think of continued on-site storage, and as I mentioned we have to provide some background on these type of questions for people to give us any kind of coherent answers.

We are not trying to tell people the absolute

technical truth about on-site storage, or any of the other options. What we're trying to do is to describe for them what they're likely to hear about these things from a mix of perspectives in the popular media. You can see the frames that we provide there, in which we talk about how opponents think about continued on-site storage, the location problems, the potential for leakage into the cooling pools, the fact that the ground level on storage of these materials might make them more vulnerable to terrorists, which incidentally is one of the touch points of public concern.

Supports then argue that there is great risk in moving the materials around, that it's less expensive to continue to store on-site than it is to try to consolidate. And, as you can see, what we're trying to do is capture the dominant arguments that are made in a policy dialogue on these questions to see how people in that situation respond.

If you could tap forward so you can see the distribution of responses?

This has been extraordinarily stable for public responses since we began asking the question in 2006. So, I'm just showing you the distribution for that overall time period. And, you can see that once presented with the arguments, you get about 44 percent opposing continued on-site storage, 30 percent who are divided, undecided, and another 26 percent, about a quarter of the population who

support continued on-site storage.

And, you can see there's a distribution there associated with this in terms of the strength of the positions taken. So, there's a slight leaning against continued on-site storage. And, in fact, if you look at the upper end, there's really no strong support for continuing to do this.

Next slide, please?

Starting in 2010, we began looking at questions of the number of storage sites that the public might prefer to see. We gave them several options, the chief of which were these two: to construct six to eight regional storage sites that could be more easily secured and provide longer term storage. And, we pointed out that if we were to move to this option, it would require transporting spent nuclear fuel over moderate distances, and that it would generate political and legal opposition. We need them to consider this.

The alternative is two large centralized storage sites, one in the west, one in the east. They could be more secure, provide permanent storage. This option requires transport over longer distances, and is likely to generate political and legal opposition. The respondents to this on the web survey are able to see these questions and compare them on a screen, and they are able to fairly carefully consider these.

The responses are shown, move a bit forward there, to the regionalized and the centralized repository, are interesting, because in both cases, the distribution is fairly broad. The bulk of the respondents in the middle, undecided. There's slightly more support for the regional repositories than there is for a centralized repository. That's a statistically significant difference, but in my judgment, not terribly substantively significant. What we see here, given the background of what people know about nuclear issues, is a soft position that there is room, latitude, for policy development.

Next slide, please?

One of the questions that loom large in policy debates is the question of retrievability. In the European context, it actually became quite a sticking point in a number of debates, in which retrievability, or even reversibility, which is designing a process in which disposal approaches can back up and take a different turn, were raised. In the U.S., this hasn't been very thoroughly explored. This year, we asked for a public response to this, whether radioactive material should be managed in a way that allows access to retrieve the materials in the future, or one that seems to permanently block access.

You can see the wording that we applied to the options. In the end, we gave them the choices provided in a

random order, and if we tap forward, you can see that by better than two to one margin, retrievability is preferred over permanent disposal.

Now, this is something that has puzzled me for quite a while. I've seen this type of response in focus group settings and other places for some time as I've studied this issue. And, mostly in conversation, what people will tell you is that over the course of their lives, they've seen substantial change in technology, in capacity, and to assume that what we know right now is the final answer for safe disposal, they think is just a little crazy. And, so, there's a tendency for people to think that permanently disposing of spent fuel right now when future generations might want to see it as a resource, or might have a better way of reducing the toxicity of the materials, is something that gives them pause.

So, in the background, we're thinking about disposal processes. This issue comes up, and I will get back to it when we get to the design. The related question, of course, is reprocessing. Obviously, one of the reasons one might want an accessible disposal facility is because you see the material as having some resource value.

The next slide shows the question wording that we asked. We provide quite a bit of information in the course of our surveys about reprocessing and about the nature of

spent nuclear fuel. A lead in to this particular question describes reprocessing, makes the point that there are remaining radioactive materials that have to be safeguarded, and that the process also produces plutonium, which like the uranium, can be used to make nuclear weapons, and we're trying to be sure that all of the different elements of the debate are included, that nobody is happy with the way reprocessing questions are asked. Because opponents can site all kinds of things that could be added that would make it seem less desirable. Proponents could also add a great deal, and then you end up with large fetuses on this question.

What's interesting to me is that many different researchers have attempted to understand the reprocessing question, and almost all get the same answer in the graph below, and that is that there's substantial support for reprocessing. It doesn't matter what words you use. I've seen people playing around with trying to call it recycling and various other things to see whether that changes the level of support. Overall, the people who ask this question, whether they were pro-reprocessing or anti-reprocessing, tend to get this pattern of response with the public see the material as a resource, implications for how we think of disposal processes.

Storage depth, which has been the focus of much of the discussion today, is also something that we approach.

Now, this is an issue that is new to the public. What's interesting is that even at this new stage, we're seeing variations in the way people respond to different storage depth options.

You see up here three different options that we present to respondents. We give them a more lengthy description of each of these patterns, and then randomly present these options, and ask them to indicate both how much they would support or oppose that option, and then to rank order that option compared to the other two.

Now, I want to point out that we do these surveys in the late spring. This survey was conducted in late May of 2010. That was right in the middle of the Deep Water Horizon disaster in the Gulf where there was a lot of discussion of drilling deeper and the potential problems associated with that technology and the way that they handled it. It was probably the worst possible time to broach the question of deep boreholes.

And, so, with that in mind, take a look at the pattern of responses that we did here. Note that all of the options are getting sort of mid-scale type preferences. The mined type repositories that could either be permanently sealed or could be designed to allow materials to be retrieved, comes out substantially more favorable in the public mind than either surface storage or boreholes.

Surface storage and borehole options are statistically equivalent in these public responses. None of them are rejected. But, you get more on the opposition side for surface and borehole options than you do on the mine options.

This is one that I fully expect to see evolve as the conversation continues. Presumably, when we return to this question in a few months in the field, we'll be away from the Deep Water Horizon problem, it's been some time since that was capped. I will be curious to see how stable the perceptions are of the appropriateness of these different depths.

But, this pattern of responses indicates that there really is, the public is pretty open minded about these options. Right now, there's a leaning toward a preference for mined type repositories, but there's no rejection of other options at present.

Next slide, please?

That gets us to the question of policy design variations and their implications for disposal. Now, we have been doing experiments in the question of bundling of the facility attributes for used nuclear fuel, and it's useful to start out by thinking what we were doing with Yucca Mountain. We had a bundle there, and the bundle was a once-through waste with a permanent disposal option. There was a lead period, a substantial period of time before closure, but that

was seen as essentially a loading and preparatory period. It wasn't about retrieval. There were no other functions associated with Yucca Mountain.

These attributes shape the way people talk about what it is you're doing. When the Nevada newspapers described the repository as a dump, it resonated in large part because it was a disposal only facility. The material was seen as having no value. In fact, it was seen as having negative value, and that's why we were isolating it and removing it.

There wasn't anything else to describe about the facility. It wasn't producing any value anywhere else. And, these kinds of attributes create this sort of narrative that colors the policy debate. Other facility attributes might have included combining the repository with a function like a research laboratory, the potential for treating the waste as a potential resource in the future, or even talking about long-term revenue and jobs for the host state. These were features that really didn't loom large.

Now, we've been doing survey experiments to measure the effect of varying the design for bundling repositories to see what effect it might have on public acceptance. To do this, we use an experimental design. We first provided people with a background option. Half of our respondent heard that we were considering a mine option, two underground

mine-like repositories, one in the east, one in the west. And, you can see the description.

We made clear that they would have to meet all technical and safety requirements for federal and state agencies. The other was a borehole option at seven regional sites. These were chosen just to provide experimental variance to see whether design attributes mattered when applied to one of these two bases.

The starting point, once you fully describe these facilities, because both of them are slightly more than they're opposed, you see the mines fare a little bit better than the boreholes, at a mean value of 4.77, with indeed a majority saying they would support it in some measure. Boreholes slight below that. Neither rejected nor overwhelmingly supported. But, that's the base case. That's where we started.

Now, let's see what happens when we vary the design. The next slide shows what happens if you ask people about co-locating a research laboratory with a repository. And, what I've done here is to split out for each of the two base cases, those people who initially supported, were neutral or opposed to the site. So, you can see for the mine-like repositories, 58 percent initially supported it, 26 percent were neutral and 16 percent were opposed.

Now, what happened to those people if they were

asked, what would happen to their support if in addition to a repository, we had a research laboratory that was focused on evaluating the material and studying ways to more safely dispose of it. And, you can see that amongst those people who were opposed initially, that 16 percent, half of them said that their support for the repository would increase if the repository were coupled with a laboratory. Similarly for the deep borehole repository.

And, what we're wondering here, the point of this kind of research effort is to see whether design attributes have an effect on those people who were initially inclined to oppose the facility. The bottom panel shows what happens to those who support if you co-locate a reprocessing facility with the repository. And, it has quite similar effects to that of a research laboratory. You get roughly half of those people who initially support the facility, saying that their support would increase if you in fact had a combined facility of that sort.

Next slide?

Now, this kind of an effect might seem that it's abstract and hypothetical and, therefore, it might not work in the event that you were talking about a real repository where there was already lots of controversy. This one is showing some data that were collected way back in 1995. We had large samples that were taken in Nevada in counties that

had nuclear power plants, and in the other counties in the United States. In each subset, there were over 1000 respondents.

Look at the Nevada panel, the first two columns with numbers in them there. Initially, 77 percent said they opposed Yucca Mountain and they would prefer to continue on-site storage. These people were then asked what would happen to their support for Yucca Mountain if the repository itself was co-located with a research laboratory. And, you can see that half of those people who were opposed, that 77 percent, said that their support for Yucca Mountain would increase if that kind of a co-location were undertaken.

And, so, the point behind this is that it's not simply a matter of people with relatively little exposure or concern. Right in the heat of this battle over Yucca Mountain, half of those people who were opposed within the State of Nevada said that their support for the repository would go up if it were in fact combined with other activities, in this case, a research lab.

Next slide shows some of our studies of the implications of compensation. I don't want to dwell on this. I simply want to point out that compensation, when it's offered for the states that host a repository, do generally increase support. But, look at those people who were initially opposed to the facility. They're roughly split

fifty-fifty in terms of those who would increase versus decrease their level of support for the repository when you do things to offer financial compensation. There is a substantial bump in support for those who are already in favor. But, financial support, as opposed to design changes, has relatively little effect on those people who started out opposing the repository.

Next slide, please?

Finally, let me just add two things about proximity and the NIMBY kind of effect, the “not in my back yard” kind of element.

Next slide shows what happens to the support for the mine-like repositories versus the deep borehole repositories, as the respondents believe they are closer to their home. We first asked what happens to their support if they knew it was going to be in their state. You see, in general, a positive response. The closer it gets, 300 down to 50 miles from their home, the greater the level of opposition becomes. This is what one would expect in the abstract, that as the repository itself gets closer to one’s residence, the greater the hesitancy that’s associated with it. And, this is where we begin to run into problems when we start talking about specific sites, particularly when we do so before there is opportunity for people to consider what the benefits might be.

The next slide, however, shows a real world experience. These are the data tracking the overall level of support for the Waste Isolation Pilot Plant from 1995 up through 2001. You can see the dashed line there, which was the date that it was opened. And, in fact, in that very period, in the spring of 1999, there was a 10 percent jump in support for the facility for the day it actually opened. And, there is a sort of reluctance until the site is operating that creates an image in people's minds that there could be catastrophe. Once it's actually operating, there appears to be a dampening effect. It's something that engineers often call a bow wave effect in siting facilities.

But, the reason I show you this is because it's important to see the longer-term trends. In fact, if I took us all the way back to the 1980's, there was over two to one opposition to WIPP in the late 1980's. And, gradually over the course of time, support grew, particularly once the facility was open.

Now, what's surprising about this is the proximity effect. The next slide shows the relationship between support for WIPP and distance from the facility. The closer you get to WIPP, the greater the support. Now, this won't surprise anybody who's been watching the Nevada case, because the towns closest to the Yucca Mountain project tended to be the least opposed, and in some cases, the most supportive of

the facility. This has been something that we have observed in many other siting cases.

The difficulty we have in the United States is that what we count as the host is the jurisdictional question that moves across layers from localities through states to the federal government, and you tend to have people who are further away, as you see, the greater the distance the greater the opposition in the case of WIPP. You have communities further away from the facility that tend to be more opposed.

In designing a process here, you have to address the concerns of those who are further away, as well as those who are nearby the facility. One of the things that become of interest to the OECD in its efforts to look at nuclear facility sitings globally has been to try to get at this question of what do we consider to be a host community? How do you address this in a way that both deals with those who are nearby and those who are further off? It's turning out to be a very challenging issue that gets at how you think about representation by distance when you're doing this kind of siting. And, it's a new and fascinating area.

The bottom line here, as you look at the relationship, is that you cannot assume that proximity is going to have the kind of negative effect that NIMBY prescribes. It's often those who are closest to the facility

who are most ardently in favor of it. And anybody who has seen Mayor Bob from Carlsbad talk about the WIPP facility will know what I'm talking about here.

Okay, let me briefly wrap up here. Public understanding of used nuclear fuel and current UNF policies isn't well developed. It's interesting, though, beliefs are integrated. The more people are fearful, the more they worry about aspects of the program, the more persuasion would be required, the more opposition you see. There really isn't a public consensus yet on a preferred option.

However, we can see retrievability and reprocessing as fairly robust preferences by majorities in the United States. And, I want to point out again that this is something that we're seeing broadly. It's not just our studies. We see it reflected at people who take very different approaches to this question.

The bundles of attributes that are associated with a repository matter enormously. I think, again, attributes of the Yucca Mountain project were interesting in the way that they affected the course of the policy debate and the kind of public description that went on about that facility and the kinds of reasons that people would have for supporting or opposing a facility.

The laboratory option is quite interesting. It addresses much of the underlying concern associated with the

material. It gives people a reason to say well, yeah, we don't like living near radioactive stuff, but we've got people working on making it safe for future generations. So, you have, in essence, conceptually for people who are thinking about living near this thing, a reason for them to say they're doing something good for somebody else. In debate of this kind, that's a very powerful lever.

State-level funding generates mixed reactions. My view is that it's ultimately going to be necessary, particularly to deal with those communities that are further away from a facility, but within the state jurisdiction. But, it's something that should be addressed after you have dealt with the features and the facility and the more general concerns about the safety of a repository.

Proximity is a problem. It does not eliminate support, but it generates a strange dynamic associated with a facility where the greatest opposition tends to come from those at more distance, with the greater support coming from those nearby.

And, I will wrap up with that. The next slide simply shows how you can reach me if you want more in-person discussion. But, I'm just going to hang in here and deal with questions.

KADAK: Okay, thank you very much, Professor. Can you hear me?

JENKINS-SMITH: You might need to turn up the mike a little bit now so I can hear you a little better.

KADAK: Okay. Thank you again. I don't know if you saw Ernie's slides. Did you get a copy of those in advance?

JENKINS-SMITH: I saw an early version of them, yes.

KADAK: Okay. Well, just to summarize it, it appears that there are parts of the country that, not talking about specific towns, but certainly states that have suitable locations. And, as you mentioned, and as we talked about earlier today, without state buy-in, it's a very difficult process. Can you address the state buy-in question as opposed to the local question?

JENKINS-SMITH: Questions associated with compensation were about compensation for states as opposed to localities because we were attempting to see whether that would address that problem. But, we have not looked at it in depth. However, that is going to be a primary focus in our survey coming up in several months for just that reason.

KADAK: And, one other question and then I will open it up. In terms of the volunteer siting process, do you have any surveys or any experience that would deal with that given where we are in the perhaps restart of siting?

JENKINS-SMITH: Yes. The point behind the volunteer process is to provide an opportunity for communities to think about the relationship that they might have with a repository

before they see themselves as the focus of an outside effort to locate a repository there. There's a dynamic that takes place there that we have seen globally now, and that is that if a site, if a potential host community is identified and singled out before they venture forth with a proposal to site the facility, that the whole dynamic of the debate is shifted in the direction of defensive. It's very difficult to persuade people in that setting that they have a real voice in what the proposition, whatever the proposed repository might be.

Canadians studied this fairly extensively before they developed their process. And, of course, we have seen in both Finland and in Sweden, a real effort to generate competition amongst sites for becoming host communities.

But, I think that this comes close to the kind of an issue that we can--in social sciences, we have almost reached consensus that you cannot successfully engage in a siting process without leaving some room for the community to advocate its own role there.

WIPP was a fascinating case because it had such a strong local proponent community. That's apart from most of the other areas where we've tried to do this. This was not an open volunteer process for WIPP, but it was different in that it had an organized local business and political lead that went out and sought this and pushed for it and fought

back against more distant communities' effort to stall the process. And, so, in a way, WIPP is the exception that proves the rule.

It's very, very difficult to site facilities without a sense on the part of the potential host communities that they chose to be there before they were fingered as a likely target.

KADAK: Okay, thank you. I'm going to open it up to other Board members. Mark Abkowitz?

ABKOWITZ: Abkowitz, Board.

I actually have a question for Ernie, and then would like to ask Hank a couple questions.

Ernie, I'm a big proponent of GIS, so I'm really pleased to see that you're starting to leverage those sources, and it sounds to me like you have an appreciation for both the advantages and the pitfalls of the quality of the information you're working with. So, that's important, and I acknowledge that you acknowledge that that's important.

My question to you is that you have provided some very interesting criteria upon which to judge the suitability of certain locations, and I was curious as to whether you are expanding that criteria base going forward. One of the big concerns I have has to do with climate change, and I didn't know the extent to which you are looking at IPCC scenarios, for example, and mapping those in terms of where we may see

more frequent and violent storms, greater periods of drought, higher mean and max temperatures, and what that might do to the qualifications of a site.

HARDIN: Okay, first, let me say that Frank Perry of Los Alamos is the lead for the used fuel on this. And, I think I might defer part of the answer to some future presentation by him. So, as far as climate change goes, there's really one comment I can make about that. You will notice that I didn't present some of the available layers, such as mean annual surface temperature, rainfall, and that was deliberate. Those might pertain, but in my view, they probably are not critical to performance. And, so, for example data suite here I didn't include them.

So, it's possible that, I'm conjecturing here, that climate change variables, such as the ones you mentioned, would not be critical to screen.

ABKOWITZ: Okay, we'll leave that for others to respond to. I would like to use the rest of my time talking to Hank.

First of all, Hank, I admire the work you're doing. I have some questions about the experimental design and what implications that has on the suitability of the results that you're reporting.

The first question I had is that you mentioned that you did both the telephone and internet survey, and it looks to be about 75 percent of the data is coming from the

internet sources. Yet, the representative and reliability issue looks to have been investigated predominantly on the phone survey side. And, I was curious whether or not you could talk to us about what you were able to do to demonstrate that the internet respondents were also representative, because obviously, the internet is a more volunteer process than somebody who answers the phone when you call them.

JENKINS-SMITH: Yes, that's a really good point. The internet survey is based on a panel of volunteers of about six million people, and the way that that's handled is that we draw from that a proportionate sample based on census data. Essentially, there's a subset that's drawn that looks like a cross-section of the United States, and then we randomly sample from that panel that looks representative of the United States.

The reason we do the paired phone and internet surveys is in order to compare and track over time the changes that we're seeing in both the phone and the internet version. And, we've seen some very interesting differences. I mean, we usually are tracking means, but in the internet version, people are actually able to look at the questions and pick an answer based on scale width. And, you get essentially much better behaved responses, far fewer extreme responses than you do in the phone version. And, so, one of

the things you get with the internet surveys are more considered responses on the part of the participants.

The mean values and the changes over time in the mean values by the phone and the internet surveys track fairly closely. Generally speaking, phone survey respondents are older. They tend to be more conservative. They tend to be more pro-nuclear, amongst other things. Their perceptions of threats tend to be more in the direction of national security, and they perceive less in the direction of environmental threats, and increasing, we're seeing that the characteristics of telephone respondents become different, reflecting the demographics of that group.

But, overall, the work we do, and many other social scientists, trying to understand the relationship between internet and telephone users, has confirmed that the internet is, unless you're actually measuring internet use or behaviors that are related to internet use, you're getting patterns of behavior that are reasonably consistent with those that are collected in other modes.

ABKOWITZ: Thank you. I have one other observation I would like you to comment on, and I'm just going to pick two examples from the surveys that you shared here, the results you shared with us. And, my question has to do with the perception of the respondent to the way that certain questions are worded.

For example, you had one slide that talked about the preferences for the number of permanent storage sites. And, the distinguishing feature seemed to be six to eight regional storage sites in one case, and two large centralized storage sites in the other case. But, I notice in the wording that in the regional storage sites, you make reference to this being a longer-term storage option. Whereas, in the centralized storage sites, you refer to this as a permanent storage option. Those have very different connotations, and I don't know whether that was by design, and if so, aren't you mixing two different factors in trying to isolate one effect?

Let me also--well, go ahead, you can answer that, and then I'll bring up the other one.

JENKINS-SMITH: Okay, very good. The snippets that I showed you, I couldn't put in the full set of question wordings about the characteristics of each of the sites. But, that reference to longer-term had to do with longer than on-site. And, when the full description is there, both the deep geologic and the regional sites, or the two centralized sites and the regional sites, are described as being permanent repositories.

The key thing to remember is that we're describing these things in terms of the mix of things that one might do with used nuclear fuel. Disposal is just one of those things

that one might be doing with it. And, so, the language reflects that.

ABKOWITZ: The other example I wanted to give you is the one on reprocessing.

JENKINS-SMITH: Yes.

ABKOWITZ: And, in the second sentence that you shared with us, I'll read this out. "After reprocessing, most of the uranium and plutonium can be captured and reused to generate electricity, reducing the amount of uranium that must be mined in the U.S. or purchased from other countries. Remaining materials are radioactive and must be safeguarded," et cetera.

My concern is that to the uninformed, they would believe this to say that most of the uranium and plutonium is being captured and reused and, therefore, there's little or no waste left over afterwards. And, I don't know that that is representative of many of the reprocessing scenarios that are being discussed. And, so, my question to you is are you concerned about coming to such a broad conclusion as the public being favorable towards reprocessing based on the language that's in this phraseology?

JENKINS-SMITH: You're touching on something that is a real concern, and that is how much does wording and design influence the pattern of responses? And, for this question, for the question of reprocessing in general, the responses

are uniform, regardless of variations in wording.

The Nuclear Energy Institute has sponsored a number of surveys that Ann Bisconti has undertaken, in which she has been looking at reprocessing and she finds consistently, since the early part of this century, great support for it.

MIT's study, which was a great deal of that was concerned with the security of nuclear fuels and non-proliferation questions, had a reprocessing question in it which had a substantial majority favoring reprocessing.

And, I guess your question is very well informed and important. We do have to be very attentive to the way these questions are asked. For this particular topic, I would say that the pattern of responses we're getting across a wide array of different studies are very consistent. I intend to push this one a lot harder.

What I would like to do would be to unfold this question in a way that really challenges people's initial disposition either in the direction of opposition or support to see what happens when fuller, more descriptive arguments about the pros and the cons are raised to see how stable it is under those circumstances. This is a remarkable topic because it is one that we have seen such consistent results from such a wide array of different attempts to measure it.

ABKOWITZ: Thank you.

KADAK: Okay, thank you. Bill, you have a question?

MURPHY: This is Bill Murphy of the Board.

I have a question for Ernie. I see in your supplementary slides that you considered ground water resources, and I'm curious if you have considered including mineral resources or fossil fuel resources. It seems like there could, for example, be a big overlap between your argillite sites and fossil fuel resources.

HARDIN: Yeah, those would be part of the study. No question about it. And, I should point out also with Dr. Abkowitz's question is that, you know, it's very clear that I'm just looking at post-closure variables here, things that affect post-closure performance. And, I didn't touch transportation or socioeconomics and some of your climate change ideas might in fact play out there.

MURPHY: I have one other question that you may or may not be willing to answer. Given the whole perspective and your knowledge and background, do you have a favorite site for a mined repository?

HARDIN: I'm tempted to answer Yucca Mountain, but I'm going to say no, you know, given the tone of this presentation is that there are any number of different possibilities out there.

KADAK: Okay, anyone else on the Board have a question? Ron?

LATANISION: Latanision, Board.

Let me just follow Bill's question by asking it a little differently. If any of you gentlemen were given the responsibility of leading a siting team, how would you approach it? What would be the criteria you would use given what we know today, based on the public opinion, comments we've gotten from Hank, your studies, Andrew's work, what would be your approach? How would you go about this? Because, you know, we're getting to the stage where siting is obviously going to reappear. So, how would you start?

HARDIN: That's a good question. You know, as I said, you've got to have the regulatory frame work established. The process stakeholders need to be identified. You know, the lead authority needs to be defined and empowered. But, given all of that, I will say that I think that what we're probably going to be doing over the next few years is establishing the capability to identify not the nominative, as Andrew Souder said earlier, but in fact to be able to answer specific questions about specific sites. So, is this site okay? Or how does this site compare with some alternatives? Or, is it representative of a certain disposal concept? That's really where we're going.

There are a whole lot of other clearly, from the discussion, a whole lot of other factors involved other than geoscientific. So, we're in a position where we are preparing the capability to answer questions about several

different media, references and concepts. And, we'll do that across the entire U.S., or we envision our capability to do that across the entire U.S., if that's what's required.

KADAK: Let me see if I can follow up to that question, because that was too easy. Let's just say for the moment science matters. Okay? That's a hypothetical. And, let's just say for the moment the criteria that you have identified in terms of geology and all of the layers that you had, would you not logically say here are the candidate states, if you will, that have suitable geological, hydrological conditions that would warrant an exploration of whether a mined or a borehole process would be acceptable?

And, then, instead of wasting everybody's time going to California and trying to site it on an earthquake fault, why not just simply begin looking in those areas where there are favorable geological conditions? And, then, perhaps explain to the public that this is the science that shows that you state, for better or for worse, has favorable features?

Now, Hank, you can chime in if you like here, and then say okay, this on a science basis, these are the things that make this area appealing. Then what?

HORNBERGER: What would the governor of Massachusetts say?

KADAK: Well, that's my question. It really ultimately

boils down to a state question. Because I heard what Hank said about a very strong local community mounting a campaign to sort of overcome the state opposition, which is kind of what he said when New Mexico first started this.

But, I just wonder if the process that we are trying to embark on, perhaps the new one, has to be somewhat different, and that's what I'm trying to seek your opinion, not naming a particular state, but as a process. Would that make any sense? And, maybe Andrew would like to answer that, I don't know.

ORRELL: Well, I'm not going to let Ernie answer it.

I'm not sure it's going to answer your question, but this issue about finding a suitable technical domain, our general feeling is is that that's not really the constraint, that there is an awful lot of territory which could be suitable. So, it would be like saying in your approach, I think, here's the maps and here are the, you know, one-third of the country that has suitable basic criteria, what community wants to volunteer in that region. And, I'm not sure that would be particular effective.

My concern with this focus on volunteer communities is we have great evidence that states are able to mount an effective opposition, and not just from Nevada. I am concerned that the mounting, overcoming a state opposition in the case of WIPP, that was something that occurred 20 years

ago, and would not necessarily play out in the same way today. And, for simple reasons of technology, the way things were communicated.

I'm one of the few people in the room who lived in both Carlsbad and Nevada, and I was there when there was no internet. I know what it was like not to have a viral campaign. Things that would happen would be reported three or four days later, and they had lost a lot of their impact. Now, we're seeing whole regimes being pressured in and out of office based on Twitter.

So, I believe that our issue about how we overcome state resistance is perhaps now myopic. We need to be thinking about whole regions. How do you get an entire region that could benefit, where it has stakeholder interest in a repository implementation, to support it? I don't know that answer, but I think looking at it from just a local or a state region is kind of ill-fated. We need to be thinking in terms of the kinds of things that were done for the Appalachia. Personally, I think this is what needs to be done. What was done for Appalachia over a period of 20 years with the TVA to remove it from dead last in poverty to, you know, an economic force in the country today? What would happen if you took that kind of approach with certain areas?

KADAK: Hank, do you have any comments on that?

JENKINS-SMITH: Yes, I do have some comments on this.

Part of what may have driven much of the state response was the Nuclear Waste Policy Act, particularly after ’87, specified what it was we were asking states and localities to do in a way that made it extremely difficult for either the residents there or the representatives of those communities to defend the decision to pursue a disposal facility. And, it did so, made it think about what it is that somebody has to say to explain their support for bringing a repository into a community.

We focus chiefly on providing financial benefits, or economic benefits of one form or another as the justification for Fremont County, or any of the other potential candidate sites for MRS’s or permanent repositories. And, I think we have to think about this distantly. I think there has to be policy, design considerations that make it possible for somebody to see why it’s in the national interest, in the interest of future generations for them to take on this kind of hosting.

And, it takes thinking about policy a bit more creatively, but we have to stop thinking about the back end of the nuclear waste cycle as a first off terminal, and secondly, disconnect it from everything else that’s going on. And, part of this change that’s happened in the what’s been referred to as the nuclear renaissance is the recognition that these things are connected, that carbon emissions and

other factors are related. And, I think that's where we're going to turn this corner.

KADAK: Okay, thank you. John?

GARRICK: Yes, it's getting late and I don't think it's any of the reasons that have been given. I think the real issue is the development of a national will to solve the problem. I think that's not been done, and that can only come from leadership. I think if this nation wants a nuclear power program, we've got to have a waste program. We can't separate the two.

And, I think that until we decide at the top that we're moving forward with a nuclear power program, and true, we have a waste program regardless of whether we move forward or not, but looking in the longer range, until somebody is able to tell the nation that this is what we're going to do, and the reasons why, that it is manifested as being in our best societal interest, and that there is indeed a national will to do something, we won't, none of these approaches, in my judgment, will work. And, I think it's that simple.

KADAK: Okay, well, we'll leave it at that. Hank, thank you very, very much. I appreciate your willingness to participate at a distance. Sorry you couldn't be here. And, thank you, Ernie and Andrew, very much for your participation.

John, back to you.

GARRICK: Okay, we now come to the opportunity for others to let off a little steam. I have four names that have been advanced to me, who would like to make public statements. It is now 5 o'clock. We would like to adjourn as close to 5:30 as we possibly can. I don't know if all these people are here, Bob Gamble, Anne Clark, Judy Treichel and Dr. Jacob. Are they all here? Yes.

Okay, well, let's start with Bob.

GAMBLE: May I?

GARRICK: Sure. That's the better place.

GAMBLE: My name is Bob Gamble. I'm with Nye County, actually the Nye County Nuclear Waste Repository Project Office.

I do appreciate the fact that the Board has come back to Nevada after a long absence in touring the rest of the country. I also appreciate, I think he may have left, Lake Barrett's kind remarks about Nye County and our participation, constructively, in the process.

Just as a little refresher for everyone, a few facts about Nye County, which most of you may already know, but it is larger than probably a half a dozen eastern states. The Nevada Test Site, now the Nevada National Security Site, which is larger than Rhode Island, is wholly contained in Nye County. There were approximately 900 underground tests that released uncontained radionuclides above in the ground water

on the test site, all within Nye County.

At the time the Act was passed when Yucca Mountain was identified as a potentially acceptable site, there were probably not much more than 10,000 people living in Nye County. At the present time, there's just over 40,000 people in Nye County. And, it's the host to Yucca Mountain.

There is a lot made of the need for local support. A lot of people think of small communities. Well, we have a state size county with a small population that has opted to take a constructive approach. We didn't volunteer for anything. Very few people, there is little leverage to do anything really in the process. But, again, we took a constructive approach, and particularly when the Act was amended in '87, it gave an opportunity to Nye County to designate on-site representatives.

I was until the DOE/OCRWM office here in Las Vegas closed, the official on-site representative of Nye County. My office was in the DOE building. And, in terms of interaction, transparency, the ability to discuss issues, I think that was a wonderful provision of that Act. Now, the State did not take advantage of that. They also had that opportunity, but did not choose to do that.

We entered into agreements with DOE with respect to our own independent scientific investigations. They were funded through oversight money. There was the agreement

regarding our role as an on-site representation. When the site was designated, recommended and designated in 2002, the Board of County Commissioners passed resolutions documenting the intent to constructively engage DOE in this process to ensure that the repository was safe, transportation was safe, and that the citizens and the environment in the county were protected.

In terms of more recent things, we were a cooperating agency with DOE on the Supplemental EIS. In fact, DOE, one of the things that have been talked about, benefits, it's not so much the benefits as an acknowledgement of potential impacts on the county. DOE did an analysis at our behest looking at 80 percent of the repository workers being employed in Nye County. That's in Appendix A of the Supplemental EIS. It shows the employment, changes which are substantial in a small county, a county with a small population. It shows the change in discretionary income. It shows the change in gross domestic product for the county. All substantially in a county with a few tens of thousands of residents.

Last week, the county, the Board of Commissioners, the chairman sent a letter to the Blue Ribbon Commission documenting some of our comments and our views. I would like to--I would like to enter that into the record. But, I would like to read just one small part of that. "Given the fact

that Yucca Mountain is by law the designated site for the nation's geologic repository for spent fuel and defense high-level waste, we would like to point out one more time that strong local community support for Yucca Mountain exists at the host county level." Again, bearing in mind the Nevada Test Site was there. A lot of the people who live in Nye County certainly are familiar with it and who worked at the Test Site.

"Our own research conducted with Nuclear Waste Policy Act funds convinces us that the science embodied in DOE's license application and its supporting technical documents is sound." We documented that in December 2008 in our petition to intervene.

We raised certain contentions that were more a matter of confidence building than of concern about the safety of the repository, and said in that petition that if our issues were addressed, we saw no reason that the Yucca Mountain repository couldn't be constructed, operated and closed safely.

At a minimum, what we recommended to the BRC was that for the sake of science and other lessons that could be learned from the experience, we recommend completion of the NRC review of the Yucca Mountain license application. People talk about fatal flaws and cases never having been made.

Well, that case is now before the body with the

capability and the responsibility to make that judgment in an adversarial adjudicatory proceeding. Anyone who wishes to challenge any of that case is welcome. We're a participant in the proceeding, the State, Clark County and other rural counties, NEI, and that's the right venue to go through the issues. At a minimum, it would be a learning experience, and the answer might be really interesting.

Thank you.

GARRICK: Thank you. Anne Clark?

CLARK: I'm a lot shorter than everyone else.

I wanted to just get back to the discussion earlier before lunch about the significant difference between Yucca Mountain and WIPP. And, it has been beaten to death about the volunteerism issue, but I do think that it's important to note in addition to the things that have already been talked about in terms of the volunteerism, is that one of the slides from the most recent presentation on public opinion showed that in New Mexico, the public opinion of WIPP declines, it becomes more negative as people are further away from the WIPP site.

And, I think that there may be an interest in finding out what the correlation between that distance is and the locations of populations that have been negatively impacted by previous nuclear or radioactive materials issues, namely uranium mining and the lab, Los Alamos National Lab.

There is a strong opposition in the northern part of the state because of its history of uranium mining and the history of the lab that is significant, I think. And, so, it's not just about the distance in terms of less economic benefit, which is one of the big implications that people see in that negative opinion going up as you get farther from the site. It's also that they have previous negative experience with nuclear issues, and, Carlsbad did not.

Okay, so the other two main issues that I think are important that did not get talked about is that in New Mexico, with WIPP, New Mexico, the State of New Mexico got regulatory authority over WIPP through the RCRA permit. And, this gives the state a lot more say into the general day to day operations of what happens at WIPP, and this was an important development that happened in the confidence building of the state as a whole as to letting WIPP go forward.

In addition to that regulatory authority through RCRA, there was also established very early in the process an independent technical oversight entity called the Environmental Evaluation Group, and that entity was very successful in maintaining its independence and frequently came under criticism by the federal government because of any criticisms that it had of WIPP, but because it was independent and it did have some criticisms, it helped to

instill additional public confidence in there being participation from the public and an influence over the situation.

So, those two things being said, it also came up earlier that why would it be important to have the federal government in a public private partnership? Why is the public part of that partnership important should we have a nuclear repository for high-level waste and used nuclear fuel, at least that's spent nuclear fuel, so I'm learning new terminology today.

And, I think the reason it's important to have that public part of that partnership, that there's that kind of approach developed, is that that creates a clear avenue for the public once again to be involved in the process and to get some sense of control over this situation.

Lastly, I just want to close with an illustration of how difficult and complex it is to get that public buy-in for a repository like WIPP. It took over 20 years to open WIPP from the time that it first began being discussed, as many of you are aware.

I am also, my role, I didn't really introduce myself, I'm Anne deLain Clark. I'm the coordinator, New Mexico Radioactive Waste Consultation Task Force, and I'm also co-chair of the Western Governors Association's Technical--WIPP Transportation Technical Advisory Group. So,

there’s a huge history through that group and through the State of New Mexico of developing that public confidence across the state. And, in the role that I have, I have a library of that history, and when I took this job almost ten years ago, I purged a lot of the files in that library as not being relevant anymore, probably 30 to 50 percent of those files. I still have the equivalent of 45 feet, when you stack those files one on top of the other, of files on those discussions.

So, I think that’s a good illustration of how much of a challenge there is in terms of really getting that buy-in wherever you go. And, I do believe that it made a huge difference that Carlsbad pushed the state, the additional parts of the state to get over their objections to opening WIPP. It was their strong support, and they still do that now, to keep WIPP there and to expand the use of WIPP.

Thank you.

GARRICK: Thank you, Anne. I think if one of the points you’re making is that the support is more complicated in terms of distance from the project than that simple exponential curve illustrated, I would agree with you. It’s much more complicated than that.

CLARK: Yes, thank you.

KADAK: Could I ask you a quick question?

CLARK: Sure.

KADAK: As you probably know, there's been a lot of talk about using WIPP for the DOE wastes, the solidified wastes. I don't know anything about Carlsbad relative to its support of that particular position. Do you have any opinions on that?

CLARK: You're talking about waste that already meet the waste acceptance criteria at WIPP? No. Are you talking greater than Class C waste? No.

KADAK: No, I'm basically talking about the solidified military waste that's--

CLARK: That's from reprocessing, that type of waste?

KADAK: Yes.

CLARK: Okay. It has been the position of the State of New Mexico, now we just changed gubernatorial administrations in January, that we would not--we would take the political stance that New Mexico is not in the interest of accepting high-level waste, whatever type of high-level waste that is, at WIPP. And, it has been the position that New Mexico does not want the WIPP Land Withdrawal Act to be amended.

Now, the current, the new administration may not take that same stance. It is my impression that they are certainly more open to the idea of expanding the role of WIPP. And, the new governor did come from the southern part of the state, and I think she is very sympathetic to the economic concerns of that area, and there are concerns that

WIPP will be closing in 2035, and that they've seen a huge economic benefit to their area from WIPP being there, and they want to see that perpetuated in the long run.

KADAK: I think you're raising another interesting point. The past administration was not supportive of expanding WIPP. This administration potentially could be.

CLARK: Yes.

KADAK: And, then, the next administration could be potentially against it.

CLARK: Yes.

KADAK: And, then, the next administration could be potentially for it. How does one address some of these fundamental needs, let's just say, to deal with, say, even the defense waste that everybody agrees has to be disposed of?

CLARK: I do think that the--okay, so 20 years, right, that it took to get--New Mexico has a history of changing parties with each new governor. So, there were changes in political environment over those 20 years. However, once the governor's office started to buy into it as being good for New Mexico economically, and once our senators who stay pretty consistent, or I think mostly, Bingaman was in the attorney general's office when it first started, once they both bought into it, then there was a consistent path towards opening WIPP. So, that did help quite a bit, even though

there was change in political parties.

GARRICK: Okay, thank you.

CLARK: Okay.

GARRICK: We'd better move on. Judy?

TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force.

I sort of have a list of things to go through here. I was concerned when Bill Boyle was originally making his presentation, and then after that, Andy Kadak asked him, "Well, when will we have a repository," and Bill went on to say that there was a fear of the public since, you know, that Yucca Mountain had sort of stifled public acceptance, and I think that's true. And, I think a lot of things have to happen in this country before you actually have a repository. I think the worst mistake that could be made is if somebody now just launched off, assuming Yucca Mountain is gone, to find another site. We're not ready to do that at all.

And, Bill said it's important that everyone know that they have a fair shake, and that is very important, and there has to be a process that's a lot longer than just taking a map, such as Ernie showed, and figuring out that this is the kind of thing we want, and going and starting again and repeating what happened here in Nevada.

On the first panel that you had, it seemed to be that Lake Barrett and George Dials and Chris Kouts, they sort

of had the opinion that people didn't know enough about the project, or didn't know enough about DOE and what it was doing.

And, I would say that just the opposite is true. I don't think the Department of Energy and whoever was in charge of siting knew enough about Nevada and Nevadans. And, they came with this idea that--and, we heard this a lot toward the beginning--that we had happily hosted the Nevada Test Site so we would, therefore, not blink an eye at a waste repository. And, that isn't true at all, and you needed to find out more about that before it even started.

So, it would seem to me that if a location puts itself up as being willing to just consider, just barely get in at the beginning, that the population not only has to learn about the project, but the people promoting the project need to learn about that population as well.

And, I was astounded when Lake Barrett said, as he was making a point about something, that EPA at one point was considering or proposing a part of the standard that would have required every bit of the grounds you comply with whatever that was. I'm not sure what it was that he was talking about. And, he said that at that point, he could have gone to Congress and told them at Yucca Mountain wasn't suitable. But, instead, he went to EPA and told them that Yucca Mountain couldn't comply, and then he said they backed

off.

Well, you see, the implimator and the standard setter shouldn’t be doing that. There was no public conversation about that. Nobody ever knew that happened, and I don’t think it should have happened. And, I would say that that goes into this fair shake idea that the public knows that they got something that they were a part of.

I would say that you’ve got to start out knowing that the public in general, as was done in Canada, actually believes that there is a nuclear waste problem, and whether or not they believe that something needs to be done. If they do, what they think should be done. If they really want, as John pointed out, new nuclear power plants, do you understand that waste comes with that, would you play a part in solving the waste problem. But, there’s a huge conversation that goes on around this, and I don’t think it’s a yes or no situation when you’re going out to find a willing host for this.

There was a speaker at one of the Blue Ribbon Commission meetings, his name is Thomas Webler, and he said he wasn’t in favor of the idea of a veto, you’d have to get all the way down with everything that’s happened, and the site is recommended, that the governor can then veto. He thought of it more as when you go to the doctor and the doctor says well, there’s something very wrong with your leg,

and I think perhaps you're going to need surgery on that. So, then, he recommends that you go to another doctor for a second opinion. You can either go to that doctor or not.

So, you decide you will, and that doctor says well, you're going to need tests and I think we need to know about this or this or this, and I think you should do that. At that point, you can decide to continue on to that. And, you go all through these steps before you're actually on the operating table, and as he put it, by the time they're putting the mask on your face, you really should have had a very solid agreement that you want this surgery.

So, I would say that you start out with willingness to go along, and then you keep checking that, and people have, they have consent for each additional step that goes and at some point, no, you can't back out anymore. But, that's all part of a process, and I think that process has to happen before anybody can tell you, Mr. Kadak, when there's going to be a repository.

So, thank you.

GARRICK: Thank you, Judy. Is Dr. Jacob here? No?

Okay, are there any questions from the Board?

KADAK: I just want to comment. Judy, I think you misinterpreted my comment or question. I was trying to see if DOE had any plan whatsoever for a repository. And, the answer I got was no.

TREICHEL: Good answer.

KADAK: And, what I would like to frankly suggest is I'd like to put you on a siting commission to find a repository site, and to see how much fun you can have doing that. Because I really believe it's an important job. And, you've got a lot of experience opposing sites, I think now it's an appropriate time perhaps for you to help solve this problem, given all your experiences with opposing it. How does that sound?

TREICHEL: You and I have not agreed on what the problem is.

KADAK: Okay.

TREICHEL: I'm not going to serve you up my solution because it may not be yours.

KADAK: That's okay, but I'm open to any solution. The question is what do you think the problem is? Is there a need to solve the waste--

TREICHEL: That's the first conversation we need to have, the first discussion.

KADAK: Okay.

TREICHEL: Is what is the problem? Because it's real hard to solve before you've agreed on that.

KADAK: Okay.

TREICHEL: You'll get better, Andy, you will.

GARRICK: Any comments from anybody?

DIODATO: You lose.

GARRICK: All right, then, I'm going to consider this meeting adjourned. Thank you.

(Whereupon, the meeting was adjourned.)

C E R T I F I C A T E

I certify that the foregoing is a correct transcript of the Nuclear Waste Technical Review Board's Winter Board Meeting held on February 16, 2011 in Las Vegas, Nevada, taken from the electronic recording of proceedings in the above-entitled matter.

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