UNITED STATES OF AMERICA

U.S. NUCLEAR REGULATORY COMMISSION

MEETING WITH THE DEPARTMENT OF ENERGY OFFICE OF NUCLEAR ENERGY

APRIL 22, 2013

9:00 A.M.

TRANSCRIPT OF PROCEEDINGS

Public Meeting

Before the U.S. Nuclear Regulatory Commission:

Allison M. Macfarlane, Chairman

Kristine L. Svinicki, Commissioner

George Apostolakis, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

APPEARANCES

DOE/NE Members:

Dr. Peter Lyons
Assistant Secretary for Nuclear Energy

Dr. John Kelly
Deputy Assistant Secretary for Nuclear Reactor Technologies

Ms. Rebecca Smith-Kevern
Director, Office of Light Water Reactor Technologies

Dr. John Herczeg
Associate Deputy Assistant Secretary, Fuel Cycle Technologies

Mr. Andy Griffith
Director, Fuel Cycle Research and Development

Ms. Tracey Bishop
Acting Deputy Assistant Secretary for Nuclear Facility Operations

P R O C E E D I N G S

CHAIRMAN MACFARLANE: Good morning.

MULTIPLE SPEAKERS: Good morning.

CHAIRMAN MACFARLANE: All right. Just a note before we begin. I understand that web streaming is not working, but this session will be archived and it will be available on the web as soon as possible.

Okay, so, today we are here to be briefed by representatives of the Department of Energy on topics of mutual interest to the NRC and the DOE. And I'd like to start by welcoming Assistant Secretary for Nuclear Energy of the Department of Energy, Pete Lyons -- Dr. Pete Lyons -- back to the NRC. I know -- maybe the last time you were here, you were sitting on this side of the table. It's great to have you here again. I hope it's good to be here again. [laughs]

DR. PETER LYONS: It's great to be here.

CHAIRMAN MACFARLANE: Good. I'd also like to welcome the rest of this morning's panel: Dr. John Kelly, Ms. Rebecca Smith-Kevern, Dr. John Herczeg, Mr. Andrew Griffith, and Ms. Tracey Bishop. Welcome.

And in addition to these -- this morning's presenters, I think we also have three Deputy Assistant Secretaries here: Dennis --

DENNIS MIOTLA: Miotla.

CHAIRMAN MACFARLANE: Yeah. [laughs] Miotla -- Shane Johnson, and Ed McGinnis. Nice to see you guys.

Good. All right. So today, as I said, we're going to discuss a number of areas of mutual interest to the Commission. And we're going to begin with Dr. Lyons, who's going to present an overview, and he'll discuss a strategy for the management and disposal of -- an issue I'm interested in -- of used nuclear fuel and high-level radioactive waste. That's going to be followed by discussion of research on severe accidents, based on Fukushima, and a presentation on advanced reactors, by Dr. Kelly. Then we'll hear from Ms. Smith-Kevern on topics of small modular reactors and light water reactor sustainability.

Dr. Herczeg will address research and development in the areas of advanced fuel cycles and long-term storage of spent fuels. Mr. Griffith will discuss long-term storage of spent fuel, and, finally, we'll be briefed on plans for the resumption of transient testing and advanced post irradiation examination capabilities by Ms. Bishop. Okay?

I look forward to hearing this. I think it's going to be a good session. We're also going to -- let me give you an advanced warning -- take a quick five-minute break between your presentations and our questions. But before I go on any further, let me see if any of my Commission colleagues have any...

COMMISSIONER SVINICKI: I just want to wish a good morning to -- I have many dear friends and colleagues of longstanding on that side of the table. So I agree with you. This will be a very interesting meeting. Thank you.

CHAIRMAN MACFARLANE: Great. Anybody else?

COMMISSIONER OSTENDORFF: I echo Commissioner Svinicki as well.

COMMISSIONER MAGWOOD: Special welcome to many of you who I've known for a long time. It feels like a staff meeting.

[laughter]

But I'm looking forward to the discussion today. I think the last time DOE/NE came to talk to the Commission, I think I was the one on that side of the table. [laughs] But this is unique because it wasn't a public meeting at the time. So this is really the first opportunity, I think, in a very long time, the public's had a chance to hear this exchange, so, I appreciate Dr. Lyons coming over and sharing his views with us.

COMMISSIONER APOSTOLAKIS: Can’t be the only one who doesn't say, "Welcome." Welcome.

[laughter]

DR. PETER LYONS: Thank you, George.

CHAIRMAN MACFARLANE: Okay, great. Well, let me turn it over to Pete.

DR. PETER LYONS: I guess that was on. Thank you very much, Allison and other Commissioners for the welcome. Yes, it's good to be out here, and we're looking forward to the discussions and interactions that we'll have today.

It's certainly my hope that this set of briefings and, of course, there'll be a number of subjects. They will be very brief briefings. But hopefully they will serve to, I think, better inform both organizations on the breadth and the depth of the areas of cooperation that we have between our organizations.

And, if we can go to that next slide. I'm frequently asked, and I'm sure you folks are, too -- first, are there interactions between the DOE and the NRC? And second question is, well how can you do that, given the individual responsibilities? And my answer is, at least there's an attempt to go through that answer on this slide, simply to point out that while there's many different modes of cooperation, we carefully recognize and respect the difference in responsibilities between the NRC and the Department of Energy.

And what I'm trying to show on that second slide is that the modes of cooperation can range all the way from relatively formal MOUs, going down to simply joint interest in areas of work that one or both of us are supporting. And out of that work, whether you're supporting it or we're supporting it, or we're both supporting it, will certainly come some set of results, depending on whatever's appropriate for that project. There'll be data, and that data will have been acquired with suitable quality assurance to meet both your needs and our needs.

But at that point -- and I was showing those two arrows separating to indicate that as you draw regulatory conclusions from whatever that information may be, it's, of course, appropriate for us to be completely out of the loop at that point. The data, the quality -- with appropriate quality -- confidence goes to the NRC, to the staff, and may well translate into regulatory decisions or conclusions.

In the meantime, we may take that same information. It may be relevant in some of our research programs. We'll find ways to make it available to industry through a variety of different mechanisms. Frequently we're cost-sharing with industry, and we have interest from industry at the same time. And that same information may well go into industry's evaluations of whether it is, from their perspective, economically reasonable to move ahead with a particular request to the NRC from a regulatory standpoint.

But I did want to emphasize that I think both our organizations are keenly aware of the difference in our roles. We respect that difference, and with -

- and given that respect, there's still a wide range of appropriate areas of cooperation in the R&D sphere that we can conduct together.

The next slide just lists a number of MOUs. I'm not even sure this is an all-inclusive list, but it was the ones that I was aware of. I won't talk through these, but this just gives an idea of the range of MOUs. And, again, I suggested that our cooperation -- about as formal as it gets is the MOU, but it can go all the way down to simply joint interest -- our folks on each of our staff or at the National Laboratories talking together or sharing information.

I'd like to use one slide out of my backup, which is simply the FY 14 budget request. I don't want to talk through that in any detail, unless you have particular questions. But I did want to just note on this, that although we obviously have a very austere budget, there are selected areas of strong mutual interests that we are protecting within that budget. Small Modular Reactor Licensing Program is one such area. Work towards used fuel disposition. Supporting efforts that would follow on to the Blue Ribbon Commission recommendations are also being well-supported. Accident-tolerant fuels are being well-supported. And our modeling and simulation hub is fully funded.

Beyond those areas are -- oh, and Light Water Reactor Sustainability would be another one that we've tried to protect very carefully. Beyond that area, there are cuts in this austere budget, but several of those areas that I mentioned for joint interest and high priority within our budget will be part of the briefing today.

That was all I proposed to do by way of an introduction. And Allison, I don't know if you still take clarifying questions now, or if I should just keep going into the next briefing.

CHAIRMAN MACFARLANE: Just keep going.

DR. PETER LYONS: Just keep going. Okay.

So that next briefing is on the administration strategy for the management and disposal of used nuclear fuel. Now, there will be subsequent discussions, particularly by John Herczeg, that will also expand on this more from the technical standpoint.

But my reason for presenting this is just that as the administration strategy is, perhaps, advanced into a legislative strategy, there would certainly be substantial impact on the activities of the NRC as well as on the Department of Energy.

That next slide is the Blue Ribbon Commission recommendations that -- those came out in January of '12. I wouldn't propose to talk to these in any detail. I'm guessing that all of you have read the Blue Ribbon Commission report rather thoroughly. Some of you had a very, very direct hand in the Blue Ribbon Commission report and can certainly give a better presentation than I could on it.

But the BRC recommendations were certainly greeted within the Department of Energy with great respect. Secretary Chu spoke out frequently on -- with compliments on the recommendations of the Blue Ribbon Commission. And in addition, Secretary Chu convened on behalf of the administration a study of the BRC report with the idea of developing the administration's position on the recommendations of the Blue Ribbon Commission.

And if I can go to the next slide -- this notes that the document that was published in January of '13 should be viewed as a statement of administration policy on the general area of the back end of the fuel cycle and recognizing the importance of activities and actions to move ahead on used nuclear fuel and high-level rad waste.

It's intended as a basis for discussion among the widest possible range of stakeholders, certainly to include Congress as well as stakeholders across the country, including industry. The summary lays out a 10-year program of work that, as noted there, would move ahead with siting, designing, licensing, constructing, and beginning operation of a pilot interim storage facility, and then moving ahead with a larger storage facility and eventually with geologic repository.

If I can move to that next slide. Just as the Blue Ribbon Commission did, the strategy is built around three key building blocks. The first, recognizing that whatever we do as a nation in these areas, it must be based on a consent-based approach. If we're to avoid the endless delays and problems that we have had with Yucca Mountain, that is certainly a strong endorsement of the need to look at a consent-based siting for any facilities as we move into the future, certainly maintaining open, transparent communications at every step along the way.

As far as system design, the strategy calls out that pilot interim facility with the goal of operating in 2021. That assumes that we could have a legislative basis by 2014. Remains to be seen if we'll have that. But, in any case, we think seven years is possible, and that's consistent with some statements in the Blue Ribbon Commission and many other evaluations.

We think a larger consolidated storage facility could be operating quite readily by 2025. And the geologic repository, we lay out a schedule, certainly with substantial uncertainty, but looking at 2048. And, included within these dates is the recognition that as we move into a consent-based siting, there will be delays, and that it has to be done in a relatively slow, methodical fashion, especially for the geologic repository, to assure that that consent basing and public education transparency is respected at each step along the way. I hope we can beat 2048, but I think 2048 is a very realistic date for a geologic repository, based on consent.

And then, finally, that last box on governance and funding recognizes two of the key focus areas of the Blue Ribbon Commission and strongly endorses them. On governance, the administration's strategy recognizes the need to move to a new organization outside the Department of Energy. Exactly how that reorganization may be structured isn't specified in great detail in the strategy. It's suggested that either a government corporation or an independent government agency could have the appropriate attributes to provide the type of continuity and leadership that would be required for success in this area. But it certainly starts with the strong recognition of the need for a new organization as well as a strong recognition of the need for an alternative funding system, like the Blue Ribbon Commission went into considerable detail on how the current funding is thoroughly broken. That's not news to any of you, and suffice it to say that the strategy thoroughly endorses that.

On the next slide, simply the conclusion of the administration's strategy noting that to move ahead significantly on any of these areas and certainly on a site-specific where it requires legislation. We're watching with great interest the discussions that are reported publicly in the Senate. Several key Senators are working together to develop legislation, and we're eagerly awaiting an opportunity to see that draft legislation whenever it becomes available. But my only point on that slide is simply that most of what I just discussed in terms of the administration's strategy does require legislation in order to move ahead.

And then if I could use, by way of my last slide, the first of my backup slides. I simply wanted to note here that as the administration released their FY 14 budget, there was a very strong recognition of the importance of coordinating that budget with the administration's strategy so that as you read the budget, you will see the very, very strong correlation. Within the president's budget is a call for $5.6 billion in funding over the next 10 years, that's built into his 10-year projections, with the expectation that within those 10 years, we can have the pilot interim facility operating, we can have the larger consolidated facility almost ready, and have made substantial progress on siting and perhaps starting characterization of a geologic disposal site.

The budget proposes funding that moves beyond the impasse we have had in the past, wherein the funding was collected from the nuclear utilities and the rate payers on a mandatory basis, but the spending was on a discretionary basis. And as long as you have that mandatory discretionary mismatch, you cannot manage to get into a situation where you're effectively offsetting between the two.

So what is proposed in the president's budget is first to recognize that it's important to have an element of ongoing discretionary appropriations, which will maintain the Appropriations Committees of Congress in and appropriate oversight and leadership role as well as the administration. But the suggestion is that that be only up to $200 million. And that beyond the $200 million, we move to mandatory appropriations, taking from the Nuclear Waste

Fund. That is what is specifically in the president's budget and the sum total of this is the $5.6 billion.

In addition, a bullet that didn't get on this slide is for the first time, this budget takes account of the payments being made from the Judgment Fund for the cases where utilities are suing the government for not taking the fuel in -- the used fuel -- in 1998. And you're well aware that these suits are being routinely resolved in favor, largely, of the utilities. And when there is such a resolution, those funds come from the Treasury Judgment Fund. That Judgment Fund is not subject to OMB or Congressional oversight. That is mandatory.

And in the past, there has been no attempt by the administration or Congress to try to forecast those liabilities with the goal of making them very visible to the public, Congress, to the administration, and potentially that could be viewed as part of the offset, as one moves ahead with these various facilities that will eventually stop the hemorrhaging of the liability payments, which are averaging now, estimated at $400 million a year, and there's been $2.6 billion paid from the Judgment Fund up to this point.

In addition, that last bullet -- and then I'll stop -- simply notes that the administration's budget also calls for actions that should be of direct relevance and interest to the NRC. And that is to provide authority and funding to the EPA to move ahead with generic disposal standards, and moving away from the site specificity that we have on Yucca Mountain. The strategy recognizes, and certainly the budget recognizes, that there can be far more credibility attached to such generic standards. And, again, funding and authorization is provided in the president's request.

I'm going to stop there, and I think John Kelly continues with -- let's see -- John Kelly is the Fukushima accident analysis.

DR. JOHN KELLY: Good morning, everyone. And, thank you, Dr. Lyons. I, too, want to thank the Commission for giving us the opportunity to discuss topics of joint interest. The first one I'm going to touch on is the severe accident analysis research based on the Fukushima accident. I think as everyone is aware that there has been a worldwide renewed interest in severe accident research since the accident. I think I'll also remind everyone that it was the NRC with the DOE laboratories that actually developed the extensive database that we have on severe accidents, which has really informed many of our decisions in the past.

It was especially useful during the accident because we were quickly able to assemble large teams of experts who could address the plethora of questions that came from the public, the Ambassador in Japan, et cetera. So if we had not had that capability, I think we would have been in a much different situation.

So, now the question is what do we do next? So in the summer of 2011, it became apparent that we needed to understand the accident much better. Most of our understanding of -- slide 2, please -- many of our risk-informed studies have been based on computer code calculations, and we really struggled to understand how useful these computer codes were. We thought they were good, but, you know, they're all based on separate effects data.

So we decided to conduct a joint study with the NRC's full participation. And it had a number of elements, first to collect and archive data on experiments. So we were thinking of the future where people may want to come back. We wanted to capture the data in real time and verify it so that, as we move forward, we at least have a common understanding of the data.

We then wanted to use our computer code, specifically MELCOR, to reconstruct the accidents, and then use the available data to assess the validity of the modeling. We had Sandia National Lab lead the effort, with support from the Idaho and Oak Ridge National Labs. In some sense, we had a lot of information on the Mark I design already. SOARCA had used this. It was a slightly different plant, but largely similar in many ways. And this was a good starting point, where we had the plant data already in place.

And then we worked with both our U.S. and Japanese colleagues -- NRC, JNES, TEPCO, and EPRI -- to fill in the blanks on getting the information we needed to complete the model. And the report on this was published in August of 2012.

And I just want to give some highlights of that. The report is out there for public consumption. But the next slide, please. This is showing pressures in the reactor pressure vessel as well as in the containment for this Fukushima Unit 1, as a function of time. Now there are periods of time when the batteries ran out, that there's no data. But if you just start to look at the curves where the squares and triangles and squares are -- the actual data. And the lines are the MELCOR calculations. I think we see pretty good agreement throughout the, you know, first couple of days of the accident, which is indicating to me that we're -- our models are capturing some of the major phenomena, and things are shown on that as well.

Now, as we move to the next slide, which is a little bit complicated slide, but it's basically showing in the reactor building, which is outside containment, the accumulation of various gases over a period of time. What's interesting to see is that somewhere after about 12 hours, there's an indication in the computer simulation, that hydrogen and carbon monoxide and steam begin to enter into the reactor building. The hydrogen, of course, is from the oxidation of the zircaloy, and carbon monoxide comes through the interaction of core material with concrete material.

Now, for a long period of time, we see the red curve on the top is the steam level. It's very high, and steam acts to inert the atmosphere. But perhaps coincidentally or perhaps we're really understanding what's going on here, at about 24 hours one day is when they -- Japanese vented the wet well of Unit 1.

This, at that point, then, allowed the pressure in the containment to drop, and gases cease to continue to come out at that point in time. And because it was a rather cold day, we see the steam beginning to condense, and about one hour after the wet well was vented, we would have predicted that the reactor building would have been in a state that could have exploded. And that's just about the right time for when the actual explosion occurred. So this very coupled phenomena, very complicated, are beginning to give some indications that, you know, we're capturing some of the major phenomena.

A similar curve is on the next slide, which shows predicted cesium release from the units. And the curve of interest is the -- actually, the last one -- is the green one to the environment. This is the amount of cesium that would be released, initially, from the fuel into the reactor vessel, into the containment, and then ultimately out into the environment. And we see that begin to come up and spike at somewhere about 14 -- just before 15 hours. And if we look back at the radiation monitors at the gate, we also see those jump at just about 15 hours. So, again, the timing of the events looks pretty well captured in this result. Now I will say there's lots of uncertainties in this, and we will continue to learn in the decades to come, as we begin to take the reactor apart. At least the initial results are very promising.

We also had two other computer code simulations on the next slide: MELTSPREAD and COREQUENCH. These deal with after the core debris material leaves the vessel, it can then come in contact with the concrete. Water is also available, so we're predicting how the melt spreads and whether the debris that is formed is coolable.

We used outputs from MELCOR and MAAP for the pore condition. And as I mentioned, MELTSPREAD calculates the extent of the spreading, and COREQUENCH evaluates the debris coolability. And these predictions are actually being done now to help provide information to TEPCO about the disassembly of the units, because they really would like to have a good idea of where the core debris ended up in the containment.

What the results show right now, the principal ones are that axial ablation -- that is, the downward ablation of the concrete, it was predicted to be on the order of 60 centimeters out of a total thickness of about 140 centimeters in that concrete base mat. And while there was significant concrete ablation, the debris was coolable for all scenarios.

Now, moving into the future, we're seeing much interest in the international community, especially in the OECD NEA, where there has been a project started, specifically on the Fukushima Dai-ichi accident. NEA is organizing this. There's a Phase 1, which is a computer code benchmarking study. And a Phase 2, which would be the real effort to gather data as the reactors are defueled, and conduct the metallurgical and other inspections during that period of time.

The arrangement that we've discussed with our NRC colleagues has been that the NRC would fund the U.S. government's participation in Phase 1. And that the DOE would fund the U.S. government participation in Phase 2.

So in Phase 1, which is already begun, there's numerous severe accident codes from around the world that are being used. MELCOR and MAAP are U.S. codes, but SAMPSON, SOCRAT, and ASTEC are from our international colleagues. The objectives here are to benchmark the codes via -- with the actual data -- and then to use those results as we get some consensus, we believe internationally, to help plan in the defueling operations, specifically, to know where to look for failures of various systems and components, and to try to discern where the core debris may be so this will aid in the defueling activity.

You see here, it's all of our nuclear allies in the civilian sector. So we see U.S., Switzerland, Spain, France, Russia, Germany, Korea, France, and Japan.

Phase 2 is currently under discussion. We conducted a similar program after Three Mile Island, where we had an international team fund the activity. And so that is certainly being considered. And we are conducting some uncertainty quantification studies right now to try to, again, help inform the planning for that study.

And then just the last slide. Much still needs to be done. Dr. Lyons, myself, and others at this table were at the unit in December timeframe. There is -- they're a very long way from achieving the goals of defueling and decommissioning the facility. And so we, you know, continue to stay abreast of the activities there and hope to learn as these activities do continue.

So, thank you. And I will proceed now into our Advanced Reactor Program. Second slide.

So our Advance Reactor Program has -- so the ultimate goal of generating safe, economical proliferation-resistant advanced reactor technologies. The major thrust of the program we have is looking at advance reactor technologies and their components, development of regulatory framework for non-light water reactors, development of industry codes and standards, development and maintenance of critical expertise and facilities, and international collaboration.

In this area, we have three programs. One, we call the Advanced Small Modular Reactor R&D Program. The second is Advanced Reactor Concepts, and the third is the NGMP: the Next Generation Nuclear Plant. Now just note that in beginning in Fiscal Year 14, our proposal is to merge the NGNP into the advanced reactor concept so that all, basically, larger advanced reactors would be within that ARC program.

Now a little bit of detail about the individual elements. So the advanced SMR program is really looking at the licensing and deployment of advanced non-light water reactor. Rebecca is going to talk about our light water reactor technical licensing support program after I'm finished here. In this program, we're looking really at advanced designs.

We've divided the research areas into four main areas: one dealing with instrumentation, controls, human-machine interface, which we think are going to be extremely important to the safe operation of these small advanced reactors. Materials, components, and technology development, as we deal with different coolants, such as lead or lead bismuth. We may embark on needing new materials that would work in those environments. Certainly, the safety of these systems, passive safety, being able to remove decay heat for long periods of time is a must for these reactors. And all of them -- I'm pleased to report -- have, I think, very good concepts for doing that. But this needs to, then, make its way into regulatory framework and into the safeguards. And, finally, we're looking at our tools that we use for assessing economic and performance of these to see what modifications would need to be made to the existing methodologies, as we contemplate these smaller reactors.

Next slide. Our advanced reactor concepts group is really looking into advanced technologies and subsystems to improve nuclear power performance, including sustainability, economics, safety, and proliferation resistance. It's in here that we have our fast reactor research and development. And then a very new and important development is in our advanced energy conversion, which is shown in the picture there, which is this supercritical CO2 Brayton cycle, which has the possibility of greatly increasing the amount of electricity generated from a given thermal input from the reactors, significantly more than the standard steam rankine cycle that's used in the current generation of reactors.

We're looking at a more advanced concept called the Fluoride Salt High Temperature Reactor, which is a relatively new concept based on some innovative use of prior technologies that had been developed in the '50s and '60s. We have significant international collaboration, both bilaterally and trilaterally. And this is where the Generation IV International Forum is supported.

And the final element is that we've reached out to industry through a process called the Technical Review Process, which gave us an opportunity to evaluate potential designs by the advanced reactor designers, and use that, then, to help inform our research program.

The Next Generation Program -- our Next Generation Nuclear Plant Program is really geared at looking at high-temperature gas-cooled reactors to produce both electricity and high-temperature process heat for industrial applications. The focus areas in this program have been looking at those non-electric applications such as hydrogen production and other uses of high temperature.

The fuels development has been probably the keystone of this whole program. This is where the TRISO fuel efforts have been ongoing, and we have now successfully tested fuel to very high-quality levels and looked at the release characteristics, and even at very high temperatures, we're not seeing significant release from this fuel.

Materials development has been very important because we're talking about ultimately reactors that would operate at 1,000 degrees Centigrade. So we're looking at ceramic components such as graphite, and looking at high-temperature structural steel materials that would actually form the pressure boundary condition. We've also had efforts looking at the design and safety methods, and work is still ongoing on the licensing framework development.

Now, an important part of our mission is to maintain the experimental capabilities that will allow us and our industrial partners and potentially the NRC from understanding the phenomena and the behavior of these advanced systems under a wide variety of conditions. I show three examples here. We're standing up a new facility at Argonne, which will allow us to do testing of components and subsystems in a sodium environment. We used to, in the U.S., have such a facility out at -- in California at ETEC. That's been now decommissioned, and so we're reinstituting that type of capability at a smaller scale at Argonne. On the slide to the right -- picture to the right of that is a delta loop, which is a lead bismuth loop at Los Alamos, which has been around for several years, but this allows us to test materials in lead bismuth coolant. And, of course, the advanced test reactor is our workhorse for irradiation studies both of fuels and of materials. So this is important for us to maintain and continue to build the state-of-the-art capabilities.

In terms of areas of cooperation with the NRC, I'll -- just to highlight a few areas -- the NGNP has certainly had a very formal interaction. EPAC, in 2005, actually outline what this interaction should be, and it was through a joint MOU to support licensing and R&D that came together. NRC and DOE issued a joint report to Congress on the licensing framework for NGNP, and we've been following the path to execute that. Another important aspect has been the development of the quality assurance program for the NGNP program. And that has -- NRC has approved the applicable portions of that program. And then I think on the R&D area, we have been -- had joint interest in this high-temperature test facility at the Oregon State University and have funded a cooperative agreement with the university since 2008. And we're continuing to work toward completing in the summer of 2013 the facility and follow-on by the experiments. And this is a scaled model of the HTGR. So we're looking forward to continuing to cooperate with NRC in this area.

And in the final slide, this gives an indication of the worldwide interest in advanced reactor technology. We see here the -- kind of the composition of the Generation IV Program, where the circles indicate areas where there is strong interest in countries, and we're actually pooling our research together and sharing our research results, therefore leveraging all the investments that we're making. Both the sodium-cooled fast reactor and the very high temperature gas reactor are by far the most common advanced systems that the international community is interested in. But the other reactors under consideration are the gas-cooled fast reactor supercritical water-cooled system, lead-cooled fast reactor, and the molten salt reactor. And in those latter four, we have significant interest in specific areas, mostly in materials and the fuels area.

So with that, I'll conclude and turn it over to Rebecca, who will continue on with the reactor R&D program.

MS. REBECCA SMITH-KEVERN: Good morning, Chairman Macfarlane and Commissioners. Thank you for the opportunity to speak to you today. Before I begin, I want to be sure that we're all on the same page with respect to how DOE defines small modular reactors. They are reactors -- they are units that provide 300 megawatts electric or less, are manufactured in a factory setting, and can be shipped to the site by use of truck, rail, or barge. The department has an interest in small modular reactors because they can be instrumental in meeting the economic, environmental, and energy security goals of the nation. Hopefully, I don't need to convince anyone here of the potential benefits, but I thought I would just catalog a few that are of interest to the Department.

SMR designs include passive safety features. They're not susceptible to key design-basis accidents. They can be sited underground and have reduced source terms. Small modular reactors are a fraction of the cost of large reactors. So for a utility, it's not a bet-the-farm proposition. The factory production can improve the overall quality of the reactor units, and utilities can add units as needed to meet demand. We also see SMR development as an opportunity to regain U.S. technological leadership in the nuclear field internationally. In addition, there is a high growth potential for jobs in construction, operation, and maintenance of SMRs. With respect to the potential deployment, we see electricity markets for -- emerging for SMRs domestically and internationally, as well as markets for process heat use, such as desalinization and shale oil extraction.

Next slide, please. To help jumpstart the SMR industry, the Department has established an SMR licensing technical support program to incentivize the first movers to get the first SMR plants certified and licensed. So we are providing financial assistance for the design, certification, and licensing of promising SMR technologies that have a high likelihood of being deployed at domestic sites. We are not sponsoring the procurement, manufacturing, or construction costs. We designed this as a five-year, $452 million program, which requires a minimum of 50 percent industry cost share.

In FY ‘12, we received $67 million and very little of that funding was consumed as we executed the procurement process. In FY ‘13, we received $65 million, and in ‘14, we have requested $70 million. The five-year funding profile is expected to support all SMR awards made under the program, and I should note that it's possible that our program will extend for its sixth year, with no additional funding requested.

Next slide. DOE's initial funding opportunity announcement solicited certification and licensing projects from vendor utility teams with plans for expeditious deployment. The Department defined "expeditious deployment" as a commercial operation date of 2022. The initial FOA was issued in March of last year. Applications were made in May, and the selection was made on November 21, 2012. DOE decided that it was in the best interest of the United States to select a single project under this FOA that had the highest probability of achieving NRC certification and license approvals, and that this would provide the licensing blueprint for the SMR industry.

The application that DOE selected was from the generation mPower team, consisting of B&W, Bechtel, and the Tennessee Valley Authority. mPower has already established a path forward on their licensing requirements with the Nuclear Regulatory Commission. The department merit review team scored the mPower project the highest based on the highest likelihood of achieving licensing approvals and the robustness and safety of their design.

DOE recently completed the cooperative agreement negotiations, and I'm happy to say that we signed the cooperative agreement a little over a week ago. We believe that this partnership will be of a benefit to all U.S. SMR designs by helping to resolve generic regulatory issues and establishing a licensing framework.

Next slide. The mPower team appears to be making excellent progress towards the development of the certification and licensing applications required to meet the program goals. On February 22nd, they signed a contract to prepare and support NRC review of a construction permit application. And DOE will track the progress of the project through a agreed-upon set of project milestones for as long as there is public funding for this effort. DOE will examine the development of licensing deliverables to ensure that government funds are used to develop quality products for the NRC review. To this end the SMR program manager conducts regular interactions with NRC staff on SMR licensing-related issues including attending licensing meetings at NRC facilities, maintaining a standing biweekly conference call to discuss current SMR-related events and issues, he has as needed technical discussions with NRC staff to validate program activities and directions, and provides input to DOE NRC management-level interactions to identify R&D collaborative opportunities.

Next slide. The evaluation of the initial funding opportunity announcement was weighted more on acceleration of licensing processes than on innovations that can improve safety profiles; so we decided to issue a second funding opportunity announcement that focuses on innovation. This will be funded out of the original planned SMR licensing technical support program budget of $452 million. The funding opportunity was issued on March 11th and the applications are due on July the 1st. DOE will hold an Industry Day on May 15th where we can publicly respond to questions on the solicitation content. As I mentioned, the evaluation criteria will be more heavily weighted on innovative characteristics and capabilities that can improve safety, performance, and economics as well as the ability to mitigate and respond to accident consequences. Once the selections are made on this FOA, DOE will have a basis for allotting program funding to all the awards. We hope to be able to complete the award on the second FOA by the end of the calendar year, and this funding opportunity for innovative SMRs is available on the web at grants.gov.

Last slide. In addition to the funding opportunity announcements, DOE is also conducting studies to provide design-independent support for licensing and commercialization of SMRs. I've listed a few of them there; the first one is the SMR utility requirements document, whose objective is to develop a clear, common, and consistent understanding of owner-operator requirements to ensure successful and sustainable commercialization of light water SMRs. We are doing -- we did a number of economics studies and we're continuing the one from the University of Chicago Energy Policy Institute, based on the changing financial environment and the cost of fossil fuels since that study was completed; these should help to validate our investment in SMRs. We're also looking at source terms, we're working with the NEI task force, EPRI, and industry stakeholders to identify where DOE resources laboratories or university partners may be applied to resolve SMR source terms to potentially impact licensing. The source term study will initially involve reviewing test data from -- representing large LWR systems over the past 20 years, identifying information gaps based on different -- the differing configuration of SMRs, and establishing a plan of experimental and analytical work to address gaps.

That concludes my remarks on SMRs. Moving on to the Light Water Reactor Sustainability Program. On the second slide, we discuss the program goals, which are two-prong. We're trying to develop the technical basis for extended operations and also develop technologies that contribute to long-term economic viability of these plants, because utilities will not continue to operate them if it isn't in their economic interest. This program supports the

Secretary's priority for nuclear energy, and objective one of the nuclear energy R&D road map for improving the reliability, sustaining the safety, and extending the life of the existing plants.

Based on our discussion with industry, we believe applications for subsequent license from 60 to 80 years are likely to be submitted to the NRC between 2016 and 2020. That means that utility decisions to make the needed investments to support long-term operation will occur in the same timeframe. Therefore, the research needed to support these applications and decisions must be conducted over the next five to six years to increase the potential for maximizing the number of existing plants that continue to operate. The bottom line is that we are applying world class science and technology to ensure the safe long-term operation of the current fleet.

Next slide. The licensing technical support program has four research pathways. The first and most important is the nuclear materials aging and degradation pathway, where we are trying to develop the scientific basis for understanding and predicting long-term environmental degradation behavior of materials in nuclear power plants. In the materials pathway, we're conducting research on irradiation assisted stress corrosion cracking of core internals, reactor pressure vessel embrittlement, stress corrosion, cracking of nickel-based compounds, and concrete and cable degradation.

The next pathway is the advanced instrumentation, information, and control system technologies. Here we're developing, demonstrating, and deploying new digital technologies for instrumentation and control architectures, and providing monitoring capabilities to ensure the continued safe, reliable, and economic operation of the current fleet. The I&C area relies heavily on pilot demonstration projects at actual nuclear power plants of new technology. Examples include a recently completed project on an advanced outage control center at the Byron plant, and the use of handheld technologies by field workers.

Next slide, please. The next research pathway is the risk-informed safety margin characterization where we're developing and demonstrating a risk assessment method that is tied to quantifications of safety margins. Specifically, we are developing RELAP-7, which is a systems code that models thermal hydraulic behavior of the whole plant. RELAP-7, along with another code that's under development called Grizzly will simulate the behavior of the aging plants in a way that provides more comprehensive safety insights, and enables more risk-informed analysis of plant safety margins than can be done with the existing tools. The advanced fuels -- nuclear fuels pathway, is focused on developing higher performance, higher burn-up fuels with improved safety and economics. This pathway has been primarily looking at advanced fuel cladding technologies such as a ceramic silicon-carbide cladding. However, in Fiscal Year ‘14, this pathway will be transferred to the Fuel Cycle, Research and Development program, their accident-tolerant fuel activity.

Finally, we have kind of a cats and dogs pathway -- it's not really a pathway, it's a catch-all systems analysis on emerging issues. In this area, we've been primarily looking at Fukushima lessons learned. That's where the work that Dr. Kelly described under MELCOR was sponsored. Finally, we have a high degree of coordination with the Nuclear Regulatory Commission, this program is the subject of the MOU that Dr. Lyons mentioned. Since the inception of this program, we've recognized the need the need to work closely with NRC on research related to reactor sustainability. Areas where we are cooperating include an NRC representative participates on the Idaho National Laboratories Program Advisory Committee. There are coordination discussions that occur weekly at the staff level between DOE and NRC staff and at least quarterly at a more senior level. As I mentioned, we established an MOU between NRC to ensure close coordination and a sharing of information as well as facilitate joint projects. Under this MOU, we have two very successful joint projects, including the expanded Materials Degradation Assessment and research on extended emergency battery operation. We continue to participate in various workshops and coordination meetings to share information and ensure our research is focused on the right topics. And we have coordinated on the collection of samples from various shutdown plants including Zorita in Spain and Zion in the U.S., and we've had some initial discussions about possible samples from Kewaunee and Crystal River. However, we should note that samples from shut down plants can be very difficult and expensive to collect, so we need to ensure that they provide the type of information that will be most useful for the research that we are conducting. And that concludes my remarks.

DR. PETER LYONS: With that, we'll turn to John Herczeg as he starts into some of the discussions on fuel cycle.

DR. JOHN HERCZEG: May I go to the second slide, please? Good morning and thank you for the opportunity to brief you on the Office of Fuel Cycle Technology. I only have 15 minutes, so I'll try to be brief. But the topic areas I would like to cover are fuels, work separations, proliferation risk, fuel cycle options typically known as systems analysis, and last I will cover the used fuel disposition program, which has two components in it, which I'll explain later. Next slide, please.

I don't want to go into depth on the organizational chart, but I did want to orient you as to where we fit within Dr. Lyons' organization. We have four offices that focus on the areas that I mentioned: separations, fuel cycle, R&D, used fuel, and uranium programs. What's important to point out here is that we cover everything from the mining and enrichment all the way to disposal with the exception of the reactor program. Next slide, please.

Over the past four years, our R&D has evolved and it has taken a different approach: scientific based, engineering driven. This Venn diagram shows you an overview of how we approach a problem: theoretical work, experimental work are put together into modeling and simulation, which ultimately will lead to the engineered scaled demonstration of various projects. We feel that this is the most sound approach for R&D within our organization. Next slide.

In the area of advance fuels, which Andy Griffith will cover in much more depth, particularly accident tolerant fuel, we focus on two specific areas: next generation light water reactor fuels and metallic fuels for transmutation and faster reactors. Now, we have done selected to metal fuel for fast reactors and that's because the rest of the world is working on oxide fuels, and we were exchanging information as we go forward. Our preference for metal fuels is primarily because of passive safety characteristics. Next slide.

In the area of separation, our goal is to focus on advance performance of our current fuel cycle, with a focus on minimizing the number of process steps to minimize the waste that is generated within the system, and to reduce the potential for material diversion. Our separations program is a long-term program aimed at engineering-scale demonstration in approximately the 2040 time frame. Next slide.

This slide gives you an overview of the comprehensive set of areas that we cover within Separations R&D. It covers everything from advanced aqueous processing all the way down to the bottom, which we call electrochemical, and a lot of areas in between. I wish to point out a couple of areas of significance that we have made major accomplishments in. One is off-gas capture Sigma team. We have been able to capture iodine and tritium at an exceptionally high percentage rate: 99.9 percent. In the area of uranium extraction from seawater, which is an area that was recommended by our subcommittee, Dr. Richter, we have actually looked at, and improved upon, the technology from the Japanese by a factor of two, is what we say here, but in actuality, it looks like we've -- we have actually achieved a factor of four, or maybe even greater, for uranium from seawater. This is a very impressive piece of work that's been done and we're putting together the science and the modeling that I was talking about in the science-based program -- science based engineering driven. Electrochemical processing is an area in which we're doing a lot of work with the Japanese. You may have heard of the joint fuel cycle study. I'm sorry -- Korean.

Closely linked to the Separations program is material protection and accounting areas. Here, we focus on real time monitoring in process plants. We wanted to be able to track the material from an entrance into the plant to the exit of the plant. We also focus on spent fuel storage security and safeguards by design. Safeguards by design applies to both reprocessing plants and also to interim storage plants. Next slide, please.

Systems analysis, as you typically know it, has been going on for a number of years. We have participated in it since over 12 years right now, but we have taken a different approach to systems analysis. We are looking at systems analysis as a framework or a tool to give us guidance on which fuel cycles to focus on. In this particular area, we are putting together a compilation of nine specific areas of critical areas to look at. For example: material security, safety, economics, risk informed, resource management, environmental impacts. This all goes into a very complex computer code which will be very easy to use, that will permit us to look at various fuel cycles by taking out one component and inserting another. An example would be: suppose I had an aqueous fuel cycle, and I wanted to take out that particular process and replace it by electrochemical processing. How will that affect the waste forms, the safety of the economics of the overall system? So it is a tool. It is not meant to down-select a particular technology, but to help inform us as we move forward as to what is the technology that meets both the environmental, political, and overall economic risk associated with reprocessing. Next slide, please.

Moving forward to the Used Fuel Disposition Office, here I want to convey to you that we have two very distinct areas in this office. One is called interim storage, which is completely separate -- well, it’s linked, but separate -- from the R&D arm which is for disposition. In this area, folks doing disposition are doing long-term work in the area of interim storage. They are doing short-term work, as Dr. Lyons has discussed. Next slide.

Dr. Lyons discussed our strategy that was presented in January of this year. I’m not going to go into detail on it. The reason I am placing this slide here is to point out to you that the interim storage facility is guided to be completed by 2021. This is a very aggressive date, but I think it is almost doable. We will see as we go forward in the overall process. Next slide.

As you might guess, this fuel disposition program is a very high priority for DOE and the country. Now we are using a broad base of information as we go forward, but we need to focus here on the near-term program where we look at the extension of long-term, interim storage of high burn-up fuel. In this area, we have just awarded, on January 16th, a new program, which I will talk about at the end, is on high burn-up used fuel -- used nuclear fuel dry storage project. This is an extended storage project which is linked to the high burn-up fuel which the utilities are now using. The goal is to benchmark predictive models and empirical conclusions developed from short-term laboratory testing for aging of dry cask storage systems. Two is to build confidence in our ability to predict the performance of these systems over an extended time period. Linked closely with the program is a university program, which we call the Integrated Research Program, which is -- which we call the IRP -- which is awarded in 2012 and is a consortium of universities, led by Texas A&M, to look at the accelerated behavior of fuel as it moves forward in time: how it’s temperature creep, hydrogen behavior, and hydration, cracking -- and how do canisters behave in this novel -- and also look at novel system monitoring.

The project that I just described for the industry is a five-year program at this point in time and is funded at $15.8 million. The project will involve loading commercial casks with high burn-up fuel. The casks will be outfitted with additional instrumentation. They will be housed at a utilities site and can be industry-monitored for 12 years. A second cask will be loaded to look more at the scientific data which has been identified as problem issues that may've arised from the first study. We have not decided where we will open the cask at this point in time, but we will address that issue later.

In closing -- next slide, please -- I wish to tell you that we've announced the award, as I said on January 16th. The team is -- the EPRI team -- consisting of Dominion and AREVA Federal Services, and the utilities at which we will do the dry cask storage will be at the North Anna Plant and the Surry Plant. Thank you very much.

DR. PETER LYONS: And we'll turn to Andy on accident tolerant fuels.

MR. ANDY GRIFFITH: Good morning. I'm honored to be speaking with you this morning. I'm here to talk about the Accident Tolerant Fuel of the Department of Energy, Office of Nuclear Energy. Turning to Page 2, emphasize that this program was actually underway several years ago; 2009, 2010, it was quite clear that there would be an opportunity for DOE to engage with industry partners to develop the next generation fuel, focusing on higher performance, including increased burn-up, increased reliability, and then also the higher power densities, for obvious reasons to the utilities. Then of course, the events of March 2011 with Fukushima, that emphasis focus shifted from the high performance to a more accident tolerant approach, which, as it turns out, many of the same fuel concepts we were looking at prior to Fukushima also translate into enhanced accident tolerance.

What resulted was actually -- where we had started some momentum, the momentum actually picked up post-Fukushima, where we were actually able to build some fairly strong partnerships in a fairly short period of time with DOE, national laboratories, universities, industry, and it turn that partnership actually grew from -- domestically. And we have some potential for strengthening that partnership further with international collaborations.

Slide 3 captures the summary of our mission. But let me just start out by saying that our position is that the existing U02 zircaloy design is a robust system. It's been -- demonstrated safe operations for decades. It's -- but its experienced decades of refinement and optimization, where the major question is, especially in light of Fukushima, can we do better? And so with that in mind, we started out with a set of attributes that we felt should be examined to determine what defines better. And so, just going around the list here, improve reaction kinetics with steam, slower hydrogen generation, improved cladding properties, retention to fission products, as John Kelly pointed out, is critical to the events of Fukushima, and then of course, improved fuel properties.

Moving to Slide 4, when we're looking at technologies to operate in the existing light water reactors, clearly, we're looking at a number of constraints, as well as the light water reactor designs that are undergoing licensing now and the new builds -- the generation three-plus type of concepts. Backward compatibilities: obviously important. Economics is going to be very critical to this deployment, because obviously with the added accident tolerance, it likely is going to come with a higher price tag. Therefore, the performance is going to have to be improved to help offset that; to make that an economically viable concept. Fuel cycle impact has to be evaluated because some of these concepts will impact the front end of the fuel cycle, as well as the back end of the fuel cycle when we're talking about either interim storage, direct disposal, or even the recycling concepts that we're currently evaluating. The impact on operations; clearly that has a major impact and consideration by the utilities that would have to put these fuels into operations. And then the impact on safety; that's a fundamental reason why we're talking about this subject.

Moving on to Slide 5, this is a Gantt chart that summarizes our overall program, which is broken into three fundamental phases: the first phase, evaluating the feasibility; the second phase, looking at the development qualification of specific concepts; and then the third phase, the commercialization. Starting with the first phase, we have gone through a fairly open door and rigorous evaluation of some fundamental concepts. We have selected three approaches through a funding opportunity announcement where we have three industry led teams by Westinghouse, GE, and AREVA. We've also undergone a competition amongst the laboratory -- sorry -- the universities with the integrated research project, where we have three teams: two focusing specifically on fuels, one focusing on a new light water reactor that has a fuel concept in it. And we've also undergone some fairly extensive discussions on developing metrics for these concepts. Obviously, we have to have some clear metrics in order to evaluate these.

Phase 1 is scheduled to wrap up in 2016, in which we will down select one or two approaches for further development and testing, including radiation testing, transient testing, and LOCA furnace testing. The objective is to have a lead test assembly, a lead test rod inserted into a commercial reactor for demonstration -- qualification in 2022.

In summary, we've built a fairly robust program. We've enlisted the partnerships -- collaborations of universities, industry, and international collaborations. Fundamental to these capabilities, though, is the ability to test and evaluate these concepts. Tracey Bishop will be speaking next, talking about the transient testing and advance post-radiation examination capabilities. Thank you.

MS. TRACEY BISHOP: Good morning. Thank you for the opportunity to present two of our infrastructure activities that we have underway that are geared to address data needs to support our research programs; not only here within the Department, but have application to other research activities at the NRC and other industry partners.

Before I get into the two activities, I'd first like to briefly discuss how we make infrastructure investments. And as Dr. Lyons mentioned earlier, we do have very austere budgets and we do take a very detailed application to ensure that we are making the right investments and are addressing the right information gaps.

First thing we do is we do look to our nuclear energy road map and our research goals and take information and advice that we have from our Nuclear Energy Advisory Committee to develop gaps and identify the gaps that we have within the programs. We then do a very detailed assessment and take our infrastructure activities and prioritize them into our funding -- infrastructure funding plans -- which look out for 10 years. And then we focus on supporting any research and development needs in a cost-effective manner, utilizing existing facilities to the extent practical, across the departments, as well as looking to universities, industry partners, and our international partners as well. An example of this is our National Scientific User Facility where we bring U.S. national laboratories and universities together to improve utilization of infrastructure.

So the first area I'd like to discuss is the resumption of transient testing. This is our main priority that we've identified, supporting the accident tolerant fuel program. As Andy Griffith mentioned, there's an estimated need by 2018 to support transient testing: to put a prototype lead test assembly into a commercial reactor. Transient testing is important to support irradiated fuels and materials, subjecting them to short bursts of intense radiation to gather and support design and safety evaluations for new fuel types. Currently the Department is initiating activities to identify opportunities to conduct transient testing. We are near completion on our alternative studies, and I'm happy to report that last week we initiated our Environmental Policy Act documentation process. We currently have two alternatives that we have identified and will be analyzing over the course of the summer. The first alternative is the Transient Reactor Test Facility at Idaho National Lab, and the second alternative is the Annular Core Research Reactor, located at Sandia National Laboratories in Albuquerque, New Mexico. In addition to conducting environmental studies, we will also be doing assessments on facility and equipment based on the identified alternatives to gather additional information to support our NEPA activities. Currently we are anticipating having a draft environmental assessment in summer of 2013, available for public review in completing our NEPA process in the fall, with either making a determination of finding of no significant impact or going forward with an environmental impact statement.

The second area I'd like to discuss, on Slide 4, is advance post-radiation examination capabilities. Currently we are looking at identifying the benefits and options to establish advanced post-radiation examination capabilities to house the next generations of PIE equipment. The goal of this is to support and improve the understanding of irradiated fuels and materials at the sub-atomic level and improve the validation of predictive models, with the goal of improving safety. We are considering options to establishing a safe, secure, and reconfigurable foot print that meets the environment, utilizing the next generation equipment and also providing a capability that would extend well into the next several decades and have an adjustable and flexible footprint that can accommodate changing research needs.

The Office of Nuclear Energy is currently early in the phase of this effort. In 2012, we held domestic and international workshops to gain a better understanding of the research needs and to validate the scope of the effort. Starting in 2013, we have initiated technical and environmental option studies, which are scheduled to complete in late 2014, to help inform the decisions on this effort. And that's all the statements I had today.

DR. PETER LYONS: Well, with that, I hope we have presented some useful information to the Commission. I certainly look forward to your discussion. My comment on those last two facilities that Tracey described: Those are facilities that we anticipate could have significant impacts and assistance to different NRC interests as well. But with that, we're open to whatever questions you might have.

CHAIRMAN MACFARLANE: Okay, great. Really appreciate it. That was very helpful in laying out areas of mutual interest. So, what we're going to do now is we're going to take a quick five minute break -- leg stretch -- and then we'll come back and we will start off with questions and our discussion, okay? Thanks.

[break]

CHAIRMAN MACFARLANE: Okay, so I think we are ready to go. All right, so now we will start the Q&A portion of the meeting this morning, and we will start off the questions with Commissioner Svinicki.

COMMISSIONER SVINICKI: Well again, good morning and welcome to all of you and your colleagues who have joined you here in the first row behind you. I know, as many of us do, I often speak to student groups or maybe audiences that are not predominantly nuclear and I have to explain the history of atomic energy development in this country and we always begin with the Atomic Energy Commission and the shared origins of NRC and DOE, and so today's presentations are a reminder of still how our work casts a shadow on each other, what we are doing here; so I appreciate the breadth and the depth as time allowed of the presentations this morning. I thought that that was very helpful.

I will say that I think the accident tolerant fuel work is very interesting. The reason that I will not have questions on that is that I had an opportunity to visit Idaho and hear from some of the investigators and researchers on that work and they talked about the partnerships, which are really impressive on that front. It was hard to find anyone on the view graphs that was not represented there, so it is really an impressive partnership and consortium of various folks working on that. So I got a really great presentation and I won't have any questions on that today. I did not want that to be interpreted as a lack of interest on that topic.

I did want to maybe pull back and speak more broadly about infrastructure and facilities support as part of these shared origins. It is interesting to note that policymakers have continued to emphasize that the regulator, which is NRC, must continue to have access to the infrastructure, which is really the scientists and also the facilities that DOE, broadly at the national laboratories, but the Office of Nuclear Energy specifically, is really the caretaker and custodian for over the decades, and I think in the fiscal environment it becomes difficult. It's experimental facilities; that infrastructure is very expensive to maintain, and I know that the Department of Energy over the decades has a real push and pull with the ability to forecast exactly what kind of infrastructure will be needed and then to have the foresight to make the investments in those key areas. We heard a little bit about that this morning in terms of how the work that you're doing now and some of the forward thinking you have about capabilities that might be needed. But would any of you just like to talk about how you address this challenge of having an appropriate forecast of what the United States will need, of what will be available or is available in terms of experimental facilities to do this type of work around the world, and then how do you plan for and strike the balance in terms of what the United States most needs to keep in terms of our own capability?

DR. PETER LYONS: Maybe I can start, Kristine, and there could be others who want to chime in. Tracey mentioned that our advisory committee, the Nuclear Energy Advisory Committee, does have a subcommittee devoted to facilities. It's headed by John Sackett. I think that's correct, isn't it? Yeah, Dr. John Sackett is the leader of our Facilities Subcommittee. There have been in the past reviews by NEAC, advisory committee, of facility needs across the country, and under Dr. Sackett's leadership they are preparing to do another evaluation to update the previous one. But you are very, very right that the infrastructure challenges are large, they are not going away, they are, if anything, becoming more and more severe both within this country and around the world. We also use our international cooperation very, very extensively, as does the NRC; and in many cases we are taking advantage of or utilizing international capabilities where we simply don't have the capabilities here in the United States. That's just one example for evaluation of samples under fast neutron bombardment. We are in the process of developing an agreement with RUSATOM to use the Bore 60 in order to obtain some data but actually using some samples that already have some radiation at FFTF; so trying to take the best that we had in the U.S. and then extend it using in this case using an international Russian capability. Those would be one example. Others may want to add to that, too, and Tracey, this is very much your area.

MS. TRACEY BISHOP: Thank you, Dr. Lyons. One of the things we also have done over the last few years is really refocused how we have done our 10-year site plans, which is our main document that we use to map infrastructure needs. We have taken a very methodical approach, working very closely with our R&D partners amongst any, to go and assess, what are the real needs and are we fully utilizing and maintaining our current unique capability and then identifying the gaps that exist, and then prioritizing those gaps and figuring out is there another capability or a facility in the U.S. or abroad that can address that need? And then if there is no capability going after and trying to fill that hole as best we can. And I think you will see that in the past budget submissions for the Office of Nuclear Energy. You have seen our infrastructure accounts have maintained and actually are growing and our FY '14 requests; there substantial increase specifically focused on addressing our infrastructure gaps and including the transient testing.

COMMISSIONER SVINICKI: Okay, well I appreciate that from both of you, and again, it is encouraging. We need to think about contractions that are occurring elsewhere. Certainly in the late '90s, early 2000s, a lot of university research and test reactors shut down as well, and so I know that some of your perhaps modest increases compensating for contractions that are occurring elsewhere in the United States infrastructure, so I think that that is very important. I was also very pleased to hear, under the topic of light water reactor sustainability, about the opportunity to get some samples from Zion. Rebecca, I think that you addressed this topic. I had visited the decommissioning work there and it was a little bit -- I think some of the discussions were more nascent in terms of the opportunity. The focus of the entity decommissioning of course is to decommission as quickly as possible, and so when we are contemplating beneficial research for the United States, decommissioning waits for no one when it is actively underway, and so I had left my visit to Zion a little concerned that maybe in the pace of business that the opportunities might be lost or also it requires resources and support. It is an expensive undertaking. I appreciate that you mentioned not only -- I think in some background we talked about some cables from Zion. Maybe there are other coupons and samples that can be taken from there but also looking at Kewaunee and Crystal River for providing opportunities. And it gets me to a larger thought I have. With a number of reactors now in their extended period of operation and having their renewed licenses we are not that far from confronting as a nation the notion that some licensees may want to further extend licenses, and I wondered if there was any kind of very global assessment that you could share in terms of having in place the technical basis for subsequent license renewal in terms of the R&D needs as you understand them and then our progress in terms of gathering that data.

MS. REBECCA SMITH-KERVEN: Go ahead, Dr. Lyons. I was just going to say that's exactly one of the things that we are focusing on; our technical integration program advisory committee talked to us about what -- do we have the complete set of information that utilities need to make a decision to extend the life of the plants? So we are in the process of evaluating that entire set and making sure that our research supports those decisions that are being made. Also the expanded materials degradation assessment looks at exactly, you know, what do we know, what don't we know, what is the high priority of research that is needed; so that's how we are trying to gather the full set of information that's needed to support second license renewal.

COMMISSIONER SVINICKI: Okay, I appreciate that and I know that there had been a number of workshops that our staff and your staff and also industries participated in in this topic. I guess I would leave it with the thought that there may be some -- the timing is getting more compressed I think, again, you know, having reactors that are already in their first extended period of operations. I think that the desire to really have answers to some of these questions or at least have confidence that we have identified all the information that we would need, I think that will become increasingly urgent in the coming years.

And on SMRs I just think it would be useful for me if you're willing to offer an assessment. As you engage with the vendor community and look at deployment dates that you've targeted for your program and you have to assess kind of licensing certainty and have enough innovation but not so much innovation that it may be complicating the deployment targets that you are setting for the technology -- you engage a lot with the vendor community. What would be your assessment whether or not unresolved policy questions on the regulatory framework contribute to significant remaining uncertainties on the licensing of small modular reactors?

MS. REBECCA SMITH-KEVERN: Well, I think of course the thing that's on everybody's mind is the resolution of the certainty of the waste disposal option. But as far as -- you know, the purpose of our program is in fact to put in place the licensing framework. By going through the actual process, I think, is the only way that we're going to identify some of these deficiencies, and that's exactly why we're involved and helping to push -- facilitate the acceleration of this. And our first FOA with B&W is designed, as I said, to deploy in 2022. For the second FOA, our focus was on innovation. We have extended the timeframe out to 2025 because we felt that those in fact would be more difficult. These innovative things that we are looking to see in the design would require more review -- longer review by the staff. So we extended the timeframe that we are allowing for that. Dr. Lyons?

DR. PETER LYONS: Maybe to just add a little bit. Kristine, I think this is part of your question. As we look at the possibilities for SMRs to sometimes use the word to present a new paradigm --

COMMISSIONER SVINICKI: I guess my question is what are you hearing about us?

[laughter]

DR. PETER LYONS: As we talk about the possibility of SMRs as one new paradigm, certainly not to replace the large plants but in addition to, there are real questions from the regulatory standpoint as well, as you are well aware. And there will be regulatory issues that you folks will be wrestling with: staffing issues, EPZ issues, security issues. All of those of course need to be evaluated from your perspectives, but they will have a significant impact on exactly how the SMR industry develops, so there is a strong interest within industry as you move ahead with your deliberations in some of these key areas.

COMMISSIONER SVINICKI: Okay, thank you. Thank you, Chairman.

CHAIRMAN MACFARLANE: Okay. Commissioner Apostolakis.

COMMISSIONER APOSTOLAKIS: Thank you Madame Chairman. Before I start I would like to relate to my fellow commissioners an incident that I consider the highlight of my professional career. Several years ago the Commission was having a meeting with the ACRS. Then Commissioner Lyons was sitting where Commissioner Ostendorff is today, and I was sitting where Mr. Griffith is. At that time I was chairman of the PRA subcommittee of the ACRS, so Pete Lyons turns to me and says, “my staff tells me that you are an expert in risk assessment, maybe you can answer my questions.” I thought that was a great praise, and I was very impressed BY what you said at the time. It was supposed to be a funny, but I think it failed.

[laughter]

CHAIRMAN MACFARLANE: It’s the jet lag.

COMMISSIONER APOSTOLAKIS: You talked about SMRs, both you, Rebecca, and John, and you used the word innovative domestic SMR technologies. When the Department announced the award to mPower, there were some articles in the trade papers that some senior members of DOE were disappointed that the submitted designs were not innovative enough. So I am wondering whether you can comment on this. I mean, what do you mean by innovative designs? Is it true that you were disappointed?

MS. REBECCA SMITH-KEVERN: Well, I can address what we are looking for in terms of what's innovative. We are looking for designs that reduce the core damage frequency, increase the post-accident coping times, provide features and characteristics to minimize the release of radioactive nuclides in severe accident conditions, and maximize resistance to natural phenomena hazards. Also we're looking for those that can present a credible case to the Nuclear Regulatory Commission for reducing the EPZ. Those are some of the specific things that we have mentioned that we are looking for. Did you have anything?

DR. PETER LYONS: Well, let me just add the decision that was made at the time of the first FOA was certainly a Department-wide decision, and certainly Department senior leadership participated in that decision. It was out of those discussions that the decision was made to move with the second FOA with a still greater emphasis on innovation. At the same time I think we recognized that the B&W design has a number of innovations, and I don't mean those statements to be in any conceivable way as derogatory towards the extent of innovation in the mPower design. But there was a feeling within the senior levels of the Department to have still further emphasis on innovation and to relax some of the constraints, as Rebecca pointed out, in the first FOA that might have somewhat limited innovation. So we are in the process now of a second FOA on the street and will evaluate this as that comes in. I don't know if that's a great answer, George, but that's a partial answer. I don't know if you want to add to it, John.

DR. JOHN KELLY: Well, as Rebecca indicated, the first FOA was looking at commercial operation in 2022; so there was some thought that if certain designs had innovation in them they may not have time to go through all the things that they need to do and have it in operation. The telling point is whether or not they could have a utility lined up willing, a decade in advance, to be their partner. Utilities may be risk adverse to going with a technology that isn't fully developed, is more innovative, et cetera. So by giving it more time and emphasizing innovation, we think that's the right combination to go with the first FOA, which was really focused on a very near-term deployment.

COMMISSIONER APOSTOLAKIS: Thank you. Well, John, on your Slide 7 you have something that intrigues me. This is the NEI Fukushima Dai-ichi project, where you say that Phase 2 is under discussion, a program similar to post-TMI project is being considered, and then the last bullet says DOE conducting uncertainty quantifications study to aid, I guess the above. If you have something that has already happened, how do you conduct an uncertainty quantification study?

DR. JOHN KELLY: Well, there is still much to be learned about both the phenomena and the course of the events in the plant. We have qualitative, I'd say, agreement -- yeah, semi-qualitative agreement right now with measurements that we have, but we have not conducted the inspections of inside that will end up, I think, significantly controlling the phenomena. I will just mention a few. At some point we know the reactor pressure vessels depressurized. We don't know if it is because of a break in the steam line, a break in the penetration, a break in the bottom, melt through, et cetera. Depending on which of those features failed first, this can actually cause a significant change in the course of the accident. So what we want to do is understand both in terms of phenomena and fidelity what are the key things that could influence the eventual outcome of the accident. And fidelity means modeling the plant in more detail; that is the better geometric representation of the actual plant. I'll just give you a point that's been coming up lately is that we know the tsunamis hit and caused all kinds of damage, but we also are learning that they believe that the water was left behind around the torus of the building. Normally we would model that torus, is just one control volume. But, if in fact, it is submerged in water, there's other heat transfer paths available, and this type of thing may then influence the outcome of the accident. So in terms of the uncertainty, we have some ideas of how these variations could have occurred. We want to address those systematically to understand how that affects the ultimate outcome of the accident.

COMMISSIONER APOSTOLAKIS: This is a subject that has been of interest to me for a long time. But you showed several graphs: gas composition and refueling bay, and other results from codes. And I believe you said that there is a reasonable agreement among the results of the various codes. But what kind of inputs do you use though? Did you have uncertainty regarding the inputs to these codes? I mean, how does one handle that when you have a real incident and you are trying to predict to see whether your code predicts what the observations are?

DR. JOHN KELLY: Well we are using our, let's say, our best estimate model, which is based principally on separate effects experiments and sometimes at reduced scale. That coupled with international peer review, over the years, in terms of certain modeling assumptions. Then we go into and we look at the specific details of components. For instance, one of the phenomena that we think happens is that the head bolts lift a little bit and there's some leakage. And this is one way of the gases from getting from the primary containment getting into the reactor building. This is something that was maybe invented 20 years ago, but there's been detailed mechanical studies of this to show that at least it's a plausible phenomena. There are other things that could be happening too. So, I think as we go forward when we identify a potential failure mechanism, it is studied at a separate effects type of way, and then it is integrated through the simulation into the overall access --

COMMISSIONER APOSTOLAKIS: So the study you are referring to will consider the possible variability in the inputs of people have assumed already.

DR. JOHN KELLY: Yes

COMMISSIONER APOSTOLAKIS: And see what the results would be. One last question from Mr. Herczeg. On Page 12, you mentioned borehole research.

DR. JOHN HERCZEG: Yes.

COMMISSIONER APOSTOLAKIS: How many of those would we need to get rid of spent fuel?

DR. JOHN HERCZEG: That's a very good question. It's a subject that has been talked about for many, many years. As you may have known, the MIT study many years ago recommended to look at boreholes. We have not really done that to any extent at this point in time. We are going to begin to look at it now and we hope to attest within the next five years. We are now looking at the subjects of how to put together the overall experiment, and we are also looking at an international partner to participate with us.

DR. PETER LYONS: Just to add a tiny bit more, there also will be an evaluation planned, looking at what types of used fuel in our inventory or other high-level waste might be most appropriate for different types of geologic disposal. And it's a project that you're going to be starting within the next year as well. Out of that, that may identify if there are particular classes of materials that may be of particular interest for boreholes. And that may -- I mean, it could be for example, be a type of used fuel we have very little of but would be very difficult to treat any other way; perhaps calling it sort of a boutique used fuel. Other forms of high-level waste might also be appropriate for boreholes, without saying that boreholes necessarily would take on the full range of possible types of used fuel. And just as an additional comment, one of the leading proponents of this research in the past has been Dr. Moniz, and he participated in the Blue Ribbon Commission and is pending confirmation, and we are well aware of his strong interests in borehole research. And that I am sure that will also help to guide our work once he's confirmed.

COMMISSIONER APOSTOLAKIS: Would you consider this a realistic option?

DR. PETER LYONS: Well, realistic may depend more, George, on realistic for what? The study that John and his team will have ongoing this next year will ask the question of how realistic would it be for simply the full-range of used fuel or how realistic would it be for specific components or specific types of used fuel. And there could also be particular types of high-level defense waste that could be considered for boreholes as well. Again, that will be part of a discussion and evaluation over the next year. I think with a goal of identifying exactly the question you are raising, of to what extent could boreholes feasibly be used for large-scale disposition, or do they have a role in, I used the word "boutique" applications, but they could be very important boutique applications that would be difficult to dispose of other ways.

COMMISSIONER APOSTOLAKIS: Thank you. Back to you, Madame Chairman.

DR. JOHN HERCZEG: May I add one more point?

COMMISSIONER APOSTOLAKIS: Okay.

DR. JOHN HERCZEG: May I add one more point on boreholes? Sandia National Laboratory has been looking at this a number of years under the LDRD program. But what strikes me very interesting about this is that we are limited in diameter of a hole we can drill. Right now at least, the latest information is 11 inches in diameter. I'm sure that will go up but 11 inches is…

CHAIRMAN MACFARLANE: Forty-five centimeters.

DR. JOHN HERCZEG: Pardon me?

CHAIRMAN MACFARLANE: Forty-five centimeters.

DR. JOHN HERCZEG: Yeah that is very small, and so we have to take that into consideration, plus the minimum depth is going to be like 5,000 feet.

COMMISSIONER APOSTOLAKIS: Okay, thank you very much.

CHAIRMAN MACFARLANE: Yes. Commissioner Magwood. SI Units.

[laughter]

COMMISSIONER MAGWOOD: Thank you, Chairman. Well first, let me thank you for appearing today. I thought the presentations were very informative. You've covered a lot of ground very quickly. I appreciate that. And also, just Dr. Lyons, I had a little conference with your staff, and I'm all caught up now. So notice I don't have a lot of questions because we covered a lot of material in the sidelines there. There are a few things to talk about. First, let me highlight a couple things because it often goes -- it's often said -- and I think that a lot of people sort of have the idea that we study these things and we study these things and nothing really gets done. There's a lot of things that have gotten done. I wanted to highlight a couple. One, I think John pointed to, was the work on the TRISO fuel. That's really breakthrough work that there has not gotten nearly enough attention. If you go to -- if you look at where we were in the United States 15 years ago in TRISO fuel and compared to where we are today, it's night and day. I mean we've really done some fantastic work, so the staff deserves a lot of credit for that. And of course the Nuclear Power 2010 program was a big success story for DOE, a project that went from the beginning to the end, and of course it's helped support other work the industry is doing today. Hopefully you've been to Vogtle, Rebecca. And now you've got SMRs. So we will have to check back with you in a few years to see if you consider that to be a success story.

But I wanted to follow up on something. Commissioner Apostolakis asked this question, and I wasn't sure I understood the answer. Because when I look at mPower I see a technology that potentially answers a lot of the questions that you have laid out as innovative design. So I'm trying to make sure I understand, for the next solicitation, is mPower a baseline that you'll be using to compare the next possible award? Or is that being done in isolation at MPower? How do you relate those two? Does it have to be more innovative than MPower or…

MS. REBECCA SMITH-KEVERN: No, actually I think our baseline that we set in the FOA is compared to what the large light water reactor designs are -- not -- we were not comparing against mPower specifically.

COMMISSIONER MAGWOOD: Okay, so -- and we're still on light water space. We are not talking about --

DR. PETER LYONS: It is not specific to light water. Neither was the first FOA, at the request of Congress, at the direction of Congress, it was not specific to light water.

COMMISSIONER MAGWOOD: So it could be liquid metal or some other technology in this next solicitation.

MS. REBECCA SMITH-KEVERN: That's correct. Congress required -- did put in the words, "Can be deployed expeditiously." And that's where the definition of "expeditious" became important. And we decided that 2022 was expeditious for the first one, and then because we were looking for innovation we determined that 2025 was expeditious with respect to the emphasis on innovation.

COMMISSIONER MAGWOOD: Okay, I appreciate that. Also Commissioner Svinicki was talking about infrastructure; one of my favorite subjects. We never spend enough time talking about infrastructure. It's not a sexy issue for the most part. It is hard to get funding for it, it is hard to maintain it, but without it you can't do very much. And I was just sort of having nostalgia moments here listening to the conversation because I remember there was a document put together called "The Infrastructure Roadmap" which was, at the time, a NEURAC product. I recall that the person who ran that was a fellow by the name of Dale Klein, who was with a university at the time, and is with a university still. I guess he hasn't done anything in the interim.

[laughter]

And the staff person who worked on that was a fellow named Trevor Cook, who isn't with us today I guess. He didn't make it. It is just these conversations go on and on. One of the things about the infrastructure roadmap and I think some of the work you have done since, then that really stands out in my mind is that we are losing infrastructure faster than we're gaining it, through age. And I do think the transient work you're talking about is very important, so I look forward to seeing what happens with the TRTF versus ACR conversation. But what about beyond that? What are the holes in the infrastructure? I mean, obviously you've talked about using Bore 60. That's something that you would like to think that we've had to resort to for fast neutrons. But what are the big holes do you think in the long-term infrastructure right now?

DR. PETER LYONS: Well, clearly, Bill, as you hinted, there is no capability for fast neutron research directly within this country. And that certainly is a substantial hole I think. Now, there may be ways to plug this. We are looking at innovative approaches short of a fast reactor. But one could certainly look into the future at the possibility of fast reactor test beds; John was mentioning the high temperature work both in high-pressure gas and fluorite cooled. Those also could be very interesting test beds to look into evaluating at some point in the future. But, those will be in the future.

COMMISSIONER MAGWOOD: You mentioned some experimental facilities. For example, you mentioned this super critical CO_2 facility. Where is that located by the way?

DR. JOHN KELLY: That's at Sandia National Lab.

COMMISSIONER MAGWOOD: That's at Sandia? Maybe the direction -- I get the sense that maybe part of the direction you're taking is to have more of the smaller boutique style of infrastructures, as opposed to the large facilities. Is that -- is that a pattern? I mean, perhaps because of the financial aspects of it, is that a pattern we might expect to see in the future? We have smaller facilities, more focused facilities at different locations across the country.

DR. PETER LYONS: Well, I think, Bill, it's certainly fair to say that yes, in our austere budget, we will look first at smaller facilities, and we will always be asking the question, whether the information that's needed can be obtained in a more compact or a smaller facility. A point that John may want to expand on, but I think it's an interesting point, is, I believe that work on the Brayton cycle is also being partly supported through the solar program.

DR. JOHN KELLY: That's right.

DR. PETER LYONS: And that is an example where a technology that began in the nuclear energy area, maybe even began with you, I don't know, has substantial potential well outside of nuclear power. And this is at least the first example I can think of where a direct -- a facility is being directly jointly funded with a renewable program. But we -- I mean, along that line, we do have ongoing comparisons between INL and NRAL to try to look at synergies between the renewables in the nuclear programs.

COMMISSIONER MAGWOOD: I appreciate that, and picking up on that point, one conversation that has gone on and off over the years between NE and other elements within DOE and others outside of DOE is having a more integrated materials program, because I think it was mentioned a couple times in this -- on this panel that materials are the enabling technologies for almost -- well, basically everything that you want to do. And a lot of these materials issues cross-cut across a lot of lines, your renewables program, fusion, many areas. Is there any effort to try to assemble a broad-based materials program on the energy utilization side?

DR. PETER LYONS: There have been efforts, even in the time I've been at the Department, to do that, and there are at least mechanisms whereby we're sharing information between, for example, sharing information between, say, the fusion program and the -- and our program, where there are similar material challenges. But John, maybe you want to add to that with additional work.

DR. JOHN KELLY: Well, there is working group type of structure within the Department that brings in people from science, NNSA, and NE, and other interested parties on these materials in harsh environments, I guess is a way to describe that. You have to recognize that the missions of each -- of the different parts of DOE are different, so we're in an applied area, so we are looking at very applied research. You go to the Office of Science, you're looking at much more basic research. So it's really this combination of the research and all those dimensions that's important, but we're trying to manage that, and then manage the integration of that through this working group type of concept.

COMMISSIONER MAGWOOD: I guess I'm surprised that, to some degree, because I would think that when you're talking about some of these events -- for example, for -- I heard you say 1,000 degree C, it was really a pleasure to hear you guys say 1,000 degree C, we're talking about gas-cooled reactors, but that requires, you know, new metallics, and probably new graphites. And there's a lot of science involved in that, so I would think there'd be a lot of cross-cut with the Office of Science on developing those materials. Is that -- is that a conversation you're having, or is that -- is that just not quite where we are today?

DR. JOHN KELLY: Well, I think in the case of the high temperature gas reactors, we certainly recognize that the TRISO fuel was, you know, a basic building block. Now, that was based on German experience of many years ago, and it comes down to a manufacturing quality. And so we did the initial runs in our laboratories; again, we're using special nuclear materials, so it's important that, you know, we have all of the proper safety and security considerations. But we set up the initial pilot demonstrations at our labs, but integral to that was then establishing at a commercial vendor, B&W, the capability to make it commercially.

So we laid out this path from the, you know, the basic science, and Oak Ridge is one of the centers that worked, and it is an Office of Science laboratory. So some of this cross-pollination between science and applied is really occurring in the laboratory itself. But anyway, the idea was to do the basic, built it up, and then eventually get to the manufacturing capability for commercial scale.

COMMISSIONER MAGWOOD: Yeah, I think is an area where I think as, really, as a nation, we have to do a lot more, because I think in innovation, we'll be fueled by a better understanding of these advance materials. And I know that there's so much work going on in the labs on advance materials for a lot of different applications, but we don't talk about it in terms of energy very often. And often, you hear about it more in terms of, you know, of high tech, or aerospace, or something like that, but on the energy side, there are real needs, particularly if you want to drive towards higher temperature, higher radiation exposure materials, and it's just an area I think we need to do a lot more work, so keep plugging away at that one.

DR. PETER LYONS: Silicon carbide might be mentioned as another area that has substantial interest across the Department in a number of different areas. RPE has been interested in, I think, funding some silicon carbide work, and there's at least some synergies there with some of the -- with some of our interest in silicon carbide and accident-tolerant fuels, and in other applications. So that would be another case where there's some cross-fertilization.

COMMISSIONER MAGWOOD: Appreciate that. Thank you, and thank all of you. It's good to see all of you again. Thank you, Chairman.

CHAIRMAN MACFARLANE: Commissioner Ostendorff.

COMMISSIONER OSTENDORFF: Thank you, Chairman. I'd like to thank you all for your very high-quality relevant presentations. I thought they really were most helpful to the Commission. I'd also like to add my compliments on a very thoughtful research agenda that you have across the spectrum of all your presentations.

I'm going to start off with some questions on the Blue Ribbon Commission, and I know there may be some things --

MALE SPEAKER: Awesome

[laughter]

COMMISSIONER OSTENDORFF: Well, we're going to -- you'll still have the opportunity to chime in here, I'm sure, but I wanted to really bore down a little bit on a couple of recommendations here. I want to start out with the consent-based approach, and specifically to how to make a consent-based approach be of a legally binding nature, and irreversible once that decision is made. And I'm curious about what you might've learned. I think that, Dr. Lyons, you've been over -- many visits overseas trying to work this area in a very robust manner. Are there any key lessons learned you have from international partners as to how they are approaching getting to a consent-based decision that has a legally binding status in their country?

DR. PETER LYONS: That's a very interesting question, Bill, and certainly a very challenging one. We are anticipating that there may well be guidance to this point in whatever legislation results from the process that's now ongoing in the Senate, and hopefully will involve the House at some point. So we may have some pretty strong guidance on this point.

You used the word "irreversible," which is a word that I would probably question, because I think that as part of a consent basis, there's going to have to be a recognition, particularly from the standpoint of a geologic repository, that while one might consent to do the evaluation of a particular site, there has to be mechanisms that clearly allow if the site is not proving out, or if the safety case could not be made. So the Blue Ribbon Commission used words like "adaptive" and "phased," as being, I think, important in trying to work towards decisions on geologic repository. Exactly how you make it legally binding, though, is going to be a challenge, and I think we'll -- we're just starting some evaluations within our office that might try to shed some light on how different groups around the country might contribute to this question of how legally binding this should be. I mean, in my mind, to the extent that the government, with whatever this new organization may be, is demonstrating a good faith commitment to move ahead, and also has access to the resources to move ahead, that that will go a long ways towards defining an atmosphere where, together with the continuity of the organization, hopefully that can contribute to the continuity of a regional or local, state interest in moving ahead with a particular facility. So I think there's going to be a large element of trust in all this. You asked about the --

COMMISSIONER OSTENDORFF: Well, I'm going to -- just, if I -- just to clarify, by "irreversible" I was meaning at some point in time, there has to be a decision made, and there has to be some adherence to some agreement. I completely agree that --

DR. PETER LYONS: At some point, yes.

COMMISSIONER OSTENDORFF: -- safety, environmental concerns have to all be squared away, and have to be acceptable, but at some point in time, X number of billion dollars down the path, or Y number of years down the path, there has to be some finality to the negotiations after all the due diligence is completed, and that was kind of the spirit with which I was mentioning that.

DR. PETER LYONS: Okay. When you say it that way, then I have no quarrel --

COMMISSIONER OSTENDORFF: That's the intent. I apologize for --

DR. PETER LYONS: -- one needs to get to that point.

COMMISSIONER OSTENDORFF: Yeah.

DR. PETER LYONS: But I think that point, particular for the repository, will be quite a ways downstream before you have enough confidence on everyone's part to do that. As far as international, we have tried to learn, as did the BRC, from a number of very successful international examples. Sweden and Finland are usually the two that we highlight as being the most successful, but France is now in the middle of a -- of what appears to be a very successful program, and well into their policy -- or starting into their policy debate, it may define their progress. So we are trying to learn from the international community.

They have at least one possible, I would say simplification, in that they have somewhat fewer levels, I think, of different governmental structures, in that they may not have a direct analog to our state governments, which, to me, just highlights the importance of this consent basis involving not only local and Tribal, but also state. And where we have a good example in this country with WHIP, I think you can clearly see where all those elements have come into play, and where we have a very unfortunate example in Yucca Mountain, you can see where all those elements did not come into play. So we have our own good examples, we have international examples, and I'm looking forward to providing a future success in this country.

COMMISSIONER OSTENDORFF: All right. Thank you very much, that's very helpful. Rebecca, I want to shift to you. I know Commissioner Svinicki, and I believe Commissioner Magwood, hit on the subsequent license renewal area, and I think the areas of research there are very important. And I know you mentioned, I believe, in your presentation concrete, cable degradation, nickel material durability, et cetera. And I have kind of a question going to -- I know in my time in the nuclear Navy, there were a lot of discussions about, how long can the USS Enterprise stay in operation? Built in the early 1960s, and that stayed -- you know, it was just in decommission here recently. And I know that the Air Force dealt with strengthening the wings on B-52 bombers through life extension programs, and there's other stress, fatigue issues associated with the aircraft industry, on the commercial side. And I was curious as to, is there any overall methodology that you're using to determine through other non-nuclear sectors what might be some lessons learned to help guide what areas for research might be appropriate?

MS. REBECCA SMITH-KEVERN: Yes. We have surveyed other industries such as the shipbuilding industry and the chemical industry, to look at techniques that they're using, areas that they're investigating. We also have gotten extensive cooperation with the Electric Power Research Institute, and also with NEI, to look at what areas of research are needed, and to ensure that we are collaborating and getting them all covered, and focused on the most high-priority research areas.

COMMISSIONER OSTENDORFF: Okay. Thank you. Rebecca, I'm going to stay with you, and maybe John just for a minute, on the topic on SMRs, and I think one of John's slides, and I think one of yours as well, talked about an economic analysis of the SMR. And I know that when one looks -- not everybody needs a 1,000-megawatt electric power source. And I know that you mentioned desalinization and heat process type applications as well. Are there any conclusions that the Department of Energy has drawn to date to suggest what are the niches, or what are the specific areas where an SMR appears to be economically viable in the United States based on grid issues, or other type of considerations?

MS. REBECCA SMITH-KEVERN: Well, I think that the sweet spot that we're looking to fill is for the retirement of old coal. Those are places where the size would be comparable, the infrastructure is already there, the -- as I said, the capacity is similar, but what are the challenges of that is some of those plants are sited near population centers where the population has grown out around them; so that's where the issues that we're looking at with respect to, are we going to be able to present a credible case to shrink the EPZ? Those are -- those are the things that are going to come to bear there.

COMMISSIONER OSTENDORFF: Okay, John, do you want to add anything?

DR. JOHN KELLY: Yeah, just to add to that, we've talked to a number of utilities, and many of them express the desire to have a portfolio approach. So, you know, today, one type of energy may be the cheapest, but, you know, they have long memories about how things can fluctuate. And so they're looking for a portfolio to balance their overall risk, and most of them say they need renewables, fossil, and nuclear. And it's just a question of what -- how they see that mix coming into play. That is true in general about nuclear. Where we get into the advantage of the SMRs as those utilities that don't have the market capitalization to be able to actually invest and get the funding they need for the large -- the very large units. We're hoping that the SMRs can come in at a place that can reduce at least their -- the price of entry into the market. We don't know these things yet for sure, which is why we're doing the studies, which is why we're doing the design certifications. We expect not only to get the information licensing in design cert activity, but also detailed enough design so we should be able to then take those and figure out what the manufacturing costs are going to be. So it's really dual purpose. So it's a combination of things that we think will lead to a success in the end.

COMMISSIONER OSTENDORFF: Thank you. Thank you, Chairman.

CHAIRMAN MACFARLANE: Thank you. Okay. So I'm going to focus, not surprisingly, all of my questions on the back end of the fuel cycle, but you talked about it a lot, so. First of all, thanks for the funding for disposal standards. We will look forward to working with you on that when that comes about.

But let me start off with you, Pete, and focus on the plans going forward for a geologic repository. And I just want to try to understand what -- a little more detail on what's planned for the next 10 years, because you said in your slides that in the next 10 years, you want demonstrable progress in your program of work. So in one of your backup slides you talked about having a facility sited by 2026, and designed and licensed 16 years later. So I want to understand a little bit more about what's going to happen in the next 10 years, what you guys foresee happening in the next 10 years for a repository.

DR. PETER LYONS: Thanks for the question, Allison. At least in the foreseeable future, meaning until we have a legislative basis, we are focused only on generic research, doing nothing that would be interpreted as site-specific. But within that generic research, we are, for example, working, to some extent, jointly with the EM programs to look at salt geologies, better understanding of thermal issues that might be associated with salt systems. John mentioned the borehole work that we will be cranking up in terms of a research program. We also have gone to considerable effort to reinvigorate a number of international partnerships. It has seemed to us that to the -- we don't know what will be proposed in terms of a consent basis. Very likely that salt will be one of the ones that is proposed, and there now are -- there's the fairly vocal groups in both New Mexico and Texas expressing interest in exploring those geologies. And to the extent that salt might be considered in the future, we have a considerable knowledge base in this country, plus the collaboration with Gorleben in Germany. But in other areas, shale and granite, we have far less experience, and in some cases, almost no experience. So we have been quite diligent about building the international ties and actually reinvigorating them, because they did exist in the past. For example, now we have an MOU, a joint MOU with ANDRA to work together to benefit from their experience in the argillite, mud, shale type of geologies. We have similar activities that we've reinvigorated with Sweden to use -- to build on their experience at Aspo, and their experience in granite as they move ahead.

There's quite a long list of international cooperations that the team has rebuilt, and the hope is, at least, once we move into -- once we have permission to move into a consent-based arrangement, that we can use the combination of our own national knowledge base in salt, supplemented by whatever other geologies we need derived from the international community that we could do a credible down-select on whatever communities propose.

CHAIRMAN MACFARLANE: So let me speak as a geologist here, and encourage you away from focusing solely on rock type.

DR. PETER LYONS: Solely on?

CHAIRMAN MACFARLANE: Rock type.

DR. PETER LYONS: Oh.

CHAIRMAN MACFARLANE: Shale, granite, salt. And encourage you to be broader, and to look at geologic environment. Okay? Including different conditions, different tectonic conditions, different oxidation conditions, different pH conditions, et cetera, that will -- different structural conditions, speaking geologically, metamorphic, geochemical conditions that will exist at each site because the rock type will vary, but so will the geologic conditions. So that's really the larger thing.

DR. PETER LYONS: I appreciate that comment. One place where that was brought home to me was in going through the Grimsel site in Switzerland, where granite, okay, Sweden's using granite, but at the Grimsel site, I understand, they decided the granite was too fractured to be usable, and moved away from granite at that site, so that's certainly --

CHAIRMAN MACFARLANE: Right, so it's -- the rock type is not the answer. Okay. You brought up a number of other things -- let me just check with the borehole issue. Are you -- you are talking about a demonstration borehole?

DR. JOHN HERCZEG: Yes. At this point in time, we're looking at a demonstration. We're trying to lay down the groundwork for what the experiment would be like, and where it would take place. We're also talking to some international partners. There is one partner which I would prefer not to say here at this point in time, but I think working together as we discussed on other activities would be an extremely positive move forward on us. You are much more an expert on how far you can drill, I'm sure, than I am, but it seems to me that as brought up earlier by Dr. Lyons, that there are different types of spent fuels that we have, and we're doing a bidding study right now to look at them because, you know, your environmental comment is a very positive one in that sense because we have such a large variety of materials out there to put into a repository, it might be true that not all -- or not a single repository could fit all. And so maybe there is a mixture of different types of repositories for different types of materials.

DR. PETER LYONS: On the borehole work, our first target is to prepare a research plan for public comment. I, in fact, discussed that last week with the NWTRB when I was addressing them, and encouraged them to provide comment to the extent that there could be experts at the NRC that would want to comment. We would welcome that as well. But our first product will be a research plan for public comment.

CHAIRMAN MACFARLANE: No, I think a demonstration borehole, just speaking personally, is important, and not only that you can actually dig the thing, and drill the thing, and that it maintains the diameter required for the entire depth, but also that you can actually stuff something down it successfully without it getting stuck on the way, or whatever. So, yeah, I think that's very important, because we can do theoretical studies until the cows come home; it doesn't help us.

So are you also -- are you doing some transportation studies for, you know, that was one of the big recommendations that came out of the Blue Ribbon Commission report?

DR. PETER LYONS: Do you want to launch into that, John? There is transportation work going on within John's overall program.

DR. JOHN HERCZEG: Yes, there is. I indicated that in the Office of Used Fuel Disposition, there are two distinct offices, one that does research and one that does storage and transportation. That particular office was just established about six or eight months ago, but its main focus is to look at, what are all the issues associated with transporting fuel, particularly from shutdown sites? Examples of problems are, for example, shutdown sites may have had railroad tracks taking to that particular plant, but today, those tracks are gone, so how do you move it, right? What can you -- you know, do you truck it, do you barge it --

CHAIRMAN MACFARLANE: And even if the tracks exist, they're either too narrow, or windy, or --

DR. JOHN HERCZEG: Yes. So, yes, there is an office -- or I shouldn't say an office, it's called a project at this point in time, and it will expand significantly as we go forward in time. The first concentration point, I can turn this back over to Dr. Lyons, but the first concentration point is to look at what is going on at the stranded sites right now, the decommissioned sites.

CHAIRMAN MACFARLANE: Yeah.

DR. PETER LYONS: We've also worked to reestablish the partnerships with the various regional transportation groups to reinvigorate those with the understanding that they will be heavily involved as we hopefully have a green light from Congress to move ahead with the pilot, or eventually a full-scale consolidated facility.

CHAIRMAN MACFARLANE: Okay. And in terms of some of the work being done on SMRs, are you guys doing back-end research? So what -- okay, you run the SMR, and then what? And seeing how transportability is part of the definition, or your definition of a small modular reactor, have you looked at the transportability at the other end, and some of the issues associated with that?

MS. REBECCA SMITH-KEVERN: That's not part of the program as currently envisioned; however, we are open to doing research in areas that are requested of us by our partners, or that we see as necessary to forward deployment. But so far, that's not part of --

CHAIRMAN MACFARLANE: So no back-end research is part of the SMR?

MS. REBECCA SMITH-KEVERN: Not at this point.

CHAIRMAN MACFARLANE: Really?

DR. PETER LYONS: Well, in addition, though, the B&W system is using fuel that is quite close to standard LWR fuel.

CHAIRMAN MACFARLANE: Right, but they’re issues, you know, even on site. So sizing of the spent fuel pool, existence of dry casks on site, I mean, is any planning going into this, or not?

DR. PETER LYONS: Well, anything associated with the underground complex was all part of the overall proposal that was made, and stop me if I'm wrong, Rebecca, but I think any of the designs have at least 20 years capability in the spent fuel pool.

MS. REBECCA SMITH-KEVERN: Yes. Yes.

DR. PETER LYONS: The underground spent fuel pool. Everything is underground.

CHAIRMAN MACFARLANE: Right. No, I know.

MS. REBECCA SMITH-KEVERN: I didn't mean to say that just because we aren't doing any specific research, that nobody's looking at it. The vendors and the designers themselves are looking at some of these issues, but --

CHAIRMAN MACFARLANE: It's not part of your requirements to have them look into these issues?

MS. REBECCA SMITH-KEVERN: No. No.

DR. JOHN KELLY: I would add that on the advanced SMRs, you know, there's possibility of having advanced fuels; that work's being done in the fuel cycle program. Really long lived cores, these type of things, so that the overall electricity production per kilogram waste produced could be significantly higher that we have today, so -- but it's in a combination of programs that are looking at more advanced fuels, and then the materials that you would need for those advanced systems so that you can get to the longer lives.

CHAIRMAN MACFARLANE: Right, but then it's even more important to think about some of the back-end questions. I mean, if you're thinking some really high burn-up fuels, I mean, what are the implications of trying to store this stuff and then -- and then dispose of it? And then when you're dealing with novel fuels, same thing, you know, in spades, you know, one has to plan, otherwise we get stuck where we are now, right?

DR. PETER LYONS: Well, I certainly agree with you, but I think to the extent, at least, with the current -- the current work, we're building off, with B&W, we're building off the decades of light water experience; they're not using --

they're not pushing the fuel beyond any of the established burn-up -- not limits, but for burn-up experience, that we're already familiar with.

CHAIRMAN MACFARLANE: But I'm just thinking about some of the questions that even have come out of the Fukushima accident in terms of managing spent fuel pools, and, you know, you know, potential, We're going to be thinking about expedited transfer of spent fuel from the pools to casks, you know, and just wondering if you guys have been thinking about those issues?

DR. PETER LYONS: Oh, for example, one of the innovative areas that was noted was to assure that the spent fuel pool is thoroughly instrumented from the standpoint of a Fukushima-type concern. That is, I believe, one of the areas that's called out in the general area of innovative approaches to natural phenomenon.

CHAIRMAN MACFARLANE: Okay. Okay, thanks. Let me see if my colleagues have further questions. No? Okay, all right, well, this was really very productive. We really appreciate you guys coming down here and sharing all of this information with us. I think we all appreciate it very, very much, and I look forward to future collaborations with you. Thank you very much. We are now adjourned.

[Whereupon, the proceedings were concluded]