UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

WINTER 2012 BOARD MEETING

Monday

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Ritz-Carlton Hotel
1250 South Hayes Street
Arlington, Virginia

# OFFICIALS OF THE NUCLEAR WASTE TECHNICAL REVIEW BOARD PRESENT

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P R O C E E D I N G S

8:00 a.m.

GARRICK: Good morning.

AUDIENCE: Good morning.

GARRICK: I want to welcome everybody to this meeting of the U.S. Nuclear Waste Technical Review Board. I'm John Garrick, its Chairman, and you'll find biographical information on all of the Board members on the table at the back of the room, I believe.

Is that right, Linda?

COULTRY: Yes.

GARRICK: It's been more than a year since we met in the Washington, DC area, and we're pleased that we're meeting here because it facilitates the participation of the distinguished leaders from the U.S. Department of Energy, and they include today the Assistant Secretary, Peter Lyons, from the Office of Nuclear Energy; Monica Regalbuto, Deputy Assistant Secretary for Fuel Cycle Technologies; and it was supposed to include Frank Marcinowski, Deputy Assistant Secretary for the Office of Environment Management. I understand Frank had a commitment and is unable to be here and that his duties will be taken over by Christine Gelles.

As most of you know, the Congress created the Nuclear Waste Technical Review Board as an independent federal agency in the 1987 Nuclear Waste Policy Amendments

Act. Our mandate is a pretty simple one. It is to provide independent and ongoing technical peer review of activities related to the Department of Energy's implementation of the Nuclear Waste Policy Amendments Act. Basically, it's our job to advise Congress and the Secretary of Energy of our findings, evaluations, and recommendations as a result of our reviews of DOE work.

In the period since the Board was created, there have been many changes in the nuclear waste field, but suffice it to say that none of those changes have led to a definitive conclusion. During the past two years, the Secretary of Energy has terminated work on the Yucca Mountain Project and, at the President's direction, has appointed the Blue Ribbon Commission on America's Nuclear Future to make recommendations concerning the path forward. Now, the Commission's final report is scheduled to be released at the end of this month, and in the short time of twelve months from now we will have a new Administration, and who knows what will happen then.

In the meantime, work goes on. DOE has initiated a new research and development program housed within Nuclear Energy's Office of Fuel Cycle Technologies, and the Office of Environmental Management continues to work to prepare DOE-owned high-activity radioactive waste and spent nuclear fuel for ultimate disposal in a deep geologic repository.

The Office of Fuel Cycle Technologies is looking at alternative fuel cycles whose high-activity waste may be different in important ways from the now-familiar wastes from the current light water reactor fleet. That office also is exploring a set of generic issues related to the development of a deep mined geologic repository to be decided somewhere, sometime, in the still undetermined future. In addition, it is examining issues associated with very long-term storage of spent nuclear fuel and subsequent transportation to the repository.

Accordingly, we in the Board have refocused our reviews and our ongoing activities to evaluate the alternatives that the Office of Nuclear Energy is considering. Over the years, the Board has regularly reviewed the Office of Environmental Management's activities as they pertain to preparing DOE-owned high-activity waste for final disposition. In the past three years, the Board has visited four facilities where those efforts have been carried out: the Hanford Site, the Idaho National Laboratory, the Savannah River Site, and the West Valley Demonstration Project. This year, we intend to publish a report based on this onsite review.

Turning to the agenda for today, the theme is integration. This has been an issue that has occupied considerable Board attention, even when the Board was focusing mainly on the Yucca Mountain Project. As I have said, we are fortunate to have Assistant Secretary Lyons and Deputy Assistant Secretary Monica Regalbuto today with us, and we will be particularly interested in hearing what they consider to be the most important areas for the integration of projects and processes.

Following their talks, we will go into some detail on selected activities, starting with DOE's Office of Nuclear Energy. Deputy Assistant Secretary Regalbuto will describe the importance of integrating waste storage, transportation, and disposal. Roald Wigeland of the Idaho National Laboratory will discuss the system studies now being conducted. Jeff Williams of DOE will consider "integration activities" within his division, the Office of Used Fuel Disposition. And because thermal management may profoundly affect various aspects of the disposition enterprise, the Board has asked Ernie Hardin of Sandia National Laboratory to discuss generic repository concepts, with a particular focus on thermal analysis.

DOE's Office of Environmental Management has to prepare for disposal of a wide variety of DOE-owned high-activity wastes. Christine Gelles, who directs that effort, will lay out the complexity of the program that will be implemented over the coming years. Following her talk, Ken Picha will discuss the tank waste projects at Hanford and

Savannah River.  Then Joel Case, DOE-EM Idaho, will describe the plans to manage the calcine waste at the Idaho National Laboratory.

At the end of today's meeting, members of the public will have time to comment and ask questions to the Board and the presenters.  This segment is always something we allow and look forward to.  If you would like to ask a question or make a comment this morning, please put your name on the sheet at the back of the room where Linda Coultry is standing.  If you prefer, remarks and other material can be submitted in writing and will be made part of the meeting record.  These statements will also be posted on our website.

Now, a comment we always have to make is about how we conduct ourselves as a Board at these kinds of meetings. We like to be free in our exchange, but we have to have a disclaimer that the comments that are always made by the Board are not always in accordance with Board positions. We'll try to distinguish when they are and when they are not, but we don't always successfully do that.  So, you will hear comments and questions that sometimes are taken by audience members as positions of the Board, and I just want to caution you that they are not necessarily.

I'd also like to note that it's very important for those of you who do have questions or do wish to make a comment that you do so with giving us full knowledge of who you are and what organization you represent and that you speak into one of the provided microphones.

So, with these few short preliminary remarks out of the way, I'd like to ask our honored guest Pete Lyons to come forward and give us his perspective on integration in the Office of Nuclear Energy.

Pete?

LYONS: Okay. Well thank you for the introduction, John. It's been quite a while since I've had the opportunity to attend one of your meetings, so I don't know if you typically start with reveille to call the meeting to order, but I was impressed. As a former, primarily French horn, but also a trumpet player, I was listening very carefully, and I think you should be very happy that someone else was playing that instead of me, but I was very impressed with the skill of whichever one of your members you tapped to do that. So, suitably impressed.

But it is a pleasure to be here. Over the years I think I've interacted with probably at least half the folks in the room and half the members of the Board here, but it is a while since I've been able to join the NWTRB at one of your meetings, and very happy to be here.

I guess, just before I start, let me just note that as I've reviewed some of the more recent publications from the

Board, I have found several of them to be extremely useful to me. The study that you did on reviewing international programs I thought was a very, very useful document. Your Lessons Learned document is another one that I think is very, very positive. You also just recently--well, actually in several documents, but also recently--have highlighted the importance of international cooperation. And I think throughout our program, you'll find that we couldn't agree with you more, that where there are opportunities for international cooperation, we will work towards seizing those opportunities and taking advantage of whatever we can in the way of international activities. And, at the same time, of course, we want to position the activities within our office and within this country to contribute to the international body of knowledge in this area.

The talk I'm going to present is quite general; it's more an overview of the Office of Nuclear Energy at the Department of Energy. I was confirmed into this position in April of last year, and before that Pete Miller had the assignment. I was serving as Principal Deputy of Pete Miller for quite some time and--although I have to admit that Pete left much sooner than I was anticipating he would leave, so I didn't serve in that position as long as I thought I would. But, in any case, with the current administration, Pete Miller came in as the Assistant Secretary, I was the

Principal Deputy, and then when Pete left to spend more quality granddaughter time, I was asked to take on the Assistant Secretary role.

I doubt that any of you need this sort of an introduction, but just by way of the briefest set of comments to set the stage on nuclear energy. I mean, you're well aware that nuclear is a very clean, reliable, safe contributor to the Nation's clean energy portfolio. That's a position that's been emphasized repeatedly by the President, as he's noted that nuclear energy needs to be component of the Nation's clean energy portfolio moving forward.

You're probably well aware of the roughly 20 percent that nuclear energy is providing to the electricity supply in the United States and the amount of carbon emissions that that is displacing. Electricity use is going to grow in the United States. Exactly how it grows using, hopefully, clean energy sources, remains to be seen, but certainly within our office we're exploring ways that nuclear power could potentially contribute to that growth in power across the country.

And the last bullet just notes the very impressive capacity factors that have been demonstrated in the United States now over a period of quite a few years, and I think it's fair to say that the safety and capacity record of the

United States is the envy of most of the operators of nuclear power around the world. It's very, very impressive.

Within the Office of Nuclear Energy, I indicate here our mission, it certainly would not surprise you, but to advance nuclear power as a resource capable of making major contributions. And we look at those contributions in a number of different areas, and certainly energy supply is the obvious one, but there are environmental aspects of this: there's energy diversity; there's national security aspects associated with virtually anything that has the word "nuclear" in the title. And I view our challenge as to understand the ways that nuclear can contribute and to understand the vast array of factors everything from technical, proliferation, safety, public acceptance, many areas that can be addressed through RD&D programs within the Department of Energy and within my office.

As some of you know, one of the first things that Pete and I began to work on as we arrived was development of a roadmap to guide the research and development activities of the Office of Nuclear Energy. We involved certainly the federal staff, but also the National Laboratories. Many other stakeholder groups were invited to comment and work with us on that roadmap, and that roadmap is of course available on our website.

We organized that roadmap around four objectives, which are summarized here. Those four objectives, the first one could be summarized by saying to understand whatever may be the lifetime limiting components of the existing plants and undertake activities to understand what may limit that lifetime as well as improve the reliability and sustain and/or--at least sustain, but certainly, if possible, improve the safety.

The second bullet, stated very broadly, is new builds, looking at a variety of different technologies and possibilities for construction of new nuclear plants within the United States and potentially contributing into the export market. Some of you are probably aware of our interest in small modular reactors, and that would fall within this second goal as well.

The third goal, and the one that I've highlighted here and I think it is of greatest interest today and to this Board, is to develop sustainable nuclear fuel cycles. And I'll give you just a few more viewgraphs on what, at least in my mind, I mean when I talk about a sustainable fuel cycle. But you can have many, many definitions and many arguments about exactly what goes into sustainability.

And, finally, within our office is a small but, I think, very important activity devoted to proliferation aspects of nuclear power. That work is also done closely in coordination with NNSA and their non-proliferation activities, and we try to be quite sure that the activities between the two offices are well coordinated.

The figure off on the right just tries to show how these four goals, shown in beige or brown, whatever color you want to call it, sustained either a general goal for electricity production or a general goal in transportation or processed heat areas. And I would just make the point that sustainable fuel cycles down there at the bottom is certainly one of the pillars--one of the foundations, rather, on which the entire activities are built. Without sustainable fuel cycles, at some point it will not be possible to proceed with nuclear power. And it's our challenge within the Office of Nuclear Energy working with the Board and with others to develop that sustainable fuel cycle and see it advance into a realization by the country, and, of course, there's many, many stakeholders, Congress and others, involved in such a decision.

Just a little bit of information on that objective three. Tried to break out in terms of goals what we view as near term and then looking further into the future. But in the near term, our focus is very much on analyzing a wide range of different technologies in order to develop options. And, in general, as I think I noted earlier, I do see our challenge within the Office to develop options that can be used by decision makers, some of which are certainly in Congress, some are in the utilities, depending on which of the options we're talking about. But fuel cycles is certainly an area where development of a range of options and an eventual careful down selection, we've noted here in a medium term extending out into a much longer term where a preferred fuel cycle would have been selected and we would have moved towards deployment.

Many, many challenges along the way, and you could make up your own list of challenges too, but certainly we're moving towards higher burnup fuels, and there needs to be attention paid to structural materials that can take that radiation for longer periods of time. And substantial work on different separations and waste management ideas also are a part of our program. The little figure there simply shows the typical breakdown, elemental breakdown, of used fuel. I'm sure that's of absolutely no surprise to this audience.

As we consider all of our programs in the sustainable fuel cycle area, we start from the premise that dry-cask storage is safe. We have the waste confidence decision of the NRC; we have confidence that the fuel can be stored for at least 50 years after the--actually, I think the statement is 60 years after the lifetime of an operating plant. But we see, and I believe in some of your work you've highlighted, the very strong need for research and development that would help us to better understand the long-term storage limitations of dry-cask storage. And Monica will probably go into a little bit more detail on some of those programs, but we recognize that the database currently supporting dry-cask storage certainly is limited as one goes out towards longer times, and is very limited when one talks about the higher burnup fuels that characterize modern plant operations.

But, in any case, we start from the premise that dry-cask storage is safe and we have time for R&D, careful evaluations, and decisions that can best serve the country moving into the future. With that dry-cask storage, we don't see an urgency to implement a fuel cycle, and that gets to my point that there's time to pursue what may prove to be better options. We're starting from the perspective that the ones through fuel cycle is the baseline, and we will be evaluating options within Monica's program against that baseline.

We also start from the premise that at least one repository is needed in any option, and, of course, Blue Ribbon information and your reports have certainly confirmed that. And I note at the bottom that the BRC, the Blue Ribbon Commission, is at work, and actually fairly close to reporting, on their final evaluation of a policy and planning framework that would have us moving into the future.

Again, you would all have your own lists of the issues that are going to impact the choices that the Nation is going to need to make on fuel cycles.  I don't think any of the ones I've listed here would surprise you.  Certainly, technical readiness has to be a part of it; costs; economics has to be a part of it.

Availability of uranium may be a very important part of it.  Some of the arguments that have been used for a closed fuel cycle hinge on the availability of uranium looking into the future.  Recent MIT studies have said that that is not a limiting factor for nuclear power for at least a century.  And, in addition, we've launched an effort, again within Monica's program, to look at what may at first seem like a fairly far out idea, but it actually is more reasonable than certainly I would have guessed, and that's extraction of uranium from seawater.  That's still a very early program.  There's been some very interesting work in Japan on this.  We now have programs started, particularly at Oak Ridge, looking at extraction of uranium from seawater. But just in general as one looks at alternative fuel cycles, one is going to need confidence in the uranium supplies looking far into the future and of the costs of those uranium supplies.  Seawater extraction may turn out to be one of the attributes that's important in making that decision.  I'm certainly not saying that uranium availability is the only reason to pursue a closed fuel cycle and possible advance through processing, but it is certainly one of the rationales that I think needs to be folded in to the decisions that will be made in the country.

Other issues here, obviously many, many issues associated with repositories, with proliferation, and a whole host of social issues. From three here, off to the side just notes that the current costs of nuclear power in this country about two centers per kilowatt hour is--well, I'm showing the representation here of how large a component the fuel is and making a point that the uranium cost is a very, very small part of the actual cost of nuclear power today. I make that point just because as we look at the availability of uranium, there could be substantial increases in the cost of uranium without a significant impact on the overall cost of nuclear power. And, of course, with the newer plants--well, the information shown here is typical of the existing plants where the capital is fully amortized. If you look at newer plants, where of course you would have substantial capital costs, the contribution of uranium to that equation would be much, much smaller.

I mentioned the Blue Ribbon Commission. They came out with an interim report in July. I believe you've had at least one briefing on that, and I'm sure you'll be looking forward to more briefings. Within the office we're very much looking forward to the final report of the BRC, which is to be issued before January 29th. And at least put me down as being extremely supportive of the work that the BRC has done. I think they have laid out, at least in their draft report, a very thoughtful, very coherent approach to evaluating options for the back end of the fuel cycle.

The seven primary goals that are listed here I know you've been briefed on before. And I would anticipate you'll have many more discussions on them, but some of the areas that I find most important would be starting from the area of consent-based approach to a siting of a repository. I might just note in passing that I grew up in Nevada, my parents lived in Nevada, I worked at the Nevada test site for decades, been at Yucca Mountain heaven knows how many times. I am well aware of the Nevada politics, and I strongly support the Secretary's view that Yucca Mountain will not be a workable solution, primarily from the standpoint of continuing State opposition. I think that moving towards a consent-based approach to siting of any future repository is going to be fundamental to achieving success in that area. And, as some of your reports have noted, there's international experience as well as domestic experience at WIPP, which clearly shows that a consent-based approach can bear far more fruit than the approach attempted in the past. Other aspects on here note the importance of both interim and repository. Certainly that's very, very important, their emphasis on a new organization to implement this process.

Now, there is not an administration position yet on a new organization, but some of you are well aware that when I was Commissioner at the Nuclear Regulatory Commission, I gave a speech on my reasoning for why there should be a new organization to implement the program. Nevertheless, I'm of course waiting to see what the administration position will be on that very, very important issue. But overall, I hope you would agree with me that the BRC has done--well, number one, we owe a tremendous debt to the leadership, to the members of the BRC, and I think they are making an extremely positive contribution to the debate in this country on management of used fuel, and looking forward to that final report.

Just to give you an idea of the organization of our office--I won't talk through this in great detail. Again, I moved in at the request of the President and Secretary after Pete Miller left, and I was confirmed I think it was in April of last year. But as you move down through there, you'll note there's several deputy assistant secretaries for specific activities. Dennis Miotla serves as our Chief Operating Officer and looks after the wide range of facilities, particularly in Idaho, that are involved within our program. You'll be hearing a lot more from Monica today on fuel cycle technologies, and we are very, very delighted to have Monica leading that portion off the program. Ed McGinnis heads our International Policy and Cooperation Office, and we find many, many opportunities where the Office of Nuclear Energy is required to provide different forms of advice within the administration on international issues or to participate in any number of developing opportunities for cooperation in the international arena. Now, we're not doing the technical aspects of the cooperation in Ed McGinnis's organization. To the extent that involves a fuel cycle activity, the technical part would be entirely under Monica. But the policy and general support of the cooperation would be under Ed's office. And then, finally, John Kelly. Many of you will know John joined us from Sandia after a very long career in particular, severe accident management. John heads all of our reactor technology area, and that too, along with Monica's area, are the two largest technical areas within our operations.

Under each of those deputy assistant secretaries are a number of offices. I think the titles are quite descriptive, and you've got handouts. If you can't read the slides, you probably can read the handouts. But under Monica's organization, the third one down there is the Office of Used Nuclear Fuel Disposition under Bill Boyle, Dr. Bill

Boyle, and that is where the activities primarily associated with your interest in the NWTRB would be centered.

So that's the organization of the office. And I guess one other comment I should be make, and you're probably very well aware, that the--it's called OCRWM, the Office of Civilian Radioactive Waste Management, was disbanded, and some individuals, about 20, from that program were transferred into my office. Those 20, through Monica and Bill, are essentially the remnants of the Yucca Mountain organization. At the same time, other organizations within DOE, like Legacy Management, have taken over key activities like the management and storage of the very critical records resulting from the Yucca Mountain program. General Council is also heavily involved. But within our office, we have about 20 folks who came over from the technical side of the Yucca Mountain Program.

Until very, very recently, like just a few days before Christmas, I wouldn't have been able to show you a slide that had an FY12 appropriation on it. And that was, for me, a marvelous, marvelous Christmas present after going the entire last year up until Christmas without a budget and operating on a series of continuing resolutions. As many of you know, under a continuing resolution, one is tightly restricted on what you can do. You certainly cannot begin anything that could be considered a new start, and that constrained a number of our programs for the entire last year. But we do now have an FY12 appropriation, and, again, that's one of the better Christmas presents I could have gotten.

Not to talk through this in detail, but some of the areas in here that are of particular importance, I've been extremely interested in the university programs. We maintain a very strong set-aside of up to 20 percent of R&D programs goes to R&D in the university community. But that first line, the Integrated University Program, is specifically scholarships and fellowships. We were, I would say, not allowed to continue that within FY11, but I was very, very happy to see Congress restore that in FY12. I believe that the scholarships and fellowships program--and not only for the Office of Nuclear Energy, it was also restored for NRC and NSA. I regard scholarships and fellowships as providing the foundation for the future generations of leadership that will be sitting in this room some decades into the future, and I don't think you'll find a stronger supporter of the need for scholarships and fellowships in areas related to nuclear engineering than I am.

A key area in this budget that we have discussed extensively, particularly within your purview, is the light-water reactor small modular licensing demonstration project. I can talk more about that if you wish, but that would look at moving ahead with a program somewhat akin to NP2010 but dedicated to light-water small modular reactors and a licensing demonstration of up to two competitively selected approaches. Reactor concepts is on there, but let me just note the fuel cycle R&D that we'll be discussing further today, that was significantly increased in the congressional process. We certainly welcome that. And there are a number of key activities that I'm sure will come up as the discussion progresses today on fuel cycle R&D. And, again, I showed you the distribution among the different areas within the Office under Monica's responsibility, and the 187 million is the challenge for Monica to optimally deploy.

I don't think I'll talk through the rest of those unless there's specific questions, and just go to the final slide, noting as I did at the start, that the President has expressed very strong recognition of the importance of nuclear energy. He's made very, very strong statements on the importance of R&D and a wide of clean energy sources, and he's made it abundantly clear that nuclear power has his support and that he recognizes that it is an important component of a clean energy portfolio looking ahead for the country.

So with that I'll stop; I'll be happy to take questions. And Monica and many other speakers will be getting into far more technical detail. Thank you very much.

GARRICK: Thank you. Okay, questions?

Andy.

KADAK: Yes. Hi. Kadak Board. I was curious about your budget, and this is not on the waste stuff, it's the NGNP. I notice you have an Office of Gas Reactors, but I don't see any money in that slot. Is that "off the table" as they say?

LYONS: NGNP is under the "advanced reactor" line.

KADAK: Okay.

LYONS: The final congressional appropriation, if my memory is correct, is 40 million--

KADAK: 40.

LYONS: --for the NGNP. However, let me just note, and I think you're well aware, that we proposed and the Secretary did send to Congress, a letter saying--this was very late in the last year--that based on what we perceive as very limited industrial interest in cost sharing this program, as I would view is required by the Energy Policy Act of 2005, that we see this program as continuing as a strong R&D program, at least for the near future, and not as a construction program. And, at least in my own mind, I think it will be difficult to see substantial industrial investment in this with gas below $3.00 now. Not very long ago I would have said, "$4.00," but now it's $3.00. Natural gas below $3.00 and the price on carbon, that makes it extremely difficult for any of the clean technologies or advanced technologies like NGNP to move ahead.

KADAK: And now the waste question. In terms of the development of the sustainable fuel cycle by 2050, what new things are you looking at that would address the waste part of it? In other words, clearly we understand sodium cooled fast reactors are the dominant waste burner, if you will, maybe high temperature gas as well, but what is new that will shed some light on what really to do? I'm asking a more high-level question about what don't we know now about what we need to do to get by 2050 this technology deployed?

LYONS: I think you'd get many answers to that, Andy, but let me give you at least a partial answer. I think you're aware that within Monica's area is a significant systems analysis effort, which I strongly support. Trying to look at a wide range of factors, and I listed some of them on the slide, that need to go into a decision, eventual decision, by policymakers in the country, the Congress and the Administration, on how they wish to proceed, certainly economics are going to be an important part of that, but there'll be many other aspects that I indicated.

You mentioned that, yes, we understand quite a bit about sodium cooled fast reactors, but there's certainly--and Monica's better to speak to this than I--there's much that can be done in terms of improved separations that could influence a decision as to whether to move to a closed fuel cycle. In my mind, and I think what the BRC is going to recommend unless they've changed since their interim report, the BRC is going to recommend that we move ahead, at least initially, with the open cycle and once-through, moving ahead with interim and repository storage. But also recognizing that we need to continue the very strong R&D programs in fuel cycle technologies and that while that fuel is in the interim storage and/or we're working towards repositories, there can certainly be opportunities to reevaluate the decision as to whether the nation is best served in the near term by once-through or moving immediately to a closed cycle.

So, in my mind, it's very much an open question, and it ties in with my comment that I see my job as trying to provide a range of options that policymakers can consider as things move ahead. And, of course, a very important aspect of this will be how the recommendations of the Blue Ribbon Commission are received by Congress and the Administration, and I simply don't know that yet. It's not a great answer, Andy; I don't know how to be any more specific at this point in time.

KADAK: Thank you.

GARRICK: Okay. Ron?

LATANISION: Latanision, Board. Mr. Secretary, thank you for that presentation. I have two questions, one related to Figure 3 if we could put that one up, please.

LYONS: I'll let the folks get it.

LATANISION: I'm intrigued by the graphics on the bottom left. What are we looking at there? I couldn't quite make it all out. Could you just describe that so I can get an idea what that's all about?

GARRICK: I did not ask him to ask that question.

LYONS: I'm sure Andy would be very happy to hear that.

KADAK: Go ahead, yeah.

LYONS: What is indicated here is the potential for a number of different approaches to so-called hybrid energy systems, at least I think that's the buzz word that's being applied to them now. It's looking at the possibility of combining in this case a processed heat from the nuclear power plant with a number of other applications that could utilize that processed heat. In this particular case, it's showing the possibility of using that processed heat not only to produce hydrogen, but also to couple that to some sort of a carbon to liquids type of system. This general approach to hybrid energy systems is--I don't know, I wouldn't say it's taking off, but I would at least say that there's significant interest around the country in looking at hybrid energy systems, and Andy was certainly one of the leaders in that when he was at MIT, which is why he could answer this probably better than I could. But just as an example, just within the last two months there was a really outstanding workshop conducted between NREL, National Renewable Energy Laboratory, and INL looking at synergies between renewables and nuclear power. And there are very, very interesting possibilities that are being explored there at MIT and other places trying to look at how strengths of the different technologies can potentially complement into a whole that's greater than the sum of the parts sort of thing. Anyway, that's--

LATANISION: It's a futuristic look--

LYONS: Oh, it's highly futuristic.

LATANISION: Yeah.

LYONS: Andy, you owe me a beer for that, but--

LATANISION: I do have a question on Slide 4, if we could go to that one. This is in reference to new build. Pre Fukushima there was a great deal of, I think, concern and delay in terms of the loan guarantee program, and a number of utilities that had expressed interest in new build, that interest seemed to evaporate. What are we going to do, if anything, to improve our capacity for delivering on loan guarantees?

LYONS: Well, the first simple answer is that's not within our office. There's a separate Office of Loan Guarantees.

You can certainly get into debates, and I don't know all of the factors as to what has led some of the entities or pursuing loan guarantees to drop out of the race, if you will. Certainly no secret that South Texas was one of them--

LATANISION: Yes.

LYONS: --Tepco was a major investor. Tepco's got other things to worry about now. Calvert Cliffs was another that was moving through the loan guarantee process. Again, you can have many different variations and statements on exactly what happened, but don't forget that Calvert Cliffs is in a merchant plant area that is not a regulated environment. And in any studies that we have done on the economic liability of nuclear power, it's very hard to see how nuclear can compete today in a non-regulated environment. It gets back to my comment of $3.00 natural gas--

LATANISION: Yes.

LYONS: --and no price on carbon. Now, within the southeastern part of the country there are, I'd say, special conditions that make nuclear significantly more attractive. And of the, I would think--someone could correct me--14 applications for the AP1000, they're all in the southeastern part of the country. And that's, of course, where Vogtle and Summer are, where brief instruction activities, and perhaps construction activities soon will be underway.

LATANISION: Yes. Well, I mean I understand your point. There's no doubt that the price of natural gas is a--certainly doesn't inspire great thoughts of building among the nuclear utilities. But on the other hand, to hold out the carrot of loan guarantees and then to make the negotiations so difficult that they can't occur seems to me to be pretty counterproductive. If we're really concerned about trying to grow the nuclear electric capacity, it would seem to me that's something we should streamline.

LYONS: Well, again, that's not within my office, so I honestly don't know--

LATANISION: Okay.

LYONS: --the details of that program.

LATANISION: Yeah.

LYONS: But I also think I'm right that it would be a little--I don't know, Calvert Cliffs I guess did claim loan guarantee was the reason. Certainly, in the press there were many, many other reasons suggested--

LATANISION: Yeah.

LYONS: --for Calvert change. I don't have a great answer for that, and certainly loan guarantees can be a very important part of this equation.

GARRICK: Dr. Lyons, I want to squeeze a question in. There's a couple more others that want to, but as you know, the Board is very active in the international arena and trying to understand just exactly how other nations are managing high-level and spent fuel waste. The question I have is--and in fact, in the last two months, I guess we've been to--Board members have been to France, to Sweden, and to China, which is continuing our legacy to try to see collectively just what the needs are with respect to nuclear waste management. In that connection, what R&D do you see that's needed but you're not doing because of the availability of information on that particular topic from the international arena?

LYONS: Honestly, that's a better question for Monica and some members of her team. But let me at least note that, number one, I compliment the Board on your activities in the international arena, and I know that we, too, have very strong interests to explore what can be done, can be learned through cooperative programs and existing data in the international arena. You mentioned several countries that your members have studied. Particularly when I was at the NRC, I had the opportunity to visit some of those. I visited Sweden, Finland, Switzerland, France, I'll be in Korea fairly soon, and, of course, WIPP I've been in countless times.

All those activities can provide important information. And I think to the extent that we look at how we can structure programs, and, again, I'll certainly be guided by the technical experts here. I think in the areas where we can obtain substantial information from the international community such as granite and clay, that may be a rationale for us to deemphasize some of our own research in that area and emphasize international cooperation, of course with our participation, but trying to take advantage of the international body of knowledge.

Salt, we have quite a repository--well, it's a poor choice of words. I was going to say repository of knowledge. But we have significant information, let's say, on salt, and we're very interested in working closely with Germany as they proceed with their interest in salt.

Boreholes are mentioned strongly by the BRC, at least in the interim report. I've seen reference in a number of your documents with slightly differing views, so I'm interested in that discussion later this week on what you really think about boreholes. But in any case, in my mind, boreholes remain a largely unexplored area. At my level of knowledge of this, I'm very interesting in knowing what their limitations are and what their advantages may be. One of the NWTRB documents makes the point that to the extent that there is some waste minimization, that boreholes may become a somewhat more attractive opportunity. But just in general, in my knowledge base I'm not aware that boreholes have been extensively studied and that they may remain an important area for us to gain a little bit more information.

So that's not a great answer, John, but, in general, where we can get international information, we should be cooperating. We should be benefiting from that knowledge. Where we are in a position to lead in an area, like salt, and where there is less international knowledge, there again, we should work in the international community. But that may be an area for us to perhaps emphasize a little more, and I'm not aware of much of anybody working on boreholes except for some very early tests here. And, to me, that's also an area of potential interest.

GARRICK: Thank you.

Bill?

MURPHY: Bill Murphy, with the Board. Could you comment on the licensing process for Yucca Mountain? May it proceed, or should it, or should it not proceed?

LYONS: Bill, as you're well aware, that question is in the courts now. I don't have the foggiest idea what the courts are going to say, and I certainly can't attempt to prejudge what they may say.

MURPHY: What's your judgment?

LYONS: I'll only say that I took this job with a full understanding that the Secretary was not going to move ahead with Yucca and did not regard it as a workable solution. I also do not view Yucca as a workable solution. I'm not commenting, and I'm not prepared to comment, on the technical aspects of that. I'm talking about little things like requiring state permits for 300 miles of railroad.

MURPHY: Thank you.

LYONS: Sorry.

GARRICK: Any other questions?

Yes, Andy.

KADAK: I'm back to the question of sustainability and making a decision to deploy new technology to assure sustainability by 2050. How does that affect the decision to go forward with the repository? Do we need to wait to get that decision made before we think about designing a repository or looking for a site for a repository? What is DOE's program now for site selection given the consent-based processed that people are proposing?

LYONS: I think that remains to be formulated--

KADAK: Okay.

LYONS: --as we better understand what the final BRC recommendations will be and equally important what the congressional response to the BRC recommendations may be. The question of whether any private or public-private entity is established to run this program has a rather substantial influence on the question you're asking. But as I indicated, we certainly recognize, BRC recognizes, you recognize we have to move ahead with at least one repository in this country, and I think we need to be doing that.

Now, you asked how this folds in with the consent-based process, and I can only give you some of my very initial thinking on that. I can imagine--and these are purely hypothetical--I can imagine that the Department, or potentially this public-private entity, could seek expressions of interest from around the country in participating, based on whatever geology they have. It would then be incumbent on, again, whoever's making the decision, whether it's DOE or this public-private entity, to be able to do enough of an evaluation of the geological possibilities of that particular site to ascertain whether it meets an initial screening test. But I can also imagine that there could be a number of sites that are selected for additional, careful R&D over a period of a number of years. And depending on the site, depending on the geology, there would be a greater or lesser background of knowledge on that particular site.

So, Andy, I don't know how to give you a good answer on that now. I think it will become much more clear in years to come. But do we need a repository? Yes. And should we do it through a consent-based process? Yes. And the details I think remain to be worked.

GARRICK: Howard.

ARNOLD: Howard Arnold of the Board. Mr. Secretary, my background is nuclear industry, and my review of the successes in the United States in nuclear technology, whether it's the Manhattan Project with the help of DuPont and Union Carbide, or whether it's commercial reactors with General Electric, Westinghouse, B&W and Combustion Engineering, leads me to believe that they are in fact key to success in the past.

I'm a little uneasy when I see a slide with a heat-generating reactor and making hydrogen from carbon and wondering if you have an industrial participant in that. And it leads me to a more general question of how you view the participation by industry as being important in your programs.

LYONS: I'm going to start working backwards. And, certainly, industry and industrial participation is important. I think Monica can go into more detail on that. But as we do the systems analysis, as we pursue different options, we certainly will be finding, through workshops and other ways, opportunities to involve industry. I fully agree that industry has to be integrated at some appropriate level as we move ahead with this. Again, the details of how the

BRC report will be received and whether they'll be a public-private entity or whether the Department will be directed to proceed are going to be fairly fundamental in this.

On hydrogen you asked whether there was an industrial interest, and, yes, there has been very, very strong industrial interest, and we've worked closely with the so-called industry alliance for years on this. However, that industry alliance has their own views about the appropriate point in time for industry to provide any support for this, and that's not soon. And for us to move ahead with a cost-share program, as I believe the legislation requires--and I was one of the two people with a pen when we wrote that legislation--I believe industrial participation on a cost-shared based was fundamental to that language. So while there's strong industry interest, and we actually have a procurement out now to obtain more input from industry on shaping high-temperature gas reactor program, we have not seen the interest in the cost share in the near term from the industry participants.

ARNOLD: I guess that tells you something, doesn't it?

LYONS: Yes. And I contrast that with the small modular reactors, where I know that my enthusiasm that we have been able to move ahead with the program some--we're about to go into a procurement, something like NP2010, and we have multiple companies claiming that they're ready to do a full

50/50 cost share. And, of course, we haven't had the procurement yet so I can't tell you that it's happening, but I can tell you that NP2010, at least in my mind, was a phenomenal success, and that was a cost-shared program with industry.

GARRICK: Maybe as the closing question, and I'll take the privilege of making this the final question, but it's a little bit of an extension of what Howard is talking about. You're in a position where you get lots of advice. You have lots of formal organizations doing that, including your own Nuclear Energy Advisory Committee and all its subcommittees, including boards like ours. But I'm curious about the National Academies and, in particular, the National Research Council, who has reports on just about all the topics that have appeared on your slides. How does their advice enter into your strategic planning, and how do you filter all of this information and advice you're getting from diverse bodies? And it sort of relates to how you are getting input from industry.

LYONS: John, I wish I had a formula to give you, a nice, crisp answer to that. Certainly, all of those forms of information and feedback are very important. As you know, there have been quite a series of outstanding reports from the National Academy and its various bodies over many, many years. And I'm sure that, for example, the Blue Ribbon

Commission, found it very, very useful to be able to refer to quite a wide range of National Academy reports that have been generated over the years with outstanding suggestions. You mentioned our Advisory Committee. I know you've met with Burt Richter from our Advisory Committee, he chairs the subcommittee on fuel cycles; and, certainly, your own Board. I can't give you a specific formula as to how we're going to assess all of that. I can only assure you that we are paying attention to it. We're doing our best to assimilate it. It's certainly folds into our systems analysis.

I would also anticipate that those different sources of information will fold into the decisions that Congress and the Administration are going to need to make as we hopefully move ahead with this. Most of the recommendations of the BRC are going to require some extent of congressional interaction and, potentially, modifications of the Nuclear Waste Policy Act. Until we have a better feeling for how such changes may be considered or greeted on Capitol Hill and in the Administration, I don't know how to give you a precise answer. All of them are important, and certainly I've found them to be very, very valuable bits of guidance and information.

GARRICK: Okay. Well, thank you. Thank you very much. This is very helpful. We appreciate your taking the time to come and visit with us.

GARRICK: All right, I guess Christine Gelles is going to take on the assignment of Frank's overview on integration. Welcome.

GELLES: Good morning, everyone. I am very honored to be standing in for Frank Marcinowski this morning, and he does send his apologies. Unfortunately, he is just returning to the office after an extended absence, and there was a commitment that he just could not rework this morning. So, he does send his regards. I'm also humbled; I'm very impressed by the knowledge that's around this table as well as in the back of the room, and I'm looking forward to interacting with this esteemed Board throughout the day.

We are attempting to provide an overview of the Environmental Management Program today, really giving a quick review of the scope of our program, highlighting, of course, the two subject areas that I think are most germane to this Board: That is our high-level waste, or what we often refer to as "Tank Waste" Programs, and our Spent Nuclear Fuel Programs, realizing, of course, that the Department does, in many cases, like to refer to that material inventory as "used" fuel. To a large degree, much of our EM owned inventory is in fact spent, and may not have a potential value for reprocessing in the future. I will leave many of the details to my colleagues Ken Picha and Joel Case, who will be with us this afternoon. Joel is in fact here this morning, so if you have some detailed questions, perhaps I could refer Joel to those. But we're trying very much just to set you a context for those afternoon discussions.

The second thing I'll do is touch briefly on the Environmental Management's budget outlook, and that's predominantly because it provides a very important context for discussing our current tank waste activities. To a lesser extent our spent fuel management activities, but we are very, very much engaged in an intensive effort to identify technology investments and alternative approaches to our projects to try and reduce the cost and the life-cycle schedule of our tank waste programs.

I will do my best to get through these slides within the scheduled 15-minute period so we have some time for questions and answers, but there are approximately 16 slides. So I'll try and go through them relatively quickly, and please stop me if I'm being too brusque.

Our program was established a little over two decades ago, in 1989, and it was specifically stood up to deal with the Legacy contamination that resulted from the Department's historic weapons production activities and nuclear resource activities, to a lesser degree. We have a broad amount of scope. On the next slide we'll attempt to quantify the various waste streams and facility inventories that we have to deal with, but our mission is clear. We have a vision of how we want to do our business. We've been working over the last several administrations, and most certainly under Dr. Inés Triay's leadership, to really refine our approach to completing our work scope so that we can improve our performance and begin to deliver better performance and a greater reduction in life-cycle cost to the American taxpayer, because our program has historically been among the top three. At one point I think it was the second largest economic liability. We've fallen down a bit since the war efforts, but we are still in the top five of the Government's liabilities.

Here on the right side of the chart these are our programmatic priorities. I've highlighted the two, again, that are most germane to this Board, and these are sequenced in relative risk-based priority based on the curie challenges associated with these scope areas. This is the graphic that I mentioned that attempts to quantify the scope, and you can see that there's really two purposes here. To give you a sense--and I'm sorry that you can't really read the details here even on this screen--of the sheer volume of waste streams that we have to deal with, as well as the very, very vast number of radiological industrial facilities that are contaminated and need to be decommissioned. And, of course, large number of relief sites and a vast amount of square mileage of contaminated area, decommissioning these facilities and remediating the land as well as the groundwater that is contaminated or potentially contaminated, generates vast volumes of low-level waste as well that have to be generated. So it is a complicated undertaking and one that we foretell will take decades and hundreds of millions of dollars to complete.

We are actively storing tank waste, high-level waste. You'll see this slide again during Ken Picha's presentation just to give you a visual of the three sites where the preponderance of our activities are generated, and I do know the Board has visited these three sites in recent times. At Savannah River we are operating the Defense Waste Processing Facility. We have produced well over 3,000 canisters of vitrified high-level waste. We're in the process of removing low-activity waste from the tanks and treating and stabilizing that for onsite disposal and some salt stone vaults. At Idaho the Integrated Waste Treatment Unit has been constructed for treatment of sodium bearing waste, which is not even included here in the curie count. There's, I think, about three million more additional curies of activity associated with that waste stream. Here, the 37 million curies is associated with the calcine, which is stored in bin sets and awaiting the development of a future treatment alternative. And you'll hear my colleague Joel Case speak at some length about that this afternoon. And, of course, at Hanford, where we have our largest volume and our largest number of tanks and our greatest number of curies, and, of course, we're constructing the very extensive waste treatment plan system there at Hanford to deal with that inventory.

The recent changes in the repository program have led many to think that our near-term activities are adversely impacted; in fact, that's not the case. We have spent the last two decades planning this high-level waste treatment system and the last decade really intensively constructing the necessary facilities, and our near-term efforts to address the risks of the tank waste in its current form are unchanged by the changes to the repository. And my presentation this afternoon will talk a bit about how we are continuing to use the Yucca Mountain Repository technical requirements as a planning basis until such time that there is a replacement repository system.

Just to give you an overview of our priorities for the tank waste program, our highest priority is to ensure the continued interim safe storage of our tank waste. We're busy retrieving waste from single-shelled tanks or those tanks that we know have some structural vulnerability. As I mentioned, we're constructing the treatment systems. Of course, we completed the West Valley vitrification facility and completed its treatment mission. We're now in the process of decontaminating that facility and preparing for its demolition. At Savannah River, DWPF has been operating for over a decade and is, as I mentioned, doing a great job, and we had a record performance year last year and we expect to have equally good performance moving forward. I mentioned Idaho with the sodium bearing waste treatment facility being constructed, and we're looking forward to starting up that facility in the very near future. We have two other treatment facilities in process: The salt waste processing facility at Savannah River and, of course, the waste treatment plant at Hanford and a third in planning, and that would be the Calcine Disposition Project that Joel will speak on.

I won't belabor these last three bullets, because, again, Ken Picha is going to build upon the Tank Waste Program in some depth. What I just do want to emphasize is that the systems that we're constructing are highly complex, and there are differences among the high-level waste sites within the DOE complex. And yet there are some similarities, and we are very focused on sharing lessons learned, transferring technologies from site to site where appropriate. But to some degree the historic missions of the sites do result in differences in the waste inventory, so it's not a one size fit all solution as we're developing our treatment systems.

We do have a large challenge before us, and I will touch on just a few slides the relative significance that tank waste management has in our annual budget and our life-cycle cost. Quickly, to set the stage for our spent fuel management, these are the sites where we are currently managing EM owned fuel inventories. There are other DOE fuel inventories stored at Idaho, some owned by my colleagues in Nuclear Energy as well as by the Naval Reactors Program. By and large, the greatest risks of the EM owned spent fuel inventories have been addressed, and that occurred through the removal of the N-Reactor fuel that was stored in the K-Basins along the Columbia River at Hanford and relocation to the central plateau of the Hanford site. That fuel was conditioned and placed in highly stable containers that are called "multi-canister overpacks," and they're stored in the canister storage building, and interim storage will be more than protective for at least 100 years. So, at Hanford now all fuel is in safe interim dry storage. We have consolidated the other fuel types from the other reactor facilities at Hanford to dry storage there at the central plateau.

At Idaho all of the EM owned spent nuclear fuel has been placed in safe interim dry storage. There is other fuel at Idaho that is stored in wet basins at CPP-666, but that is a robust modern facility.  It continues to serve storage for Nuclear Energy owned fuel and some Naval Reactor fuel.

And at the Savannah River site we are safely storing all of our fuel in L-basin, which is a wet storage basin.  We have gone through some capital improvements to provide additional storage capacity in L-basin.  We do continue to receive foreign research reactor fuel into that basin.  We have some capacity constraints that are affecting our near-term decisions about the rate of receipts, but we're working hard to manage that pending some future decision about whether or not to process the aluminum clad fuel that is the majority of the inventory at Savannah River site, and we are looking forward to the Blue Ribbon Commission's recommendations to help inform the policy decisions associated with that.

We are renewing two NRC licenses, one for the Fort St. Vrain facility, where we have custody of that commercial fuel inventory, as well as the Three-Mile Island fuel debris storage facility, which is at Idaho.

And, just at a very high level, the mission of the Spent Fuel Program:  Continued safe and secure storage of our existing inventories, and to work with our stakeholders and comply with all the legal agreements associated with the management of fuel notwithstanding the uncertainty of its final disposition path.  We are seeking some additional technology developments to improve the safety and performance to ensure the continued integrity of our existing storage facilities. The lower picture shows you some dry casks that are being used. They weren't intended to be used for decades beyond the current timeframe, and yet we're facing that very real possibility, so we're doing some additional evaluation about the integrity of those casks and the reliability of those storage systems. And we thank the Board for their insights in that regard as well as the Government Accountability Office, they've also offered us some recommendations, and, of course, the Defense Nuclear Facility Safety Board.

Now if I could move to budget. This pie chart provides you a look at the relative significance of those programmatic areas that were listed on that second chart in priority order. These are scope areas broken by percentage bases against our total "To-Go-Life-Cycle Cost" as of the fiscal year 2012 budget request. And I'll read that number to you. We estimated a range as of last February of 185 billion to 218 billion dollars to go to complete the existing environmental management scope, and that's before we add any additional excess environmental liabilities or additional material or waste streams that continue to be generated by the other Department of Energy programs. So, that's a very vast amount of responsibility that we feel, and weighs on us every day, to be honest with you, and we are working hard to try and figure out how to chip away at the life-cycle cost and improve upon our current project schedules.

Relevant to this topic today, note that there on the right-hand side of that pie, from about 12 o'clock to 5 o'clock, is radioactive tank waste stabilization, treatment and disposal making up 38 percent of our life-cycle-to-go-cost, but know that 3 percent is associated with the fuel management activities. And, of course, that would not include the cost of transporting to interim storage or the cost of disposing, which are assumed to be borne by other departmental elements.

Here's another look at our EM life-cycle-cost-to-go, but this time represented over time. You'll see that the curve tails out in the 2050 timeframe. Again, that gives you a sense of the number of decades before us. And this color scheme is a little bit difficult to read, but the bottom chunk, that big, dark--what I would call burnt sienna, because I remember my Crayola days--that is the tank waste cost The Spent Fuel Program doesn't really show up by itself. It's wrapped up with our other excess special nuclear materials activities, which is that bright yellow just above it. But you could see for the foreseeable future tank waste makes up approximately half of our average--our annual investment each year.

One more look at our cost curve. That's the basis of the line here in the graph, and I've drawn a little red star for you and shown you what flat funding might look like. Our Fiscal Year 12 appropriation is 5.7 billion dollars, just a little over that. You can see that our baseline needs, what we estimated in our detailed project plans to complete the environmental management activity, exceeded 6 billion dollars, approached 7 billion dollars in fiscal year 13. So, we have a gap over what funding is available to buy us now, forcing us to do some replanning. But if, in light of the current national budget context or outlook right now, the Administration's warnings hold true that we'll see no increases in discretionary funding, in fact decreases as much as 5 percent, you're going to see our problems of having to rework and defer work are just going to further be exacerbated. And, for that reason, we've undertaken a very intensive strategic planning initiative, and the Tank Waste Enhancements Program is a key component of that.

The strategic goals that I'm going to touch on in the next few slides were announced by Dr. Inés Triay in a document that was called, "EM's Journey to Excellence, a Roadmap," was published a year ago this past December, and it set forward seven very high-level strategic goals. Four of them were technical in nature and three of them were more management or programmatic in nature. We are revisiting the feasibility of retaining those strategic goals in light of this budget context, but at this point they do remain the strategic focus of our program, and for very obvious reasons, because they are core to what we are doing day to day.

The first goal was to complete the three major waste treatment projects on cost and within schedule, and that is proving to be pretty challenging. I mentioned the Sodium Bearing Waste Project has completed construction a few months behind its targeted schedule, and we are struggling right now to resolve all of the safety issues and support the start-up of that facility, but it does look that it is going to occur in the very near future. We have both a contract goal and a compliance commitment to complete the treatment of the sodium bearing waste by the end of this calendar year.

Down here on the lower left is a slightly dated picture of the construction of the Salt Waste Processing Facility. This is a pre-treatment facility before the tank waste at Savannah River is then sent on. Portions of the tank waste at Savannah River are sent on for vitrification at the Defense Waste Processing Facility. We've been doing some in-tank processing to mitigate the impacts of this facility being delayed from its original schedule, so we are very focused on trying to complete the project on its revised schedule, which is targeted for 2014.

And, of course, the Waste Treatment Plant; very popular and widely covered construction project. Some refer to it as the largest construction project underway in the world. I don't know if that's really a true statement or not. We do continue to face technical challenges there as well as we face budget challenges. We had an approved project baseline that required 690 million dollars a year. That approaches the annual nuclear energy budget. But we, because of some challenges, had wanted to accelerate that baseline and had requested from Congress 840 million dollars in Fiscal Year 12. We received just 740, so we have a 100 million shortfall from what we had been planning on. Although it's slightly more than what our baseline called for, we know that baseline does not support the kind of acceleration and life-cycle cost reduction that we are targeting.

The second strategic goal was really totally focused on trying to find new ways to complete our work scope, or slightly varied ways to complete our work scope, so we could reduce the life-cycle cost by as much as 43 billion dollars and shave off as much as a decade. And a key component of that, as I mentioned, is the Enhanced Tank Waste Strategy. Again, Ken Picha, who is very--right now he's the Deputy Assistant Secretary for our Safety Office, but he's very experienced in working with the Waste Treatment Plant and our tank waste projects in previous versions of the EM organization. And in our pending reorganization, he is going to be the Deputy Assistant Secretary for the Tank Waste Office, so he is going to remain very involved in this area, and he'll be providing you much greater detail about some of these investment opportunities.

I just want to set the stage. I won't read these, but these are some of the areas, some of the components, of our revised and improved strategy for tank waste management, really focusing on bringing technologies to the tanks to advance and accelerate retrieval, using some advanced melters, pursuing higher waste loading where appropriate. And that's an important point. We'll talk about that a little bit during my presentation, because there are very specific waste loading assumptions that were in the license application regarding the Yucca Mountain Repository System that we may revisit in the future. Alternative treatment and disposal processes, looking for modified waste form. We need to rethink some of our disposal site selection strategies, additional mixing, and other areas. Again, we'll touch on these in more detail this afternoon.

This slide, too, is just a little bit dated, but it was intended to give you the illustrative sense of the kind of schedule advances. If the blue shaded curves on the River Protection and the Savannah River graphs are a current baseline, the green line is showing you what our accelerated schedules would support. You'll see that there are some additional investments needed at Savannah River in order to realize a 3.2 billion dollar savings at the Office of River Protection. Because there's a longer schedule remaining, we don't need so much advance funding or additional funding in the near years, but we can still, with some very refined technology investments, bring the total project cost in significantly, we believe.

So, I'm closing, and then I look forward to your questions and some dialogue. We are very focused on continuing to safely retrieve and deal with the imminent risks associated with our tank waste management, as well as safely storing other high-level waste forms and our spent fuel inventories. We believe our on-site storage capabilities that we have today, including our glass-faced storage buildings and our fuel storage systems, will be fine for 100 years; however, we are continuing our efforts to confirm that for ourselves. We are very focused on completing the construction of the remaining elements of our tank waste treatment system, and, as I mentioned, we're working hard to identify ways to reduce those costs and accelerate the schedules.

We are continuing to share experiences between our tank waste sites. We have a corporate board, it's called the

Tank Waste Corporate Board, that meets on a relatively regular basis, a couple times a year, to do just this, to collaborate on technology investments. A lot of coordination has gone into this Tank Waste Corporate Board that was set up, again, by Dr. Inés Triay, to ensure that we are maximizing the opportunity for integration among our sites.

We are very focused on ensuring our treatment methods will ultimately meet whatever future repository is developed, and, again, that's what I will talk about this afternoon, ensuring that we've got the pedigree on the waste forms we've generated to date, whether it's canistered fuel or vitrified high-level waste, but also having a very rigorous approach to revising the technical requirements so we've got full pedigree whenever the next repository development effort is undertaken.

We are looking forward to the recommendations of the Blue Ribbon Commission as well as the Secretary's reaction to those, as appropriate. We also agree, as Dr. Lyons said, that any future repository system needs to be based on consent. We have great experience with the WIPP facility, and as our national transuranic waste repository and our successes there would not have been possible by any stretch without the support of the Carlsbad community and the state of New Mexico. We are well aware that Governor Martinez in New Mexico has expressed some support for some potential future missions for the WIPP area, and we have been in discussions with our colleagues in other elements of the Department to figure out what additional research of salt might support some revised or expanded mission for the WIPP vicinity.

And, bottom line, we are fully committed to meeting our compliance commitments. We do have a number of compliance commitments to the state of Idaho, to the state of Washington, and to the state of Savannah River, regarding our tank waste and fuel inventories, that there is some uncertainty about how we will ultimately meet those, but we're engaged in looking at alternative strategies, as appropriate, to ensure that we can continue to meet them. And that may involve shipment of waste offsite for interim storage; it could involve investments in a replacement repository for defense waste. All that remains to be seen, but we're very busy working with our colleagues and our stakeholders in those states.

Thank you.

GARRICK: Thank you.

Questions from the Board?

Andy.

KADAK: Yes. Thank you for your presentation. I was particularly interested in your last comment relative to still able to meet the commitments. I think Idaho is 2035?

GELLES: Yes.

KADAK: Are you looking at an independent repository solution for your waste streams versus the commercial waste stream to be able to meet that commitment?

GELLES: I'm going to be careful about how I answer this. Are we looking at it? We are evaluating the merits and the potential advantages as well as the programmatic impacts of proposing that the Administration revisit its current policy for comingling of defense and civilian wastes, so we are looking at elements of that; however, there has not been an Administration's position on that yet. We are, again, awaiting the Blue Ribbon Commission's recommendations. I think they were a little bit open to the possibility of a separate facility. We most certainly have a need for the development of a repository that can accommodate the defense waste inventories, and I think all of you are aware that the Yucca Mountain Repository would not have accommodated the entire inventory of EM owned high-level waste. Could potentially have accommodated all of the EM owned spent nuclear fuel, but the rate of receipt may not have supported us meeting our compliance commitments, given the delays that the Yucca Mountain Repository Program had incurred. So, given that there is uncertainty about a future repository, we are taking advantage of the opportunity to make some recommendations about what pace a future repository would have to be on and what acceptance criteria we'd need to have in order to fully accommodate all of the EM owned waste streams that we could completely comply with all of our regulatory commitments.

KADAK: Are you concerned about making waste that has no place to go at this point relative to the characteristics of the glass and so forth? I mean, the whole engineered barrier system, is that what you're going to ultimately rely on then given a waste form?

GELLES: Most certainly we are concerned about generating waste forms that cannot be disposed or could not be disposed in some, you know to-be-designed repository, but because we have such great knowledge about the waste forms that we have generated to date, and they were generated in compliance at the Yucca Mountain acceptance criteria, the anticipation of the Mountain acceptance criteria in the NLA, that we--you know, we believe as long as a future repository system can provide a system that is acceptable of those waste forms, we will have no problem. I think that it's very feasible to me that we can design a repository system that could accommodate the existing waste forms as well as some of the optimized waste forms that we are contemplating in the future. And, again, that's why we're retaining the existing high-level waste requirements that were specified for the RW system so that we don't create some uncertainty about our existing glass.

Did I answer your question?

KADAK: Yes, yes, fine.

GELLES: Okay, thank you.

GARRICK: Yes, Ali?

MOSLEH: Yes, Mosleh, thank you for your presentation. Would you elaborate more on the third bullet that you have in terms of what form this sharing of experience is?

GELLES: Yes. I mentioned the Tank Waste Corporate Board, which is one entity that's comprised of both our federal leadership and our contractor leadership from each of our tank waste sites and the contractors involved, because in some cases there's multiple contractors involved in our tank waste management systems at our DOE sites, they get together and they share information on program plans, share information on the challenges they're experiencing. Most certainly if they have retrieval experiences, obstacles they encounter where there are truly lessons learned and may give strategies that have to be employed, that's a critical component of the Tank Waste Board sharing experiences. But the Tank Waste Enhancements Program, which I touched on and that Ken will elaborate on, is a very robust effort to bring together the National Laboratories to team on certain technology ideas, whether it's advanced retrieval technologies, or advanced melter technologies, or alternate waste processing techniques; it could be technetium treatment, technetium capture, and then some of the waste disposal questions that a modified waste form would present. Those are dealt with in earnest through this tank waste strategy group that's been convened, and it comprises our site contractors, expertise from the National Laboratory, some of which is in the back of the room today. And we have some consistency in our current contractors. We have URS present at all three of our tank waste sites, so there's some natural sharing of experiences throughout that corporate entity that we can leverage as well.

GARRICK: Can we go to Slide 9, please?

GELLES: I can try. Whoops. There we are.

GARRICK: Your mandate is an impressive one; it's just hard to get your arms around an annual budget of around $200 billion. And, so, you have tremendous responsibility and you've had some very impressive successes, but if you look at curves like this, I would be very curious as to what gives that curve real credibility. And what I'm thinking of is if you produced that curve over the last three decades, would that give that curve--enhance its credibility? In other words, how is this cost--and the Board does not have cost in its mandate, but it certainly has an impact on the success of the technical activities that are a part of the process.

Would you be able to reproduce that curve as a function of time, say over the last three decades? And would it look like that, or would it have a clear resolution as to what was the basis for--and I suspect the growth of the curve?

GELLES: That's an excellent question, and I'm going to answer it as honestly as I can. I'll preface it by saying that I've been with the Department since '93, and the first six years of my career were spent with the chief financial office as the budget analyst for the Environmental Management Program. And since '99, I've been with the Office of Environmental Management at headquarters, so I'm pretty familiar with all of our strategic planning efforts and our projects.

GARRICK: So I'm asking the right person.

GELLES: I believe you are. Although strategic planning is not my responsibility per se, there's a whole office set up for that, but we do support it and are engaged in it.

This is the most credible curve that we've ever had. We could generate what the curve looked like not three decades ago, but maybe a decade ago.

GARRICK: Okay.

GELLES: Ten years ago we could give you a version of this. It would have not been informed by the bottoms of detailed project plans that are in place today. To a large degree, we were relying on M&O contractors at all of our tank waste sites. We didn't have life-cycle plans across the complex for all of our activities. To to a large degree, key elements of the waste treatment system had not been constructed. And that still remains true today if you think about the waste treatment plant being such a large component of that, but we at least have a facility that's greater than 50 percent complete, and we have a sense of what the total project cost and schedule will require. So, we've gotten better at our planning. I think even five years ago there were some unrealistic assumptions within our project plan, so I would say that a curve drawn five years ago would not be as credible as this one. This one, though, still assumes a level of funding that we're not going to see, so I have--I don't want to describe my confidence in this curve as high. I do have confidence in our strategic planning effort that's underway now, though, to identify how we can change this curve and retain as much credibility as possible. Which, you know, at my core I'm a project planner. I mean, I believe that you have to use just core project management principles in planning a program of this complexity to have any sort of credibility. So we are going to continue to try and refine this as best we can.

GARRICK: Which of these components would you say has the greatest volatility or the greatest uncertainty?

GELLES: The tank waste component most certainly. The facility D&D in soil and groundwater has volatility from the standpoint that to a large degree the exact remedy is to be determined, because we haven't reached final remediation decisions at most of our sites. And to a certain degree, those are the last activities that are ever performed at sites. I mean, we'll have to remediate the soil and groundwater around the tanks when we ultimately empty all of the tanks, and we've got--that's the longest duration activity within our program. So, there is volatility there, but the relative technology changes there carry a smaller cost differential, and the relative reliance on innovation is lower. So I think the greatest magnitude for change is in the tank waste component as well, which is why we are spending so much time and effort on the enhanced tank waste strategy that you'll hear Ken talk about this afternoon.

GARRICK: All right. Thank you. Thank you very much.

Any other questions?

KADAK: Can I ask one more?

GARRICK: You may.

KADAK: On the Hanford Waste Treatment Facility, I've heard the design isn't yet complete and the processes that have proposed may not work in terms of high-level waste form. Can you just comment on that and how far and how much over budget is it right now?

GELLES: Okay. I'm going to reserve the most detailed answer to Ken--

KADAK: Okay.

GELLES: --and I'll be sure to mention before he gets here that you're going to ask him that--

KADAK: Okay.

GELLES: --so he's prepared. The facility is not 100 percent complete in design, and it is a design build. We're trying to keep the design substantially ahead of where we are in construction, but there is still a little bit of design remaining to be complete. I think we're over 80 percent design complete. And if any of my colleagues in the back know the actual number, please shout it out.

In terms of total cost, that's a challenging question for me right now, because we have a total estimated cost of the project that is still potentially viable and yet our project, which receives a lot of oversight and support from other elements of the program, including the Office of Engineering and Construction Management. They've recently coded this project "red," meaning that they anticipate that some of the risks that we have been carrying on our risk register are going to be incurred, and for that reason that the cost is likely to increase. It's not exactly clear to me, and Ken is the cognizant authority on this, whether or not we have concurred that we're going to incur those costs.

A lot of what you'll hear him talk about are the efforts we're taking to try and bring the project in on cost and on schedule.

So, we've got real risks we have to deal with. There are some uncertainties about elements of the system, but I believe that the system is well designed and will perform. It's just we may have to work out some of the bugs, as we always have to do on these one-of-a-kind treatment systems. We're experiencing that on a much smaller scale with the Sodium-Bearing Waste Treatment System now. I mean, these are robust first-of-kind treatment facilities that are massive undertakings, and we're dealing with highly radioactive waste streams, so we have to put the safety first, and sometimes it just takes longer to work out those details.

KADAK: Is decommissioning of those facilities included in these cost estimates?

GELLES: They're intended to be, although I'll tell you that that is the one element of the facility D&D curve that's probably not fully articulated at this time.

GARRICK: Okay. Thank you, Christine.

GELLES: Thank you.

GARRICK: We're going to get another change to question you a little later in the day.

GELLES: I so look forward to that.

GARRICK: Thank you very much.

Okay, we're going to take a 15-minute recess.

(Whereupon, a short recess was taken.)

GARRICK: Let’s reconvene the meeting with the Honorable Monica Regalbuto.

REGALBUTO: Well, good morning. And I just want to express my thanks to the board and the staff for inviting me to be here today.

You heard from Dr. Lyons the presentation related to an overview of the Office of Nuclear Energy, specifically as it relates to Objective 3 of the Roadmap, which is Sustainable Fuel Cycles. What I'm going to focus on is more on the integration that we conduct within the Office of Nuclear Energy and also within other offices of the Department of Energy as it relates to Fuel Cycle research and development we do. In addition to that, the last part will be pretty much an introduction, and I will also touch throughout the presentation, how do we use system analysis as a tool for integration and optimization and Roald Wigeland will be presenting for you right after my talk; or if you want to do questions in between, that will be up to the Chairman.

First of all, just a quick reminder, Dr. Lyons covered the mission for the Office of Nuclear Energy. I just want to present a little higher roll-up from that. The Department of

Energy released a strategic report the last calendar year, and we basically support the Department of Energy's mission, which is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges. We specifically support Goal Number 3, which is secure our nation, and that implies enhancement of nuclear security through defense, nonproliferation, and environmental efforts.

Of note is that also supporting Goal Number 3 is the Office of Environmental Management and it's also NNSA. So you will see that there are some natural synergies that the three offices have as we all support the same goal, and I will present that towards the last part of my presentation.

Dr. Lyons covered advance nuclear power, and I just want to remind you that Objective 3 for the fuel cycle research and development is the development of fuel cycles, sustainable fuel cycles. When the Roadmap was originally done, the emphasis on used fuel waste management strategies was not completely imbedded as it was still being transitioned from the Office of Radioactive Waste Management from the old OCRWM, so we have had added it to our mission statement just to emphasize that that is also part of our mission. Of course, we do this by improving resource utilization, minimize waste generation, improve safety, and limit the proliferation risk.

On the right-hand side you're going to see some of our program objectives. This is very grossly lumped as Near Term, Medium Term, and Long Term. In the near term, to no surprise, it is down select of the fuel cycle options for further development. Similar to the Used Fuel Disposition Program where we're still looking at a number of options for disposal, in the area of Fuel Cycles we're still looking at a large amount of Fuel Cycle options; and, of course, we have a lot more options to look at compared to disposal. So that is why we do the System Analysis and Integration Program to narrow it down to a number of feasible alternatives that we will be looking at. Notice that this alternative is a down selection that allows us to concentrate unlimited research and development funds. It is now an elimination--or completely endorsement of certain areas, and Roald will be describing that a little bit more in detail. This is basically to provide options that weigh the pros and cons of doing each of the fuel cycles. There's been a preliminary screening, and some of those options have already been either lumped in groups or completely eliminated, and Roald can comment to that during his presentation.

We also have an increased focus on accident tolerant fuels in the near term. This is really after the results of Fukushima. And John Herczek, who is sitting in the back and many of you know, in addition to Sal Golub from the Office of Reactor Technologies, are leading this effort;

and we are at very, very early stages in which we're still just planning. We are going to be holding workshops and coordinating with industry and other stakeholders, including universities, of how we're going to develop this initiative. So we are at the very early stages; and if you have any good suggestions or ideas, I suggest you talk to John Herczek, because this is at the stage that we're in, which is the planning stage.

In addition, addressing BRC recommendations for used fuel disposal, this in the near-term action. We do have a deliverable for six months after the last--after the final report is out on the response of the Department of Energy to this area.

In the mid-term, we're looking more at conducting R&D at a much more select and down select of fuel cycle options, working on the implementation plan for the Test and Validation Complex for extended storage of used fuel--and you will hear the usual disposition group talk about that--and we're also evaluating the benefits of the various geological media for disposal.

In the long term, which is 2050, we're really looking more into completing the demonstration and engineering work that is supporting the medium and the near term objectives.

The Fuel Cycle R&D has key strategic linkages that support the four NE objectives, and those four objectives are shown outside of the circle in here. So this is what you will see on the Roadmap and Dr. Lyons covered in detail, specifically, he was addressing Fuel Cycles. In the middle of the circle I have listed a number of areas that we use to conduct strategic linkages. And rather than--this is just a snapshot, and I just want to give you some examples of the areas that we do. Obviously fuel management, accident tolerant fuel, advanced reactors, fuel resources, spent separation, secondary waste development, and some of the special nuclear materials protection and accountancy.

But I prefer to view this in the context of the fuel cycle, which I will be showing you on the next slide, so this is in line with--okay, there we go--this is in line with this report. But, you know, if you're a visual person, you probably can view it better as it relates to the fuel cycle overall. This also addresses some of the integration areas that I was asked to talk about today.

How do we achieve integration within the Office of Nuclear Energy? We do that by focusing on working towards an integrated fuel cycle approach, and I will describe that. This is a very simple diagram, but obviously it is a very complex thing to do.

First of all, I will mention the three federal directors that work into this area. That's Andy Griffith, who is Fuel Cycle--traditional Fuel Cycle R&D, and he's someplace in the audience--there is his hand--Rob Price, who is in charge of the System Analysis and Integration--he is in the front row--and, of course, all of you know Bill Boyle, who is in the Used Fuel Disposition area.

Okay. So one thing that I like to emphasize is that this is the first time that all the Fuel Cycle is in the same Office of the Department of Energy; and that may be very simplistic, but it's not that simplistic for somebody who works in a large organization. All of you know that OCRWM was in charge of some portions of the back end, which included interim storage and disposal, but some of the back end areas such as Recycling of Fuel, Separations, you know, building the recycled fuel, and Secondary Waste Treatment used to be part of the Office of Nuclear Energy. So even in the back end we were not completely integrated.

In addition to that, since the last time we seen each other, I believe, Uranium Resources has moved to our area, which is NE5. And in Uranium Resources, in addition to looking at the innovative approaches, as Dr. Lyons mentioned in his presentation, like uranium from sea water, we also look at conventional production. In the area of fuel fabrication, we look at enhanced LWR fuel and also at high-performance fuel like high-burnup materials; and we also look at, you know, advanced fuels, for example transmutation-type fuels.

In the area of Reactors, it's shaded in gray, because the area of Reactors falls outside of my office, which is Reactor Technologies, but we work together in coordination with them, and that's John Kelly's area, and Sal Golub is his deputy, who is the one leading the effort with John Herczek. So Reactors is shaded in gray just to note to you that it's outside of my area of expertise, but there are folks in here who are working in that area if you were to have some questions.

In the area of Interim Storage, we're looking at evaluation of extended time frames and transportation after storage. Recycle is separations obviously, recycled fuel fabrication, secondary waste treatment. In addition are some other critical areas like stabilization of damaged fuel and so on. And disposal, we're looking at alternative geologies and alternative waste forms.

These are just some highlights of the program. It is not meant to be inclusive of every single thing that we do, but I just wanted to list to you more or less a little snapshot of what the fuel cycle is currently under the Office of Nuclear Energy. In addition to that, we optimize through Systems Analysis and Integration, and you probably noticed that that covers all the areas including the Reactor part.

I understand and I have read many of the Board studies, and I know that the Board has championed a system approach for fuel cycle technologies, specifically as it relates to linkage among all elements. But our challenge is pretty big, and it is a little bit broader than just research and development.

One of the things that I usually have in conversations with my colleagues that work in the international area is how we all have to share the same pieces, but we do not have the same strategy and goals. And one of the things that surprises people--I, you know, clearly remember one conversation with my colleagues in the UK where they finally understood why it didn't make sense for us to do some of the things that were done in the UK. And the model is--it's a little bit different in the United States than it is in some of the other countries, especially those that have different forms of government that are more socialist, for example.

One of the things that is important to note is, for example, that these three first parts of the fuel cycle are really run by private enterprises in the United States. They are not run by government organizations. What we run as a government organization is the back end. In some countries spent fuel is the responsibility of the utilities until it goes to the disposal site, so until you get to this area. In this country it is right here.

So when we do economic analysis, when we do some comparisons, even though we have the same parts, the optimization is not as straightforward as it is in other countries. One example, for example, in Uranium Resources--I'm showing you a very simplistic box in here--but we do have multiple industries even in Uranium Resources. We have mining, we have enrichments, all run by different corporations, different parts. Fuel Fabrication is run by different entities; Reactors is run by the utilities. So when I speak to my colleagues overseas, for example, they say, well, you know, our economic analysis shows that we can stand to do a fuel cycle total cost benefit, and in our case it doesn't work that simple, because a benefit sometimes in the back end causes an increase in costs in the front part, and that is run by two different entities. So in countries where it is usually the same entity--take France as an example--even though they are different, they're still government owned, there can be a compromise quickly reached that if there is a benefit in the back end at the expense of some on the front end, then, you know, people move forward with that, and a policy is developed.

But, in our case, you're looking at two different parties. You're looking at industry and government responsibilities, and they don't align together, especially if we don't have a national policy of how we move things. So that is one of the challenges that we face as we do some of the integration. We integrate to the extent that it's possible, but we cannot force utilities to do something that is uneconomic for them for the benefit of the back end unless there is a national policy that addresses that.

In other countries like France, that can easily be done. For example, MOX is a typical example of critiques that you hear back and forth on economic analysis and who does what and how much waste minimization is done and so on and so forth. But the benefit of MOX in France is, in the whole fuel cycle they have it worked up to the last level of detail, in which exactly how much amount of fuel is worth it to be recycled or not--they don't recycle all their MOX--how many passes and so on; but in this country we are detached in that area. So that's the one area that I'd like to point out as we present the integration of the fuel cycle in the context of the United States.

Even though you see the different pieces of the fuel cycle, we align ourselves in different areas in terms of the fuel cycle, and it's probably five different areas that we call our technical focus areas. The first one is Fuel Resources. The next four, in addition to Systems Analysis, which is shown in the bottom, are what you may have been heard is the traditional fuel cycle R&D campaigns. So you have Advanced Fuels, Separations and Waste Forms, Materials

Protection, Accountancy and Control, and Used Fuel Disposition all being coordinated and integrated by the Systems Analysis and Integration campaign.

This campaign is listed separate, but it really falls for administrative purposes underneath the Separations and Waste Forms, because it's a very small effort. We do have some work on conventional production, a very, very small effort being done by Los Alamos in terms of some green mining development. And I think I saw Bruce Robinson in the back someplace there, and he is a young staff member who is working, in addition to our forms, with some forms from the State of Wyoming that are looking at some more green technologies for mining, for example.

Dr. Lyons talked about some of the integration approaches, specifically as they relate to some of the recovery of uranium from sea water, but those, again, are small efforts, so for administrative purposes are run by Separations that, you know, some of the technologies are of benefit of Separations.

Advanced Fuel, we're working on development of the next generation of light water reactor fuels to improve operating margins, accident tolerance, and high burnup; and we're also working on development of transmutation of fuel that has a high degree of tolerance for accident conditions and also represent advances in resource utilization and reduction of waste.

Separations and waste forms is probably the area where we have the most natural intersection with EM, and you will be hearing about that in the next couple of slides. We've developed the next generation of Separations and Waste Management technology that enable sustainable fuel cycles. Andy asked a question a little while ago, What is new? Obviously the new part is reduction of secondary waste as to maximum extent possible and also trying to look at things that are--in terms of proliferation resistance, I would like to develop streams throughout the process that are more easy to be monitored. We're not, you know, doing proliferation resistance per se, because it is a separations process after all. But one of the differences is, we do have a mixed stream of transuranic material like separated plutonium, for example.

We also work on fuel disposal conditioning techniques, and what that means is we look at stabilizing fuel that has been compromised. This is fuel that we stabilize and not necessarily--is not necessarily scheduled with recycling. So one thing that usually comes to mind when people think about separations and waste form development is they associate that campaign with recycling of spent fuel, but that's not really all that that campaign does. We do a lot of stabilization of waste streams that are not necessarily scheduled for recycling.

And the last bullet, of course, acknowledges the fact that we do work in recycling technologies with the goal of minimizing secondary waste and potential for material diversion.

In terms of Material Protection, Accountancy, and Control, this is an area--oh, I'm sorry, I should back up a little bit. In the area of Separations, we also interact very closely with NNSA; and you may question why that is their interaction, but that is the area of medical isotope production, which is a GTRI program, has many of the same separation challenges, especially as it comes to the recovery of material that we do face in fuel cycle R&D. And I'll touch on that, too.

Obviously the next box, which is Material Protection, Accounting, and Control Technology, it is very well aligned with NNSA, and you may question where the difference is between what we do and NNSA does. It's pretty simple. We work on advanced fuel cycles where we do have a mixed stream of transuranic materials. We don't have pure plutonium streams anymore, which those represent a different challenge when one is trying to do some instrument development and signals that are being masked by the presence of other actinides and some of the fission products.

In the area of used nuclear fuel, I will not cover that. You all are extremely familiar with that. And Jeff is going to be giving you an update on that.

And Systems Analysis and Integration, I highlight it in yellow, because Roald Wigeland will be presenting after me. The Systems Analysis and Integration effort, as I mentioned from the federal side, is being led by Rob Price, and from the laboratory side is Roald Wigeland and Tammy Taylor, who is sitting in the second row with us.

So I have provided an emphasis on focus areas, but these focus areas will likely change, and one thing that will cause this are the key challenges to succeed and the out year’s considerations. I have listed the two most important ones, at least for my program, and that is the Blue Ribbon Commission recommendations and the events of Fukushima. For the Blue Ribbon Commission, recommendations could lead and likely will lead to near-term program shifts and a major restructuring in the longer term. We also are bracing for the potential to consider interim storage and associated transportation to centralize storage facilities, which has not been done for a number of years during the Yucca Mountain program. There is extensive work that was done before that, and we are prepared to use that information to address the recommendations of the Blue Ribbon.

In terms of Fukushima, it may lead to the shifting of the program priorities; also as we deal to reduce some overall program funding that you will be seeing. And, in addition, there is a severe accident tolerant initiative that I have mentioned already.

This year we will be conducting some relevance reviews in two of the different campaigns. One will be Separations and Waste Forms, and the other one is Fuels. A relevance review is something new that we will be starting this year, in which every two years we will be reviewing our program and make sure that we are aligned with the priorities that need to be done, as some of the programs and initiatives throughout DOE change frequently.

In FY 13--yes, I'm sorry, 14--we plan to do used fuel disposition, and you will be hearing from that as we move forward after we do fuels and seps.

Before I go on into how we integrate with the different offices of the Department of Energy, let me just spend a few minutes on the '11 and '12 budget summary. Dr. Lyons presented the total NE budget, and we were one line in there, which you probably saw, and if you wrote it down, it was--the slide was 186 million dollars. Note that for the first time in a long time we are not under CR this year, which really makes things a lot better for us. It allows us to do some planning. We are still in the process of re-baselining and are conducting our planning efforts. That will not be completed until, like, February. Unfortunately, we missed the February FIM plan by the time all the last dollars had been done. You will notice a shifting on the dollars with an emphasis on Advanced Fuel and Used Fuel Disposition, as the language in the appropriation bill has instructed us to do, and that results in the reduction on Separations, Systems, and MPACT, which is the safeguards area.

Another area that you may see zero out is Transmutation R&D. That's basically a collection of cross-section-type data, and that has really folded under Advanced Fuels. In the area of Modeling and Simulation, the delta that you see in there, which is about roughly 10 million dollars, did not disappear; it just got reallocated into a crosscutting area that we do with the Reactor Technology group. So that's not a delta; it's basically money that has been shifted to another line item in the appropriation bill.

Okay, so now let me just quickly touch on how we do some of the integrations within the other offices. We discussed how we integrate within NE, in which the System Analysis group has a big role in doing that, so we discuss some areas in here. I listed a few other things just for completion. We do heavily integrate with the Reactor Technologies and also with the Facilities. In Dr. Lyons' presentation in the org chart you see that as different boxes, and my little last bullet unfortunately got cut out, but there is the international program that should have been listed here, and that is Ed McGinnis's area, which, unfortunately, got cut out of my text box.

In addition, we also coordinate with other offices within NE, and not shown in this slide is coordination outside of the Department of Energy. Specifically listed in here are NNSA and EM, which I told you share the same objective and the same goal, which is Goal Number 3 from the DOE strategic map. And the Office of Science, you know, we clearly closely interact with them, as we have a number of areas that are very similar in terms of the kind of technical work that is being conducted, and we leverage work that is done in the Office of Science. Office of Science has a more discovery mission as related to NE, NNSA, or EM, so we have successfully used some of the work that has come out of the Office of Science in many areas, including EM and NE.

Specifically, one example that comes to mind is the development of the BOB Calix, which is the solvent that we use to recover cesium from either tank waste or spent fuel or, you know, accident recoveries from some of the leaching soils. That work was done--the fundamental work to develop the BOB Calix was done by Bruce Moyer, funded through the Office of Science, so you can see how we have incorporated. So we work very heavily with the Office of Science results.

And I have as many stories on modeling and simulation--because that's not my forte; I'm a separations person--but there are similar examples in some of the high-performance computing codes, specifically as they relate to the platforms that everybody uses, and then we do the technical plugging into those platforms. Nuclear physics is another area.

So one of the other areas that is--you see in NNSA some of the safeguards work. You see in EM some of the disposals and waste forms, and you see in Science, you know, different areas that I've listed. One of the areas that I would like to show to you as an example is separations. I mentioned in NNSA we have the medical isotope production program, EM has the tank focus program, and Science has the heavy element chemistry, and we have the separations campaign. We all have similar technology needs, but we have very different missions, and what time of development the different things come is really what differentiates the scope of work for the four different organizations.

In July of this year we conducted a separations technology workshop where all organizations worked together to help identify crosscutting needs for DOE in the area of separations technology with the goal to expedite development and examining opportunities to leverage our R&D work across DOE. Needless to say, many of the scientists that work in all four different areas know each other, and it's a very,

very small community, but we do have different missions, and we also have different areas that need to be closely coordinated. The report is available on the website, and I think Jeff may have a link that can be provided to all of you if you're interested in reading the results of that work. That was a very successful workshop. We have an incredible participation from universities, industry, and the national labs in all four different offices; and we were very pleased. This work was championed by S2 and really came out to be one of the best work that we have done this year.

So, finally, as we seek towards working an integrated fuel cycle approach, one of the tools that we rely heavily is on system analysis and engineering studies. Roald Wigeland will be presenting after me, and I just want to give you a little snapshot of what he will be presenting. Obviously this will help us evaluate and screen the process, and the goals are to provide systematic and objective processes to prioritize our research and development activities and to also inform programmatic decisions. This is a very simplified nuclear system, not even as complicated as my simplified fuel cycle, little box diagram that I show you, but you can see some front-end options that are being taken into account. Some of the nuclear power alternatives we're benchmarking from once-through all the way to recycling. This includes work in reactors, fuels, processing and reprocessing, waste production, storage, and ultimately leading to the final disposal in the different types of media.

So, with that, this is my last slide. Roald is the next speaker. And, Mr. Chairman, how would you like to do questions?

GARRICK: I think we'll postpone it until we have Roald's presentation.

REGALBUTO: Okay.

GARRICK: That's the way it's shown on the agenda, so we'll follow that. So we'll hear from Dr. Wigeland first.

WIGELAND: Thank you. I would also like to thank the Board for the opportunity to discuss this project this morning and make a presentation on this. I'd also like to thank both Pete Lyons and Monica for introducing the subject as well as the context in which to understand this topic. I'm going to talk about the projects we have underway on looking at nuclear energy systems and the evaluation and screening that we're doing to inform R&D directions going forward.

Now, as you've heard this morning, one of the main objectives in the program is to develop the sustainable nuclear fuel cycles; and what I did here is provide a quote from the Roadmap, the DOE Roadmap. They wanted to emphasize improving uranium resource utilization, maximizing energy generation, minimize waste generation, improve safety and limit proliferation risk. Those are many things to look at.

What we are developing is what we call a Nuclear Energy System Evaluation and Screening Process with the goal of identifying what we call the most promising options for sustainable nuclear fuel cycles. It's important to understand that in this process we consider the nuclear energy system to include everything from mining through disposal, so it's the entire process, the entire system. The evaluation will be done based on the performance of this entire system with respect to performance metrics, and I'll discuss that in a minute. Once these have been identified--once the most promising options have been identified, we use this--the intention is to inform R&D on technologies--the supporting technologies going forward.

Now the criteria--the evaluation criteria that we're working from, some of them are given in the definition for a sustainable fuel cycle, but there are certainly many others. Economics is a very important one. Another one that doesn't get mentioned that often is how much R&D is needed to bring a particular concept to maturity; and if it's just unbelievably expensive, this would not weigh favorably for developing that option.

Behind all of these, of course, are environmental impacts. Many of these criteria have environmental aspects to them. The key to the whole process is developing relevant performance metrics, and that is being developed with the FCR&D program by all of the campaigns, as well as having input from external stakeholders; and these include industry as well as other parts of the DOE, in particular, for example, NSA when it comes to proliferation and security issues. The purpose of this is to allow an objective comparison between the different nuclear energy systems and to be able to explain to people why the most promising options are what they are and what they might potentially do.

Currently in FY12 the development of this process is underway. The intent is to have this study consider all conceivable nuclear fuel cycles, and that's a tall order, so showing completeness is one of the jobs that we have. In order to do this properly, once we have the performance metrics defined, a significant amount of detail analysis will be required to support the evaluations. Now, of course, we're not going to analyze everything that we identify as a fuel cycle. It is possible to group these with fuel cycles that have like characteristics, so it turns into a more tractable problem, but that is another one of the areas that we're working on this year. At the end, the process and the results will be documented, they'll be independently reviewed--and this is a very important aspect--and publicly available. Our target date for this is a report March 31, 2014.

Now, I'd just like to briefly describe what we mean when we talk about our nuclear energy systems. There are two basic types of nuclear energy systems. This slide shows the once-through nuclear energy system. And the schematic at the top shows the major pieces in a once-through system, and it's color coded. The color coded part, the left-hand side in blue, shows the part that has already been implemented in the United States. The right-hand side in yellow shows the part that has not yet been implemented, although work has been ongoing in that area for some time. When we look at once-through systems, including today's use of nuclear energy, we have a number of issues. One is the continuing storage of a growing spent fuel inventory. We also have the evolution of fuels, the high burnup fuels and potential for advanced fuels, including the accident tolerant fuel that you've heard about this morning. There is also the potential for other fuel types.

An underlying question here is: How would extended storage affect the rest of the nuclear system? Does it have aspects that affect, for example, disposal? There is also the possible deployment of reactor alternatives. As we sit here today, the American industry is centered on LWRs; but, as you know, there is a lot of effort in SMRs. There is the NGMP project, which is looking at VHTRs, which is a very different kind of fuel.  Geologic disposal still needs to be implemented, and I think there's the question:  What is the impact of alternate disposal system environments?  Is there a synergy between what happens in the power generation part of the fuel cycle and the potential disposal environment?  And at the end can we identify more promising sustainable nuclear fuel cycles within the context of once-through nuclear systems?

The second one schematically shows recycle nuclear systems; and in this case the difference here, of course, is that the spent fuel that's discharged from the reactor is considered for reprocessing and recycling one or more times or even on a continuing basis.  And what you see again is that in this case the blue squares would be the mining and milling for uranium and uranium enrichment.  The green represents possible alternatives that could be implemented, and they include different kinds of reactors.  Spent fuel may still be generated in this process, so you don't have to process all your fuel.  That's fuel that we would consider as waste.  Used fuel is typically described as fuel that has value, and that would be reprocessed.

The question here is:  What is the potential for recycle systems?  Does the spent fuel have a value that can be recovered by reprocessing?  Are there operational and storage issues?  Are there environmental issues with this?

One question that is a very important question: Does high-level waste disposal offer advantages over spent fuel disposal, or does it really make any difference? What about other fuels? I'm sure everyone in the room is familiar with the proposals for using thorium along with uranium in the fuel cycle as a way of resolving some of the issues.

There are a very large number of options for recycle systems. They include limited recycle, after which you would dispose of the fuel; there's continuous recycle where the only thing you would dispose of is high-level waste; different reactors and fuels; use of extended storage both after your processing and your fuel cycle activities, but also within the fuel cycle itself. And, again, the question is: What are the most promising alternatives back to the definition of what we're looking for for a sustainable fuel cycle?

For this process to really be valuable for us, the process must be credibly comprehensive; and so the performance of all potential sustainable systems must be represented for both once-through and recycle and uranium-based systems as well as uranium/thorium-based systems. The evaluation criteria must cover all of the stakeholder interests: waste management, resource utilization, proliferation and physical security, economics, safety. Most of these are in the definition of a sustainable fuel cycle;

but, as I said, it goes beyond that. The process must be able to identify these most promising systems, those that are best able to meet the requirements.

This slide shows schematically how we're approaching the evaluation process and, again, in the spirit of making the problem a tractable problem so that we can meet our time schedule. The nuclear energy system is broken down into three major components. The front-end options, which includes a wide variety of things, but in principle you could start with uranium resources, and you could add thorium resources if you like. There are also the other front-end processes that are involved, but mining can also include alternative ways of obtaining uranium. Pete Lyons this morning mentioned uranium from sea water.

The center box is the nuclear power alternative. That's the part of the system that actually gets useful energy out of the use of nuclear power and includes reactor storage, fuels, processing/reprocessing if that's used, waste production, and extended storage. The box on the right is where we consider the disposal options, and we have a wide range of disposal options available to us for consideration. Some of those are listed there. And in the process what we'll do is we'll evaluate each of the nuclear power alternatives with each of the front-end options as well as the disposal options as appropriate. Some of them don't match, but most of them do.

And the point here is to identify if there are beneficial or detrimental interactions between these pieces. It's also important to note that waste disposal, although the focus many times is on what are we going to do about (FILL IN) disposal, there is still low-level waste and hazardous waste that can be generated, so all of those must need to be considered as well in the environmental impact part. Our intention is to use objective quantifiable metrics wherever possible. We do this to reduce the uncertainty in the results. The results are then more easily clearly documented and communicated. Communicated is a very important aspect of this process, and it will facilitate the independent review.

After we have the evaluation done where we get all of the information about the performance of the fuel cycles, the next part is to then screen them. What do we think are the most promising ones? We base this on the performance of the evaluation criteria, and I think there are many questions here that we are trying to answer. Do the alternative nuclear energy systems offer promise in addressing the issues represented by the evaluation criteria? How well can they achieve the goal of sustainable nuclear fuel cycles?

The second question is: How much improvement can be obtained? This is a very important question. For some of the criteria even a modest improvement, say in the area of economics, would have a significant impact. In other areas it's necessary to achieve very large changes or very large improvements to have an impact.

A side issue here is: What is the value of the performance improvement? And that's: How much is that change in performance worth in the context of the system? And, as I said, if we could reduce the cost of the system by 10, 15, 20 percent, that might be a very big issue. When we look at other parts of the--other aspects, other criteria, it may require us to make an improvement of an order of magnitude or more for it to be worthwhile.

The second major bullet here, this is very important going forward. Policy guidance really determines the relative importance of criteria. The statement on sustainable nuclear fuel cycles reflects what we believe is required to achieve sustainability, but history shows us that the relative importance of these criteria evolves with time and events. Certainly, for example, the Fukushima event has raised the issue of safety higher than it had been in some years. The intention in the process is that we intend our results to show the effects of possible policy choices. We will be able to explore what it means if you make certain policy decisions and how that would affect your identification of most promising options. Do you get the same set of most promising options, for example, if you vary what is important to the policy makers?

The most promising options then identified with this approach are used to guide and focus the R&D directions and priorities. Of course, the goal here is to end up with a much smaller and focused number of systems that we would support. That would then allow us to define the functions and performance goals for the supporting technologies, which is really how it ties into the R&D campaign.

So our schedule, as I said, in FY12 we are developing this evaluation process, including the data, the metrics, and the approach to support the planned 2013 screening. In '13 we will do the screening process to identify the most promising options. We hope to inform on the effects of extended storage, both as it may be used in a once-through fuel cycle or as part of a recycle approach and also to inform on the effects of the different geological disposal environments and how that may interact with the other parts of the fuel cycle.

Subsequent to this, we intend to then work on the identified subset of most promising nuclear energy systems. We will assist in the technology evaluations and assist in evaluating the effects of the achievable performance versus what we set forth as requirements. We will also begin looking at other issues, including how best to transition. If we identify new nuclear systems compared to today's system, how would one best transition to that? Transition is always possible, but optimizing is certainly an important question.

And that concludes my presentation.

GARRICK: Okay. Yes, Bill?

MURPHY: Bill Murphy of the Board. I don't know exactly who to address this question to, so whoever feels the inclination can respond.

I noted in the first presentation that a near-term objective was to address the BRC recommendations, and we saw earlier today in Dr. Lyons' talk that one of the recommendations--where was it--one of the recommendations was the prompt development of a geologic repository. And my impression of the talks we just heard was that the response to that recommendation is to ignore it, because I saw nothing on site selection or site characterization discussed. I saw a short list of alternative rock types, but nothing that addresses site selection or site characterization, which are hard problems, both socially and technically. From a technical perspective, which is our mandate, we were making giant discoveries at Yucca Mountain 20 years into the site characterization project. That's not something that is done easily. Where does site characterization fit into what you've described here?

REGALBUTO: Those are two parts. First let me address the prompt response to the recommendations to be received, because it is one of the requirements of our budget in the FY12 appropriation bill. We have a line item that says within six months the Department shall produce basically this Roadmap, which addresses the issues that you just mentioned, including the seven key recommendations, of which one is site characterization. There is still some--our inability to address some of those issues until BRC issues the final report. So, unfortunately, even though we know how to get started already, we cannot fully get started on that.

Regardless the area--you do keep on finding things. I think that was well covered and understood by all of us in the area, that we don't just take a snapshot of what is today, because as we keep on developing a site, you are going to find things that you need to address. And I think one thing that we may have not been very good at communicating to people is that, you know, when you go to a site, it's not what you find today and we're done. This is similar to EMs, many one-of-a-kind facilities, in which, as you learn more, you have to address more issues. And one of the things that I think we may have not done very correctly is to give the illusion that when we pick a system, it's fixed and ready to go. You know, we tend as a society to want some quick answer, and we don't. We learn and then we have to address the problem.

So it is an evolutionary type of approach. Obviously after X number of years, we do have to freeze a design and move forward. But it cannot be conceived that, you know, everything will be known from day one until you really start doing that. I don't know if Bill Boyle would like to address any other areas.

GARRICK: Howard.

ARNOLD: Arnold, Board. This Board has expressed its concern about integration in the back end of the fuel cycle as we've looked at it, but we have a more mundane view often, for example, the interaction between the choice of how you encapsulate the fuel and how you ship it and whether your choice is consistent with being able to package the fuel at the reactor site where it is now and things like that. And I would like to hear more about your addressing that more mundane level of integration.

REGALBUTO: Yeah, that is going to be addressed by Jeff Williams' presentation, so if you would like to hold that problem till then. This was the more--you know, we have so many integration levels; right? We have within Office, we have within DOE, and that we have outside of DOE, which is with industry and universities. And, of course, you're looking at one area within used fuel disposition, and Jeff will be covering that. So if you don't mind waiting after his presentation, it will be addressed then.

ARNOLD: Thank you.

GARRICK: Rod.

EWING: Ewing, the Board. So this is impressive in terms of the scale of the integration from the front end of the fuel cycle to the back end. I was thinking about the front end. I'm presuming then there will be an analysis and comparison, say, of traditional mining techniques, open pits, underground workings for uranium as compared to in situ leaching, which has really come on within the last few years and has a very different impact on the environment. Is that correct?

WIGELAND: Yes, that's the intention.

EWING: Okay. And so, given that and thinking about the full-scale integration, actually, from my point of view, if you look at the impact of uranium mining, that's one of the major impacts of the fuel cycle.

WIGELAND: Yes.

EWING: And it's very instructive, because it shows in some ways how minor the impact is at the back end of the fuel cycle. Looking through schedule, 2014 is on one hand a long time to wait for the report; right? On the other hand, given what you've outlined, that's barely enough time for the integration of everything. So why not consider a series of reports? It would be very interesting to have an analysis of the front end of the fuel cycle, the impact of in situ leaching, both on the environment but it changes the resource estimates for uranium, and issue a series of reports that finally have to be connected but would satisfy immediate needs in terms of evaluating the impact of an expansion of nuclear power. Have you thought about having such a series?

WIGELAND: Well, I think this year in FY12 we have a number of reports scheduled throughout the year. In terms of the results, as we go through FY 2013 and we start to get some of the answers, I think we have to wait and see how it goes to whether or not it's more valuable to people to have a report just on one aspect of the nuclear system or whether it really is best understood in the context of the entire system. I don't know that we know the answer to that yet, but certainly we'd consider it.

EWING: But just sitting back and thinking about it, it's hard to imagine that the alternatives for uranium mining will have much impact on the fuel cycle you select; right? You put uranium in the front of the fuel cycle and go with that.

REGALBUTO: Not necessarily.

WIGELAND: Well, for an example, you know, as you pointed out, uranium mining can have one of the largest impacts on the overall system. If we then compare that to a system where we don't have--say uranium from sea water works out and they find that it has very little environmental impact, for example, that changes the nature of the importance of that part of the front end. Now, let me take those two parts. If I'm taking uranium from some kind of mining that has a significant environmental and economic impact, the value of recycle, and especially recycle where you maximize your use of that resource, is very important. If, on the other hand, I have a uranium resource where there really isn't much of an impact and it's reasonably affordable, then one would view differently the value of maximizing the use of that resource in the system.

EWING: Right, I understand that, but what I'm saying is, the analysis comparing uranium extractions from sea water, in situ leaching, and underground mining, that can be done. You need that information anyway.

WIGELAND: Sure. Well, I think it will be.

EWING: Yeah, and I just--you know, it's just a thought. But, also, a lot of the groundwork is already done in the literature, particularly the recent Academy report on the impact of uranium mining in Virginia. They laid out all the possibilities. It would be a shame to wait so long for some of this information.

REGALBUTO: You know, you do bring a very good point, and I will tell you out flat the reason why, you know, the number of reports is shrinking. There's been basically a shifting of the budget going to certain areas and not the others. With that said, your point is well taken, because to me that kind of analysis is something that can easily be done by the NEUP program where the work is done, and some of the universities can actually take this task and do that kind of comparison and feed it back into the campaign work so the limited resources that we have in the campaign are not being utilized--you know, they're being utilized so that we can influence the majority of the areas, which is mining fuel, separations, reactors, and so on. But I think the area that you bring is something that can be very well done by a university enterprise, so that will be considered in--

EWING: Or the U.S. Geological Survey or--

REGALBUTO: Yes, right, in conjunction with other areas, so maybe we have to be more creative and move to other forms of funding so we could develop that level of fidelity.

GARRICK: Thank you. We have a couple of more here, but I want to squeeze one in because it's tied closely into the concern raised by Bill Murphy.

When I look at the BRC key recommendations, I look at Number 1 and Number 4 and Number 5 of what they tend to call the seven key ones. Number 1, an approach to siting and developing nuclear waste management in disposal facilities in the United States; it is adaptive stage, consent-based, transparent, and standards, and science-based; Number 4, prompt efforts to develop as expeditiously as possible one or more permanent deep geologic facilities for the safe disposal of spent fuel and high-level nuclear waste; and, Number 5, prompt efforts to develop as expeditiously as possible one or more consolidated interim storage facilities as part of an integrated comprehensive plan for managing the back end of the nuclear fuel cycle. So here's seven key elements, almost half of which are very much in the category of implementation and action.

And, Monica, you admitted that the challenge to your program is broader than R&D, and I realize that R&D is the centerpiece for today's discussion. But one really does get a feeling of emptiness with respect to action and implementation, particularly with this kind of background. Can you elaborate a little more on why we're in this state of frustration?

REGALBUTO: I think I'm going to have to throw under the bus Dr. Lyons in this case, because it's a little bit beyond what a fuel cycle program does, and it does have other parts of DOE like the Office of General Counsel and so on. So I'm going to have to defer to Dr. Lyons.

LYONS: I got a question somewhat similar to this, too, John. And, at least to me, the recommendation from the BRC to emphasize consent-based is somewhat in tension with the suggestion to move expeditiously towards either repository or interim storage. Obviously, if we go out and do an extensive characterization on Site A, then to some extent we are bypassing the consent-based. I think I gave an answer earlier today that, at least in my mind, we're likely to end up in a situation that I don't know if it'll be DOE or this public-private entity that might be set up. I think one of those two entities will need to solicit proposals from communities that would be interested in hosting either an interim or a repository.

Then there is going to have to be a procedure within either our office or this public-private entity to down-select based on the best knowledge we have of the geology that they are offering. But I can also imagine that, because there will be proposals coming in from communities where there has not been extensive research on their geology, that there is going to have to also be a phase then where one looks in more detail to characterize the particular geologies that are being proposed by communities.

I know this sounds vague, but I don't know how to do it any better. If you start from the premise, as I believe the BRC is emphasizing and as I strongly believe, of consent-based, you can't do all your characterization up front, because you don't know where the consent is going to come from. So there's going to be this tension. Exactly how it gets resolved, I can't tell you for sure, but I think the procedure I outlined at least is sensible. It also supports the need for generic characterization of alternative geologies such as Monica is starting into with her program without picking a specific site. That's also why I made the comment that whenever--in my talk--to the extent that we can use international experience in granite and clay to help evaluate sites that may propose that geology, that gives a leg up. There may be other geologies that are proposed by communities where we have much less knowledge or where we--or we in Germany--have the key expertise in salt for example.

It's not a great answer, John, but I don't know how to do better at this stage. I wish I did.

GARRICK: I really appreciate the attempt.

Okay, we have Ali and then Linda and then Andy and Ron, and we only have four minutes to do it.

MOSLEH: Can we all do it at the same time?

GARRICK: Go ahead, Ali.

MOSLEH: Thank you. So my question--this is Mosleh, Board--a rather methodological one. In this evaluation and screening process, obviously it's a complex process, complex problem, multi-dimensional. And if you do an adequate level of detail, you will have many parameters and factors to consider in the process. So it looks to me that, in light of the fact that the evaluation criteria may change and are likely to change, you kind of need more like a living tool as opposed to a series of recommendations so that people can actually apply when some of the assumptions and conditions change. Is that the plan?

WIGELAND: Yes, it is. The plan right now, of course, is to give us a focus over the next year or so, but we will be, of course, responsive as conditions change. That's why I put the point in there about we don't really know what happens as the years go by, what becomes important. Some of the performance metrics may change. Some of them I expect will stay constant. So we expect it to be a useful process that we carry forward for quite some time.

MOSLEH: So there's a flexibility built into this?

WIGELAND: Yes.

MOSLEH: As the assumptions change, you can actually--

WIGELAND: Yes.

MOSLEH: --reevaluate.

WIGELAND: Yes.

GARRICK: Linda.

NOZICK: Nozick, Board. Just to follow on Ali's comment, would you mind speaking a little more about the process you're going to use to create the process? This is a very wide-ranging goal. I mean, this is ambitious, so that process is going to be very important.

REGALBUTO: We have a report that explains the methodology that we probably should pass to you.

WIGELAND: Yeah, we have a short report that we can provide that explains it.

NOZICK: That would be great, yes. It's very important.

WIGELAND: Yeah, we can provide that.

GARRICK: Okay, Andy.

KADAK: Thank you. I too am somewhat frustrated by the length of time it takes to figure out a sustainable fuel cycle. I do appreciate the fact that one of the MIT report recommendations was to do exactly what you're doing, but I see this as separate from the Blue Ribbon Commission’s mandates, the seven. Okay, so if this holds up, the action that John and others are talking about, I think that would be a big mistake. The thing that I would say is, Roald has been around for many, many years. He knows what the choices are. You know these processing options. Put 25 people in a room--25 smart people who know what they're talking about--in a room and figure this out, at least on a skeleton basis, because nothing's going to change in the next two years from what we already know. You're going to spend a lot of time arguing over criteria that in the end will distract you from the real objective of how do we make a sustainable fuel cycle.

REGALBUTO: Let me answer your two-part question. First, this work was initiated independent of the BRC, so this work has been ongoing since FY11, I believe, when you guys--

WIGELAND: We started in '09.

REGALBUTO: Yeah, right, I mean, this has been ongoing, so it is independent and rest reassured that we weren't holding our breath to get this work done.

The other thing that I want to emphasize is, we're conducing R&D research today that is relevant to many of these options. So, for example, take separations, okay? If you focus on aqueous separations, you're still doing work on separations, you're still advancing the area. What we have not zeroed down is what kind of transuranics do you want to see in there, okay? That is a very specific fact. We do need to coordinate with the Reactor folks, because, you know, we can't just separate something and then not have a place to burn it. And what is the economic penalty that the utilities--or is this a government-owned reactor that all purpose is just to destroy actinides? Those are key different questions.

If we do the suggested approach of can we sit down all and put 25 smart people, we have been accused in the past of doing exactly that. So this is our need to document systematically how this grouping of different fuel cycles has been done, but I do not want to give you the impression that work has stopped and is waiting for this. This is an area that is going to emphasize where will the dollars better be invested. So if, after the result of the screening we realize that an area is going to take 15 years to move forward versus a small investment in another area that can provide returns, a return on investment of three years, it will make us reconsider.

I did also mention we have these relevance reviews coming in on fuels and separations specifically to reflect that, but we can, unfortunately, not shortcut the process, because we have already been accused in the past, specifically during the GNEP program, that we narrowed it down too quickly without looking at all the options. So, unfortunately, we do live by certain rules.

KADAK: And, please, I'm not suggesting a GNEP approach. What I am suggesting is the smart people look at those options, catalogue them, put them on a piece of paper, instead of going--

REGALBUTO: No, no--

KADAK: --arguing over--

REGALBUTO: And, unfortunately, you don't have access to the report that I just mentioned to Linda, but that exercise was already done, and that report already has narrowed down to the groupings that were interested. So we're not looking at thousands of options anymore. How many did you get narrowed down and eliminated some already in the pre-we call it the prescreening. That was already done. So we will, you know, release the report to you, and you guys can take a look at it. But it is a big area, and we cannot do justice in 20 minutes, unfortunately.

GARRICK: A final question from Ron.

LATANISION: Latanision, Board. Yes, very quickly. Does the Department look at the recommendations that are being produced by the BRC as a step in the direction of the evolution of a nuclear waste policy or--how do you take them? How do you regard the recommendations? Maybe Pete--this is a question for--

REGALBUTO: I don't think I can answer that.

LYONS: I indicated that we don't have the administration position yet on the BRC recommendations, nor do we even have the final BRC recommendations, which are kind of a prerequisite. I'm sure there will be such an administration position forthcoming, but I can't say when it will be. But certainly the President requested the Secretary to convene the BRC from the co-chairs on down. It's hard to imagine a more outstanding group to look at this. And, certainly, looking at their July interim report, I thought it was a fabulous step forward. I'm looking forward to the final report. But as far as an administration response, I believe that has to be forthcoming, but I can't tell you exactly when.

LATANISION: All right, thank you.

GARRICK: Thank you.

Thank you, Monica and Roald. Very good.

Okay, Jeff. We're following the same pattern this time. We'll hear from Jeff Williams and Ernest Hardin, and then we'll ask the questions.

WILLIAMS: Thank you. Good morning. I'm the Deputy Director for Used Fuel, and I was asked at the break why am I doing this as opposed to the Director, Bill Boyle. And you've seen him the last two times, and we thought you needed to see someone different. But, actually, I've had a long history--

GARRICK: We kind of like Bill. He's all right.

WILLIAMS: I have had a long history in my career working on this topic. What I'm going to talk about here--I started to title this Integration, but then I went back to something--looking on your Website, we talked about this back as early as 1989, 1993. And it's been a subject of previous presentations to the Board, but it seems to have new interest now. And it's also relevant to the theme of integration that the question was just asked about.

What's changed, though, since then? Basically we've got a whole lot more fuel in dry storage; we've got canisters that are larger; we don't have a repository project; and we're now considering alternative media, which could result in various designs. And, also, as you've heard throughout the meeting, we may consider interim storage, which is a recommendation by the BRC. The whole presentation that I'm talking about here is basically a subsystem of what Roald and Monica was talking about. We're talking about only the commercial spent fuel here. And, as I learned early on in my career, somebody's subsystem is--or somebody's subsystem is someone else's subsystem. Go to the next one. Oh, I control them?

GARRICK: Yes, to the right--

WILLIAMS: Okay, all right, got those. So this is basically an outline of what I'm going to talk about. I'm going to give you just a background on the amount of fuel that there is, the amount of fuel that's in dry storage and some constraints on disposal, how much is projected--and these are all estimates--and then I'm going to give you a few examples of approaches to integrating storage, transportation, and disposal such as the direct disposal of dual purpose cans or repackaging fuel into some other type of container. And then, lastly, I'm going to talk about some of the work that we're doing in UFD, which is--this is new work. You heard in September in detail about the R&D. It's been mentioned by Monica and Pete. And when we started our program, we were guided by the ME R&D Roadmap, which was focusing on R&D related to extended storage and R&D related to different geologic media. This is a little bit different effort, and so we're just now getting it underway.

Okay, in this background section I'll describe the current situations of where we are with respect to fuel discharges, the storage technologies that are out there, and then I'm also going to show you some recent comments from the TRB, from the NEI, from EPRI, from the BRC related to this topic.

This is probably one that you've seen over the years, and it's got a lot of information on it. It goes through every reactor and shows its situation with respect to dry storage. I think there is about--I didn't count them up, and I didn't check the details, but over 50 somewhat operating independent spent fuel storage facilities right now. All of them are dry except for Morris, Illinois. There's over 1,500 casks or canisters that have been developed. Almost 60,000 spent fuel assemblies are in dry storage. This map also shows you reactors that are shut down. That would include Big Rock Point that uses a fuel solutions technology for dry storage; Connecticut Yankee that has a NAC/NPC; Main Yankee; Trojan; Fort Saint Vrain, which is now DOE fuel; Humboldt Bay; Rancho Seco; Yankee Rowe. And they're using--they're not all using different kinds of storage, but there is a variety of different storage technologies employed--deployed. There's also several sites that have planned life-of-plant storage already. They've invested in what they're going to do for several years into the future.

This is a chart that the Office of Civilian Radioactive Waste Management initially developed, and we extended on it with--providing projections. First I'd like to say, this is based on projections that were collected through a process, but the last time the data was collected was in 2002, and we're now--the projections have a little bit of uncertainty; however, I don't think they're going to miss the point, which the point is, the farther we move to the right in time, the more dry storage there's going to be. In pool storage, I believe there's around 50 to 55 thousand tons of pool storage at the existing reactors. And today there's about 15 thousand tons in dry storage; so as we continue on, there's going to be a higher and higher proportion of dry storage to pool storage.

The next two slides just shows you the dry storage casks that are in use today. I'm not going to go through and talk about all these. The only point is to show you that there are a variety of dry storage technologies used, and some of these can use the same transportation casks; some of them can't. Many of these—the hole techs, for example, their literature talks about how they built the pond, the Department of Energy's multi-purpose canister effort, which was to try and standardize shipping and disposal type of containers. And this is looking at casks that are bare spent fuel casks. The transnuclear ones, they don't have--they're specific to those two sites and then below that legacy casks that are no longer being loaded. The first ones, for example, at Surry that has a storage-only certification, it's not--there's no transportation certification being pursued, same as the other ones at Surry, which was the first site that loaded dry storage, I think, in 1988. But the point is, these are dry storage casks as opposed to canister systems, showing you a variety of different casks and canisters.

Okay, what I wanted to explain here is the constraints on used fuel management, and basically the on-site storage containers are designed by the utilities without input from the Department to meet their on-site safety needs and from their own cost and specific needs. Spent fuel disposal in salt, clay, crystalline may require smaller packages, and I think Ernie will talk a whole lot about the--I know Ernie will--about the thermal constraints. In February there was a presentation on borehole concepts where they talked about only one assembly per package. If you were going to repackage all the fuel that we've just described, there's lots of considerations, concerns about that, financial, operational, radiological, and regulatory. And no matter where it's done, whether it's the utilities or a repackaging facility, these considerations apply.

What are the options? You can modify disposal concepts specifically, or you could develop an integrated cask that could address this. This is what was done for the Yucca Mountain license application through a concept called the TADs; however, without the disposal concept known, we're not sure how to do that at the moment.

Recently there's been comments that have come out, as I mentioned before, from industry and so forth; and I just wanted to focus on these just a tiny bit. People talk about standardization, and they also talk about compatibility and integration. Sometimes these terms get confused and mixed up. In my mind standardization means trying to make as few different kinds of cans as you can. Compatibility has to do with trying to make a container that you can use in storage, transportation, and disposal, but they're both related.

The NWTRB in the report that Dr. Lyons mentioned from last summer talked about the downsides with--they mentioned the TAD and the MPC programs that DOE had done and talked about how those were significant steps towards preventing repetitive handling and working towards standardization. They also talked about in the next bullet about compatibility and how that was important. The Blue Ribbon Commission in their draft reports have mentioned repeatedly to promote better integration standardization should be considered. They also focused on the need for systems analysis, which is something that the Board has for years and years talked about--the importance of using system analysis to provide input into decision-making. Again, you can see the three bullets there where they discussed standardization. However, in the December meeting--in the BRC meeting Dick Meserve talked about, well, possibly standardization, although it's desirable, maybe it should be a voluntary effort.

And then I wanted to go just a little bit to the other side and talk about comments that EPRI has provided to the Blue Ribbon Commission. They basically said that they disagree with standardizing dry storage systems and that standardization can only be done once the details of a storage or disposal system are at hand, and they recommend that the current standard approach of independently selecting storage and transportation systems be maintained. NEI had made a similar type of comment where they said they don't agree that standardization will improve waste management systems and overall costs, and they don't think that containers can be standardized until the requirements for a disposal system are known.

However, then in the FY12 Omnibus Budget we were provided, as Monica showed in her slide, 10 million dollars for the development and licensing of standardized transportation, aging, and disposal canisters and casks. And so this is one thing we're going to need to work together to figure out what's the best way forward on this. In the most recent letter from the TRB dated December 3rd, they talked about standardization there and that standardization can help with avoiding complexity in later stages of the fuel cycle, the waste management system.

As I mentioned before, the used fuel program has really been focused on R&D of extended storage and geologic disposal, which were consistent with the NE Roadmap; however, we're just now restoring the capability to conduct what I call systems analysis or what some people may call subsystem analysis to look at the very back end of the fuel; and, again, we're focused on spent fuel specifically.

The first thing I wanted to talk about--we don't have an actual project in place, but we're giving this a lot of thought, and we're going to touch on this in one of our studies, which is the subject that EPRI and NEI commented to the Blue Ribbon Commission on, which is the direct disposal of dual purpose casks. What would it take to build a repository that could dispose of existing casks? And these casks and canisters are 24 to 37 assemblies. The Yucca Mountain waste package was 21. As I said before, borehole disposal was quite small. The international concepts are on the order of 4 PWR assemblies in salt and--I mean, in clay and granite. However, the existing ones are much larger, so the much larger ones are going to have issues associated with higher temperatures. And, again, Dr. Hardin is going to talk a lot about that in detail. And there's also an engineering and other challenges such as criticality that's been addressed by EPRI and DOE in the past with waste package sizes.

So there's going to be quite a bit of work to demonstrate this or to determine what it would take to do such a thing, for example, ramps versus shafts. These are going to be much heavier. The site-specific geology is going to matter. I think WIPP is about a thousand feet deep. Some of the repositories that were considered early on were like on the order of three thousand feet deep, so a ramp or a shaft would be quite a bit different in those types of environments, cranes, hoists, transportation/haulage mechanisms; in Sweden they have a 14-1/2 percent grade down. Maybe that's too much for this large of packages. It's an engineering project that the labs that are now working for DOE haven't typically done. These are the type of work that's been done by industry. The Civilian Radioactive Waste Management in the past used people like Bechtel, Flohr, other people like that.

The higher temperatures resulting from the packages are going to require work as well as the near-term--the geochemistry surrounding a higher temperature environment. The models that we used at Yucca Mountain will need to be looked at in different environments and as well, as I mentioned before, criticality evaluation. On the Yucca Mountain repository criticality was screened out based on probability; however, with more fuel, some analysis will need to be done.

This one I'm not going to spend any time on, really, because Ernie is going to cover this in detail; however, again, from a thermal aspect, this is one thing that's a consideration for disposal of existing packages. So, as I said, Ernie is going to talk about that specifically.

This is an example of something that we have just now started in the used fuel campaign from Oak Ridge, and Oak Ridge titled this the Flexible Integrated Modular Nuclear Fuel Storage, Transportation, and Disposal Canister System. As you can see, what I call it is the can-in-can system, which is four assemblies that are packaged within another can. And, again, this is something that would provide additional flexibility for different geologic environments and different concepts, and it could allow direct disposal. But in no way am I suggesting that this is something that we should employ right away to require all repackaging of existing concepts. This is just something that will flow into our systems work to look at in more detail.

You can see that, for example, this is something that probably would not be compatible with the borehole concept as we understand it today, because these packages are--even 4 PWR assemblies are rather large. And if you've just been to Sweden, I think you may have seen their copper canister that's 4 assemblies, and it's still--it's a good-sized package, which might be tough to put down a hole.

Okay. This integrated canister concept, as I said before, is being led by Oak Ridge, and in FY12--we're just putting this in place today, so I can't give you any results, but we plan to develop design drawings, evaluate some operational concepts, and look at subjects such as welding versus bolting, how it could be dried. And we plan to look at the--do some initial evaluations to demonstrate compliance and identify any benefits related to criticality, shielding, the things that are important to dry storage, shielding, thermal, confinement, and then to develop a cost basis. This isn't proposed as a solution. As I said, it's input to our decision-making.

The next topic that I wanted to mention to you also is a new effort, systems analysis to inform decision-making. As I said before, this isn't part of our typical R&D portfolio; however, it's important to inform decision-makers; and we're just now beginning to develop the capability as well. I think you've probably heard over the years or the Board has heard over the years presentations on system modeling that was done within RW. That was not done by our labs; it was done by our M&O contractor, and we're now having to rebuild that.

Along with rebuilding that capability, we've also started what we call an architecture evaluation. The BRC's report recommends, I think it's been mentioned here, prompt efforts to undertake the development of storage or geologic facilities, and the Nuclear Waste Technical Review Board over the years has recommended a systems approach. This is in the June 30, 2011, correspondence as well as the October 31st correspondence to the BRC. And we've initiated a system-level analysis. As a matter of fact, we have people meeting this week to try and figure out exactly what we're doing, how it's going to be approached.

This is just to touch on past work which could inform what we're going to do today. In the 1990s and actually prior to the 1990s there was extensive look at how is best--what's the best way to operate the nuclear waste management system. One storage facility, does it start up early, late? Does it receive a certain percentage of the fuel? What's the acceptance rate? And these pictures over to the right are just out of the 1984 report that shows some potential scenarios that were done in 1994 in this study. This is work that is dated, it needs to be updated, and we need to develop the capability to be able to update that work; and we need to develop the tools for updating the work.

So in this system architecture work, we really need to start with the reactors. We need data on what they have; the database that we have needs to be updated; we need to develop new projections; and we really want to provide a focus on providing flexibility, or that's going to be one of the measures of merit. In the past we've looked at primarily cost and dose, and flexibility seems to be a key requirement at the present time.

We want to evaluate the implications of the current status, a strategy for on-site storage, how it impacts potential disposal in the different environments. We want to look at alternative strategies for managing fuel, how to package it, where should packaging possibly be done. And the factors that we'll use are things like emplacement compatibility, thermal constraints, need for repackaging, impacts on utilities; and then we're going to have measures for flexibility, is going to be important. We'll also have rough orders of magnitude for costs associated with each of the alternatives, and in this work we hope to start to address the disposability of existing canisters.

And, lastly, we're starting a new effort again this year on doing logistics--developing system logistics tools. This is something that's been briefed to the Board in the past by the Office of Civilian Radioactive Waste Management, and that capability really has been lost in the last few years. This is an effort that now is going to be picked up by Argonne National Lab, Oak Ridge National Lab, and Sandia. In the past we had a contractor, SAIC, primarily led the development of this. So what we need to do is we need to rebuild and update that capability, and what we plan to do--what this slide is showing you are the four major factors to be considered, the four major types of facilities: the reactors, interim storage, repackaging--whether it's done at a reactor, interim storage, or a repository--and then finally the repository.

And the way we're going to approach this is from evaluating scenarios. We start with scenarios where we look at: When is the operation start date? Is it 2020? Is it 2050? How much dry storage will there be in the two different time frames? What is the package size that is used for transporting things? What's the package size needed for repositories? What's the repository start date? What's the acceptance rate? Is it 3,000 tons a year like traditionally been used? Could we do more? Could we do less? If you do more, what does it do to your transportation cask fleet? So there's a lot of variations. When does the interim storage facility start?

And this work--we have a report scheduled at the end of this year where we're going to evaluate scenarios. My thinking on this is that this will just be a first report. We'll have a new shot at looking at the new capability; however, when you get this information back, the first thing people want to do is they want to say, Why didn't you consider this? Why didn't you consider that? And so we'll refine and change the scenarios that are going to be evaluated.

And then, lastly, just to summarize, the current approaches that are being used or being employed--this is nothing new--may not be the optimal solution for storage, transportation, and disposal. Large casks are definitely effective for storage; however, smaller waste packages may provide more flexibility for disposal. However, we are where we are. By 2020 there's going to be probably 85 to 90,000 tons of spent fuel in storage and as much as 30,000 tons in dry storage. That's coming off the top of my head. I don't have a database, but I think it's fairly accurate.

We need to do analysis, and we've just initiated that analysis that looks at integrating storage, transportation, and disposal. And we're going to do that through our system architecture study. And, in addition, as I said, Ernie is going to talk to you about is the thermal aspect of large packages. And then, finally, is reaching an agreement on how to standardize storage containers that are compatible is going to require integration and integration not only within DOE, but also within industry and various other organizations. And I'm not promoting repackaging, as I said, at utilities or small packages. It's something that needs to be looked at. My guess today would be, if you were going to have a borehole disposal concept, it's probably best to put it in single-element assembly packages. If you were going to have clay or granite, it would probably be four or so, a small number of packages. Salt could probably handle more. And if you had an open repository such as the Yucca Mountain, it could handle larger packages.

And that's really all I had to say about what we're doing in this area now, and I'll turn it over to Ernie to continue on the thermal aspects of this subject.

GARRICK: Thanks, Jeff. I assume you'll stand by for questions later.

HARDIN: Okay, thank you. First, notwithstanding what it says on the agenda, I am one of a dozen or so technical leads in the UFD program at Sandia and other labs. I don't have an outline for this talk, because it's really in the title. I'm going to show you the generic disposal concepts that we selected and then go through a straightforward thermal analysis and then draw conclusions from that.

So here's a real general mission statement for the UFD campaign. And, of course, the work I'm describing here is part of that. In FY11 we spent eight months on this and reported out in August, so this is sort of a progress report on a work in progress. In FY11 we looked at these three mined geologic disposal concepts. These are media but, as we'll discuss later, is that the concept is sort of a package that addresses what you would do in each of these plus the deep borehole system.

One of the messages I'd like to leave you with is that we talk about saturated versus unsaturated crystalline, clay, and so forth. But there's really an overriding distinction here I'd like to make, and that is the open versus enclosed emplacement modes. And so when we go to the international community and look at their experience and select these referenced disposal concepts, it so happens that they are enclosed modes; whereas, Yucca Mountain was an open mode that permitted various things, lower temperatures at the waste package, and permitted pre-closure ventilation, so it sort of combined certain functions of long-term storage of spent fuel with disposal.

For this study we selected temperature limits, a hundred degrees for clay/shale media and buffer material, so that would be the crystalline concept, and two hundred degrees for salt. Now, clearly these are round numbers. They are supported in previous U.S. experience and in international experience, but they are subject to adjustment up or down. They depend on site-specific factors. And I should point out also that there are trade-offs in thermal management strategies that we'll ultimately use for this problem that allows some fine-tuning here. So these are the numbers that we use today.

Now, a disposal concept by definition has three main elements, and those are the waste inventory, the geologic setting, and the engineering concept of operations. Now, inventory is the link to fuel cycle options that Roald discussed and to the upstream technologies that enable those. We have for this study selected a small sample of waste types from possible future commercial fuel cycles, and we'll talk about that. We've selected some geologic settings and then the engineering concepts of operations that go along with those. So we go to the French program--how to make this work--okay, we'll go to the French program for the clay/shale concept; to the Swedish program for the KBS-3 vertical disposal concept; the generic salt repository concept published by Joe Carter and others starting in 2009; and then the deep borehole concept.

The thermal analysis approach here is fairly straightforward. We want to evaluate temperature histories at the waste package surface. Well, that turns out to be a good point of reference for any thermal constraints from EBS materials outside the waste package. Typically waste package containment and structural materials in the waste form itself can withstand higher temperatures than those materials outside.

We want to look at multiple combinations of waste types, age out of reactor--i.e., the duration of decay storage--and these disposal concepts. And we want to look at waste types from advanced fuel cycles, and I put quotations around those. The list that I'm about to show you is certainly not exhaustive. It represents a kind of a focus on the near-term on the types of wastes that we could be asked to dispose of permanently in the next 50- to 100-year time frame. So we'll go on to compare the peak temperatures with those assumed temperature limits, and we'll look at the trade-off between decay storage duration and the number of assemblies that you can put in a waste package.

So this is a description of the six heat-generating waste types that we look at in this study. I would point out that we're certainly interested in other waste types. The number of possible waste types from future disposal is smaller than the number--much smaller than the number of possible fuel cycle options, so we think we can realize some economy here. We chose a high-burnup spent fuel from a Generation III+ or next-generation type of LWR. We chose a representative modified open strategy, which involved a reprocessing of LWR spent used fuel, and then production of Pu/MOX fuel and then a once-through burnup of the MOX fuel and direct disposal. And then, as a representative closed fuel cycle, we looked at a process that would reprocess LWR uranium oxide fuel to provide fissiles to a fast reactor, a salt fast reactor, a sodium--sorry--sodium fast reactor operating in a burner mode; and then we would fully recycle the used fuel from that. So that results in six heat-generating waste types. The new extraction is Joe Carter's concept that would combine TRUEX with some other processes to completely separate TRUs.

Now I want to change gears a little bit here and talk about the generic disposal concepts. We've got four of them. This one is our crystalline concept based pretty closely on the KBS-3 vertical mode that SKB is pursuing. We recognize that the overpack might be copper or steel. For our thermal analysis it doesn't really matter, because we're calculating temperatures on the outer surface. For the clay or shale--and I use that term throughout the discussion right now; those two types of media, one being more indurated, the other more plastic, are grouped together--is that the concept we would adopt as a reference here is pretty close to Andra's concept that for spent fuel we'd use an in-drift disposal mode with a smaller drift similar to their borehole disposal mode for high-level waste. We might also use a buffer, and in the case of both high-level waste and spent fuel is that the access drifts and all the other openings in the repository would be filled with a crushed rock backfill material.

For the generic salt repository--I don't know if most of you have probably seen this before--it uses alcoves, and we would lay the waste packages down on the floor. We envision that we'd mill out the floor; there'd be a half-cylindrical cavity there to accept the package; and that would serve to improve heat transfer with the salt. It's possible that you might have one heat-generating package and then multiple non- or lesser-heat-generating packages in the same alcove and that the alcoves would be backfilled at the time of emplacement.

And then this is the deep borehole disposal concept that you were briefed on by Pat Brady in February. Basically, the idea here is that you drill down into the crystalline basement, the hole could be on the order of five kilometers deep, and that the lowermost two kilometers of that would be used for emplacing waste canisters--they might contain high-level waste or spent fuel--is that the waste form would have to be consolidated to fit in a smaller canister that's consistent with our capability to drill larger diameter holes to that depth, that the canisters would be stacked in the hole, and that the upper section of the hole would be sealed. This concept in its performance relies on the fact that the deep crystalline basement is hydrologically static. It tends not to circulate. The fluids there are very old, so it's isolating.

So let me just briefly describe the semi-analytical thermal model that we use for this. It's real straightforward, but we need such a tool so that we can quickly do sensitivity analyses on some of these different combinations. It is based on conduction-only heat transfer. We know from our Yucca Mountain experience that you can go quite a ways by using conduction-only; and, besides, we're applying this to some geologic host media that have very low permeability and would--therefore, fluid convection would probably not be as important to heat transfer. There are other reasons here, which I won't go into in great detail, about why we think conduction-only is a fair choice at this stage of the work. We've also done finite ALMA calcs to verify some of these calculations, so we know approximately where they're weak and where they're strongest. The waste package surface temperature, of course, is a good choice for the point of reference for temperature calculations.

The methodology is to do a 3D transient analysis using a real simple solution and then couple that with a 2D steady-state that takes count of the annular geometry, and in so doing we can drill down on the EBS and look at the temperature at the waste package surface. And this is what the geometry of a repository might look like, so you've got the waste package--in the very center is the one where we're interested in calculating the temperature, and then we use various approximations to simulate adjacent packages in the same drift and adjacent drifts in the repository.

And the annular configuration that we use for the EBS then has these layers. This is sort of a superset of all the layers, but you can see that we can fit almost any published EBS concept that relies on either in-drift or borehole emplacement into this framework.

KADAK: What code are you using to do that?

HARDIN: I'm sorry?

KADAK: What code, computer?

HARDIN: This is constructed--we use mostly Mathcad calculation.

So now we--these are the six heat-generated waste forms, presented in sort of a novel way in terms of the watts per assembly or watts per high-level waste canister. The two highest curves, of course, are the glass waste forms from reprocessing that contain the short-lived fission products. Then we have the used fuel or spent fuel waste forms down here. The black curve--the black dash curve is Pu/MOX, and the blue one is that high-burnup LWR UOX fuel.

Okay. This is an example--it's 1 of 24 cases, so we've got four disposal concepts and six waste types, and this is one of those, so this would be for the high-burnup

LWR direct disposal once-through case. And what we have on here are temperature histories at the host rock interface for a range of different waste package capacities expressed in terms of number of PWR assemblies, and then the time is in the years out of reactor. So this just represents what we can do.

This is an interesting figure that gives you a little insight, is that the top black curve is the total heat output or total--I'm sorry--it's the temperature increase at the host rock interface from all the waste packages in the problem. And then the other curves express the breakdown of how much of the temperature signal at the waste package surface is caused by that waste package, how much from adjacent packages in the same drift, and how much from other drifts. This is one of the things you can do with a superposition solution very easily. And the point here is that, in the actual design of a repository, given more details and site-specific information and perhaps better resolved information on the heat output of the waste forms, is that we would go back to these curves and use them to adjust the spacings between the packages so that we can optimize the density of emplacement while meeting our temperature criteria.

And so if we pull 1 of those 24 cases out and look at it in a little bit more detail, this is the high-burnup

UOX fuel case with a 4-PWR package in the KBS-3 type repository. And this is basically where the action is, is that for different durations of the surface decay storage-- and these are temperature histories, and we can see what the relationship is between the peak and the assumed temperature limit for that particular repository. So this compares to Slide 16, but it's a subset.

And the next three slides then summarize the results from the analysis. The green-shaded part calculate peak temperatures that are less than or equal to the assumed temperature limits. And this particular figure summarizes for all the different disposal concepts what we learned for certain waste package types, either a 1-PWR or 4-PWR, and four different durations for surface decay storage.

So the upshot of this is that for these smaller packages, particularly the UOX spent fuel 4-PWR, we had no trouble placing these right away, if necessary, into a salt or into deep borehole. For the deep borehole there are no temperature constraints per se. The concept does not rely on the characteristics of the thermal-affected near-field for its post-closure isolation performance. Consequently, we're not placing any temperature limits on the near-field in that deep borehole disposal concept. And here's a breakout for the granite and clay concepts for high-level waste. Same type of thing going on here, and here is the breakout for high-level waste in salt or for the deep borehole.

To summarize some of these numbers is that if you go to a medium with a higher temperature limit such as salt, which has a higher thermal conductivity, significantly higher than, let's say, shale, is that you can expedite the time frame for permanent disposal by on the order of 50 years for enclosed emplacement modes.

And here's the figure that Jeff showed you previously. So this sort of summarizes the results, and it clearly indicates that if you choose a higher thermal K medium, you might be able to greatly increase the number of assemblies and decrease the amount of surface storage required. This comes with a couple of caveats. These are based on those assumed temperature limits. And, of course, this particular aspect of thermal management is only one consideration in the overall waste management picture.

So, in conclusion then, I have shown you a relatively straightforward study. It has concluded that if you go to the international experience and previous U.S. experience with the enclosed emplacement modes, is that you are limited insofar as the waste package capacity; that the required surface decay storage periods are on the order of 10 to 100 years for high-burnup LWR spent fuel, depending on what medium you select. The MOX case is sort of a representative hottest waste type that we might have to dispose of. You can see that far greater decay storage periods would be required. All other aspects held constant.

So, basically, as I pointed out, you get about a 50-year move-up of the time frame for permanent disposal, depending on what medium you select. And it turns out, because the deep borehole concept uses such small waste packages, that the peak temperatures are actually fairly low so that it doesn't become a real major issue conceptually for us insofar as the thermal management or the effects of heat.

And, finally, continuing work, like good analysts that we are, we kind of take a straightforward problem and make it less straightforward. We want to look at the open emplacement modes. Yucca Mountain is clearly a reference open emplacement mode for us. There might be additional reference options for us to consider, and we're looking at those right now, in fact, meeting on those tomorrow.

As for waste types, we do need to look at the existing inventory of LWR spent fuel, but we chose a high-burnup fuel which brackets or bounds the existing inventory; and then we're expecting that we would look at additional waste types from advanced fuel cycles consistent with the fuel cycle option system study that Roald is conducting. And we're going to look at--there are other elements of the UFD program currently doing R&D on the maximum temperatures for some of these EBS materials, particularly clay buffers, so it's possible that sometime in the future we could extend that 100 C limit. There are some rather interesting considerations there in chemistry and the coupled physics of clay materials, and this is also something you'll see in the literature right now. I think internationally people are starting to question the temperature limits that have been used in the performance assessment, say, for the SKB repository, but I think for the time being that 100 C is a good sound number to use for scoping and generic studies of this type.

In salt the 200-degree limit is also probably a little conservative. The original salt repository work in the '80s projected that 250 C might be possible, but I think in the long run that, with bedded salt at least, that the temperature will be limited not by the behavior of the host salt itself, but by the behavior of some other layer which is adjacent to that in the stratigraphy.

And then, finally, yeah, we've set about to do some numeric calculations to verify and some uncertainty analyses to understand the range of results that we should be reporting. And we have people looking at a better description of--a more detailed description of the facilities that would be required to implement these different disposal concepts and the rough order of magnitude costs of those. So, basically, we're assembling a package of information that supports the system study. And that's it. Thank you.

GARRICK: Thank you, Dr. Hardin.

Okay, we'll open it up for questions.

And, Bill, you raised your hand first.

MURPHY: Bill Murphy of the Board.

Ernie, what is the technical basis for the 100-degree limit for clay and granite and the 200-degree limit for salt?

HARDIN: As I understand it, the 100 C limit for the clay buffer material is based on the prospect of alteration mechanisms, I think, principally cementation. So, for that to occur, there has to be a certain amount of moisture present, and I think that one will find that in the literature there are cases or experimental data reported where dry clay materials that might have 2 or 3 percent moisture can be taken to higher temperatures, cooled, and then hydrated. But that may not necessarily--I mean, I wouldn't assume that that was possible universally, because these are kinetically-controlled processes, and the rates are very slow.

You asked about salt as well. You know, salt itself--halite has a melting point much, much higher, and that's on the order of 800 C. And these formations are very dry. They have water on the order of 2 or 3 percent max. It's quite likely that in the near-field we'd drive that water off right away with consolidation, and that would be thermally accelerated. You'd return to a very low permeability condition to where that moisture could not get back into the vicinity of the waste package. And so with a dry situation, it's possible you could go to higher temperatures. If water were present, then you would expect some high-temperature, high-pressure, brining-type melt behavior that might be corrosive or might be destabilizing in some way. These are questions we've asked but have not answered yet.

GARRICK: Rod.

EWING: Rod Ewing on the Board. Just to follow up on Bill's questions, actually, it seems to me very important early on to look at the effect of temperature on the chemical reactions for the different rock types. I think if you look at international programs, you'll find the stability of clays, the release of water from clays as they break down, movement of fluid inclusions in salt. There's a huge literature that already has laid out the basis for these temperature limitations, and it's probably not necessary to do a parametric study of full range of temperatures, because there's a logic behind the limits we see in these international programs; or if the logic isn't solid, then, of course, we can expand on that. So I would just say, my disappointment is, there's no chemistry in the analysis; and, finally, in terms of radionuclide release and transport, chemistry matters quite a lot.

HARDIN: Right. You would have to consult with the members of our team who are doing the basic R&D on these materials to get their views on the dependence of chemical processes on temperature.

EWING: Right, but I would say it's your job to consult with them and have the rest of that information. That's my suggestion.

HARDIN: Yeah, we're sort of in between right now. I mean, we're doing a scoping study.

GARRICK: Okay. Andy.

KADAK: Yeah, I like to do a reality check occasionally. We have--and I've sort of tried to calculate right now--we've got about 176,000 or so--or will have by 2020--176,000 fuel assemblies. And by that time in 2020 we'll probably have close to 3,000 canisters for waste--stored in some form of wet/dry, but they will be in some kind of canister form. And I'm just thinking about in context of the sustainability discussions, are we going to reprocess or not. And I'm saying to myself, and then you're going to a four-element can that's going to require 42,000 canisters to be handled, which has the 176,000 fuel assemblies, and knowing that right now we're probably going to dispose of spent fuel anyway; okay? We're not going to reprocess all that back stuff. We're probably going to look forward to a sustainable fuel cycle maybe with a fast reactor system. Who knows?

But, given the fact that we've got all this spent fuel sitting here, would it not suggest, instead of looking at clay or salt, but looking at a repository that can handle the waste forms that we now have, which I would argue are canister-based systems holding anywhere from 20 to 60 fuel assemblies, and let's kind of just focus on that particular problem rather than try to solve a problem with a very small temperature limit on the various media you're looking for. Doesn't that sort of guide you in a different direction given the reality of the day?

HARDIN: As an alternative, yes.

KADAK: Well, as a practical thing to really look at as perhaps a mined geological repository, because clearly, if bentonite is the limit, okay, it doesn't make any sense to even think about it if you're going to repackage all this other stuff, unless we take as a waste management strategy, let's reprocess all this stuff, let's partition, let's use boreholes for actinides, and store the spent—sorry, the fission products on the surface. I didn't hear anybody talk about that yet as one of your options.

HARDIN: Well, yeah, I was going to point out that we could very easily have multiple repositories or multiple disposal concepts in DOE's portfolio for eventual ultimate disposal of all of these different types of wastes that we're talking about. We're not limited to any one geology. And one other point, our mission here, speaking for UFD, is to maintain the capability to implement any one of these solutions, so we're not quite ready at the point you're talking about, you know, to commit to one or the other.

REGALBUTO: I think Andy’s point is well-taken. It will be an option that you will have to add to your portfolio of options, in which you actually reverse the problem and say, What will the solution look like if I was to address what I have already there, and what will be the required geology and engineering barriers for that? So I think you need to add that to your set of options. You're looking at it from a traditional way where we start from zero, but now, since time has gone by and we are already in a different situation, his point is, will the answer change if you were to address, as a snapshot, what we have today, and I think that merits looking at.

WILLIAMS: Right. And that's what those two slides are about on direct disposal of existing canisters and what would it take to do that, and that is something that has really not been much of a consideration until just recently. I mean, we've been looking at Yucca Mountain--

KADAK: Remember MPC? That's not recent, trust me.

WILLIAMS: No, no. And MPC was designed specifically for Yucca Mountain. It wasn't--the canisters that are out there would not meet the TAD or the MPC specification. They won't do it.

KADAK: The solution is integrated. You talked about criticality, burnup criticality issues, burnup credit. All that's got to be fit together in a program that makes sense.

WILLIAMS: Right. And that's what was done in the MPC and TAD program when we had a Yucca Mountain repository to develop specifications so that that could be done and--

KADAK: But forget Yucca. I think what--

WILLIAMS: Right, right.

KADAK: --what Monica is saying, is there a place that is a mined repository that could hold high heat-load materials in a can that's already there, that's already here? That's what we're asking.

WILLIAMS: And we get it through a voluntary consent process.

KADAK: Of course. Which speaking--now that you've brought it up--I'm sorry, John--I would like to know if DOE is working on a voluntary consent process given that in whatever they released the report you're asked to do something or even to start yet another study to figure out what the voluntary consent process is, which will take at least two or three more years. Am I right? No?

REGALBUTO: Do you want me to answer again?

HARDIN: Of course. No, no, no, don't even—I’ve got it. Better wait till the BRC comes out. Okay.

KADAK: But that's really important, because, you know, as we all have learned, it's not the local community that's going to have a problem. It's the State. And that's where the BRC report fell badly down, because it didn't address that political reality.

LYONS: I certainly don't want to speak for the BRC, but I believe that point's been made to the BRC. I don't know how they're going to address it in the final, but I believe that point has been made. And discussions I've had with a few BRC members, they are certainly acutely aware that State issues are rather important.

GARRICK: Okay, George.

HORNBERGER: Ernie, I noticed that the last appendix in your report is on cost. Is there a take-home message in the analysis you did relative to cost?

HARDIN: Right. That was more of a book report, as I'm sure you picked up on. But I think the only trend that I'd identify in there is that, you know, the Yucca Mountain total system life cycle cost estimates are pretty representative of the estimates generated internationally for the same problem, but they are in contrast to Joe Carter's estimates for disposal costs for high-level waste in glass and 4-canister direct disposal such as the generic salt repository. So, you know, if you take away the need for some sort of an overpack for disposal, that reduces the cost significantly. We're in the process this fiscal year of refining and updating those and making those cost estimates more specific to the generic reference concepts that we have.

GARRICK: Jeff, I thought your slides 9 and 10 were very interesting that provided comments from the different groups as to the usefulness of standardization, and the fact that there was quite a bit of widespread opinions was also very interesting, but I'm wondering if we're looking at the right thing here. It just seems to me that what we're really trying to do is to minimize the operational risk associated with the handling of this material. And we see arguments put forward that, well, you can't do this until you have a repository and can back-calculate exactly what the needs are and so forth.

I have a number of questions here, but one is, given that the issue is really a basic one relative to minimizing radiation risk during operations, aren't there some effective things that we can be doing in terms of developing design specifications or criteria or what have you that would help us a great deal down the road when in fact we do have a repository? Are the people that are disagreeing with standardization--what's their perspective? Are they looking at it from the standpoint of an operational risk issue? Are they looking at it from a cost issue? Or are they looking--what are they looking at?

WILLIAMS: Well, I mean, we could turn this over to the people from industry, but my understanding is, the larger the package, the better it is from a cost standpoint and also from a dose standpoint, because the dose actually comes from the setup when you start to weld the canister. And so if you have--the more assemblies per canister, the lower dose that you have associated with that loading operation. Is that enough?

GARRICK: Well, again, I'm trying to probe a little bit on what can we do about saving us a lot of headaches downstream in the absence of a repository with respect to these kinds of issues.

WILLIAMS: Right. That's what I'm struggling with, especially with--and that's what we've--as Andy pointed out, we've worked on for 20 years was trying to do that; and when you had a certain repository environment and you had more knowns, it was easier to address. And I think John would like to say something.

KESSLER: John Kessler, Electric Power Research Institute. Yeah, I put together the words for the EPRI response to the BRC. The perspective was, as Jeff talked about, we were considering the upstream implications as much as the downstream implications. The downstream concern was, as I think Ernie's presentation showed, it's unclear what size the package needs to be for different kinds of disposal concepts or geologies when we don't know what the geology is. It could be anywhere from one assembly, maybe up to 21, assuming the nation picks some other kind of porous fractured medium in the unsaturated zone or something like that.

The other concern--certainly cost is one of them. The other question I asked the utilities back in May--this was in the context of more rapidly moving fuel out of the pools, Fukushima-related issues, things like that--was how much faster can the utilities move fuel out of the pools based on their operational constraints? And the answer seemed to be somewhere in the factor of two to three times faster, and those are in large canisters. So if one is talking about even a 4-assembly canister, now you're talking about six, eight, ten times as many canisters that would need to be loaded, dried, welded at the site. Operationally, I'm not sure that that could be done. Again, maybe if there was a way to do that, that could be instituted.

The last one is not necessarily technical, which is, it would be interesting to know how the Department of Justice would view utilities volunteering to pick much smaller containers at presumably a much higher cost, whether the Department of Justice would consider that justified. I don't know. But these are the kinds of considerations, the technical and the economic ones both at the front end and the back end, that EPRI considered when making its comments. The last one is also dose risk, which is that worker dose is involved with the loading, the drying, the welding, the moving of these out; and that would incur a higher dose risk to provide options for different kinds of disposal systems.

So that was what was involved in EPRI's comments, which was essentially, why should a decision be made now when it's unclear whether there is or is not a benefit to the nation to do it, given that there are these upstream downsides of doing that. So that was the basis for the EPRI comments.

GARRICK: Thank you.

I think we have another short perspective.

LEVIN: Thank you. Adam Levin, Exelon Generation. One of the things that I think the Board should get their arms around from an operational perspective is that we are loading somewhere between 250 and 350 assemblies into dry storage every year now at our sites that have run out of room in a spent fuel pool. So if you're looking at canisters that are 4 assemblies in size versus the 68 at a BWR that we're currently loading, you're now talking about loading on the order of 70 canisters every year, which is something that we could not do. It takes about seven days right now to load a large BWR canister, and there is no corollary for saying that it's only going to take one day or two days to load up 4-assembly canisters. It's still going to take you four to five days to do that regardless.

GARRICK: Very good comment.

WILLIAMS: I'd just like to add that in our architecture study where we're looking at that packaging, it isn't just necessarily at the utilities. It could also be at an interim storage facility; it could be at a packaging facility that's associated with an R&D facility; so there's a lot of different ways to do it other than at the utility.

GARRICK: Yes?

REDMOND: Everett Redmond, Nuclear Energy Institute. I just want to add a couple comments based on the comment letter that we drafted. When looking at standardization, in many respects--and we made this comment to the BRC--the systems are standardized to some extent. In fact, Jeff in his presentation talked about it with the transportation casks that are single transportation casks able to accommodate multiple systems.

The last thing I'd like to mention in terms of standardization and one of the areas that could be focused on here is not necessarily on the casks in that system, but let's start looking at the transportation systems that need to be done, because we have multiple systems at different decommission site, for example, and if you're going to move them, you can make a great effort to standardize as best you can the rail cars, the handling equipment, and all of that infrastructure. And that's a good place to start.

GARRICK: Thank you.

REDMOND: Thank you.

GARRICK: I think Carl Di Bella had a comment.

DI BELLA: But it was covered by the discussion among Andy Kadak and Jeff Williams and Monica Regalbuto.

GARRICK: All right, yes.

ROWE: Most of the graphs--

GARRICK: Name?

ROWE: Rowe, Staff. Most of the curves that you show were obviously for an unventilated repository, and you mentioned open and closed repository. And based on some of the studies that were done on Yucca Mountain, the waste package size can increase greatly if you have an open repository versus a closed repository. I didn't see any analyses looking at an open. Have you done those analyses, are you planning to, and what are the waste package sizes when you do that?

HARDIN: Okay. We're doing those analyses now. We need to actually--as I mentioned, this week our team is meeting to select some open modes.

ROWE: Okay. Do you think there will be any difference in relationship to the medium with the open concept?

HARDIN: Oh, absolutely. I mean, if you're removing 80 or 90 percent of the heat by forced convection, that gives you considerable latitude. It adds, you know, another couple degrees of freedom to the thermal management problem.

ROWE: That's my point.

GARRICK: Okay. Any other questions from the Board? Yes, Andy? I guess I would have expected that.

KADAK: Yes. We didn't hear much about what you're doing on transportation. Who is in charge of that program?

WILLIAMS: Right now our transportation program is looking at the technical aspects of transporting in terms of what can you do after extended storage, the research that's needed to fill those gaps that you were briefed on in February--or, I mean, in September. In terms of doing the things--developing a transportation system like rail cars and casks and security, that type of work is not ongoing at the moment.

KADAK: And the routing question, I know you were fairly active with the regional governors' association types of organizations. Is that--

WILLIAMS: That was all stopped. This new logistics code is going to have some routing models developed into it in the next year; but in terms of all the interaction along the routes and the regional integration groups, none of that is ongoing right now.

KADAK: My question is really--because I am quite sure--and I'd bet a lot of money on it--that there will be a recommendation coming out of the Blue Ribbon Commission that says we need to site several interim storage sites. I'm pretty sure that's going to happen.

WILLIAMS: You might be right.

KADAK: And I think it would be good for the Department to start thinking through, if several regional sites are going to be needed, where does it logistically make sense to put them given the network that we have over the rail systems? And you're not doing that now?

WILLIAMS: No, no, we're not doing that. It wasn't part of the R&D roadmap or R&D portfolio that was laid onto us when this program started that's been explained to you. And those are some things that are identified in the Blue Ribbon Commission's near-term actions that could be done prior to legislation to do these kind of things, that could be done, but there hasn't been any decision made to do those yet.

KADAK: A follow-up question for Pete. Suppose the legislation that the Blue Ribbon Commission is sort of suggesting doesn't happen, and DOE is still charged with the mission of disposal, that would take--rephrase the question. The legislation will take many years to pass, likely. It's not going to happen this year. And so is DOE going to do anything in this area even after the Blue Ribbon Commission has done that you can do? For example, interim storage was part of your charter when David--what's his name?

SPEAKER: Leroy.

KADAK: Leroy--was in charge, successful program that was. It started with the volunteer siting process. If the legislation doesn't get passed, is the DOE planning to do something in this area?

LYONS: Andy, as you know, we're constrained by something called the Nuclear Waste Policy Act right now.

KADAK: Right.

LYONS: My memory is that under the Nuclear Waste Policy Act, you could not move ahead with interim storage today unless you are previously moving ahead with licensing of Yucca Mountain. I believe that's the way it's worded. I'm not positive. All I'm suggesting is that I think there needs to be substantial guidance along with substantial budget questions that are going to come up as we move past the BRC study and start to look at what the actions will be.

KADAK: Well, Leroy was able to do what he did in terms of seeking volunteer sites even though we did not have a repository, so there was some leeway in being able to do this.

WILLIAMS: There is some specific language in the Nuclear Waste Policy Act that says we could look for sites, but there is a linkage between--

KADAK: Correct.

WILLIAMS: Right, right. And so whether we do that or not is a policy question. And, you know, thinking back when David Leroy was there was, you could go through the voluntary process, and there would be potentially an agreement that then would allow the law to be changed.

GARRICK: Any other questions? Yes, Linda.

NOZICK: Nozick, Board. It's a question for Jeff.

How does the—so you’re going to re-resurrect Calvin's last TSM? How have the requirements for that been shaped so that they support some of these other analyses like the analysis structure by Wigeland--earlier in the presentation when Roald talked about an analysis structure of a total system analysis? How will the rebate TSM Calvin model--will that support that effort?

WILLIAMS: I don't know. This is just getting underway. And, yeah, that does probably need to be integrated. This study that's being looked at right here is just a small piece of that, and they--like he said, he has been doing this work since 2009, I think, so that's been underway. And from what I've seen--maybe you have to ask Roald--is the work that's being done in this probably won't have any influence on what he's doing with respect to fuel cycles, but it will inform what you would do only in an open fuel cycle with respect to packaging and costs and so forth or interim storage facilities. But it's something that, as we get it started over the next year, that we'll need to look into.

GARRICK: Okay. Any other questions? From the staff? From the audience?

With that, we will--and thank the presenters--we will recess until 1:45.

(Whereupon a lunch recess was taken).

AFTERNOON SESSION

GARRICK: Let's reconvene. Here's Christine Gelles once again, this time she's going to talk about planning for future disposal of DOE oil and high-level waste and spent nuclear fuel. Christine, the podium is yours.

GELLES: Thank you, everybody. Thanks for coming back, and I appreciate your indulgence since now I'm going to gab at you for a second time today. And if you haven't been outside, it's snowing, if you can believe it. So if I look a little spotted it's because I was wandering around in the great wilderness.

Okay, so the purpose of this presentation is to share some information with the Board about the Department of Energy Environmental Management Programs, and I'm emphasizing it's the Environmental Management Program that I'm speaking for. Our approach to planning for EM waste form disposal, in light of the termination of the Yucca Mountain repository program. The focus is not so much on what we're planning for in terms of development of a future site. I think you heard me respond to the Board member's question this morning that we're considering some of the advantages of proposing a repository focused on Defense waste streams, but, you know, the administration has not made a decision now. We're really watching closely what's developing in other corners of the Department and awaiting the Blue Ribbon Commission's final recommendations and any actions the Secretary may take in response to those.

But what I did want to speak with you about were the conservative measures we’re taking as a program to retain the pedigree of the waste forms that we’ve already produced; those that were produced assuming the Yucca Mountain repository program, and then the proactive approach that we have planned so that we can be more in the driver’s seat when there is a future repository program, or repositories, or even interim storage programs.

And I’m sorry, I failed to say it this morning when I introduced myself, I’m the Director of an office called the Office of Disposal Operations, and the responsibilities of my office within the Office of Technical and Regulatory Support is to ensure that there is a disposition path for any of the EM-generated waste streams. We also have some statutory responsibilities related to some civilian or commercially generated waste streams, specifically the greater than Class C low-level waste streams, which also might need geologic disposal.

But my scope does go beyond tank waste. We include transuranic wastes; we’re very integrally involved in the operation of the Waste Isolation Pilot Plant and our Transuranic Waste Disposition efforts, as well as low-level and mixed-level waste. Uranium management, or uranium bartering activities, providing for disposal of any commercial uranium enrichment waste streams that any commercial enrichers might request us to provide, and then we also have some scrap metals management activities. So we are--the scope of my office touches a number of areas within the fuel cycle, so I would look forward to working with you on any of those matters moving forward.

So this slide is old history, and all of you know it already. The important point here is that we are self-regulating in the management of our high-level waste streams and our fuel inventories, while they're at our DOE sites. There is a special exception in the case of some commercial fuel inventories that we've taken custody of, where they're being retained in NRC-licensed independent fuel storage installations. So we do maintain two NRC licenses, and I mentioned those this morning; one at Fort St. Vrain in Colorado, and other at the Idaho National Laboratory for the TMI fuel debris.

We have absolutely been working with other elements of the Department to plan for the future disposal of our program--of our EM waste forms, and they were focused and structured and planned to be accommodated at the Yucca Mountain repository. Of course, everybody knows that RW was created to provide that geologic disposal, but, of course, their program was terminated in 2010 with the change in the administration’s position on the Yucca Mountain program.

There is an MOA. The final bullet here is the one I want to focus on. There was an MOA developed between EM and RW and it provided, effectively, the contract between us for the acceptance of EM-owned waste forms. And it really was developed to mirror the standard contracts that are signed between the Department and the commercial utilities for the acceptance of commercial spent fuel, and it order for our waste forms to be fully considered in the RW program, and in the future, hypothetically, to have been accepted as a repository, we would have had to fully comply with all the requirements of the MOA, and those requirements included the technical requirements that were part of the repository system.

Of course, you know all of this as well. The only important point here is that the LA, as it was submitted, covered, in general, the majority of the waste forms that EM manages, although the initial license application would not have covered the total volume that we possess, but it covered all of our high-level waste, assuming it was vitrified into borosilicate glass, and it covered all of our EM spent fuel, assuming that we placed it in the DOE standard canister, and there was some ongoing debate about that. And then it did a good job of analyzing how our multi-canister overpacks that contain the end reactor fuel from Hanford would perform, although there were still some outstanding analysis that would have been required in some subsequent place since update.

There are other waste forms, though, and, potentially, some variations on our future waste forms from those that were analyzed in the LA, and that really is what we're going to talk about in the later slides of the presentation.

So a little bit about the existing requirements for managing. Pursuant to our AEA authority, it's DOE orders, which would be comparable to NRC regulations, that guide our activities, and those applicable orders include our safety orders, our--both radiation safety, nuclear safety and our occupational safety orders--and then DOE Order 435.1, which is the Department's radioactive waste management order, is currently in the process of being revised. It is the second radioactive waste management order that we had. Our previous order was 5820, but it had the same title. There are four chapters. One chapter is High-Level Waste, and it tells us everything that we need to do in terms of ensuring the safe interim storage and treatment of the waste, and it does make some extensive references to the RW document system.

And then, of course, we have some quality assurance requirements that we also have to meet, and in addition to those, by virtue of the MOA we signed with RW, we were also meeting the quality assurance requirements of the Yucca Mountain repository system.

We use DOE and DOT transportation regs, orders or requirements, when we’re moving fuel or high-level waste samples between our sites.  And then we have a broad network of environmental analyses and documented decisions that support our overall management strategies.  The grandfather of them all is the programmatic waste management EIS and its record of decision, which of course said that we’re going to dispose of high-level waste in a geologic repository.

And then there are site-specific environmental impact statements that are tiered from those, so there would be very detailed decisions and analyses related to the high-level waste systems at Idaho and Savannah River, and at Hanford.  And the Hanford site-specific EIS is in the process of being updated; it’s called the Tank Closure Waste Management EIS.  It was published in draft, and we’re about to issue a supplement to that draft EIS as we’re moving forward to a very comprehensive site-specific NEPA evaluation for activities there.

There are compliance commitments.  I am--this is not an exhaustive list, I’m just calling the two out that are the most obvious, the Idaho settlement agreement between us and the State of Idaho, and it’s this agreement that requires that all of the high-level waste be road ready by 2035, and all of spent nuclear fuel be out of the state by 2035. There are some site-specific, or some site treatment plans, that were negotiated pursuant to the Federal Facility Compliance Agreement, and that set some other near-, nearer-term decisions, about the rate of treatment for some of our hazardous waste streams, including sodium-bearing waste in this case. We have the Hanford Tri-Party Agreement, and the consent order, which sets some schedules related to the tank retrievals and the rate at which we'll be vitrifying high-level waste at Hanford.

So there's a hierarchy of documents, and I'm not going to read all of these to you, but this is really your legend for the next slide, but there are a series of RW documents that provide us the framework, and then we have some programmatic documents that tier from those, and then some site-specific documents. And this is what the hierarchy looks like, at least in our mind. RW probably would have taken issue with where we placed the MOA. They probably would have thought it sits over to the side and that the CRD is the overarching document.

But I just wanted to call these out. The QARD is the Quality Assurance Requirements Documents, the WASRD in the middle is the Waste Acceptance System Requirements Document, the IICD is an Interface Control Document. All of those above the red line were RW developed, RW maintained and were called out in the MOA as things that EM would have to comply with in order to ensure--in order for our waste forms to be acceptable into the system.

The red line below starts the EM series of documents. The WAPS is the Waste Analysis Product Specifications, and this is where we take the requirements of the waste acceptance requirements document from RW and make them specific to the treatment methods that we're employing at our sites. And right now WAPS is specific to vitrification and specific to borosilicate glass. We do have other high-level waste forms planned. You'll hear Joel Case talk about our calcine and the anticipated waste form there. We propose to develop a second WAPS for the non-vitrified high-level waste forms in the future.

The light blue boxes are high-level waste sites, Hanford planning to be operational in 2019; Idaho, of course, with the calcine project, sometime to be road ready by 2035; Savannah River is in the process of producing, through the Defense Waste Processing Facility in West Valley, completed its vitrification mission, as I mentioned this morning. But each of those sites then have to produce the site-specific documents, which is the lowest box, and those include the Waste Form Compliance Plan, the WCP, the Waste Qualification Reports, the WQR's, and then site-specific shipping and storage records as they are germane to the production of the waste forms at each of the sites.

Our current direction moving forward is to continue--you've heard me say this before--but to continue to safely store our inventories in a safe and secure manner pursuant to the site safety bases, which are developed in full concert with DOE safety orders, and to manage those projects and those waste streams consistent with the project plans that we alluded to this morning. And again, those project plans were based in large part on the RW system and their specific technical requirements that were laid out in that hierarchy. And we will continue to comply with those until such time that we have an informed basis to change them.

We're maintaining very rigorous configuration control, in part because we don't know what the future holds. It's not unforeseeable that some future repository program will begin where Yucca Mountain left off, even if it's a different site that it works on, and for that reason we want to make sure that we've got a ready set of data supporting our waste forms so that they're not left behind or orphaned any more than they already are by the change in the repository program.

Our Q.A. program is managed by the Office of Safety within EM. That's one of Ken Picha's current organizations he is heading right now, and he has chosen to maintain the

QARD as the basis of doing Q.A. audits at our high-level waste sites and our fuel management sites on a periodic basis. I think the QARD requires it annually. We do do some graded approaches to deferring that and doing partial reviews for sites like West Valley, where there's no change to the inventory because the high-level waste is basically produced and just simply in storage in a static mode. But we do--that's the most external sense of oversight that we have, a headquarters Q.A. organization overseeing the implementation of the Q.A. requirements at our production sites.

Our vision is that we will adapt the requirements to address our other waste forms. Ask I mentioned, the calcine might lead to the development of a waste form-specific waste WAPS document, Waste Analysis Product Spec document. And we'll do that in order to optimize our future operations, and consistent with those enhanced tank strategies we spoke of this morning. So, in short, in the future we want to be less reactive to the repository program than we were during the development of the Yucca Mountain program.

Let me just go back here, a point that I failed to mention, and I apologize for going backwards, but as these requirements were developing, we were developing our treatment systems, so, by and large, they were happening in parallel, and a lot of times we were being forced to refine our plans as the RW requirements were being changed. In fact, I think there were revisions up to the 15 and 16 range for some of these RW documents, and every time the RW requirement document was revised, we had to, by matter of contract, pass that revision on to our contractors and force them to incorporate them into the plan. So you can see that we were constantly reacting to a changing repository system. Even if the system wasn't changing, the specs and the specific requirements were evolving as the repository was developing. Again, we were constantly in response mode. We're hoping that we'll be a little more of a determining factor in future repository efforts, which is imperative for us then to be, you know, fully engaged with the folks in nuclear energy, or whatever future endeavor takes on the development of the repository.

So our current planning context is that Yucca Mountain will not be restored, even if, as I said before, the future planning begins where Yucca left off. We expect that the NRC will continue to review the LA if nothing more than just to ensure that the safety evaluation report is comprehensive. I know that they have no funds to do so now but in the grandest scheme I think it will just close the books on the existing application and let it be part of history, and a reference for future efforts.

The MOA between us and EM or us and RW has been overtaken by events, and that means that requirements such as repository acceptance planning, how we would fit into the queue, the transfer specs and any payment of repository fees, in terms of us, the Department of Energy, paying our share, because of a comingled repository, is all going to be redefined sometime in the future. There are certain management requirements that we don't want abandoned, such that we assume most fuel is going to have to be packaged into a canister of some sort. We continue to want to use the DOE standard canister as a planning basis until it's replaced with a better--a more defensible assumption. We're going to limit free liquids and organic content. Our canister design requirements are pretty static, in terms of using 10-foot canisters in Savannah River, we have 10-foot canisters at West Valley, we're using 15-foot canisters at Hanford, and we know we want to maintain rigorous Q.A. programs for both our high-level waste and our spent-fuel programs.

But we're in the unique position now where we are both the issuer, the maintainer and the implementer of the technical requirements documents, whereas before RW was the issuer and maintainer, we were the implementer, and then there was some external or independent oversight on the part of RW to make sure we were complying with them. And this is okay because we're used to self-regulation, but it is potentially problematic, and I think that expertise from a group such as the Board, or other organizations such as Nuclear Energy, would be useful to us as we began to deviate from the existing set of requirements so that we can have some independent eyes helping us to understand what the potential impact would be.

So, moving forward, we're completing an update of the Waste Analysis Products Specifications, just to get it fully aligned with the last set of RW revisions and the license application. We issued the WAPS in 1996 and we did not change it since then. Although the WASRD and other repository documents evolved multiple numerous times, we have never formally updated the WAPS, so Phase One is to get our WAPS document up to date with the RW system when it froze, prior to the termination of the RW program. And then Phase Two will be beginning to march away from the existing set of requirements as our performance-based analysis justifies it to accommodate the other waste forms.

We will propose those, we hope, in a very transparent manner. Again, we don't intend to do it in a vacuum. We hope to work with other DOE offices, seek the counsel of our General Counsel Office, since they're maintaining some of the interfaces related to the compliance standard contract, even if the MOA between EM and RW is effectively overtaken by their abolishment. We will maintain very rigorous records for all that we do, both producing our waste forms and revising our technical documents.

We will have to pursue delisting of some of our high-level waste forms. If the assumption that any future repository will not be RIPA-regulated holds true, as it had been planned for the Yucca Mountain repository. We are completing the revision of DOE Order 435, and there will be some changes about high-level waste, including changing our high-level waste definition in the DOE order to be fully in accord with that which is in the Nuclear Waste Policy Act. We will also clarify some of the additional authorities we have pursuant to Section 3116 of the National Defense Authorization Act that has to do with how we close high-level waste tanks after all of the tank waste is removed from it. We're going to continue our coordination with NENR, Nuclear Energy Naval Reactors, science, general counsel, and this is really emphasizing the theme of this meeting, continuing our integration with other elements of the Department, and then we'll implement our policies. We'll change them as appropriate, in light of what the BRC recommends and the Secretary decides.

This is our vision of what a high-level waste and spent-fuel requirement set might look like in the future, with the QUARD still being the RW-issued document, maintaining the commonality between the two, but we envision a set of high-level waste requirements, and then a set of spent-fuel requirements that would tier through program-level documents down to site-specific documents, and I won't bore you with the detail here, it's just really to share with you a vision that EM, left to our own devices, would have a very robust set of technical requirements that we would adhere to, but we would structure them this way just because there were significant differences between what we must do to our high-level waste inventories versus what we would do to our fuel, and, quite honestly, in terms of cost, you heard me this morning, the tank waste, you know, it wags the dog a lot harder than our fuel programs do.

So our assumptions, and again, these are just EM's assumptions, about the future repository is that they'll be designed to dispose of the high-level waste forms and canistered fuel that's managed by EM, and I'll emphasize that we're envisioning that to be all of the high-level waste forms, not just the vitrified, and all of our canistered fuel, not just that which would go in a DOE standard canister.  We fully expect our multi-canister overpacks will be acceptable.

We are open to even our TMI casks, the 27 larger casks that contain smaller canisters, might be acceptable in their current form.  It would be great if we could avoid repackaging some of these fuel inventories.

We also expect that the repositories will accept all of the DOE-managed forms. There are ceramic high-level forms generated by any NE, and of course there are the larger fuel casks generated by naval reactors. We assume that the repository will require NRC licensing. Don’t know if it’ll be generic or site-specific. I have my assumptions about that. We assume the regulations will be risk-based. We assume EPA will have the regulatory responsibility, or at least a rule-making responsibility to set some standards. And we assume that the transportation system will not be our responsibility. But, of course, these are assumptions based on today’s state of affairs and could certainly be changed significantly a result of the BRC and the Secretary’s reaction to those.

This is all old new for all of you, so I won’t read it. Just a reminder that we get a lot of help taking a look at our programs, in light of the changes to the repository strategy. GAO did numerous reports, I think five in the last two years, that somehow touch on what the impact of the Yucca Mountain termination is on our activities. And of course there’s the Blue Ribbon Commission, and we touched on it this morning. They are very focused on consent base. They’ve paid a lot of attention to our WIPP experience, of which we are very, very proud, and we are well aware of the Blue Ribbon Commission and the State of New Mexico’s support for building upon our WIPP experiences.

So, in closing, and then again I welcome your questions and our continued dialogue. We are committed to the safe management of our waste forms and our fuel inventories. We also have extensive experience in this area that I believe can--we all believe in EM--can be relied upon in future repository development efforts. We manage materials and waste both in a DOE regulatory framework, as well as within NRC licenses. We have experience transporting fuel between sites. A good example would be West Valley to Idaho, as well as our continued receipt of offsite Ford research reactor fuels, in both Idaho and Savannah River.

We have experience in different storage-type of facilities--wet, dry, vault, cask. We have extensive experience in vitrifying high-level waste, as well as developing other pretreatment steps, and we're working on some alternate high-level waste forms. And we actually have a lot of experience developing and operating a geologic repository; of course, I'm talking about WIPP. And we know how to evolve that repository after its initial opening so that it can be licensed to take more waste forms than it was originally commissioned. And by that I mean we began with a contact-handled transuranic waste mission at WIPP, always with a vision to take remote-handled, but it took us years to get to that point--very targeted regulatory changes that we had to move through--but we did that and now we’re poised for the next phase, if it’s appropriate and that’s what the administration decides to pursue.

So, as fuel cycle, energy production disposition plans change, we think we’re ready to respond to those, and we’ll adjust or program plans as necessary. And as we continue our efforts to optimize our projects to live within those budget constraints we spoke of this morning, we’re going to, in a very rigorous and disciplined manner, begin to propose some revised technical requirements, while ensuring safety and security, in order to reduce the total volumes that have to be transported and disposed in the future, and in order to reduce the life cycle cost of our systems and prepare ourselves to fully comply with our regulatory commitments.

And with that, I thank you for your attention.

GARRICK: Good, thank you. Questions. Yes, Bill Murphy.

MURPHY: This is Bill Murphy of the Board. Could you go back to slide 12, please? It says here that the GAO has proposed alternative uses for the Yucca Mountain site. Can you tell me what some of those are?

GELLES: Yeah, they didn’t actually make any recommendations about it. “Propose” might be too strong of a word there, but they did a study on it and solicited some input from stakeholders, and I think they heard about 30 different types of uses, but I anticipated your question and printed out the one-page summary of it. And there were five categories--nuclear and radiological uses, such as citing a nuclear processing complex; defense or Homeland Security activities, such as it being a testing site; information technology uses, such as secure electronic data storage; energy development or storage, such as using the site for renewable energy development; and scientific research, such as geology or mining research. Those are the general five categories that all of the stakeholder input fell into as they aggregated there. They did not have any recommendations per se, they just wanted--they were offering Congress some practical, I think, considerations and were quick to say that any reuse of the site would obviously carry significant legal and regulatory hurdles in order to implement.

MURPHY: Thank you.

GELLES: Thank you.

LATANISION: Ron Latanision of the Board. If, as seems likely, dry storage is included in the path forward, and perhaps for a period up to a hundred years, how would your office respond to that?

GELLES: In terms of our existing storage facilities?

LATANISION: I’m sorry?

GELLES: Are you asking me in terms of assuming continued storage at our existing storage facilities?

LATANISION: Yeah, yeah. How would your office--

GELLES: We'd respond much as we're doing right now, which is we've undertaken a review directly in response to one of the GAO reports that I cited here, to ensure that our existing systems could withstand a more extensive period of storage than they were originally designed. I think most of our storage facilities probably were evaluated for a 50-year life and now we've gone off and revisited the analyses to ensure that they could be good for up to a hundred years. We have confidence in that. We continue some materials durability studies just to make sure that there are not any weak points or vulnerabilities, but that's part of our continuous process in any case.

LATANISION: Just so I understand, you have confidence up to 50 years or 100 years?

GELLES: I think we're up to 100 years now, for all of our--

LATANISION: What's the basis for your confidence?

GELLES: I wish I could answer that in great detail.

Ken, do you know the answer to that?

PICHA: I'm sorry, I don't.

GELLES: Okay. We can follow up with you, if you'd like, and I can give you some--

LATANISION: Yeah, I would.

GELLES: --some more specific--our wet basin and our L basin in Savannah River might be the one exception where I've already mentioned that we have some capacity constraints there, and obviously seismic studies have to be done to ensure its continued safety, but our vault systems are pretty robust, and I mean we've looked at this, it's part of upgrade safety and management system, but I absolutely will follow up with you.

LATANISION: Well, I asked the question because, as you probably know, the Board did issue a report on dry storage--

GELLES: Uh-huh.

LATANISION: --and there were a number of issues identified in that report that we believe needed research, and so I'm just curious to know whether there's any office, whether it's yours or any other office within DOE, that might be thinking of research, and a research agenda, that might address some of those issues going forward beyond 50 years.

GELLES: Okay. Gary DeLeon is the Director of our Nuclear Materials Disposition Office, and he is the one who's led the effort to respond to the GAO reports specific to our spent-fuel storage facilities, so I'll follow up with him and we can get back to you. And he's within the Office of Technology and Engineering, and they are tapped into our national laboratories, so we're using those resources there.

GARRICK: Thank you.

HORNBERGER: John, just a quick follow-up on that. Do you run into any legal issues?

GELLES: Yes, the Idaho Settlement Agreement requires us to have materials road ready or out of the state in the case of high-level waste or spent-fuel, respectively, so we would absolutely have some issues if we had to retain them in our current configuration at our current sites. But that's obviously a slightly different question then whether or not the facilities themselves can withstand it.

GARRICK: Christine, I notice you're revising the DOE Order 435.1, the high-level waste chapter.

GELLES: Yes.

GARRICK: Are there orders or regulations that you consider to be outdated, or that are impeding the cleanup process or the waste management process?

GELLES: Hmm, thank you for that question. Let me think about this for a second. Impeding--

GARRICK: Because we've learned a lot in the last few years, and some of the orders are pretty old.

GELLES: The Department has undertaken a comprehensive effort to reduce the number of DOE directives that we have, as well as to streamline the directives that we're going to retain. That's one of the reasons why DOE 435 is in revision. So I'm not aware of any DOE orders that are impeding us, per se. There are some regulatory circumstances that I'd love to have tightened up a little bit.

For instance, the fact that we don't have--3116, that I mentioned, that allows us to empty high-level waste tanks at Savannah River and Idaho and close them as a low-level waste form to be analyzed through a site-specific performance assessment and be left intact, that authority does not extend to our tanks at Hanford, so that's a regulatory gap that could potentially hinder us in the future, but it's not impacting our near-term activities. It's just one of those issues that has to be resolved moving forward. DOE Order 435 allows us to make such determinations under our DOE authority but that's been litigated before and would likely face litigation in the future, so that's a vulnerability that we have.

I think the most relevant thing I would respond to, Mr. Chairman, is that we have these technical requirements that are tiered from the RW repository system that could constrain our waste loading, could constrain our PU loading, at Savannah River and DWPF, that we want to make sure that we do the research to support a conscious deviation from those--

GARRICK: Yes.

GELLES: --while ensuring that we can maintain some preclosure criticality considerations, and then really optimize our waste treatment activities moving forward. Those are self-imposed constraints right now, and as I tried to share with you, we have a vision for improving upon those. We just haven't gotten there yet.

GARRICK: Yeah, well, history indicates that the regulations and the orders do become very dated, and sometimes unnecessarily, and so it's kind of important for the people that are on the side of doing the work being sensitive to constraints and boundary conditions that don't make sense anymore, and I just wondered if you had a process for challenging those from time to time.

GELLES: I assure you we have a vision for doing so--

GARRICK: Yeah.

GELLES: --and we just need to make sure we do our homework and can make a, you know, a technically defensible case for doing so.

GARRICK: One thing I noticed in your newsletter that you might be able to comment on, that the Office is developing technology to revolutionize sub-surface exploration. Can you comment on that? I think that would interest this Board a great deal, even though you haven't addressed it specifically in your presentation.

GELLES: Ken, are you going to have a slide on ASCAM in your presentation?

PICHA: No. No.

GELLES: Okay. We have a very advanced modeling capability that we've been developing in concert with the national laboratories and some other DOE offices that is going to give us a greatly improved ability to characterize--

GARRICK: Well, that's something--

GELLES: --sub-surface contamination and inform our decision-making moving forward. If you'd be interested in receiving a briefing on ASCAM, we can arrange for that.

GARRICK: Well, they certainly--it's certainly got words in it that would capture our attention and interest.

GELLES: We're very, very proud of this development.

GARRICK: Yeah.

GELLES: Okay. I'll take that as an action.

GARRICK: Okay, thank you.

GELLES: Uh-huh.

GARRICK: Questions? Yes, Andy.

KADAK: Yes, I'm intrigued by your capabilities of--and this goes back to my earlier question about can you--well, given the fact that the MOU is now defunct because RW doesn't exist--

GELLES: Uh-huh.

KADAK: --where does the requirement that you need to be licensed by the NRC appear for disposal of your waste streams? And since you had success with EPA, might that be a path forward for you, independently, to solve this problem on your own, because it seems like you have your act together--

GELLES: Thank you.

KADAK: --as they say.

GELLES: Thank you.

KADAK: Uh-huh.

GELLES: That's a wonderful question and I thank you for it. What I shared with you were our assumptions about a future repository--

KADAK: Uh-huh.

GELLES: --recognizing that there will have to be changes to the statutory framework of the Nuclear Waste Policy Act even to get us on whatever track we're going to be on moving forward, but assuming there is a repository, or repositories, that is for both DOE and civilian, I assume the NRC will have a rule and EPA will be setting standards. In the event that there is a decision to separate those two, I think then that we have a wider range of regulatory strategies that can be proposed. We're open to those. That's part of the thinking that we're doing, again, notwithstanding that there's no administration position on pursuing a change to that current policy. We're just trying to do some homework to tee up a robust set of alternatives to our decision makers in parallel with waiting for the BRC's recommendations.

We are very pleased with our regulatory relationship with the EPA as it pertains to the WIPP repository. And even as we're looking at WIPP as an alternative for greater than Class C low-level waste disposal, my office published a draft environmental impact statement for that waste stream that also analyzes some DOE waste streams very similar to greater-than-Class-C low-level wastes, such as non-defense transuranic waste. WIPP was an alternative evaluated, it faired very, very well in the analysis, as did some land disposal alternatives in the very arid sites like Nevada and the WIPP vicinity.

And one of the things that we will report to Congress on in a statutorily required report on alternatives will be some possible changes to the current statutory requirement to the NRC license, the GTCC low-level waste repository. Passing no judgment on NRC’s value as a regulator, I’m sure they’re very wonderful, but if WIPP were to be part of the GTCC answer, it raises the question whether or not we really need a second external regulator given that EPA has done such a wonderful job since the commissioning of WIPP in ’99.

KADAK: All right, the other question is when we toured, I think it was Hanford, I think there was some waste, I think it was cesium, in, like--

GELLES: Cesium and strontium capsules--

KADAK: Possibly.

GELLES: --stored in the WESF facility?

KADAK: And they don’t really kind of make the high-level waste criteria, but by some artifact of an old regulation they are classified as such, therefore, they're stuck. Are you doing anything to kind of deal with that issue so you can get rid of it?

GELLES: It's absolutely part of our high-level waste inventory--

KADAK: Right.

GELLES: --because of the origin of those cesium and strontium capsules. They were removed from the tank waste at Hanford for commercial reuse and then, of course, returned to Hanford for storage after there were some issues, some safety concerns, associated with that commercial use. Right now in this project, and what ultimately will happen with the cesium and strontium capsules, is the subject of that tank closure waste management EIS I mentioned. It's part of that. It's also part of the future baseline assumptions that might be revisited as part of our continuing strategic planning efforts to try and reduce our life cycle costs.

The current plan is to store them. The previous baseline plan was to dissolve them and have them be vitrified with all of the tank waste, and that's not what we're looking to do at this point, so there are alternatives being evaluated that involve relocation from WESF, which is a very old facility, that the Defense Board has raised some concerns about, maybe for some consolidated onsite storage for decay.

There's also some other processing alternatives that might be evaluated that would support their disposition as something other than high-level waste, but we're very early in that alternative evaluation.

GARRICK: Other questions? Questions from the staff?

GELLES: Chairman, if I may, I'd just like to introduce Tony Kluka of my staff. I'm not going to be able to stay for the whole afternoon.

Is Tony still in the room? Thank you.

Tony's my high-level waste team lead, and thank you, Tony, for developing this presentation. So I just wanted to point him out to the Board members, the staff and the audience, if anybody has some follow-up questions in this area. Thank you.

GARRICK: Okay, well, thank you very much.

GELLES: Thank you. Our next speaker is Ken Picha, Director of the Office of Safety Management, Office of Environmental Management. He's going to talk about the tank waste projects.

PICHA: Good afternoon. I don't know if having an afternoon presentation after lunch is always the best, but I'll try to keep it somewhat interesting. I'm here primarily because we're forward-looking into the EM organization, I'm not sure if it was mentioned or not by Frank or Christine, but we're in the process of reorganizing the EM organization, and under the new organization I'll be responsible for tank waste and nuclear materials organization.

So one of those organizations that Christine talked about, the nuclear materials, the spent nuclear fuel, Gary DeLeon will fall underneath our program, so--anyway, that is the context.

We have three, basically, active tank waste sites in EM, and I think you all are fairly familiar with that. The bulk of the volume is at Hanford, the bulk of the activity is at Savannah River in the tanks. As you can see there, it's about twice what's at Hanford, in terms of activity. And then at Idaho we have a smaller volume of waste, I think, of liquid waste remaining, several hundred thousand gallons. We're in the process of completing a facility there that will treat those wastes, and then we also have high-level wastes that are no longer in tanks. The bulk of the curies are actually in calcine bin sets that are located at Idaho.

The one site I didn't--that's not up here--all right, there--up here, in Western New York, south of Buffalo, is the West Valley Demonstration Project. I understand you all have been there? Okay. So you can see the status there. We've got 275 canisters that were produced there, and some liquid still remaining in the tanks, and they have a tank waste EIS that they've completed, and they're marching out on doing a--implementing a Record of Decision there for completing the mission that takes place at West Valley.

This diagram basically just shows a composition at our two primary sites at Hanford and Savannah River, in terms of both the phases, the different kinds of constituents in the tank waste, supernate, saltcake and sludge, both the volumes and the curies. You can see that at Savannah River there's pretty much the activity--and at Hanford--the activity is split about equal between the sludges and the salts and the supernates.

And then this is just a picture of inside some representative tanks. I'm thinking this is Savannah River primarily, and just to show you some perspective, visuals of what each of the types of wastes look like.

And then the next few slides here just kind of show the general plans for disposition of the wastes at each of the sites. You've all probably seen this several times. At Hanford we're waiting for the big activity here, this waste treatment and localization plant, which is in construction, to complete so that we can start processing some waste, and through either the low-activity vitrification facility for onsite disposal or to the high-activity waste facility. And those facilities there are part of--I know it looks like it's separate but it's actually part of the waste treatment plant. And I'll have a slide later on that shows some of the facilities, but you all have been there as well, correct?

Okay.

KADAK: Long time ago.

PICHA: Pardon?

KADAK: Long time ago.

PICHA: Long time ago? Okay. I think we'll have some more recent photos to show some of the facilities there. The bottom line is we've got a lot of canisters of low-activity waste to store, to dispose of onsite. The intent was to have the bulk of the volume be disposed onsite, and then only about 5 percent or so of the curies, 5 to 10 percent of the curies, and then the bulk of the curies, and a smaller volume, to go to a repository.

And then we also potentially have some waste here. There's about 24 tanks that received waste from PFP that we're exploring now whether or not those might be candidates for disposal in WIPP as transuranic waste.

So here is the waste treatment plant. It consists of four primary facilities, the low--let me get these pointers right--the low-activity waste treatment facility, the high-level waste facility, the pretreatment facility, and then the analytical laboratory. And then these other sort out-buildings, we use the generic term, "balance of facilities." There's a huge air compressor facility because, particularly in pretreatment, for mixing purposes we rely on compressed air; there’s the glass-forming storage material facilities that’s going to have its own boiler. It’s about 15 or so facilities that comprise this balance of facilities. Just looking at the roofs on those facilities, I’m thinking this was taken within the last year or so.

Savannah River, as you all probably are aware, it’s a little bit more mature in their program, in terms of being able to actually process and treat waste. We have two tank farms, F and H tank farm. The Deep Defense waste processing facility is the core for treating waste that was destined to go to a repository. I think we’ve produced something like 3,500 canisters so far. Most--in fact all of that--no, I’m sorry, let me correct that. Up until about 2008, all of that waste was essentially sludge waste. In 2008 we brought on this facility here, this MCU ARP facility that basically employs the same separations technologies that we are incorporating in the salt waste processing facility currently under construction and projected to go online sometime in 2014, that will have a higher volume capability of treating salt waste. I think I’ve got a metric on how much has been produced through here, something like 5 million gallons so far of salt waste.

And then we have several--two canisters--let’s see, they’re not showing here, two canister storage facilities--you probably saw those at Savannah River--with plans for a third being discussed. And then the Saltstone Facility, that is our low-activity waste disposal site. There's several vaults in operation. They just completed construction of two new vaults with a new design. This is a circular design, and I don't know if they took you on a tour of that or not, but with the plans to take those and basically come up with what they call a "mega salt cell" that will have a larger diameter salt disposal facility cell.

And this is the Salt Waste Processing Facility in construction. I'm not sure what the vintage of this picture is. They're basically 100 percent through with design, and something like, if I remember right, 60 to 70 percent done with construction. The one thing that they're waiting on here is fabrications of some key vessels that will go in here. They've had to do a lot of work-arounds to continue to be able to build up the facility walls while they're waiting for those facilities to come in, and they're expected to come in sometime this year.

At Idaho, these are the--I mentioned that earlier--the calcine, the sodium-bearing waste and the ceramic metallic waste, which, I believe, that may come from the sodium-bonded nuclear fuel. Maybe the folks in NE have a better handle on that than I do, the processing of that. I'm not sure what the NE thing is here.

And the Sodium Bearing Waste Treatment Facility, they're planning on doing their contractor readiness review sometime in late January or early in February, and then the DOE readiness review is being targeted for March. I'm going to go out there, actually, tomorrow, and this week take a look at that see, hopefully, we're on progress to do that. They're trying to get that waste processed by the end of this year. I believe there's some kind of a milestone agreement associated with that.

Here, this slide just provides a general overview of some of the accomplishments, in terms of tank waste management. We have done--and I think Dr. Garrick was aware of some of the early tank closure activities we were trying to close in the late '90s and early 2000's. We were successful in the late '90s in closing two tanks at Savannah River, and when we actually developed the DOE order that Christine Gelles was talking about, 435.1, we had some legal challenges to implementing that. We had to put some of those activities on hold. Part of the path forward to allow us to get back to proceed with closure activities, as well as provide a clear path at Savannah River and Idaho--at Savannah River for our low-activity waste, and tank closures was this 3116 section of the NDAA for 2005. And so that allowed us to continue to work on some tank closure activities, which we're proceeding with at Savannah River, and allowed us to close 7 of the 11 tanks at Idaho.

As noted here, we processed over 3,500 canisters of high-level waste at DWPF, and then 5 million gallons of salt waste, of which that was--excuse me, sorry--of which some of that, where, basically, the Salt Waste Processing Facility separates the salt waste into a high-activity component that goes over to DWPF for treatment with the sludge, and then the low-activity waste gets stabilized at Saltstone and disposed of onsite in the Saltstone vaults.

West Valley, I think Christine talked about that as well; basically ran for six years and produced about 275 canisters. They are in the process of trying to disposition some of the materials produced during that high-level waste processing, including the melter, expended melter, and some of the primary vessels, and they're going through the 435.1 process for waste incidental to reprocessing to do that.

And then I think we touched on the three plants that are in construction at each of our sites, the Waste Treatment Plant at Hanford, the Salt Waste Processing Facility at Savannah River, and then the Sodium-Bearing Waste Treatment at Idaho.

In the late '90s up until, let's say, 2002 or so, we had a pretty well-funded tank technology development program. It was under a program called the Tanks Focus Area, and it was organized into several key functional areas; there was characterization, there was retrieval, treatment--I forgot the different--all the different functions, but it was a pretty robust program. Say, over the last five, six, seven years, we haven't quite had the resources that we had previously, however, we were able to leverage what we had to do some things and to focus in some areas, including some advance glass formulations, developing some pretreatment capabilities that would be at-tank or in-tank, using some ion exchange processes and some filtration. We actually have tested those at Savannah River, and within EM we have implemented a process for reviewing the maturity of technologies, a technology readiness assessment process. It was something that DOD and NASA had, and allows us to identify and peg specific maturity of technologies, and then, if they're not to a certain level, called a TRL-6, then we go through a process to mature the technology so that we have the confidence we need to be able to deploy it.

The 2012 program, we're actually--with the new organization, we just had a conversation with some of the folks that are going to be part of this group last week to figure out what funds we have, what funds we'd like to have, in addition to be able to proceed, but these are some of the things that we pretty much already have committed to, in terms of we had either ongoing work or work that we know that we want to do. Some of the work, the cold crucible induction melter, primarily targeted for Hanford, Savannah River. We actually are on the second melter; third melter is onsite, and if need to be, could be installed. And we already have plans to secure a fourth melter. The Cementitious Barriers Partnership is something that we're doing with an organization called CRESP, and some other federal agencies--I believe NIST is involved--to look at performance of our things like saltstone and other materials that we might want to use potentially for secondary waste at Hanford.

And then the sulfate removal activity, that's a limiting activity in terms of how much waste we can put in glass, particularly at Hanford, where sulfate seems to be more of a problem. I don't think we have anything specifically targeted in funds for that right now. It's something that we would like to consider.

And then an activity that's fairly, fairly far down the path is an enhanced simulant for separation of salt; primarily it's Savannah River. Right now they're using some kind of a crown ether material to do the extractant. This is a new generation being developed at ORNL. I think they've done some tests in the lab scale and identified that the DF's that they can get out of this simulator are quite good and have some real potential to reduce some of the processing time in the Salt Waste Processing Facility.

System planning, I don't know if when you all were at the Savannah River or Hanford they talked to you about system plans. One of the ways that we try to understand what scope we have to do to complete our missions in the tank waste program, including assumptions, is to document those in a system plan. At Savannah River, we're at 16, so you can see these are somewhat dynamic. The costs of updating these is not miniscule, so they're probably not done as frequently as perhaps some of us would like. And I have an opportunity perhaps to exert some leverage in that regard in the future, but they do get looked at periodically, and they include assumptions such as funding, technologies we're going to rely on, those kinds of things.

And there is a mistake in here. The system planning forecast, I believe is 2028 for completion of the mission at Savannah River, at ORP the assumptions there are that WTP start up in 2019, and then completion of their program in 2047, although I will say that with current budget scenarios we will be revisiting that for sure, in terms of some of the assumptions in the system planning.

We are going to also tackle a systematic review of the system plans to make sure that they are where assumptions should be consistent, in terms of a disposal path for the high-level waste, treated high-level waste, that those are there, that both sites are using broad funding assumptions in terms of what EM's going to get as an overall budget and what we think we can get to both sites.

And at Hanford, that’s another dynamic because the tank waste program is on one side, wants one part of the budget, and then the RL, the Richland, for the non-tech waste thing, is on the other side of the budget, and so those are some other budget considerations.

Over the past two or three years the tank waste program has undergone a number of reviews, some of those initiated by our Assistant Secretary. In 2010 she established a technical expert group, which was comprised primarily of laboratory personnel to look at different parts of the EM program. They did a review of tank waste and had a number of recommendations. That was actually completed in 2011. There was also a tank waste subcommittee established as part of the Environmental Management Advisory Board. The genesis of that was that as we were completing a peer review of the WTP project, the Secretary and the Deputy Secretary wanted to do a review to make sure that past or previously identified technical issues that might challenge the ability for the WTP to meet its contract requirements had been resolved, but to also identify whether there were any potential lingering technical issues that hadn’t surfaced. We decided to use the FACA approach and do that through a tank waste subcommittee that was established to do that review. Following that, the Assistant Secretary chartered that group to look at more a tank waste system issues associated with tank waste at Savannah River and at Hanford, and the bullets there identify some of the key aspects. What's not in there, or not explicitly in there, is to look at some of the methodologies included in the system plans that I identified in the previous slide.

In 2001, the Defense Nuclear Facility Safety Board issued a recommendation for how we manage high-level waste at the Savannah River site. They were concerned about a few things, including there was some older-style tanks that we were trying to use--old style, meaning, basically, single-shell tanks--that identified some potential cracks in the upper areas of the tanks. And so they were--obviously, we were concerned about that. And also at that time, we didn't really have a good path forward on salt waste. We had a previously identified technology that didn't pan out like we had hoped. We'd started it up and tried to operate it, and it had some safety and some process issues, and so for the last ten years or so we have been working with the Defense Board to propose strategies for resolving their issues, and we had probably seven revisions of a plan to address the recommendations. In December, I believe, the Defense Board said, hey, we think you've done the basic elements to be able to close this recommendation. They were interested in some specific things that we'll continue to provide to them to show that we're making the progress that we think we should still be continuing to make.

Another process that we initiated in EM, oh, say in about 2008 time frame, 2009 time frame, was a set of peer reviews. This is modeled on the Office of Science approach. They use something called the Layman Review, after Dan Layman, which is a group of folks, basically peers, in terms of from other projects or other program’s secretarial offices, or other contractors come in and do a review. It’s a fairly high-level review. We don’t have criteria, assessment documents, CRADs. We use lines of inquiry, and we do it at a more macro level, but it’s a pretty good opportunity to look at big-picture issues with these projects, and we issue a series of recommendations, the teams do. I’ve been on one on the WTP, as both a sponsor and a recipient of the recommendations, and then most recently as a reviewer. I’ve been on the last three for the Salt Waste Processing Facility as a reviewer.

And then we’ve also had these technical reviews of some of the technologies, external technical reviews, of the Small-Column Ion Exchange, and then a technology readiness assessment that we hope to complete in 2012. It was not quite complete at the end of last year.

I already talked a lot about the Tank Waste Subcommittee, so I won’t spend a lot of time on this slide, but I will just talk briefly about the recommendations. This is basically a binning of the recommendations that they came up with in terms of the functional areas. As you can see, there's a number having to do with the modeling that is a basis for the system plans. They had some recommendations, in terms of the low-activity waste forms. A number, probably the largest number here, for our at-tank or in-tank candidate technologies. We had them look at the reliability of the waste delivery plans, particularly at Hanford, where we don't have that infrastructure complete yet.

And then the last item there is a vision to be able to fully integrate the tank farms and the WTP operations.

We are in the process now--one of the reasons for a establishment of a tank waste organization is it was difficult with the current organization for somebody, or particularly in this instance, our Assistant Secretary, to point to and say, who's the belly button, if you will, who's responsible for tank waste activities? Or, when you went down to a lower level, who could I point to as the single person who had ownership of Hanford tank waste or Savannah River tank waste programs?

So one of the things we're trying to do in this reorganization is establish some clear responsibilities for that. And that will be one of the things that's on my plate is to make sure we go through all the recommendations we've had under these different reviews and make sure that we have a response, or at least actions planned as appropriate; or, if we don’t think it needs to be responded to, that we’re very clear in that regard. But we have not yet done that, in terms of going through all these recommendations to ensure that we have good knowledge across both EM and the two tank waste sites about what the expectations are to address these recommendations.

Basically, the conclusions are we’ve had a number of reviews over the past three years or so that we need to sort of step back and take a look at what all these mean and whether or not we have actions in place to address them, or what we have specifically identified that we don’t think actions are appropriate. And then we have an R&D program that we hope is going to yield some significant savings, both in time and costs. And that’s it.

GARRICK: Thank you. As a matter of curiosity, what--you got some of that up there--what was the operating period for each of the three plants, the one at Hanford, Idaho and Savannah River?

PICHA: At Hanford the waste treatment plant would nominally start up in 2019 and then run through the initial completion, 2047. Now, what I didn’t say there, and thank you for the question, is that, as currently proposed, it will not have the capability--the low-activity waste facility will not have the capability to process all the low-activity waste produced through the pretreatment facility by 2047, so we're looking at a supplemental treatment to do that.

At Idaho, the sodium-bearing waste treatment facility, we're expecting about a year's worth of operation. Now, whether or not that can be configured, and maybe Joel Case, when he talks, can talk about whether or not there's some opportunity to do anything with calcine, I don't know. It was certainly envisioned and it was sometimes called the Integrated Waste Treatment Unit, should it be able to have some local capabilities.

And I don't know much about the plans for how long it would take to package or disposition the calcine into a road-ready form. At Savannah River, the Salt Waste Processing Facility has said it's supposed to start up late 2014, and then also operate, basically, through the end of the program, 2028 or thereabouts.

GARRICK: Uh-huh, and just as a matter of curiosity, what was the capital cost for each of these facilities?

PICHA: The projected capital costs?

GARRICK: Yeah, right.

PICHA: At WTP--let me just tell you the baseline, the approved baseline. At WTP the approved baseline for the project, all the four facilities and the balance facilities, is $12.2 billion. At Salt Waste Processing Facility, it's $1.3 billion and some change, I can't remember exactly. And

SPW, I’m going to have to get back to you on that.

CASE: Yeah, and--

PICHA: Oh.

CASE: --all the project costs is $571 million, and it’ll end at that because it’s under cost cap, so--

PICHA: Thank you.

CASE: --TPC is 571.

GARRICK: Thank you. Andy?

KADAK: Yes. Earlier this morning I asked the lady--Gilles? Is it Gilles?

SPEAKER: Yes.

KADAK: --about the status of the waste treatment facility in the sense that I had heard that it was not completely designed because the processing methodologies were not working, technically, and whether or not it was on schedule and what the budget was relative to your baseline. So could you first address the technical problems associated with finishing that facility, and then the schedule and budget, if you could?

PICHA: Sure. Primarily the primary technical issue we have is the demonstration of the capability of the pulse-jet mixers that are going to be in about 38 of the vessels to operate as envisioned. There was a testing program done to satisfy the closure criteria of a previous review that was done in 2005, 2006. They closed that out but said, you know, it looks like we need to do some additional testing. At about that time, which was late 2010, the Defense Nuclear Facilities Safety Board issued a recommendation that basically followed up a DOE commitment that we would do this larger scale testing and said we think--the Board basically said, we think this testing is real important and we want to make sure that you all are reducing the uncertainties that we can through this testing program.

And so that is something that is--that we are continuing to work on, that is not an inexpensive effort that will be undertaken over the next couple of years to demonstrate that the technology will work. We're doing testing in four-foot, and in eight-foot-diameter vessels. Depending how those look, in terms of the ability to predict what's actually happening with some of the computational fluid dynamic models are using could go to a fourteen-foot test facility. But that is the primary technical issue. We have had other technical issues in the course of events. There's certainly some questions about, for instance, accident scenarios that could pose some issues for the primary ventilation system. I apologize, my mouth's dry.

So with respect to engineering, the project is about 83 percent done with design and engineering, but you're right, it's not complete, and some of the--particularly the mixing issue has gone on a lot longer than we expected.

There is some risk in that, that's all I can--

KADAK: So what does that do to your schedule and cost?

PICHA: In terms of cost, some of that is imbedded in the contractor management reserve, some of that is in contingency. The other part of that is when a construction project review looked at the project in 2010, mid-2010, the team recommended, they said, you know, based on your steady funding, we were getting $690 million a year, we don't see that you have a great deal of confidence. They run, basically, Monte Carlo simulations to look at the confidence level in being able to complete the project within the cost and the schedule, and, in fact, the confidence levels were about 20 percent, and, typically, our construction, if you look at things like MOX, if you look at SWPF, if you look at a lot of our facilities, they have a typical hump.

You have a ramp-up during peak construction, and then a tapering off. And they said, we think you really need to ramp up very significantly in the years 2012 through 2015 if you're going to be able to get a higher level of success and confidence, and I think the confidence that they were able to predict was somewhere in the 70's, that if you had a modified funding profile, it--we certainly didn't get what we expected to get, in terms of that funding profile this year, in FY '12. It probably--we're trying to verify what things look like for '13 and out, but it would mean that it looks like we probably have to consider a re-baseline.

GARRICK: Okay. Rod?

EWING: Ewing, Board. At Hanford, the plan that you've described would leave a significant volume of low-activity waste, vitrified waste, onsite. Has that plan cleared all the regulatory requirements and agreement with the State of Washington? Is that settled?

PICHA: I don't know if that's cleared or not. I don't have the specifics. I understand that they are, at least, conceptually on board with it. Whether or not they've gotten all the permits that are necessary to achieve that, I can't say.

EWING: Thank you.

PICHA: I mean, it's been in their baseline for a quite a while.

GARRICK: Ron and then Carl.

LATANISION: Yeah, Latanision, Board. On your slide 12, the Technology Development and Deployment Program, what was the goal of the work on advance glass formulations? What was the orientation of that work?

PICHA: Right now at Savannah River I believe we're in the nominally 30 percent waste loading. What that essentially means is that, basically, you get one-third waste and two-thirds glass-forming materials. If they're--with the ability, also, part of that is predicated on getting the confidence that we were looking for to be able to achieve a product with the certainty that it would meet the requirements that we had that flow down from the WASRD and the WAPS that Christine talked about earlier, primarily through--we had a product consistency test that was the measure of a effective glass product. With some of these new technologies we may be able to bump that waste loading up.

LATANISION: So if you were looking at waste loading and not the chemistry of the glass--

PICHA: Well, I think it was both. Actually, I'm probably not, since I wasn't involved in the recent activities--Tony, do you have any insight to that?

KLUK: Well, I...

GARRICK: Microphone.

PICHA: If you don't, don't bother.

KLUK: I would just point out that I believe they're trying to approach 40 percent as the number that they hope to--waste loading that they hope to get. They may be below that but that's where they hope to get.

PICHA: But we're still targeting borosilicate glass. We're not doing anything iron phosphate or anything else.

KLUK: It's also--that's correct.

GARRICK: Would you give your name and affiliation before--

KLUK: Tony Kluk.

GARRICK: Thank you. Thank you.

KLUK: Yes.

GARRICK: Carl?

DI BELLA: I'm Carl Di Bella, Board Staff. I wonder if you'd put up your slide 2?

PICHA: Okay.

DI BELLA: Yes, that's the one. So at Hanford you have 194 million curies, and later on in the presentation it says that's going to go into 9,667 canisters. So, if I remember, you've got more curies that's going to go into 6,300 canisters, of which you've already made 3,500, so that leaves 2,800 left, which says that the waste loading, from a curie point of view, puts Savannah River on the order of six or eight times what Hanford is, and Hanford's canisters are 50 percent larger. So am I misreading the numbers, or is there perhaps a composition reason for this very large difference?

PICHA: I think the primary reason is--somebody asked Christine Gelles the question before about the cesium strontium capsules. There's about an equal number of curies in those cap--well, that's not true, but there's a lot of curies in those capsules. I forget the exact numbers. It just turns out that when they extract this strontium and cesium from the tank waste and put it into capsules, they just were left with a smaller inventory. In terms of the overall volume, I've never done that comparison in terms of the number of canisters per unit volume, or curies per unit volume--per canister.

I think one of the things is that they have some challenges at Hanford that I don’t believe are present at Savannah River. One is chromium that they have. Chromium, which is, as I understand it, and I’m not a glass chemist, so--it has limitations in terms of waste loading, and you have to reduce the amount of waste you can put into canisters. The sulfate issue is another issue that also potentially limits glass loading in canisters at Hanford. Those are the two main things that I recollect are some of the drivers there.

DI BELLA: May I have a follow-up question?

GARRICK: Go ahead.

DI BELLA: The product consistency test, or durability test, and I’m not sure the right name for it, has--is--gee, it’s more than thirty years old, and particularly now that Yucca Mountain is not being looked at as a repository, and that there is certainly time, is there any revisiting planned of the product consistency test?

PICHA: That’s a good question. I think that’s something that I’ll need to get with Christine on to consider that as we map out a path forward for disposition of our high-level waste. If we do that, though, it certainly could have potential ramifications on--certainly at Savannah River and, potentially, at Hanford, because the contract is geared towards the WAPS and the PCT as a key component of that, so it has to be done in a very--if we're going to do that--done in a very careful and deliberate manner. But I would say that there may be some merit in looking at that.

DI BELLA: Thank you.

GARRICK: Andy?

KADAK: Yes, just a question in terms of lessons learned. You have not only high-level waste, but you also have spent fuel. Is the intention not to reprocess any more of that spent fuel as a waste management strategy and dispose of it as spent fuel assemblies?

PICHA: I think that that decision always seems to be--I won't say that--that question--I'll put it better--that question always is on the table. We still have H Canyon as an operational facility at Savannah River. There are limitations to what we can do in H Canyon. We have funding limitations. But I'd say that one of the things that we will need to do is develop a pretty--something I'd like to do, see about doing, is developing some kind of a program plan that documents a path forward for some of our nuclear materials that's a bit more perhaps visible. But there's certainly that opportunity. I don't think there's any--there's no decisions right now to reprocess anymore spent fuel.

KADAK: So given your experiences of dealing with reprocessed materials, high-level waste, your preference would be to take this spent fuel and dispose of it directly rather than go through another cycle of this cleanup effort?

PICHA: I probably am not going to get into a personal perspective on that. I think both have challenges and both have advantages. I can't say that I've sat down and done any kind of a methodical comparison about the advantages or disadvantages of each.

KADAK: Okay.

GARRICK: Okay. Any--oh, yes, go ahead.

REGALBUTO: I think it's important to recognize, Andy, that the way that the Defense Program was run was very significantly different than the way a commercial spent-fuel program is run today. So, unfortunately, this was during the war, and we built a separations, you know, facility, not a recycling facility, because a recycling facility for spent fuel is the separation and the waste management together, the way the French do it, for example. This facility had the separations component, and then fifty years later, we build a waste-removal facility, and that's why you have the tanks. In France they don't have tanks, okay? There's no tank farms of any kind.

So I don't think it's a good comparison to compare a Defense program that was constrained by the war with a commercial recycling facility for spent fuel. I think for that we don’t have any experience in this country to really assess that. You have to go overseas to look at the right way to do that.

KADAK: Here’s why I asked the question. You can build reactors to recycle, and that may be a justification for going into a sustainable fuel cycle, where you built a reactor as a burner, or whatever, breeder. That would be a path. The other path is, well, let’s just deal with the spent fuel as a waste. And how do we best manage that? Separately from recycling.

REGALBUTO: Yeah, I think that’s what the systems work is doing.

KADAK: Right.

REGALBUTO: They’re evaluating once-through options and recycling options, and then advanced recycling options--

KADAK: Right.

REGALBUTO: --but the Defense program, especially the United States Defense Program, cannot be compared to a commercial spent nuclear program.

KADAK: No, I get that, but my question is more narrow. Let’s just say we take and we want to try to minimize waste disposal, okay? By reprocessing, not recycling, reprocessing the material into a waste form that’s suitable for disposal, which is why I asked this gentleman the question. Would you consider reprocessing your waste as part of your waste management strategy to reduce volume, let’s just say, or make it a more robust waste form, regardless of whether you use the byproducts?

REGALBUTO: It depends on the fuel. One example comes, the Magnus reactors in the U.K.--

KADAK: Right.

REGALBUTO: --where you have to reprocess--

KADAK: Okay.

REGALBUTO: --before disposal. You have no choice.

KADAK: Right.

REGALBUTO: You have to stabilize the--

KADAK: Uh-huh.

REGALBUTO: --so it’s a very, you know, we have a boutique of fuels in this country, if you want to call it, compared to other countries that have more, you know, uniform, you know, inventory. That’s a case-on-case basis. And one of the things that we would like to do is, for example, take a look at the spent-fuel inventory and say, hey, out of the whole spent-fuel inventory, what really needs to be stabilized? So we’ll consider stabilization or volume reduction, based on the specific need. You know, the U.K. Magnus reactors is one of the perfect examples that falls into that category.

PICHA: Okay, and if you’re just talking about using existing capabilities, H Canyon, for instance, at Savannah

River and the tank farm infrastructure, I'm not--that would be where some of the tradeoff would be, in terms of, because it's not acidic we neutralize it and then we get those things. You have to--if you wanted to do it direct and keep it acidic, you'd have to have different tanks, and build new tanks. I'm not sure when you neutralize it, and then have to subsequently treat it, that you end up with reduced volume. You might end up with reduced volume on the high-level-waste side, but not necessarily on the low-activity side, so that would have to some considerations.

GARRICK: Any other questions from the Board?

(No response.)

The staff?

(No response.)

The audience?

(No response.)

Good. Thank you. Thank you very much. We're a little ahead of schedule. I think we'll take a twenty-minute break and then come back, okay?

(Whereupon, the meeting was adjourned for a brief recess.)

GARRICK: Let's reconvene. Our first speaker after the break is Joel Case, who's going to talk to us a little bit about the calcine project at Idaho that's been around for a long, long, long time. And then we're very curious about what's going to happen to that stuff, and maybe he's got all the answers. Joel? It's yours.

CASE: Thank you. I'm Joel Case. I'm with DOE, the Idaho Ops Office, so I'm not a headquarters person, and there's nothing wrong with not being a headquarters person, but I deal more on the day-to-day implementation of policy and projects. So, as I think I mentioned, I'm the Federal Project Director for the Calcine Disposition Project. I'm also doing kind of double duty right now, I'm the Deputy Federal Project Director for the Sodium-Bearing Waste Treatment Project, which we're in the commissioning phase of that project, but there are some relationships there, as I'll get to the presentation.

I'm going to give a little bit of project background. I know the Board was out to Idaho. I think we talked with you all about it in 2010, I forgot, I think it was the April time frame, so we talked a little bit about the project then, project drivers, the scope of the project and current status.

We're kind of blessed in Idaho, where we had stainless steel tanks. We actually did what we thought was a final treatment process, pretreatment on--when we generated our liquid waste we processed--mainly the mission in Idaho back then when we were reprocessing spent fuel was DOE owned fuel and navy fuel, because we do have a naval reactor facility and all the navy fuel does come up to Idaho for examination, and then we reprocess that fuel.

What we use in the process--a tank farm that had stainless steel tanks, and we had what was called the Calcine Waste Facility and then the NUWASTE Calcine Facility, which is a fluidized bed technology that processed that liquid waste. So it was acidic waste we didn’t have to neutralize because of stainless steel tanks. And we generated about 8 million gallons of liquids that we were able to run the calciner and develop a process of--or, develop a product that produced the calcine.

About 7-to-1 volume reduction. We did shut down that facility, NUWASTE Calcine Facility, back, I believe it was 1999, 2000, time frame. I was in charge of that program. We really had to shut down for regulatory reasons. The facility didn’t meet the current requirements under EPA and State of Idaho air emissions and RCRA treatment, because this waste is considered mixed waste. As you see, we have listed metals--I mean, metals, RCRA metals and listed waste codes, so that was really the drive why we shut down the facility. It was a very old facility and we really couldn’t upgrade to meet current treatment standards.

But again, it’s a very stable waste form stored in bin sets. Key on this one, it is high-level waste and it is regulated under RCRA, so there are some interesting nuances with the process, with EPA and the RCRA constituents. And for an in-state repository, it drove some of our decisions on where we’re at with treatment at that facility.

As I mentioned, Ken mentioned, we do still have about 900,000 gallons of liquids in our tank farm. We call that sodium-bearing waste. It is really mainly D&D solutions, a lot of cats and dog waste liquids. Everything always streams liquid at the tank--or INTEC, the Idaho Nuclear Technology and Engineering Center, a former chemical processing plant. A lot of the radioactive liquids all went to the tank farm. Right now we’re considering that as we manage it as TRU waste. We’ll need the waste determination after treatment. It’s about 900,000 gallons and we do have the integrated waste treatment facility that will be treating that waste.

As Ken mentioned, we’re in commissioning phase now. Construction was completed this June. Total project cost for that facility is $571 million. It’s using a steam reforming process. We will utilize that facility after we retrofit for the calcine treatment. That’s the plan with the process cells.

Commissioning, we’re looking at the contractor OR toward the end of January, federal OR, depending on what needs to come out of the contractor operational ratings review, toward the end of February with a startup in the

March time frame. And the waste treatment campaign for that will be about a ten-month campaign to meet the commitment with the State of Idaho December 31st, 2012, to have all that waste treated.

So I just gave you a little background. But this is how we generate the calcine. As Ken mentioned, a little bit more diagram. We have seven bin sets. They're stainless steel vessels, containing concrete bins. One is empty, that's bin set 7. The first three bin sets, 1, 2, 3, are below grade; the other are half, above and beyond. Each one has a little different design, based on the waste types and spent fuel types we have, so it is, I mentioned, this waste is considered RCRA regulated, State of Idaho; it has a permit for storage. It's not considered compliance-based. We had to have a compliance agreement because of the waste form, it's not compatible; we need double containment, stainless steel and the concrete vaults. The concrete vaults are not compatible with the waste form, so the State had to give us a compliance agreement with the RCRA permit because the concrete is not compatible with the waste form for double containment.

Just a little interesting nuance. So the total volumes, as you can see there, per bin sets. And this is a photo of the bin sets, where they're at. And I mentioned the first three are basically underground. Let's see, bin set 1 and 2, and then--can you see 3? They're all cut up. That was for shielding. They were put there for that reason, and then the remaining--you can't see bin set 7, it's off toward the right, I believe. It's empty, and bin set 6 is half full.

One of the issues we'll be dealing with is retrieval from the bin sets. They do have access ports; bin set 1 doesn't. We do have an R&D program, engineering and development program, looking at vacuum retrieval. Some of the issues we're dealing with this is, is there caking of the powder? We don't believe it is because of the heat generation. And about ten years ago they did do a sampling campaign. They did drive a sampling port down through bin set 3. It seems to be very viable and loose, so there hadn't been any indication it was caking, but that is one of the risk factors for retrieval.

This just shows the old NUWASTE Calcite Facility stack, when we ran the calciner. One of the issues was, since this is nitric acid-based waste stream, we had a lot of NOX. There was no NOX treatment capacity for the air cleanup, so it just went out the stack. So those were some of the issues we had on shutting down a top-grade facility. We decided to go to a new facility to treat the remaining liquids.

That's the bin sets. So, again, it's a very safe storage configuration, engineered facilities. You know, we've done some studies working with the State of Idaho, because of the seismic issues in Idaho, what are the lifetime of the bin sets? And you'll get anywhere from 300 to 400 years. I'm always a little skeptical. Engineers aren't perfect, and so--but the studies are. This is a very robust facility, and we do have corrosion coupons inside, inside on the outsides.

Project drivers, as you heard mentioned, Christine, and Ken also, we have what's called the Idaho Settlement Agreement. It's a court order compliance agreement between the State of Idaho, Department of Energy, and also the Navy Nuclear Program. It was signed way back, gosh, in probably '98. But it really sets milestones for all waste streams, so it's a court ordered agreement.

If we wanted to change the agreement we have to go back to the Judge, the Court, and the parties have to be in agreement, but these are really our drivers. We had to issue a Record of Decision to identify a treatment process for calcine. Before we issued the ROD, we were looking--we spent probably about ten--oh, gosh, ten years looking at different alternatives over the life of, you know, when we were doing the EIS and from the settlement agreement. I think we looked at various--120 different options, leave in place, direct processing, and, basically, we selected hot isostatic press.

It’s a thermal pressurized treatment, and I’ll talk a little about the decision basis for that. Really driven by waste loading, the requirements for vitrification, a glass-like waste, and performance to meet the WASRD, and it minimized the amount of waste we generate, product we generate.

We have to submit Part B permit next December, well this December this year, December 1st. One of the challenges is we’re very early in the design phase in technology development. Historically, on RCRA Part B permits, they like final design. We won’t be there, so that’s one of the things we’re working the State about, is what level maturity of the design, and also our technology maturity of the process, to submit that Part B permit.

I mentioned the one bullet there, it may include sodium-bearing waste processing schedule. We have to--one of the concerns the State has is we’ve made no progress on getting the treated SBW, except as at WIPP. Well, we would have to go through a waste determination process for WIPP, and also a permit modification for this waste. It’s about a factor of 10 activity level, compared to the high-level waste calcine. So they’ve asked us, as we submit the permit for the processing schedule, to HIP the treated SBW.

And I mentioned we’re using steam reforming, so it does produce a material very similar to calcine. It’s a dry powder, and that was one of the decisions when we selected steam reforming for processing the liquid sodium-bearing waste, is it compatible with whatever future treatment decisions we'd make for calcine? We didn't want to have to build two different treatment plants. So that's the only issue that's still in the air, and they may require us to submit a schedule for that.

A big driver, Christine mentioned, it has to be road ready, which means processed and ready to ship to a repository by December 31st, 2035. The other driver, of course, is under the Federal Facility Compliance Act. We have a specific Idaho site treatment plan. It has a number of milestones for all our mixed waste. The real key one for us is for the calcine project we'll have to submit to the State of Idaho our project milestones by the end of this year. And again, start construction, design reviews, et cetera, complete construction, and also with the Part B permit of the treatment schedule. So those are the real drivers for the project.

Project scope is design, construct processing system. Again, key here is using an Integrated Waste Treatment Unit facility to the maximum extent practical. When we first started the design and selection of CWI for sodium-bearing waste and steam reforming, one of the things that EM wanted to look at is we're not going to build two major processing facilities in Idaho, so we looked at kind of maximizing use of these process facilities. So the facility itself, Integrated Waste Treatment Unit was designed to what's called a Performance Category 3 Standard. That's really a seismic type standard. A robust facility based on our material at risk for both the sodium--it's a PC-3 facility, which is driven by the source term for the calcine. So the intent was once we're done processing the liquid SBW, we would remove those vessels and place a treatment process in for calcine, which is a HIP. So that's really driven a lot of our design efforts and technology maturity efforts.

We have about 4,400 cubic meters of calcine, and it has a weight of 12.2 million pounds. We're going to be utilizing WASRD requirements for Yucca, as Christine mentioned. Protomatically, that is kind of, you know, what the assumptions are for high-level waste. We're using right now waste-forming canisters. We're looking at different various permutations. Because of facility constraints, we may not be able to use 10-foot canisters. We're looking at naval reactors on their spent-fuel container, it's a little wider a little more stout, so it will fit in this facility without any modifications. But that's one of the trade-off studies we're doing. And once it's treated, we'll ship it off--store it onsite or store it off-site, pending final disposition.

Total project costs, this is pre- what we call

Critical Decision 1. We don’t have a project baseline, so we’re--that comes to Critical Decision 2 when we get to a preliminary design. We’re in conceptual design. The cost range is $.9 billion to $2 billion. That’s design and construction, it doesn’t include life cycle. You know, just to design and build the facility, doesn’t include operational costs or shipping costs, or repositing cost if we have to--like we did pre-Yucca Mountain. There was a per-canister cost for disposition.

I mentioned we did select back in 2009, I think it was December 26th, the Hot Isostatic Pressing concept. It is--there were some questions today about teaming partners with commercial companies. We are--AVURE Technologies. HIP is a process that’s been around a long time, since 1941, mainly looking at sintering metal products. I think it’s also used in fuel fabrication. But it’s really a great process that makes components, airplane components, engine blocks. It’s basically anywhere you have a metal, sintered powder metal, you can make a component.

So it consists of a pressure vessel and electronically heated furnace, and uses, basically, isostatic pressure, so kind of internal, and argon gas and high temperature, high pressure, and you get a glass-ceramic waste form. Some of the attributes that drove this in the RCRA decision process is you get very good waste loading. We’ve been studying hot isostatic press for calcine waste form in various forms and permutations since 1988, if you look at the records, and that’s all in the NEPA documentation. You get very good waste form loading, anywhere from 50 to 75 percent in some of the surrogate waste we looked at, so--and it also produces a waste form that’s not very leachable.

That’s one of the challenges we’re looking at because we do have some heavy metals, and the PCT tests, the product, you know, performance testing, but we don’t want it to leach metals from a RCRA standpoint, so we’re doing a lot of waste form development work. We’re working with ANSTO, the Australian Nuclear Technology Organization. This is--you’ve heard of Sinerop (phonetic), this is kind of the same thing, it’s their spin on HIPing. So developing a very glass-like ceramic waste form. And we’re in the middle of testing right now on very small samples, and we’re doing a--we have a very good technology roadmap to get to full-scale demonstration of the process.

But the key here is it would fit in the facility, don’t have to build a glass--it seem seems to have better performance characteristics from--minimizes the number of canisters you produce, get very good waste loading. Downside is it’s outside the whole BDAT, what’s called Best Demonstrated Available Technology for high-level waste. That’s vitrification, borosilicate glass. So we do have some challenges of getting through the land disposal restrictions and the BDAT determinations. We're working with Headquarters, Christine's group, Bill Levitan at headquarters, on that whole petition process, depending on where the repository is, because of our constituents. Very large life cycle cost savings because of the smaller volume and number of canisters generated.

Process overview. View this schematic. We tried to break it out in critical technical elements. This is the bin sets, the mack (phonetic), we transfer it. We have done some full-scale demonstrations, actually, plus with COGEMA a few years ago. I think they sold that part of the company, but we did do some mockups using simulated calcine, full-scale, of using the mack transfer, transport lines, to get to a feed tank. We did that in Raleigh, North Carolina. They have a test facility there. So we--but we do have a program looking at nozzle design, penetrations, access to the bin sets, because we do have risers, but they're four-inch, six-inch, very small. So there's challenges there.

And then you basically have a day tank. One of the things is a key with the recipe with that, with the additives, to get a glass-ceramic waste form, we're doing--we have three main types of calcine. It was all based on the fuel types we process. But the major types, aluminum-based fuel, that was calcine; zirconium-based fuel; and then a mixture of the two. So we're looking to get a formula development that has an additive, it really covers all three fuel types.

But you would go--you have a hopper receipt, and then you have a--you bake out the calcine. One of the processes you don't want to have any moisture content, in the HIP process. It just--because bad things can happen with--if you have any moisture in those sealed canisters. You don't want to breached can. So there is a calcine bake-out process. Let's see, the additives come in, and after we do the bake-out, and they have their own separate bake-out, and then it would be mixed to the recipe and then loaded into the HIP can, which then is placed in a HIP furnace and then loaded into the HIP unit. We're talking about a 24-hour cycle. That's the estimate we're looking right now, but that's one of the things on the R&D program, technology maturity, is what's the best mix for processing the calcine?

We're looking at three treatment trains, three HIP units in the facility. We're looking at a 12-year processing time. So that, basically, 24 hours, we assume we'll get about a 40 percent reduction of the actual HIP can. That would be then removed, cooled off, and loaded into the--in the packaging treatment area. We're looking at five, basically, HIP hockey pucks there. They'd be about, oh, two feet by five. Load five to a canister, and then package for shipment or storage, so that's kind of the basic process.

We do have mercury in our waste. That's one of the issues dealing with the RCRA constituents in off-gas treatment. So there is right now a mercury condenser. We don't know if we really need it, but that's some of the testing we'll have to do. We do already have a GAC bed process, because sodium-bearing waste--we're trying to use as much of the infrastructure at IWTU for this process. So it's really new. You know, process cells here. We'll remove the vessels we're using for steam reforming and place this process here. There will be a new addition on the rail transport, or truck transport, and I'll show you an overview of that.

So I won't say it's a very simple process, but it is. We're working with AVURE Technology. They're a Swedish company but they're worldwide. Also ANSTO and a couple of other companies. Michigan Tech. They have world-renowned expert on HIPing. So we're trying to get that commercial experience and apply it to radioactive waste.

The Australian government, they are looking at this. They're in final design and they will be using the HIP process to treat their test reactor they have there for research medical isotopes. They'll be treating remote-handled waste they generate from that, the generators--I think it's Moly Generators they use, and they're going to be building a facility using HIP to process the waste that comes off that facility. So they're under contract with us. They're helping us out on the HIP can design and the waste formulation.

This is the Integrated Waste Treatment Unit Facility. Again, the way the contract's structured, this is the facility but it's under the sodium-bearing waste treatment project. This is--whoops, sorry--this is what basically $571 million buys you. It's, basically, this is the shell of the building. One of the real key issues we had at this facility was Performance Category 3. If you look inside the facility, this is really the shell of the building, with the process cells inside, but seismic analysis, you know, we're engaged heavily with the Defense Board on our seismic evaluations and the design of that. A very robust facility. You can't really tell from the outside, but this building houses the process cells and the control room, and all the other off-gas ventilation equipment. And this is the--

LATANISION: Just for a point of information--this is Latanision, Board--is the HIP unit in a pit in that building?

CASE: No, it--right now this facility has a steam reforming process.

LATANISION: Oh.

CASE: The plan is, path forward, is once we're done treating the sodium-bearing waste, is you would remove the steam reforming process vessels.  And they were constructed in modular units.  And they're big modules, but we have access hatches that we can lift them out, and there's a crane in there, and then you just remove this process and put the HIP process in.  And, you know, but that--it's going to be a challenge, but, again, the thought process was is we don't want to build two major treatment facilities.  But that's one of the challenges we'll have, and we're working with the contractor on that, on the D&D, et cetera, of that, so--

LATANISION:  One other point of information--Latanision, Board--is it a wire round--a wrap?

CASE:  We're looking at a wrap--the HIP unit itself? Yes, because if you look at the two types of HIP units, historically there's the wire round ones, and the others that are big.  There have been some safety issues with the non-wire round, so it's coiled because you can get a breach of the HIP unit, especially with water.  I hate to say--it's not deflagration, it's just a pressure explosion.  So the wire ones have a very, very good history, and that's what we're assuming right now when we started to work with AVURE and those people.  So we are looking at a wired unit.

And we have gone to some of the facilities to look at their operational experience.  But this is IWTU, and right now scheduled for commissioning toward March for startup, but this is where we house the process.  This gives you a little bit--nope, sorry--this is right now the existing process cell.  So what you were seeing was the shell of the building outside.  This is the process cell. We have what we call the four-pack.  Here is where we have all our steam reforming vessels, so you would really retrofit the facility, remove the steam reforming vessels.  We have like four main process vessels for that process, drop the HIP units in.  We'd have three HIP lines.  Here's load-out cells.  This would be, you know, cool off in the HIP units itself.  And then this--so this is all existing right here, the footprint, and then this facility would be the shipping annex.  We'd have storage areas here we could load out, a little bit below grade, and then your transport capability here.

And then if you need storage, we'd have to build a storage unit.  Right now that's not in the design, but we have a private storage building for the treated sodium-bearing waste.  We're assuming we're going to make 750 canisters of waste.  There's 16 to a vault, and that storage facility is right up here.  So we'll just--we'd have to add on after treatment if there's no repository for treatment--for disposal.

So that just gives you a schematic of what we're looking at to retrofit the facility.  Very high level.  Right now we're in conceptual, looking at a lot of different issues, value engineering studies.

Project focus for most of this fiscal year is really to lead to our Part B permit submission, both for retrieval from the calcine bin sets since they're under their own permit, and for the permit for this treatment utilizing IWTU. IWTU has an existing permit for steam reforming. We're building upon a permit that was basically a liquid waste treatment permit that goes all the way back to the NUWASTE calcine facility days. It's a lot easier in the permitting process just to modify existing permits. The state's been very receptive working with us on that. The real challenge here is enough design information and technology maturity to submit that permit. So our real focus is focusing on those design elements that have the least understanding with the process, and also focus on technology maturity of the main HIP process, focusing on waste form development--HIP can design is kind of an art--and some of the off-gas issues.

We are looking--one of the lessons learned always is you really need to have full-scale testing development. For steam reforming we did a 1/10 scale of the whole process at Hazen Facility in Golden, Colorado. About a six-month program, 1/10 scale, but there are always scale-up issues. We're look at a full--of the actual HIP process, having a full scale unit work on cold waste once we get the recipes down. So we focus on that design, and then all the engineering files for the process, to submit as part of the permit.

And then technology development. We're--a big effort on waste form testing with simulants. We're working on a scalable process, focusing on 100-gram samples, working up to 1 kilogram, to 25 kilograms, and then build upon that. So, furnace filter testing. That issue was, under the pressure, if you had a breach, we didn't to contaminate the process cell, so it's been a big effort working on a confinement system for the HIP unit in the furnace. So that's what we call a "furnace filter."

AVURE Technologies. It's been very beneficial working with them. They've got some really great ideas on that, and we think we've got that one, at least the design, ready for that.

HIP can testing. Since it's isostatic, it's very interesting, the algorithms for that on the process. Again, high pressure. It's got to shrink in a nice, very succinct kind of way. So we only--so we're working with them and their engineers in the computer modeling of that, and also small-scale testing. They have a facility in Ohio that they're helping us with.

And the same thing with the HIP can profile testing. It's all related. And Bodycote is the other company. They use this process a lot at their facilities. So a lot of commercial involvement engagement. Because, again, this is a technology in DOE we're not that really familiar with, it's just not your classic vitrification.

Mentioned technology development. We think it was Ken, or was it Christine, talked about our technology readiness level. We're using the 413.3A guide process on your technology development levels. We had it reviewed, and, in fact, Tony Kluk, he led a team a year ago last summer that did an assessment of our process. We tried to develop the process into eleven key technical elements, critical technical elements, in the process. Evaluation was done July 2010. They did come back in December and took a look, so this is where we're at on the major areas for the process. The main focus, as you can see, you know, the waste form is very, very critical for us. That's one of the ones that we need to do some really good surrogate waste work on.

HIP can design. I mentioned that's one where you want to make sure of the process, you don't get a breached can. It's kind of critical to get the right algorithm for that, modeling for it, and then do the testing. HIP can confinement. I mentioned that's a filter issue. We believe we've got that issue addressed, at least, for the TRL-4. We'll do full-scale testing for that, and everything else.

Simulant formulation really goes into the ceramic waste form additive. We're looking to try to get one recipe, but we're testing three major recipes we think cover the spectrum of the calcine we have. So that's where we're at, and with the goal being at the Technology Readiness Level-4 by Critical Decision-1, which is we go back to headquarters to be able to get design funding and really establish the project and get a baseline, and that's scheduled in 2014.

You had a lot of questions about waste form today, and the WASRD. Again, we're looking to get a waste form that meets "good as glass," and you hear that term a lot. It basically performs as well as borosilicate glass, so you won't have--and will not leach the metals and the mercury. So that's where we're looking now.

The other aspect is we've been working with headquarters and EPA here in Washington headquarters, as the LDR and the BDAT; we'll probably be using a petition process to get this process equivalent to vitrification. That's the best demonstrated available technology. Since this is high-level waste, BDAT is vitrification. This is not vitrification, so it will require some process and rule-making for that determination.

And all the data, you know, in our discussions with EPA, very data intensive. They'll be following our waste form development program, the test results, et cetera, so that will go hand in hand with our technology development process. And we do have a strategy document they've commented on and given us some feedback informally, so--and it's about a five- to six-year process for that, we're estimating.

Waste form testing. This just gives you example of the 100-gram test we've done. This shows a HIP can before it's HIPed, and, you know, you put the powder in, and the calcine in, seal the can up, it goes in and then gets HIPed. And you get, really, a very nice ceramic waste form. We've done our first round of testing on a recipe with ANSTO. This has been done over in Australia. They've been able to do actual real RCRA metals. It's been hard to find a lab because of the RCRA issues, lab testing. It's very hard to find a lab that can do that in this country that has permits. They don't have the same regulatory requirements over there, so we were able to--and they have the technology and they have the test bed at their facility at ANSTO, so they're doing the testing for us, at least at this level, and we plan on scaling up to the 1 kilograms this fiscal year also.

One of the problems we've had is Cadmium. The first tests indicate we're not meeting the requirements for Cadmium, but we're just kind of over the edge, so there's some work going on to analyze those results, to change the recipe to look at how we can hold Cadmium in in the process.

So, mentioned project reviews. I think Ken had some of his on your slide that talked about the TEG group and the CRESP review. One of the things EM asked after we first started the program last year, she wanted to take a look and just where we were at the with the process, other alternatives, as part of an enhanced-waste tank initiative. So we did have a consortium for risk evaluation and stakeholder participation. That's run out of Vanderbilt.

Dr. David Kosson had a team and they did a technical review of the process, and I won't--you can read the slides. You know, they were recommending for risk mitigation, make sure we have a backup plan. Don't know if you know, we don't have funding enough for one plan, so that's why those things will just have to--we'll share as much knowledge with some of the stuff going on with cold crucible and other work that's going on in EM

And also we had EM's technology evaluation group. They were out this summer. They came out to take a look at where we are and, you know, they did support what we're doing. Again, two risks in regards to waste acceptance criteria is we're vulnerable because right now we do have to go through a process with EPA to get this as BDAT. And they are also a little concerned about relying on one recipe. They thought, you know, because that's our ultimate goal, so they're really concerned about that, and so we are looking at the three, but--and then sampling, we'd really like to minimize the number of samples in the process, but, you know, that's one of those things and, you know, because it's very costly on real waste, so they identified some of those risks, which we're taking into account in the program, so, and they're very good reviews.

What we're looking for, a process--we're really driving towards submitting our Part B permit in December. For two years it'll be kind of a minimized--take-a-look at engineering studies for D&D of the IWTU based on the design we have.  Scale back up on 2014.  Really ramp up the process on testing.  Final designs, submit the CD-1 package.  And then acquisition strategy post-2015.  It's still under discussion because our current contract with CWI, who's doing the majority of this work for us, is--there's a three-year extension right now being considered, this is consistent with that, but this would probably be a separate design build once we complete the 2015 studies, up to--once we get to CD-1, it would fall into a separate acquisition.

So that's kind of a summary of where we're at.  A lot's moved forward since you guys visited back in 2010, so I'll open it to questions.

GARRICK:  Okay.  By the way, what's the specific activity of the sodium-bearing waste, approximately?  Because it's pretty low, isn't it?

CASE:  You mean from a radionuclide standpoint?

GARRICK: Yeah.

CASE: I guess--oh, gosh, it’s factor of 10 less than this, like, gosh, I just saw that, I--

SPEAKER: I think that’s right, Joel.

CASE: Yeah, it--

GARRICK: Would it--

CASE: It’s a factor of 10 lower than the calcine, but, you know, that’s--

GARRICK: Factor of 10 lower than the calcine?

CASE: Yeah. I think we--yeah, so--

GARRICK: Go ahead.

LATANISION: Latanision, Board. I was interested in the design of the HIP that you’re using because I’ve had experience with HIP failures, three of them, and they are very spectacular as you can imagine, given the temperature and the pressure that are involved. And so my advice is that you be very careful to make sure that your staff understands how important the alignment of the yoke and that assembly is, because if it’s misaligned, the danger of a failure is enormous and--

CASE: Well, I looked at some of the historical--like you said, there have been some spectacular failures that we’ve looked at, and, you know, again, this is a technology that we’re not familiar with, from a, you know, DOE standpoint, and that raises everybody’s eyes when you say those type pressures and those temperatures, so--

LATANISION: Yeah.

CASE: --we've--part of the review we had is CRESP. The CRESP review--we had a safety person involved with that, and we are cognizant, and that's one of the things, it's--that's why I've gone to the coil and very, very--and we have the industry involved. It's as if--it would not be a good day in Idaho if you had a failure with this, so--

GARRICK: What's the driver for the HIP process? Like, why did you even consider it?

CASE: You know, I wasn't involved in the Record of Decision, but going back on the history and review it looked like a lot of it was really driven by volume, waste-loading and volume reduction, and getting to a waste form that could meet vitrification. If you look at the number of canisters--if you looked at some of the cost drivers, I'm not saying cost wasn't a driver but it was probably double the amount of canisters that they assumed for vitrification, and I think when they were assuming about $680,000 per canister, disposition cost, and that skewed the cost way out for that, for vitrification compared to this technology. The other is waste length because you get smaller volume. So it was driven, I think, a lot by the total life cycle costs.

But there was kind of a tabletop session and we have documentation. We did do a--I won't say a bake-off. As part of the IS process, we did invite companies for technology. We put contracts in place, I think AREVA, actually, for the cold crucible, Energy Solutions with joule-heated melter, ANSTO, so we did get some data that we--to support it, and but it seems to come down to total project cost and the number of canisters and waste form performance, based on the limited data we have. Did that answer the question?

GARRICK: Yeah, uh-huh.

CASE: It was kind of long-winded, but--

GARRICK: And how about this steam reforming facility? What alternatives were considered before you settled on that?

CASE: I was involved with that. I was the FPD for that project since its inception. That really was looking at, if we couldn't run the calciner, it was a process--in fact, in those days we didn't--we were going to do direct disposal of calcine. That was kind of the--so we didn't try and relate--we were asked to de-couple SBW, but it was driven by if we can't run the calciner, can we send it to WIPP? What's the best technology that produces a calcine-like product? And we did go down to Irwin, Tennessee. It looked very attractive of how they were processing waste. This facility's a fairly robust design, a little different, but that was really driven by--all right, we looked at probably, oh, a hundred technologies--you know, the whole EIS process. We really limited it down to direct disposal, run the calcine, vitrification, risk separations, out separations, and I think there was direct evaporation, the final selections, and it was really driven by what can we produce that's very similar to the calcine material in case we do have to retreat the treated sodium-bearing waste. So that kind of drove it. Plus, you know, you looked at the facility down in Irwin. It was a very attractive option, so--

GARRICK: Questions? Yes, Rod.

EWING: Just to follow up, for the waste form from the steam reforming, did I understand that would be HIPed afterwards?

CASE: Well, one of the issues--the State of Idaho, we've always acknowledged that the sodium-bearing waste should really be disposed at WIPP. If you look at the history of the waste we have with sodium-bearing waste, it's less than 1 percent of recycled per cycle waste, just the way we filled them--

EWING: Right.

CASE: So we've been trying--you know, early on in the process we basically would like to get that waste managed as TRU waste, and do a waste determination and send it to WIPP as TRU waste. The State of Idaho, because this also is governed by a site treatment plan and the Settlement

Agreement, they haven’t seen much progress in us getting that issue resolved, so they’re asking, when we submit the HIP process permit in December, to add a schedule for potential treatment of the treated SBW. So that’s where that comes in.

EWING: So how would that work if you do your steam reforming then pull that out and put your HIPing--

CASE: We would--we have a product storage building. We would have to go back, open up the canisters for the--because we’re using 10-foot canisters that will fit in what’s called the RH-74 B package for shipment, RH TRU to WIPP. It’s designed as a pinnacle, so we’d have to basically retrieve the treated SBW and run it through the HIP machine, so--

EWING: So it would have to be stored, waiting for the--

CASE: Yeah, and right now we do because there’s no disposition path. It’s like that picture showed there was a--there’s a product storage building right now that will accommodate all the treated SBW because we have no--we had to modify the contract because the assumption is we’d ship it to WIPP, but we do have, oh, I think it’s 64 concrete vaults that can hold 16 canisters each, and that’s part of the IWTU facility that’s being constructed. So it’ll be stored there right in the product storage building right next to the IWTU.

EWING: All right. And in terms of the durability of the waste form, just looking at the calcine without any treatment, wouldn't it come at least close to being as good as glass, compared to this environmental glass?

CASE: No, it's--if you look at the calcine it's aluminum nitrate process. It does leach in water. I won't say it dissolves, but part of the calcine is--kind of dissolves in water. It was a--the process produced just--it looks like Tide powder, if you've ever seen--

EWING: Right, I know.

CASE: --yeah, but it is very leachable. Not leachable in the canisters, but--and we had worked with Yucca Mountain with RW about looking at performance in the canisters, and, really, when you compare our inventory with the rest of the high-level waste inventory in spent fuel, it would have met their performance requirements from a PA standpoint, but not the glass performance requirements.

EWING: Okay.

CASE: So--and that's why we're looking at direct disposal for calcine. And that was the preferred alternative until we did the selection, because of some of the risk factor with that.

EWING: And did it fail, in terms of the RCRA constituents or--

CASE: Yes, and glass, PCT. It just, you know, it just fails both. And it has to be treated under RCRA because of those listed waste codes. Now we do have approach where we think we can work with the State, because those--the listed waste isn't there. It's just because of the lab waste we generated. You know, it's just, once listed, always listed, so we think we have a path forward to try and address that, and then you're really left with the Cadmium, which is in the waste, and that has, you know, it's really there. The rest of the waste goes to (unintelligible) and the solvent. They got processed out though when we calcined it. But it's listed, and that's--you have to do delisting, so--

EWING: Thank you.

GARRICK: Any questions from the Board? Other questions form the staff? Yes, Nigel Mote?

MOTE: Mote, Staff. Joel, I take it the 10-foot containers that the HIPed units were going to is the same, or approximately the same, as the Savannah River site.

CASE: The canisters?

MOTE: Yes.

CASE: We're actually looking at using the Navy spent-fuel-type can--package, because one of the issues we had with, if the nine--a 10-foot canister, or 15, like for Hanford, we had to modify the process cells, and that gets to be really, really costly to try to modify a PC-3 facility, those process cells. So we've actually had some trade papers working with naval reactor program to look at, I think they’re 5 by 15, so it’s more of a box as opposed to a canister. So that’s what we’re looking to package them in.

MOTE: Okay, can you tell us what the 40 percent reduction relates to? What was the start volume and what’s the finish volume?

CASE: Oh, I’m sorry. Go ahead.

MOTE: I saw the slide you had up. I realized that probably, or, possibly, it means a 40 percent reduction from the initial fill of the HIP can.

CASE: Yes, that’s--

MOTE: Right.

CASE: Yes.

MOTE: How does that compare with the volume of the raw calcite? What, is it an increase or a decrease, compared to the current volume of the waste?

CASE: It’d be quite a decrease, actually, because the calcine’s got a lot of air in it, and so, the additives--it’d be a decrease is what we’re estimating. And I don’t know--have it off the top of my head, total volume.

MOTE: Okay. Can I have one extension?

GARRICK: Go ahead.

MOTE: I recall there was a competing technology being developed at Idaho, which was a cold vitrification. I mean, it was almost like an epoxy resin mixed with constituents that came together in a slurry with the calcine in, and then poured into a container very similar to a HIP container, and that, at the time I saw it, which was about eighteen months ago looked like it was going to give the same volume reduction but with no temperature and no pressure issues. What happened to that?

CASE: We did a--it's still ongoing. We're working--that's on the lab side. BEA is on our, you know, we're kind of under two contracts, but they provide a lot of support to us. And one of the things Dr. Triay, who's part of Enhanced Waste, you saw--I think there was a slide mentioned studies on cold crucible--there is some limited funding going on, looking at cold crucible treatment process for calcine. That's still limited work going on with that, and they have a test facility in Idaho. In fact, they have a little cold crucible unit.

MOTE: Cold crucible is still a hot technique. The crucible's cold, but the medium which is used for processing is a high-temperature technique.

CASE: It's high temperature. I forget what the temperature is, I'm not sure, but I know, yeah, it's just--it gets better waste loading and, like you say, better--it's really key, better waste loading. One of the challenges we have with cold crucible is the off-gas system. HIPing should be a dry system. There's some real concerns about--with cold crucible, it's going to be a wet scrub system--and that, and will it fit in IWTU. But we are--there is some limited funding going on through the EM, I don’t even know what EM it is now, it used to be EM-20, I think, the technology and development, what the lab is supporting, and also at Hanford. So that work is still going on and--

MOTE: Okay, the process I saw was cold. I mean, not cold crucible with a high-temperature process. It was a cold process.

CASE: Oh, a cold--like a ceramic grout-type of process?

MOTE: Yes.

CASE: Oh, I--

MOTE: Yeah, it was like an epoxy. A cold epoxy that--

CASE: Oh, okay, I’m not aware--I know we do a lot of grout. I’m not aware of that--

MOTE: Okay.

CASE: --work, so--

MOTE: All right. Thanks.

GARRICK: Any other questions?

(No response.)

Okay, thank you very much, Joel.

CASE: Oh, thank you. I appreciate the opportunity.

GARRICK: We’ve now come to the point in the program that's dedicated to public comment. I have two names. One of the may have, I'm told, may have inadvertently put their name on here when they meant to have it on the other registration. Dr. Michael Baughman?

(No response.)

He didn't want to wait this long, I guess. All right, Steve, we can count on you. You can go up there if you want to. If you want to go up there--

FRISHMAN: I just have a very short comment.

GARRICK: Okay.

FRISHMAN: I'm just here to ruin your day, once again. I'm Steve Frishman, representing the State of Nevada. In listening to Ernie Harden's presentation on the thermal considerations in various geologic media, his presentation seemed to carry an implication that is something that we talked about years ago, and it's probably worth your keeping in mind, as you see that kind of work developing again, and that's when we had early discussions about the MPC.

One of the considerations that I brought up, I think to this Board, was to think carefully about both the size and the emplacement mode of the container, and mode or configuration, because it appeared to me that, with the MPC, what was happening was it was beginning to drive the repository design, and in the course of driving the design, you have limited your scope of safety considerations.

So the implication from what Ernie was talking about somehow sort of came across that bigger is better, but in this case, I think if you're looking at geologic media, thermal considerations and design scenarios, bigger doesn't necessarily mean safer. So I'm just sort of warning that we got into this once before and it ended up that the large container, horizontal, in drift, sort of limited some other safety considerations and led to some things that, you know, may have actually compromised safety in order to preserve that particular design. So I just wanted to get that back into your thinking. So while you're thinking about the work that NE is doing, and the way of--sort of considerations about different rock types and designs, just sort of keep that in mind as you are reviewing that type of work, because we got locked in once before and I'm still not convinced that the early lock-in didn't have a lot to do with later safety considerations for the Yucca Mountain design. So, thank you.

GARRICK: Thank you. Any comments from anybody?

(No response.)

Ernie? Ernie gone?

SPEAKER: They all left.

GARRICK: Well, I believe that pretty much concludes the day's activities. I want to thank all the presenters. We know how much effort it takes to make these presentations, and we greatly appreciate it. The Board always learns a great deal in these exercises, and we’re delighted. We want to thank you very much for the effort.

And with that, unless somebody has an issue that they’d like to bring before the group, I think we will adjourn. 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 2012 Winter Board Meeting held on January 9, 2012 in Arlington, Virginia, taken from the electronic recording of proceedings in the above-entitled matter.

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