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U.S. NUCLEAR REGULATORY COMMISSION

BRIEFING ON SMALL MODULAR REACTORS

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TRANSCRIPT OF PROCEEDINGS

Public Meeting

Before the U.S. Nuclear Regulatory Commission:

Kristine L. Svinicki, Commissioner

George Apostolakis, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

APPEARANCES

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P R O C E E D I N G S

COMMISSIONER MAGWOOD: Good morning. For those of you who are confused, I am not Gregory Jaczko.

[laughter]

COMMISSIONER MAGWOOD: You're not convinced. We are here today to receive an update regarding activities associated with the development and licensing of small modular reactors. With many people in this agency still working hard to provide assistance to our friends in Japan as they continue to deal with events at the Fukushima Dai-ichi Nuclear Plant, it is clearly not business as usual at the NRC. Nevertheless, the usual business must proceed. In that vein, Chairman Jaczko has asked me to preside over today's meeting as he travels to Japan to convey directly to our Japanese colleagues a message of support and cooperation, and to assess the situation there. He's also meeting with NRC's team in Japan, to receive a briefing on their efforts to assist Japan in resolving this crisis, and express our appreciation for the team's hard work and dedication. He's asked me to pass along his regrets that he cannot attend today's Commission meeting.

During my time with DOE, we gave considerable thought to the potential benefits of small modular reactors. In concept, SMRs present the opportunity to manufacture nuclear reactors in a factory, rather than constructing them on site. This can entail both economic and safety benefits. These technologies enable us to consider very different models for both industrial deployment and regulatory approval -- models that could prove more efficient,

more reliable, and more predictable. However, despite these apparent benefits, bringing these concepts to reality has proven elusive over the decades. As we will hear today, the latest surge of interest in SMRs has garnered significant support from both industry and the federal government, and therefore deserves our full attention. But it also has prompted a series of very challenging questions, which the Commission must grapple with. We therefore look forward to hearing from our DOE colleagues, industry representatives and the staff about their plans and recent progress towards answering these questions. With that, I invite my colleagues to make any opening remarks. All right, very well. So we'll move on to the first witness, and it will be John Kelly from DOE. John, welcome.

JOHN KELLY: Four weeks ago, I was here talking about a different program. Certainly much has transpired in the last four weeks that has captured all of our attention, especially in the nuclear community. But today I would like to talk about our SMR program -- proposed program -- and express our continued strong support for continuing to endeavor along a program to deploy SMRs.

Over the last several years, the Department has conducted market research into the liability, feasibility, et cetera, of small modular reactors, and on this next slide I indicate some of the -- both the value proposition and the potential markets that have resulted from that study. We see SMRs as having enhanced safety and security attributes; the safety largely due to the lower power levels and the greater ability to rely on passive heat-removal systems. Certainly we expect them to come in at lower cost which makes them more affordable and more feasible for a large number of utilities. Shorter construction schedules are also a potential benefit due to modular construction. Factory fabrication also offers the capability to improve the quality of the product and replicate it in a

factory setting. And as electric demand increases incrementally, we expect the SMRs to be able to fill that market. The market space is great, both domestically and internationally. We see a large need over the next several decades to replace fossil-fuel plants, and these small reactors have an opportunity to either replace or repower as we retire those units.

Because of lower power levels, air cooling and reduced water usage are potential benefits, which increase the ability to site these reactors, especially in the Western United States, where we have arid climates. The small modular reactors could also be used in non-traditional, non-electrical situations, where processed heat is the primary output from such reactors. And if that were the case, then we'd be looking to co-locate these with industrial applications, and so all of these together are quite a large domestic market. And then there's the international market, where the electrical demands are probably smaller in certain countries, and we see the SMRs as a nice fit in those regions.

Let me address some of the things that we've discovered over the past several years. The first has to do with the capital cost of entry for a utility into the large nuclear power plant business. The barrier is high. Typical companies have revenues on the order of $13 billion -- perhaps $13 billion in outstanding debt, $40 billion in total assets, leaving something around $17 billion in market capitalization. With a cost estimate of 5 to $10 billion for a new unit, this is a significant part -- fraction of their market capitalization, and makes it a difficult decision. Moody's pointed out a couple years ago that a utility considering this may come down to a bet-the-farm kind of decision, and they strongly encourage that the utilities are consolidated, or at least partnered with

larger companies, to get enough market capitalization to lower the risk to the utility. Next slide, please.

We've also looked at the situation with coal fired plants in this country. This chart shows -- plots it basically by megawatts and by year put in service -- the coal capacity of the United States. What we see here by the red line is those units under 600 megawatts electric that were put in service before 1980. What we're looking at here, then, is, considering a 40 or 50 year lifetime for these plants. Over the next 20 years or so something on the order of 120 gigawatts of power will need to be replaced, either with new coal, natural gas, or, in our view, small nuclear reactors. And so we see this opportunity for coal replacement as one of the big drivers for the domestic market for SMRs in the U.S. Next slide.

So the other aspect has to do with the construction and fabrication of the units. On the slide here we show the construction activities underway in China for the AP-1000. And it's just meant to indicate the complexity of such an operation. I contrast that with what's envisioned for the small modular reactors, which have already been demonstrated, at least from the naval reactor program, to be able to be factory-fabricated, and then transported on truck to the location -- certainly a much simpler construction period. So the SMRs offer this contrast of simplicity versus the complexity of the large units.

And then in the next slide, we've also examined the data associated with learning; that is, the cost reduction as we build more units, and how the cost reduces over time. The Navy has extensive experience, as they instituted these types of practices: going to assembly line replication, trying to get to the "nth" of kind, et cetera. The data from that program indicated that

there's a factor of 8 reduction in the labor costs as the number of units increased, and we expect, and hope, that such reductions can be also achieved in the SMR program. Next slide, please.

So to date, the Department has had numerous design organizations come and talk to us about the SMR designs that they have. We basically have grouped these into two categories. One is near-term designs, which are based on light water reactor technologies, so they're basically using fuel that we're familiar with -- that is less than five percent uranium oxide fuel. There is a regulatory and operating base with light water reactors, and so for this class we expect to be able to deploy within a decade this type of technology -- this light water SMR technology. Next slide, please.

There's also been a number of other concepts that have been put forward. These are mostly non-light water reactor designs, and they use advanced fuels, advanced concepts, long-lived cores, et cetera -- many important advantages, but we see a significant amount of R&D being needed prior to their deployment. So we put these on a time-horizon in the 15 to 20 years out. These longer-term and more advanced designs, may allow the mission space, or the market space for SMRs to expand with time. And that's what we're interested in seeing so that we can get more nuclear power in the market, replacing both electricity and non-electric applications. Next slide.

So in this slide, and the next one, I outlined the elements of the program. I think it's very important to point out in the beginning, we're not talking about deploying a few, or even a handful, of SMRs; we need to be thinking of a fleet: hundreds or thousands of small modular reactors. The 150 gigawatts I

spoke about earlier, with plants averaging about 100 megawatts, implies a fleet, if we replaced all that, of about a 1,000 small reactors.

This program has a new start -- it actually hasn't started yet. It was proposed over a year ago in the President's budget, and we're still waiting on Congress to act on that. But it is structured to accelerate the deployment of the light water reactor technology first. And again, we're looking at trying to do those things necessary to get the first units online within a decade. And then, in addition to the accelerated deployment program, an R&D program to address the needs of the advanced concepts, as well as look at generic issues that affect all SMRs, and use our R&D program to help address that. Next slide, please.

So the SMR program is divided into these two main activities. One is the licensing technical support, which will support cost-share with industry, design certification and license activities. We've outlined a program of about 450 million over the next five years, and we're hopeful that we'll be able to have two designs -- help two designs get through that process of design certification, first of a kind engineering, and associated licensing activities. The R&D program is at 35 million a year, and hopefully we'll be able to sustain that. It's first to conduct the innovative research -- research on innovative concepts -- and to support licensing. The work here will be at the national labs and universities to advance the innovative technologies.

We're especially looking at the codes and standards -- national codes and standards that would need to be updated, augmented to support SMR technologies. And we are certainly very interested in continuing to collaborate with NRC on the SMR licensing framework to support SMR commercialization. I should point out than in the NGNP, we laid the pioneering efforts to begin this

collaboration on licensing framework. The Department fully contends to continue the work on NGNP, especially in the regulatory framework effort, and we sincerely hope that the Commission will continue to provide the support necessary to establish the regulatory framework for innovative concepts such as NGNP and the SMR program that we're outlining. Next slide, please.

So what I've talked about to date has been the technology push -- what the Department is doing to develop and push the technology. I should also add that we're also looking at the pull side -- the market side. And we've already done surveys of the electricity needs at our plants -- sorry, at our sites -- as well as at some of the DOE sites, and many of these look very attractive for us in our deployment. So what's shown here is a business case for the Oak Ridge, and I think my colleague, Jack Bailey, will probably speak more to this so I won't, but the department is actively looking at these opportunities where we bring the power purchase agreement -- that is, our instruments to purchase electricity as a means to accelerate deployment. And the final slide.

So in our view, small reactors fit very well with the President's view of innovation and competitiveness. These are very innovative designs that can help domestic economy as well as create jobs. And so it is a challenge -- the environmental challenge that we have ahead of us is still there, and SMRs, we believe, can play an important role in meeting that challenge. Thank you very much.

COMMISSIONER MAGWOOD: Thank you, John. Mr. Walters?

DOUG WALTERS: Thank you, Mr. Chairman. Good morning. Commissioners, thank you for the opportunity to be here today to talk about what NEI and the industry are doing to license and deploy small modular reactors. In

May of 2002, the Commission was briefed on new reactor licensing activities, and at the time, Commissioner Dicus served as Chair over that briefing. And in her opening remarks, she said, “This is an area in which the amount of activity has been rapidly increasing. A few years ago the suggestion that new nuclear plants might be built in the near future would likely have been scoffed at. However, the influence of a number of political, economic, and technical factors have served to make the nuclear option attractive again. The industry, with the support of the Department of Energy, is vigorously pursuing technical, financial, and regulatory issues associated with new reactor designs, and the NRC has followed suit.”

And I thought that kind of describes, maybe, where we are today, in part, with small modular reactors. Clearly, they have captured the interest of the public, members of Congress, energy companies, and other entities. Next slide, please.

And John talked about this in his remarks, but there’s a number of reasons we believe SMRs are attractive. First, it provides an option to non-nuclear operating companies to have clean, safe, reliable generation at a lower cost and less financial risk. Small modular reactors have a variety of applications. Certainly we talk about them in the context of producing electricity, but as John mentioned, they could be used for industrial applications, such as processing heat for chemical plants, refineries, desalinization plants, and others.

Also, there is a sense that some fossil units will be retired in the coming years. You can look at a number of studies. For example, the Energy Information Administration issued its annual outlook for 2011, and they assume 8 gigawatts of coal will retire by 2035, regardless of other circumstances or policy.

The Brattle Group has looked at the EPA regulations, and in a study they issued in late 2010, they presume that there will be 50,000 megawatts of coal retirements. Now that depends on the retrofits; that could be greater if those retrofits include cooling towers. So regardless of which study you look at, I think it's clear that we will see retirement of fossil units, and small modular reactors are ideally suited to replace those units. Next slide.

As licensing any new technology of course is not without its challenges, I think, from our perspective, a stable and predictable regulatory process is always desirable. I think for small modular reactors it's critical. In a minute, I'm going to talk about some of the generic issues that we're looking at, but one of the challenges is: can we address enough generic issues to get that stable, predictable, and efficient regulatory process that we need?

Also, it's clear that you could license small modular reactors under the existing framework. The challenge is: How do you demonstrate compliance with the acknowledgement that small reactors are just that -- they're smaller in size, they have a lower power density, they have a lower probability of severe accidents, and they have a smaller off-site dose consequence. So we're looking at how we can meet the current regulations, but recognize that there is a need to be commensurate with the design of the units.

With that backdrop, on the next slide I just go through our activities, which for this presentation are focused primarily on the regulatory efforts. We have other activities within NEI looking at working with DOE, and with Congress on budgetary issues. But our goal is to achieve an efficiency of staff -- resources, excuse me -- and to maximize those resources through development of generic industry-position papers. And we've been doing that, and working with

the NRC staff, and I compliment them for their willingness to work with us to review those documents.

We use our typical NEI governance, which is working groups and task forces. We have an SMR licensing task force. We have six vendors, six utilities; we have INL on that group, EPRI and Oglethorp. They develop the consensus positions on a range of issues, and then they submit those to the NRC for interaction, and as I mentioned, we've been meeting regularly with the NRC staff, and that's been very beneficial. We recognize, however, that as we now move forward with these licensing issues; there are going to be policy issues. And in that regard, we have developed a working group that Jack Bailey chairs for us, and again, the makeup is about six vendors, six utilities, we have others, including Mid-America at the executive level to deal with the policy issues that we anticipate will come out of this work.

If we go to the next slide, this is a list of the issues that we've got on our plate. It's consistent with the list you should have seen in the SECY-10-0034. On the left-hand side are the papers that have been developed and submitted to the NRC for review. On the right-hand side, in no particular order, are the remaining papers that we expect to complete and submit this year. Obviously, the right-hand column are those issues that are a little more challenging and require a little more work, but we do intend to deal with those issues and get those papers into the NRC for discussion.

So let me close with the obvious that small modular reactors, we believe, clearly have a role in the nation's energy portfolio. I think they're an important element, or will be a potentially important element, to an individual company's energy mix, or generation mix. But key to this, at least in our view, is

having a stable and predictable regulatory process. And I think, through the coordination we have with the industry, through our working group and task force, and the interactions that we have with the NRC staff, we'll be successful in achieving that goal. Thank you very much.

COMMISSIONER MAGWOOD: Thank you, Mr. Walters. Jack.

JACK BAILEY: Thank you. It's a pleasure to be able to speak to you this morning. I thought I'd start off with my first slide giving you a perspective on the utilities' desire to achieve a balanced portfolio that gives us cleaner low-cost power, because ultimately, how nuclear fits into anybody's decision, whether small or large, is dependent on the overall business environment, and other needs that it has to meet.

TVA spent a considerable amount of time over the last couple years doing a detailed integrated resource plan that involved the public and many stakeholders. And in that process we got almost as many views as there are opinions about how to supply our future energy supply, and after all of that, running multiple cases and scenarios and portfolios, we came down to a nice fact, which was that nuclear was part of most of those portfolios, and it was necessary in order to achieve our overall vision of trying to have a cleaner low-cost power, certainly, in the future; and our goal is by 2020.

I guess my contention would be that every utility wants the same desire: to have a cleaner, low-cost portfolio; I don't think that's unique to TVA. I believe they all also want to look at all the alternatives in that portfolio. At the same time, what we're seeing is most utilities are migrating to natural gas for their energy supply right now. But they will say, when they tell you that that that's the bridge to a future portfolio that is more balanced. And when they talk about

that future portfolio, they're still saying that nuclear is a part of that. So, go to the next slide.

So, really, I guess what I would say is that we're trying to build that future portfolio starting today. Others may start a little bit later than TVA, but as we move forward to try to solve this problem of cleaner air, nuclear will be a part of that portfolio, in our view. And even though we will have a mix, as shown on this slide, of increasing gas, decreasing coal, increasing renewables and energy efficiency; nuclear we see is also increasing in terms of its need and capacity within the nation's energy mix. Next slide.

So that brings us to the topic today, which is: How do we meet that nuclear need as we go forward? Given that we need to expand our generation, we need to have options for that, and we think both large and small reactors provide options, and that's a good thing for the country. We became interested in light water small modular reactors for a number of reasons. Most of them have been mentioned either by DOE or NEI up until now. I listed several on this and I tried to supplement or amplify some additional ones that they may not have mentioned as much. I think the -- I won't talk about them individually; I'll talk about them as a group. The first one, I think, is important for three reasons; and it says it all in the statement. They are simplified, which means we ought to be able to build them and maintain them with less equipment, less complexity. That's at least one of our goals. They are advanced passive safety systems, which is going to certainly have a benefit in today's environment, as we move forward. And they're light water reactors, and that means it's an existing technology that we know a lot about. We're not trying to introduce something brand new that we can't do. For those reasons it was very important to us, and

it's very important to the utilities, to begin with these LWR small modular reactors. And in that regard, I'd say the NRC staff and the Commission got it right when they started two years ago and prioritized the technologies that way, given the proliferation of the small modular reactor designs that were being talked about. And they said, "Look, if we're going to do this, we're going to focus on light water reactors first." And that is the right thing to do.

We certainly list some other benefits that deal with the attractive design features, and I think Chris Mowry is going to talk in detail about some of the ones that his design provides. But we also think there's other benefits, and there's some examples here that talk about how to improve quality of construction, which is in the fabrication in a shop environment, that can be replicated, and improvements in the construction schedule overall, which some of those features also allow us to achieve. Next slide, please.

Clearly, there's a lot of potential challenges that are out there and some of the issues we've identified on the NEI list of regulatory areas we want to improve upon are only a sampling. There's certainly a lot of issues on the construction side, or the operating side, that we're going to be dealing with as an industry going forward that don't require the Commission involvement.

We do, again, thank the NRC staff for early on moving out with their work with the Commission identifying the issues that we thought needed regulatory improvement, or fine-tuning is may be a better way; not all of them require new rules, they may require new interpretations of how to apply the rules for these small modular reactors. We do -- when we look at -- I won't go through all of those. Like I said, they deal with both regulatory changes and industry changes on how we manage and operate our facilities.

We are looking at, though -- one of the goals we have is to be able to license a bunch of these once, though, and be able to build them when needed. That's the idea of incrementally adding the power when needed on the grid. And so that may present challenges as we go forward. We haven't gone far enough down the path to know whether it will or won't. But, for example, trying to license six of them at one time, but then waiting a decade before you implement some of the licenses to start construction may present some unique challenges that we haven't thought through from a regulatory point of view. We were thinking about that even on the COLAs that were going to be issued, or the COLs, for the AP-1000, for a while on whether that would present a challenge in terms of how we implement the regulations going forward, I think we'll have some similar questions and issues come up for the small modular reactors.

We also believe, though, that there will be some changes, probably on the inspection branch side more than design and safety review, on how do we get maximum credit for, but make sure we do things properly in a factory environment where more things are being built and constructed. It's not new stuff, but it's a lot more than what we've done in the past, and we may want to be able to take credit for preliminary testing or design features that are demonstrated before they get to the site as part of that process, too, although we don't expect to do a lot of that. Next slide, please.

Well, in this process, the good news is we've learned a lot from advanced reactors already, and we are committed -- at least TVA is -- on the efforts we're initiating with the teams that we've been working with to standardization of this process, along with how we try to standardize other processes. The designs themselves we're going to want to maintain them the

same as we move forward to achieve the benefits of that. For smaller reactors, it's even more important to make sure you maximize those benefits. We are going to be using design-centered working groups in our approach. As we'll talk about in a moment, we're looking at the One Issue One review. We would do that under a Part 50 or a Part 52 license approach. And we are certainly going to deal with design-specific issues through that design-centered working group, but we'll elevate up through NEI generic issues that may apply to multiple designs in the process, so that we can deal with those effectively and in a central way that gets the focus so everybody can get the results and do what they need to appropriately.

And finally, the industry teams that we're forming are there to not only support the licensing process, but to try to support the construction and build-an-actual-plant process, and keep it standardized to the extent we can, and use lessons learned, and look at ways to make it more efficient in the process. Next slide, please.

All right, so TVA has already been out in the public saying that we plan to implement a Part 50 process if we move forward with our first plant. And again, the good news is the staff and the Commission have been very clear that both processes are certainly allowed under regulations, and there's been a lot of support by the -- what we have, I guess, put forward out in terms of what we would like to see happen. We do recognize that there are benefits and risks in any approach you take. The risk has always been, for why would we move to a Part 52 process, is we didn't want to take all that licensing risk that was at the end of the process. We believe with small modular reactors that are simple, that are based on known technology, those risks are smaller than they would be for a

large new design technology. And we do believe that there is more flexibility in doing a first-of-a-kind approach through a Part 50 process, because you can make changes as you're continuing to evolve your design through the design phase, up to a point in that process before you have to lock down for the final operating license decision. So we plan to implement that as Part 50, but we also recognize the benefit of Part 52 for a standard plant design for multiple customers, going to the future.

So our main message on this slide, at the last bullet, is that there clearly is going to be a preference for the Part 52 process for licensing multiple units at multiple sites long-term, but we do think first-of-a-kind has benefits by using a Part 50 process. So go to the next slide, please. So we've actually thought through this and tried to lay out how our first project that we're trying to develop at our Clinch River site, as DOE showed on their slide, is trying to be planned and executed.

On the top part of this is the 10 CFR Part 50 process, where we would prepare a construction permit and submit it. We can get a preliminary safety analysis report reviewed, and then get some good feedback from the NRC on the basic design and issues associated with the plant. Once we get a safety evaluation report on that design, we would submit a design certification application for the design, and then they would go through the Part 52 process at that point. May actually take the lead on reviewing technical issues under the Part 52 process, and then we would take advantage of that under a One Issue One Review approach, once our operating license was submitted under 10 CFR Part 50. So this is high-level, it lays it out, the overall schedule -- the point is that we have informed the NRC that we do plan to submit that construction permit

application in fiscal year 2012, at the end -- that's our target -- and to have a plant actually built and operating by 2020. So this is not something that's a research project at this point. It's a real project that we're developing and moving forward with. And the last slide. So, there have been many articulated reasons on why SMRs are good, and they are potential benefits -- we're trying to realize those. Clearly, we have to do everything we can right now to deal with the regulatory certainty, and processes associated with that, as well as the economics of making a small modular reactor actually work. And both of those are the focus of what we're doing over the next couple of years at TVA, working with the vendor. We certainly appreciate the staff and the Commission's support with the activities so far. The organization of your staff into units that focus on SMRs is a big plus as we move forward, and the openness and responsiveness on them wanting to deal with these issues is also seen as very favorable by the industry. So thank you very much.

COMMISSIONER MAGWOOD: Thank you. Mr. Mowry?

CHRISTOPHER MOWRY: Thank you. Good morning. It seems my fellow panelists have said almost everything there is to say about the benefits of SMRs. So if you go the first slide here, I'm going to focus my remarks first of all on the robustness of the design of mPower, talk a little bit about the progress we've made in the development program, and then say a few words about our views on continued industry support for the technology. Next slide.

As you know, mPower is a 425 megawatt thermal small reactor. And just as a matter of review, the size of the reactor has been defined in order to accommodate the complete factory manufacture and testing of the design. We think that this is a critical feature -- something that's been mentioned here

previously on the panel. The other features, of course, of the small reactor, is that it has a small core with only 69 fuel assemblies, and therefore a small source term. But the primary feature of our SMR, of mPower, is really that it's an integral NSSS system, with no large primary system penetrations. And this single feature is what drives the cost and the simplification in the nuclear island, but also drives robustness in the overall design and safety performance of the system. And of course, by an integral NSSS, we mean that the steam generator, the reactor coolant pumps, the control rod drive mechanisms, and the pressurizers -- all distributed components in a typical large reactor -- are integral in one pressure vessel. So with this design, it provides this inherently robust safety performance, because first of all, there's no penetrations below the height of the core, there's a very large reactor coolant inventory compared to the power because of the geometry of our design, and this drives a scenario where you have no core uncovery during a design-basis accident, which is obviously a very beneficial feature. We've chosen to maintain standard PWR fuel because of the solid experience base, and also are keeping the design within the five percent enrichment of a standard 17 by 17 fuel assembly.

One notable feature of our design is that the service environment of the fuel is significantly less severe than you typically find, both in terms of flow-induced vibration, because of the core flow rate is about half of what's typical for a PWR -- power density is about half of a PWR, and of course you have lower temperatures. This, of course, drives increased margins for plant operations in off-normal conditions.

And finally, we've tried to simplify the reactor cycle by driving a four-year interval between refueling, and notably we've taken Boron out of the

reactor coolant system for normal reactivity control, and this is another simplification effort -- it takes that whole system out of the nuclear island. So, go to the next slide.

Let me transition over to a few comments on the containment of the nuclear island. The key feature for us on the containment is that it is fully embedded underground. And in fact, the entire reactor building is underground except for the top floor, which contains no safety systems. All the water systems that are required for normal operation and accident response -- refueling water storage tank and the ultimate heat sink -- are contained within the reactor building underground, and therefore protected from external events. In addition, the underground containment in reactor building provided very favorable seismic response attenuation, and also dissipation of energy into the soil. The spent fuel pool is also located underground in an auxiliary containment, and it has a very large water volume compared to the amount of the spent fuel that would be stored there. Of course, this helps in extended station blackout response.

The overall architecture of our design is driven by an inherently safe system that utilizes passive gravity-powered ECCS. The containment is dry and we're focused on trying to either minimize or eliminate entirely the debris entrainment issue by the way we're designing the systems.

Another important point here, especially when you look at our baseline twin pack for the plant layout is that each of the safety-systems is dedicated to an individual reactor. There's no shared safety-systems between the two reactors. And again, the overall containment and nuclear island layout is also focused on improving severe accident response, passive filtering, and we

have passive hydrogen recombiners, and we're also looking at some other features.

Taken together, these features of our design are really focused on driving toward a 10^{-8} core damage frequency. That's the goal of the program. Next slide.

If I step back and look at the overall plant layout. This is an image of our standard, 250 megawatt twin pack. That's what you would get with an air cooled condenser field. If you go to direct water cooling, it would probably be closer to 300 megawatts. The key feature here is that we are driving toward a security-informed plant layout; the key feature is an isolated reactor building with all the non-safety related structures, including the turbine island removed and outside the protected area. And in fact, in our design, there's about 150 yards separation between the reactor building and the turbine island. And this greatly simplifies the overall security requirements for the plant, and this is something we're really focused on in the future.

From another design feature perspective, the digital, the I&C system is going to be digital. And right now we're in the final process of defining what the defense-in-depth architecture will look like, whether that's analog or digital has not yet been established.

From a construction perspective, the goal is to complete something in the neighborhood of 30 to 36 months, and that is enabled by the basic concept of doing parallel manufacture of the NSSS system, while the civil structural work is going on in the field. And, at the very end of the process, you're shipping the integrated NSSS system to the construction site, and installing it at the end of the

process, rather than at the beginning of the process. And that's a fundamental change from the way construction is done with large reactors. Next slide.

A few comments on our progress. We are well down the path of design, and we're in prototyping and testing various components, including control rod drive mechanisms. You see a picture here of our full height scale, full scale height integrated test facility that's located in the State of Virginia. That's going to be completed here later this spring, and we're going to begin testing over the summer. And this thing really forms the core of a $100 million test program that we've committed to, to evaluate all normal and off-normal performance features of our design. Next slide.

With more than 300 engineers and designers working on mPower, we've made good progress. And that has enabled us to accelerate the overall process of pre-application licensing. In 2010, we were able to deliver eight licensing topical reports and other submittals, and we're on track to submit at least 12 of those in 2011. So, continued NRC staff support is going to be essential for us to maintain the overall schedule for our lead plant deployment. Next slide.

I just want to say a few words here about our initial assessment of the Fukushima event. But really, it's a broader view, and a couple of points about our overall philosophy of safety on SMRs. The basic goal of mPower, from a safety-system performance perspective, is not to have a cliff, in terms of the safety performance. The goal is to have a multi-layered defense that is very robust against all major threats and events that could be postulated here, both design basis, and beyond design basis.

So, a few comments in particular. As I mentioned earlier, with regard to earthquakes, the design of mPower, with its deeply embedded reactor building containment, really helps with the seismic response, and the attenuation and dissipation of energy makes it a very robust, inherently robust design from an earthquake perspective.

Regarding loss of offsite power, of course, we have a passively safe design that does not require AC power for any design basis safety functions. But in addition to that, we have in our design two back-up diesel generators that can provide the grid-independent AC power capability.

Regarding station blackout, the basic design is 72 hour safety-related batteries that support all accident mitigation. But, again, keeping in line with the philosophy of defense-in-depth, we have, behind that, two auxiliary power units that are going to be located in the reactor building, protected; and they are capable of recharging the safety-related batteries, and also providing DC power post-72 hours, to provide the necessary control power and monitoring. And then, behind that, we have long-duration station keeping battery that will provide monitoring capability, remote monitoring capability, and limited control capability to the safe shutdown panel.

So you can see here, the philosophy is to have a multi-layered capability to deal with station blackout for an extended period of time. That is coupled with the overall emergency core cooling design that we have. I mentioned earlier, the natural circulation process for ECCS, without the requirement for pumps. And that, coupled with the low power density in the small core, together with a very small break size, maximum break size in the

reactor vessel, compared to the reactor inventory, give a very robust performance from an ECCS perspective.

Regarding the containment, and containment integrity, and ultimate heat sink, I mentioned earlier the passive hydrogen recombiners. The other point here to look at again is that the ultimate heat sink for mPower is located inside our reactor building, underground, in a shielded location. And it has an extended performance window of up to 14 days without the need for external intervention or make-up. So that gives a nice long window to respond to external threat events.

And then, as I mentioned earlier, the spent fuel pool. And, just as a point of reference, after 40 years following a full core offload, you'd be able to survive more than 30 days without the need for make-up in the pool, given the size of that.

So the goal here, again, is to have a multi-layered defense with no cliff in the design basis, to mitigate the extreme beyond-design basis challenges. Next slide.

Just close with this slide. And we reached out to our consortium members last week. And there's some quotes here that indicate very strong continued support for the benefits that we're trying to achieve with our SMR design. Thank you.

COMMISSIONER MAGWOOD: Thank you. Thank all of you for your statements today. Commissioner Ostendorff?

COMMISSIONER OSTENDORFF: Thank you, Commissioner, Commissioner Magwood. And I also thank you all for being here; this presentation's really very helpful. I wanted to start out with, maybe, just a

somewhat of a high-level question, and give each of you a chance to respond to. Let me set the stage for that. Jack, you, in your presentation, talked about the economy as a scale of SMRs, compared to the existing nuclear reactors in this country. And we recognize there's all types of business market-based decisions, as far as grid demands, alternative sources of capacity, natural gas or others, et cetera.

I wanted to, maybe, put the market side piece over, park it to the side for a moment, and to talk, maybe, just a little bit about the NRC regulatory aspects. And ask a question, and I'll start with John, and maybe go down the line here, to maybe address your perspective, DOE or industry, but for each of you, what you see as the biggest hurdles, or the biggest uncertainties, at this point in time, as far as any regulatory framework issues for the licensing of SMRs.

JOHN KELLY: So, from our perspective, the economic issues are two things. One is the capital cost, which we are addressing by smaller size. But the other is the operating cost, which are largely driven by the regulatory requirements. This has to do with staffing, emergency evacuation zone planning, and a whole host of other things related to that. We need, I believe, to be looking at risk-informing the requirements, so that as we move forward we can balance the risk that the plants pose with the appropriate response and resources in terms of human capital and systems so that we can have operating costs that are manageable at the plants.

So what we see is that the regulatory framework structure requirements are going to directly influence the operating cost, which will be a large determinant into the economic feasibility of these plants.

COMMISSIONER OSTENDORFF: Doug?

DOUG WALTERS: Thank you, Commissioner. Yeah, and to just add to what John said, I think, at least from our perspective, if you look at our list, what was on the right hand side are probably the issues that we need to resolve in a way that's commensurate with the design of a plant. Security is one that continually comes up.

I don't think that it would be viable for a small reactor to have to implement security the way we implement it today at the 104 operating plants. It's not feasible for them to have whatever number of officers we have, if it's 100, 150; that's just not feasible. So alternatively, and I think as Chris mentioned, we can look at what would be, perhaps, an alternative way of meeting some aspects of that regulation through design. That would certainly minimize or reduce the O&M costs that the plant will have.

Emergency preparedness is another one. Smaller source term. We're looking at, in our paper, two options: one, what you do inside the existing EPZ, and what you could do to reduce the EPZ. So I think those are two areas that have potentially high impact, in terms of O&M as we go forward, that we need to work with the staff to come up with a way to meet those regulations, but with an alternative means of doing so.

COMMISSIONER OSTENDORFF: Let me just -- if I can just put a fine point --

DOUG WALTERS: Sure.

COMMISSIONER OSTENDORFF: -- on a comment you made on the O&M cost. From the industry perspective, is it fairly clear, or are there big uncertainty bands around the operating costs of an SMR, compared to alternative sources of electrical capacity, such as natural gas? And do you feel

like -- is there a range or band of operating cost on an annual basis, for a given megawatt SMR facility, that you feel pretty comfortable looking at from the industry perspective, to make a decision on whether an SMR makes more sense, or does natural gas or coal make more sense?

DOUG WALTERS: We have not, at least in our work on the licensing activities, looked at that. I think, maybe Jack and Chris can probably give you a better answer to that. But we are aware that that's a critical component of the business model. And that's why we're working with the staff to understand what compliance means with the existing regulations, and how we can do that in a way that considers, you know, what the O&M costs would be. Now, certainly, we would get that input from our utility members in those groups, but I think they may be in a better position to answer that question than me.

COMMISSIONER OSTENDORFF: Jack?

JACK BAILEY: Thanks. I'll start with your first question first. They did highlight most of the issues from a regulatory perspective that we're trying to focus on. There are some obvious ones, though, that aren't hard, that people don't often mention that still have to be done. For example, the fees charge on small reactors per unit, the NRC fees, is an issue, but it looks like it'd be an easy issue right now, so people aren't worried about it, it still needs to be processed all the way through to closure, through rulemaking, I believe, in that case, or at least your annual budget rulemaking.

On the cost issue, it's never about just operating cost, or just fuel cost, or just construction cost; it's about all those things together. When we do our evaluations of alternatives, we look at the total, all-in cost of everything over

a long period of time, or short period of time, depending on what you have to survive with.

So we have to, one, manage their capital construction cost within a range that we think is competitive with a larger reactor, when you take into account the length of construction, the length of borrowing money, and all the things that go along with that. But then you have to -- you know you're going to get the advantage of fuel either way because it's the same fuel cost as the larger reactor, or essentially the same, and that's going to be stable, not volatile. So those have benefits even beyond just the cost numbers. And then the operating cost on top of that. I'm sure we can tolerate a cost that's higher than what it is for existing larger reactors and still make these viable alternatives for most utilities, including us. But I don't think there's a magic number. I think you have to look at all those things together.

COMMISSIONER OSTENDORFF: Thank you. Chris?

CHRISTOFER MOWRY: Yeah. I guess I would just echo the comment made earlier regarding security. You know, we have looked at the entire levelized cost of electricity target that you need to achieve with mPower, and we do believe we have a path forward on the construction, the capital cost side of things. Of course, that needs to be finished up.

But the main challenge, in our view, is, and the thing that really drives the operation maintenance cost into the zone that it needs to be in, is security. And that's why I mentioned that our overall plant architecture, plant layout, is what we call a security-informed, or an inherently secure design. Because the current method of -- I'll just call it a brute force method of securing the plant, with hundreds of guards, as it was mentioned earlier, just doesn't work;

it's a non-starter. And so we need to have a requirements-based approach that uses technology and the basic architecture of an underground isolated reactor building with all the safety-systems in it to create a situation where we can secure the facility with an appropriate staffing level that meets the overall O&M requirement.

I think we've had some good interaction with the staff so far, I believe there's been two meetings. And, so we feel good about the path we're on, but this hasn't finished. And in my view, at the end of the day, this is the thing that's going to make or break the large -- you know, whether SMRs get deployed in large numbers or not is going to come down to O&M. And the biggest variable that we can attack directly, the single biggest one, is the security issue.

COMMISSIONER OSTENDORFF: Thank you. I'm going to shift to a different topic here. John, you mentioned in your slides a very helpful example, I think, for many of us, dealing with the Navy industrially-based experience. The learning curves associated with that, and I can recall over about a 25 year period, the Navy built between 55 and 60 Los Angeles Class nuclear attack submarines, and Electric Boat shipyard, Newport News shipyard, were beehives of activity at times in the late 70s, early 80s, building a lot of the SSNs. So that was a very helpful data point you provided.

So I want to, kind of, now turn to Chris. B&W's had a long experience working on that Navy side, with the Naval Reactors Program. And could you share with us, just, you know, briefly, any of the key lessons learned that you would hope to leverage from your Navy experience, doing the naval reactors work?

CHRISTOFER MOWRY: I don't think there's a huge amount, beyond the high level comment that you made, you know, there's not a lot of, there's really no relationship, on the technology side, to that. But I would say, I would echo the comment that for this thing to reach its long term goal, from an economic perspective, we do need to get into a scenario where you're building more than one reactor every two or three years.

Because the core precept here is that, not only the NSSS system, but quite a few of the other systems can be fully built in factories just because the overall plant, the reactor plant, is about an eighth the size of the typical gigawatt class reactor. And so that basic reality enables you to modularize conceptually in a way that's just not feasible with big plants. So you're really trying to shift most of the construction into a manufacturing environment, and of course, the value of that is when you get into an assembly line situation, where you have a reasonable volume going through there. That's when you get a cognitive of scale, good learning with your workforce, and all these “nth” of a kind benefits that you alluded to.

COMMISSIONER OSTENDORFF: Thank you. Thank you, Commissioner Magwood.

COMMISSIONER MAGWOOD: Thank you. Commissioner Svinicki?

COMMISSIONER SVINICKI: Thank you all for being here today. NRC conducted earlier this month, although it seems like a hundred years ago now, its Regulatory Information Conference, and I'm told that the session on small modular reactors was perhaps the most heavily attended, it was beyond standing room only, and that we had to, I believe, turn participants away,

because it just was simply not possible to accommodate everyone. So the interest that some of you spoke of in this topic is clearly -- was even demonstrated at our information conference, which is our largest event of the year.

So it certainly -- it's good that the Commission is meeting today to once again hear the status of some of the paths that the staff put in place with DOE and others a few years ago, and hearing about what progress we're making on underlying issues, policy issues, issue resolution; so I appreciate the work that all of you are putting in on that.

Dr. Kelly, I might turn to you first. And I have some questions here that arose out of your presentations, but if anyone would like to comment -- if I've taken good notes, I'll direct them to the individual that made the comment, but if any of you have a comment to make, please just chime in.

Dr. Kelly, one of the areas that you talked about was codes and standards. And I have some interest in this. I think I visited at least a couple of DOE labs where work is going on on building code cases and things for advanced materials that might be used. But my familiarity with this process is that it can take years, if I have this right, to do one code case, or get it all the way through the system. What assessment would you give, generally, of where we are, kind of, as an entire community: industry, DOE labs, NRC, in terms of development of codes and standards? Are we kind of behind where we would optimally be, or are we making good progress there?

JOHN KELLY: Well I think the development of codes and standards is a consensus process, so that in itself dictates long periods of time to come to that consensus. From the DOE perspective, we have focused on, in

some sense, high temperature materials and other things, where we need to extend their range of applicability to what we see in our advanced reactor program. So that's work that we're doing within the labs.

But through the Department of Commerce, the NRC, DOE, there is a nuclear energy codes and standards organization that's trying to oversee what the ASME, IEEE, and ANS are doing in this area. And are soliciting, and then funding proposals with contributions from each of the agencies into that.

I think the process will be slow, but I think what we're doing now is trying to prioritize what we think the most important codes and standards are. In a different program, we are looking at the ANS 54.1, 53.1, which are general design criteria, which we see are a very important front-runner for both the NGNP high temperature gas reactor technology and liquid metal reactor technology. Those are moving forward, and I think, once we get those things in place, we can broaden that to the other areas that would need to be adjusted or developed for advanced reactor technology.

COMMISSIONER SVINICKI: Thank you. I raised it, of course, because, and I'm sure Mr. Mowry is very familiar with this, but, you know, there's an interest in innovating, but that if your developer has to be balanced against the familiarity of the regulators. So there's that balance that needs to be struck. And I think, if innovative materials are going to be used, or innovative approaches, these underlying codes and standards are an essential component of willingness to innovate, or whether or not there's a good benefit in innovating, if you have to balance that against the regulatory or licensing risk. So I know it seems like a down-in-the-weeds topic, but I think it's actually, you know, at heart it's really essential to our ability to bring forward innovative approaches.

Mr. Walters, I might ask you, even though I'm sure everyone sitting there would have an opinion on this. We talk a lot about the policy issues. We have a list of policy issues, I think your presentation had, some of them on one side, had check marks, and I don't think that means fully resolved, I think it means, you know, under development, and the other side is, maybe there's more work to be done. But what's your general assessment of whether or not we're prioritizing those policy issues, or the order in which we tackle those policy issues? Do you think, generally, we're prioritizing them correctly?

DOUG WALTERS: Yes, Commissioner, I do. We read thoroughly the SECY paper. We reviewed the list that the staff had put together with our task force, the end users, if you will. And I think generally we're in agreement. But I think that, perhaps, as we move forward, and we develop the papers, those priorities will change. And we're constantly monitoring that ourselves. I think the staff has shown acceptance to modifying the priorities if it's warranted.

But I think that, in general, we have the right priority. I do think an example, though, would be security. I mean, we've heard from our membership that that's a critical issue. We agree with that. I don't remember, in the SECY paper, what the schedule is that the staff has outlined to provide you something in that area. But that may be one where, as we assess the paper, and what we need, we would come back to the staff, and maybe ask to accelerate that one.

COMMISSIONER SVINICKI: Okay. And I want to use that as a platform for another comment I would make, is that I think there are a lot of moving parts here. I don't know what assessment my colleagues on this side of the table would make, but as I looked at the SECY paper, and a lot of the other underlying documents, I think that we're trying, on a regulatory side, to push

forward on a lot of things. I did not have a clear sense, in looking at all of it, of what is being produced when, and when the Commission might need to act. And so, this is my own personal assessment, just in preparing for this meeting, and now hearing these answers.

You're mentioning a very practical point, which is, as we explore issues, we might move them up and down in priority. You're also, I think, indicating that the staff is being agile in that regard and I appreciate that. I think that we need to be. But I want to key off another statement, Doug, that I think you made in answering another question. And it was on the topic of security. You said: “meeting regulation through design.” And it's a curious phraseology to me, because, when I think about it, if the regulations are truly performance-based, if you simply meet the regulation through your design, I don't know that the regulatory framework itself has to be changed. The compliance is done another way. And if the regulation is written to just have you demonstrate a certain performance, you could do that through design. But I'm also a practical person, so I have a feeling that, when we look at the regulations themselves, there probably are some complications to truly complying through your design. And just, perhaps, that isn't the framework or the prism through which we develop the regulations. And so, as a practical matter, maybe we can't do that.

But something that -- codes and standards take a long time. So does rulemaking. And so, if there is kind of a body of issues that, at the end of the day, the NRC staff is going to find it necessary to have some sort of provisional regulation, or have, maybe, a regulation as it exists now, for large light-water reactors, but have provisions to be invoked for small modular, that will take some time to put in place.

As an agency, we're continually asked by the Congress about our state of readiness to begin to seriously review and license small modular reactors. And I think if we're getting to a point where we know that there might be a body of rulemaking, and that we need to be thinking about that in our agency planning. So, I think that's, at the heart of some of what I'm asking about policy issues, is that, ultimately, that might ripen into rulemaking that we need to do, that takes time, as a practical matter. So that's something I think I'll also explore with the staff panel.

I also, Mr. Bailey, wanted to touch on something that you had talked about, because I'm interested in this issue as well. You talked about taking credit -- well these are my words now, for factory acceptance or other testing because of this manufacturing nature of small modular reactors now. In another meeting the Commission might hold on new reactors, we hear a lot about our ITAAC and other acceptance things that, as the regulator, we're going to have to go through.

So I would ask you, Mr. Bailey, what's your sense of the exploration with the NRC staff, of this issue of how might you structure this, given this, you know, offsite manufacturing of small modular reactors? If I am the constructor or the person who's going to operate a small modular reactor, I might do factory acceptance testing, and how do I get the regulator to be a part of that process? Is that yet ripe? Or are we at least talking about it?

JACK BAILEY: Yes, as you know, in our assumption letter for the Clinch River Project that we submitted to the NRC, we identified that we want to be able to do the manufacturing inspections in accordance with ways that are very similar to how we do it with existing manufacturing oversight processes. But

the staff brought up to us in those interactions, public interaction we had last December, that their inspection criteria and processes may not be aligned fully to doing that as it might be necessary for these integral designs.

So the good news is both parties understood that issue very well at that point. I believe the Region inspection branch has an action that they're going to develop time and resources to supporting it and commensurate with the needs on what's happening on the small reactor side. It hasn't gone much beyond that right now. We haven't talked about: Does that mean ITAAC or non-ITAAC type inspections? But the idea is you are putting together a lot more stuff in a final form, and at what point does there have to be an acceptance of whatever's happening by the regulator in that process, too? So it is identified, there have been preliminary discussions between at least our team and the staff, but a lot of work to go there.

COMMISSIONER SVINICKI: Okay. Thank you. And Mr. Mowry, I might ask you that you add a list -- a long list in 2011 of topical reports, and other things, that you're submitting. I imagine that you have but perhaps have not shared today another long list of other things that you have under development. On the general issue of when you approach the staff with some of your more innovative aspects -- or things that the staff has not previously licensed -- let me put it that way -- I'm not going to hang the label of innovative on it. What is your sense of the regulatory readiness with which that's received? Is there a lot of -- kind of saying, "Well, we've never seen that before, so we're going to have to get back to you?" How would you characterize that?

CHRISTOFER MOWRY: Actually, to date I think we're very, very pleased with the responsiveness of the staff and their willingness to engage.

We've had excellent interaction so far. So I would just say that so far it's been very, very positive, and we've had all the resources that we've needed to proceed with the reviews on the schedule that we've hoped for. So thank you, that's gone very well.

I'd also just like to add -- go back to what Jack said on the manufacturing. You know, we obviously manufacture steam generators today. And in fact, the largest steam generators are larger than the mPower module. And while it is more complex, the mPower integral PWR, I would say it's not qualitatively more complex if you remove the fuel from the discussion. And so, I think what we're looking for here is more of an incremental approach to this whole thing, rather than some significant qualitative shift toward a manufacturing license, or something like that. We see this as being more inside that same box that a large, complicated steam generator sits in, in terms of what types of reviews and support we would need to license the overall power plant.

COMMISSIONER SVINICKI: That's an interesting analogy. I appreciate you mentioning that. And with your indulgence, Mr. Acting Chairman, I just have to comment for the record on the wonderful taste in watches that Dr. Kelly has. I'm assuming the 'M' does not stand for MIT, where he also got his PhD. but it stands for Michigan Wolverines, so I appreciate that. Thank you.

[laughter]

COMMISSIONER MAGWOOD: Which goes to show that no one is perfect.

[laughter]

COMMISSIONER MAGWOOD: Commissioner Apostolakis?

COMMISSIONER APOSTOLAKIS: Thank you, Commissioner Magwood. I'll start with Mr. Mowry. On your slide eight, you have a comparison between your design and, maybe, the Fukushima design, and how unofficial I guess, is what you're doing, as compared to that. But of course, at Fukushima, we had an event that was, I would say, incredible, highly improbable, and created a lot of problems with the infrastructure, as we know, and defeated a lot of the safety systems, electric power, and so on. I'm not going to ask you to speculate what kind of event could happen to your reactor, because if we could figure it out we would design against it, or we would do something, anyway. But suppose something like that happens, and the fact that your reactor is underground, wouldn't that impede any efforts from the outside to intervene, and maybe cool the reactor like they're having now -- in Fukushima, the problem is the lack of infrastructure and the damage that the tsunami did. But the reactor is above ground. In your case, it's underground. So how would that affect similar efforts?

CHRISTOFER MOWRY: Well, as you pointed out, I think we still need to wait for all the details to emerge, here, before we can definitively talk about that. But just two observations: First of all, the damage, at least the apparent damage, to the reactor and the supportive infrastructure was, at least in part, caused by an external event, i.e. the tsunami, and therefore, by definition, having an underground reactor and containment building, and all the safety systems, at least qualitatively would cause one to think that there would be less exposure to some kind of external event.

The other observation I would make is that there seemed to be quite a challenge, post-event, in making up water to the reactor spent fuel pool. That's because, in that design, the reactor and the spent fuel pool are high and

your water source is low. And if you think about mPower, it's exactly the opposite. The spent fuel pool and the reactor are essentially at the lowest point, and the water sources are high. And since we're a passively safe, inherently safe design, you don't need pumps; and the combination of that and the geometry really create a scenario where it's easier to get water into the places that you want, rather than hard.

COMMISSIONER APOSTOLAKIS: So I guess what you're saying is that there are no downsides to burying the reactor. That's okay. You can say that. Mr. Bailey, just a point of a clarification: If I look at your slide eight as well, with a timeline, Part 50 and Part 52; am I to understand that the first-of-a-kind reactor would be licensed under Part 50, and that what you have here, the lines underneath on Part 52, will be the design certifications for the future -- second-of-a-kind and beyond: Is that correct?

JACK BAILEY: Yes. That's the plan right now.

COMMISSIONER APOSTOLAKIS: So for the first-of-a-kind, you will never switch to Part 52.

JACK BAILEY: That's correct.

COMMISSIONER APOSTOLAKIS: So you will never submit a PRA?

JACK BAILEY: We would have a -- no, we will. We have indicated that we will maintain the licensing requirements, even under Part 50, consistent with the requirements under Part 52 -- because we're doing the one design, one review -- so we want to make sure that we meet all the requirements there. The issue of Part 50 gives us the flexibility to do a two-part with the construction permit followed by the operating license, and still make changes to the plant after

the construction permits are issued a little bit more efficiently as we learn and improve or have engineering changes. But we are going to still have a PRA.

COMMISSIONER APOSTOLAKIS: Okay. Good. Good. That clears it up. Thank you. Mr. Walters, you had the whole list of issues there on which you plan to submit white papers. One of them is defense-in-depth. What does that mean? And does it mean you're going to list the defense-in-depth measures, like Mr. Mowry did with his comparison with Fukushima? Or is there something you think more fundamental? Do we have to reconsider that concept when we come to small reactors? Or is it premature to ask?

DOUG WALTERS: Or is it what? I'm sorry?

COMMISSIONER APOSTOLAKIS: Premature to ask the question.

DOUG WALTERS: Well, we haven't scoped that paper yet. It's on our list. So I'm not sure I can give you a satisfactory answer. But I think that, conceptually, it would be to look at, again, recognizing the size and the differences between a small reactor and a large light water reactor, and try to understand what defense-in-depth measures would look like, if that's the right way to say it. I mean, we know what they are for large reactors. Do we need those same kinds of things to the same depth for small reactors? That's the concept that at least I have.

COMMISSIONER APOSTOLAKIS: But the main philosophy of having compensatory measures and barriers -- that's still the same. The question is how you implement it.

DOUG WALTERS: That's right.

COMMISSIONER APOSTOLAKIS: Okay. Now, speaking of those issues, and the special attention on security, and so on, it seems to me that the

whole decision-making process, both on your side and our side, would benefit by having a level three PRA. Now, why would that be so? Well, you're talking about different EPZ. I would like to see the consequence curves from the PRA. Security even -- you might be able to say a few things. I know that we have not risk-informed the security requirements yet, but someone has to start. And the other thing is that, of course, the level three PRAs that are out there are the reactor safety study, and NUREG-1150, now that we are doing the SORCA studies, and so on. But all these are for large reactors and, either directly or indirectly, they have affected the mindset both of the staff and the industry. And I know the industry is kind of cool to the idea of a level 3 PRA for existing reactors, but it seems to me that for the smaller ones, you want to shake that mindset a little bit and make people start thinking differently about defense-in-depth, or other issues, security, evacuation plans, when people should stay indoors or should be evacuated, and all that. And I for one would feel much better informed in making decisions along these lines if I see a PRA level three, a good level three PRA. So I wonder how you feel about that. Well, you don't have to feel anything, but --

[laughter]

COMMISSIONER APOSTOLAKIS: I know you can't commit right now.

DOUG WALTERS: I think you characterized our view appropriately.

JOHN KELLY: From the DOE's perspective, the information that we could get from a level three PRA would really inform any kind of decision with respect to siting, emergency zone requirements, plants, et cetera. The issue

we'll have is cart before the horse, a little bit, in can you do a level three PRA before you have your design complete? And so this is an integration issue. How we do design and PRA concurrently so those insights are transmitted as we go forward.

Now, again, we're thinking of a fleet, here. And from my perspective, and the Department's perspective, the first units may take conservative engineering approaches in order to get those units through a demonstrated regulatory process. So even what Mr. Bailey's talked about taking the Part 50 rather than embarking on a Part 52 for the first -- is, in their view, a little conservative approach in order to get that first unit going. Then the question is, as we move to the fleet how can we better inform that with more studies once we have designs and better information? So I see this as moving forward, getting a first -- going through the regulatory process, exposing all of these issues, and then doing the technical studies that are going to be needed to fully inform the better regulatory framework that we need for fleet deployment.

COMMISSIONER APOSTOLAKIS: Well, yeah. And I appreciate those comments. But we are using incomplete PRAs already in design certification, and we're fully aware of it, the staff is fully aware of it, the ACRS, everybody on the Commission, so it's not like it's going to be a new issue. The other thing that is a counter-argument to what you said is that once something is accepted, it's very difficult to remove it. I'll give you an example: safety-related equipment. That was done 40 years ago and now people are really scared to touch it. It's all over the regulations; we can't do anything about it, and so on. So I would be a little bit cautious to say let's have the first one licensed, because you

may agree to certain things that you may regret later, and they will not be easy to remove, or soften, so to speak. So there are both sides to the argument.

And finally, a question for you, John. You mentioned the NGNP. What's going on there? I don't hear anything. On the one hand, the industry is not willing to help you. On the other hand, the law is the law, right? It's in the Energy Act of 2005. So are you going ahead with it?

JOHN KELLY: Well, this was a decision year whether to move ahead. And we're still slated to make a decision in the later part of this fiscal year as to whether we proceed to Phase II, which is the design and full licensing activities for that program. Today we are in the midst of conducting a review by the Nuclear Energy Advisory Committee, which was stipulated by the Energy Policy Act, so that review is in progress, and that review will help inform the Secretary's decision. We're continuing our R&D program, which is largely geared toward qualifying fuel and materials which have both, let's say, safety implications, as well as production capabilities. So those types of programs we see continuing, because they'll help inform both aspects.

In addition, I think the thing that had been missing until recently is the formation of a public-private partnership. So if we're going to move forward, the Department's not going to do this on our own; we're really looking for a public-private partnership to take this on. And so we've initiated those efforts to establish -- we've issued a request for information in February. We've gotten responses; we're drafting an agreement process to basically solicit some industry partnerships that would be willing to work with us. If these things can all come together then I think -- and proceed forward. The rate that we proceed forward

will depend on appropriations, though, and I think we all need to keep that in mind.

COMMISSIONER APOSTOLAKIS: Thank you. Thank you. Commissioner Magwood?

COMMISSIONER MAGWOOD: Thank you. Just a few questions. As I indicated when I opened the session, this conversation about small reactors has kind of come and gone a lot over the years. This time does seem to be a bit different because there does seem to be a broader base of support and interest in this. But, you know, I do, with baseball season getting started, and being a lifelong Pittsburgh Pirates fan, I understand the meaning of hope.

[laughter]

So I appreciate that you're very hopeful that this time it will be successful. But the questions that my colleagues are asking are -- sort of point towards the complexity of these issues as we go forward. And one sort of overwhelming question that, I think, reflects a lot of this, is one that I've had for quite some time. I thought this was a good time to ask it. And that is, when you look at the reactors we have in operation today, we have reactors at about 500 megawatts, we have reactors that are over 1,100 megawatts, we have everything in between. If someone brought us an application to build a 1,500 megawatts reactor, and wanted to use Part 50, we would do it. So we treat a very wide range of reactors -- are they bowling again upstairs?

[laughter]

We treat a very large range of reactors the same. And I think the basic question I have is: Why are these different? I've heard, and I recognize, particularly in the case of mPower, there's some very specific design features

that you would point to, but as a class, why are smaller reactors different? Why is a 125 megawatt reactor inherently different from a 500 megawatt reactor? And why does that call for a different EPZ, and a different security structure, and a different -- when you get to issues like fee, and Price Anderson, those are administrative issues, and it makes sense that those would be different. But from a nuclear safety perspective, why are these really different? I'll just sort of throw that open. Maybe -- it looks like -- Chris, you want to jump into that?

CHRISTOFER MOWRY: That is an excellent question. Our view is that, first of all, I don't think that -- it's not, in the context of this discussion, I'm not sure that it's proper to view all SMRs in the same class. And going back to the beginning to your comment about hope, I think what's really important here, for this to be successful, is that we don't create a bridge too far. And so therefore the focus on the first SMRs being light water technology is appropriate. And I would take a step further in that we need to be very careful about the amount of rulemaking we're trying to achieve in terms of deployment here. And so it's incumbent upon us, as a designer, to be very careful to try to keep the basic design of this plant in a box that can be licensed, generally speaking, within the current regulatory framework, so that you don't create a scenario that makes it just unachievable, or unrealistic, to get from where we are today to where we're going. And so I view those reactors -- those SMRs -- that fit inside that box as the reactors that ought to be focused on initially in order to be successful as a broader class. There are some areas where we would look for change, but they have to be very limited, and we need to be very careful about which areas we go after in terms of rulemaking or regulatory changes. The security area is not an area where we see new rulemaking being required, but more a matter of how we

meet existing requirements. So I think there's a spectrum of designs out there, and for mPower, given the schedule we're focused on, it's really important to stay inside the box as much as possible within the existing regulatory framework.

COMMISSIONER MAGWOOD: Let me reinterpret what you just said, to make sure I understand what you said, because I think I agree with what you're saying is that, at least in the specific case of mPower, you are not arguing that it is a dramatic change from the regulatory approach we've had in the past. But because of the specific features of mPower, you plan to argue for flexibility on a variety of issues. Is that a fair way of saying it?

CHRISTOFER MOWRY: Yeah. And again, I would use the security example. It's more a matter of how we meet existing requirements than whether or not the requirements themselves need to be changed. And again, if you think about the fact that we're designing this plant today instead of 50 years ago when there was a totally different set of security requirements, we have an opportunity to design in security, rather than putting in security on an existing facility that may not have been optimized from a security perspective. So it's not about changing the regulation, but it's about designing into the system in a more efficient, optimal manner the way to achieve the existing requirements. And that ought to be the primary goal, and once you've gotten as far as you can go with that, then you need to step back and say, "Do we need to make any other changes?" I can say right now, we're hopeful that we can achieve what we need within the existing regulatory framework.

COMMISSIONER MAGWOOD: Jack, did you want to weigh in?

JACK BAILEY: I was going to add just a couple comments. Your question from the standpoint of, "Is there anything inherently different about

these than there would be a large reactor, or a larger one?" -- clearly, on the side of the culture it takes to operate these plants safely, the oversight that we need in some areas to ensure that's done properly, it doesn't matter if you're generating power with nuclear, you're going to have to have that in place to do it well and do it consistently over a long period of time. So we don't think there are shortcuts or differences in how that has to be done. We think operating these things well, and safely, and with a focus on the plant's risk are all important -- I use that "risk" in a broad sense, not in a narrow PRA sense.

We do believe, though, that those rules and regulations were derived over time without a real focus on what the end criteria might be that they were trying to protect from or against. A good example is on the emergency planning there's a lot of interpretations of what the ultimate goal is, and how many people we're trying to protect over what kind of range, or whatever the case may be. If we just define that, the question, some of these smaller reactors probably have less of an impact than larger reactors. So it is a legitimate way to look at -- not from a standpoint that you have to have a different regulation, but do you have a regulation that's clear on what the ultimate result needs to be, and can someone demonstrate through their design-specific technology that they meet it or not. So that's probably where the focus needs to be.

DOUG WALTERS: Yeah, I would just add that from our perspective, it's like Chris said, we're looking at the existing regulatory framework, and I think the Commission and the staff have always shown a willingness to exercise flexibility where it's justified. I think we have a number of examples of that. So when you talk security or EP, we're looking at the existing framework and then asking ourselves, "Is there another way to meet the intent of

the regulation, recognizing some of the unique features of small reactor designs?" and then working through that with the staff. I think we have experience with that, and I do think, at some point -- when you get so many modules, what makes them different? I don't know. I think that's a valid question. But with what we're dealing with today and deploying the reactors we want to deploy, we're just looking for alternative ways of meeting the regulation recognizing the design features of those units.

COMMISSIONER MAGWOOD: John, did you want to weigh in?

JOHN KELLY: From our perspective, and this is actually from a safety perspective, a lot of the things we worry about are meeting design-based requirements, or severe accident, and trying to understand that. And by going to a lower power-to-volume ratio, which these plants do, we get into physics regimes where we have much better understanding of the physics and how passive systems can remove the heat, as opposed to complex engineered systems, where their ability to perform their functions seems to leave a lot of questions. So by moving into a physics regime where things are better understood, uncertainties are less, we can have higher confidence that the system can withstand design-based and beyond design-based types of events.

COMMISSIONER MAGWOOD: Thank you. Appreciate that. To some degree I wonder if the exercise we're going through -- the staff -- which we'll talk about in a few minutes, to deal with these policy issues one by one, I actually begin to wonder, given your answers, whether it's really a worthwhile exercise, or does it make more sense for us to wait for the mPower application, or other applications, come in, and deal with them on a design-by-design basis. I mean, I really have to wonder that at this point. Jack.

JACK BAILEY: I think we have to do a little bit of both, and that's kind of why we started down that path. I believe the interactions between us and the staff are helpful in understanding some of those design-specific things we need to address, and on the other hand it also helps us put a spotlight on where are the policy or regularly weaknesses that need the most work. So I don't think it's one of waiting for either one; I think it's working together in parallel like we have been doing.

COMMISSIONER MAGWOOD: Jack, since you have the microphone, let me ask you another question. You said something a few minutes ago that I thought was interesting. You said that the nuclear safety culture required to operate these small reactors is the same culture you would need to operate larger reactors. And I think several members of this panel had already indicated that for all this to make sense, basically, we have to see these systems deployed by the hundreds or thousands. And I think some of the examples that were in Chris's presentation pointed toward utilities that are not currently nuclear operators. So if the thought is -- is there a little bit of inconsistency there somewhere? We're spreading these technologies to companies that do not have nuclear operating experience, but yet we have to maintain the same culture. How do you see that?

JACK BAILEY: That's a great question. We don't think we're being inconsistent. I think the challenge is, for these small reactors, if we're going to deploy them to a lot of companies, for example, that have not run nuclear plants in the past, you either have to find a larger company that does operate plants already, and they expand their skills as an operating role for other smaller utilities, or one of the things we've been looking at, how we could do longer term,

as we evolve, is how do you form an operating company for maybe these non-profit G&T companies for example, that hires the right people, trains the right people, established the right standards, all those things that go along with companies that have that experience today and they operate those plants for a group of customers that are like their own, non-profit, in that mode. So there's a number of avenues out there that already exist where you can leverage the experience and culture that has been developed over the last couple decades to get where we are today. You can't let that go away, and you can't allow it to not be done without some sort of process that ensures that takes place going forward.

COMMISSIONER MAGWOOD: Thank you. One quick question for you, Jack, before we let this panel go, and that's on your slide eight, which Commissioner Apostolakis already pointed to at one point. You show the relationship between Part 50 and Part 52 processes. Where in that process do you see the design being fixed?

JACK BAILEY: We show -- this is slide eight in my package, but most people don't have it in front of them again -- but what we did lay out is a process where the construction permit is being reviewed and issued, then operating license is submitted, and then the design certification parallel under Part 52 is submitted during the construction permit approval phase. But you can see that in about -- actually a few years before we finish our operating license, the design certification scope needs to lock down in order to meet a schedule to issue a design certification. That's an issue that's not locked in stone; it will float depending on a number of these things, but it is going to be earlier. We originally thought at one time we might be able to complete all of our design, all the way

through operating license phase, before we had to lock down a design certification. In order to meet the needs of future customers as early as possible, we will have to lock it down earlier than that. We think we can identify most of those issues because most of the engineering will be complete. It's not like we built plants in the old days and we engineered them as we were doing it.

We do expect to have most of the engineering complete by the time we start construction. So there's going to be a few things that we learn as we start to implement those things in the plant. But we don't expect major changes after that point, so we think we can lock it down where it says the design certification scope freeze on that bottom line under Part 52.

COMMISSIONER MAGWOOD: So there will still be some design work going on after the DCA is submitted?

JACK BAILEY: Could be. If that were to happen, we have a couple processes we've talked about. One you could, in a future combined operating license application, use that as a difference from the DSA that they would have to be justified or reviewed separately. And then a future update of a DCA that could incorporate any of those that have been coming through, not only from the Part 50 process, but under future Part 52 processes.

COMMISSIONER MAGWOOD: Thank you very much. Any other questions from this side of the table? Thank you. Appreciate it. All right, we'll take a 10 minute break.

[break]

COMMISSIONER MAGWOOD: All right, we'll start the next panel. We have Mike Johnson today. I understand the EDO is testifying this morning,

so Michael, I appreciate you coming by to give us a staff briefing. The floor is yours. Please.

MICHAEL JOHNSON: Thank you. Good morning, Commissioners. Today we plan to discuss our progress in preparing for the potential licensing and oversight of small modular reactors. As you will appreciate, like many areas in the new reactor program, this area continues to experience a significant amount of change. But despite that change, I think, as you'll hear, and in fact as you heard in the previous panel, we continue to make considerable progress in trying to place the NRC in the best position to be ready to review applications when they arrive. Mike Mayfield, who is the director of the Advanced Reactor Program in NRO, is going to provide a sense of where we are with respect to those overall activities related to our preparations. Of course, our licensing process is a key area that we focused on in terms of being ready, and as a result, in fact, of Commission direction, we've looked at and developed a plan to risk-inform our small modular reactor reviews. Stew Magruder, who was the chief of the Advanced Reactor Branch 2, will provide an overview of that process, and, in fact, we're going to talk in a little detail and give you an example of how we would implement that particular process. That paper is before the Commission awaiting Commission decision. And finally, we are also, of course, working on addressing the policy issues, the technical issues, Bill Reckley, who is the chief of Advanced Reactor Branch 1 -- well, previously, I should say, was the director of Advanced Reactor Branch 1; he's now supporting the risk task force to support the Commission direction -- will give an update on the policy issues. He's going to talk a little bit about the plan and the schedules, to address some of the questions that I heard in the first panel.

In addition, we're going to provide a little additional detail on several selected policy issues, and tell you where we are in terms of moving those issues forward, also. So with that, I'll turn it over to Mike Mayfield.

MICHAEL MAYFIELD: Thank you, Michael. Good morning, Commissioners. My role today is to give you a broad overview of where we are with the Advanced Reactor Program, and we'll leave the heavy lifting to Bill and Stew. I should point out to you that there's a hint there as to where your questions should go when we get to that part of the briefing. We stood up the Advanced Reactor Program in January of 2009. We had a staff of five and a lone secretary. We had a loosely-defined program that was based on the next-generation nuclear plant program. Advanced reactors, up to that point, had largely been an activity in the Office of Nuclear Regulatory Research, with some dabbling interest from the licensing program.

In the intervening two years, we have moved from that largely research-focused activity to a licensing program with very strong Research support. I've noted to the staff, and I believe to the Commission, previously, we will not be successful without strong support from Research. It's just that simple. However, we do have a licensing focus today.

We have matured as a program. We're fully engaged with partners in other key offices, starting with Research, certainly, including the Office of the General Counsel. A lot of discussion this morning on security, we have NSIR fully engaged with us. The Office of International Programs has proven to be an interesting partner office, because of so much interest in the small reactors overseas. We, of course, are engaged with the ACRS, and we have had a

number of meetings with them, with several more planned over the course of the summer.

We're developing relationships with Region II, as we've started looking at construction inspection. There was some discussion this morning about TVA and B&W's interest in factory inspection. So, Stew will talk a bit about the work we're doing with Region II on construction inspection. We've had some early discussions with NMSS regarding fuel fabrication, principally for the advanced designs, liquid metal designs, not so much for the small PWRs. But we are having that, anticipate further discussion with that office regarding waste storage and transportation for the future.

The Advanced Reactor Program staff has grown from those five brave souls to a staff of 28. We have full engagement with the technical divisions in the Office of New Reactors. So we actually have something on the order of 60 people engaged in looking at advanced reactors, and, principally, the small PWRs and NGNP.

We have previously reported on our progress to address infrastructure and the key policy issues. And, as Mike noted, Bill Reckley's going to talk about that in some detail. One of the earlier questions had to do with, do you deal with those issues separately, or should you deal with them, somehow, in a combined fashion. And I think we are of a mind that you have to look at both aspects of it. I think Bill will discuss where we are on those in some more detail. And, as Mike noted, Stew's going to talk about preparations for the small PWRs and the risk-informing activities. I believe both of these areas are making excellent progress, and I hope, by the end of our briefing, you'll agree with me.

The greatest challenge with the small PWRs is the rapidly evolving nature of that market area. NuScale, as you know, had been one of our early movers, and they have recently asked the staff to suspend pre-application activities because of their financial difficulties. Over the last year, TVA has announced plans, as you heard this morning, to submit a construction permit for up to six of the mPower modules on the Clinch River site. The Department of Defense has prepared a report looking at the viability of small modular reactors to power key military installations. There was a favorable finding in that report. The domestic industry in this area continues to evolve, with Westinghouse and Holtec both announcing plans to submit design certification applications for small modular reactors.

Commissioner Svinicki, I think you have evolved your phrasing over time, and the last I heard was we needed to be "adroit." I would characterize it somewhat differently. We can't be slow off the mark. This is a rapidly evolving, rapidly changing area, and we need to be able to move and move to that quickly.

NGNP is an area that is moving forward, as John Kelly described this morning. The staff is paying attention to it, is moving forward at a deliberate and careful pace, and our activities in advanced reactors, as well as the Research activities, are maintaining awareness of the DOE activities, and are pacing them.

Fast reactors is an engineer's dream. They're innovative, great science, there are great challenges for fix-it kind of folks. However, we have to be careful to not get captured by the science, and stay focused on deployment time schedules. John Kelly talked about 15 to 20 year deployments; that's consistent with what we're also hearing from IAEA. So our challenge is to be

ready when those designs come in, but to not go beyond maintaining awareness of the technologies, and developments in those technologies.

Go to the next slide, please.

That's the right one. I don't intend to go through this in any detail, rather, I shared it to point out that this work is real. It is on our table. It is coming forward. It has schedules from the vendors, it has schedules from at least one of the utilities, and we're working hard to make sure we're prepared for it. With that, I'll turn the presentation over to Stew Magruder.

STEWART MAGRUDER: Thank you, Mike. Good morning, Commissioners. I'd like to start off our presentation with three brief topics. First, I'll provide a status of the pre-application activities between the staff and the first vendors, the integral PWR vendors. Second, I'll provide an update on the staff's preparations for what you heard this morning from Mr. Bailey about TVA's applications for some mPower reactors at the Clinch River site in Tennessee. And then, as Mike mentioned, I'll talk on some key points from a recent SECY paper on risk-informing our SMR reviews. So, next slide, please.

I'll start with NuScale. The staff has been engaged in pre-application activities with NuScale since 2008. They've made several presentations to the staff on their design, and they've submitted several reports detailing specific aspects of their design. In particular, the staff has had discussions with them regarding their human factors engineering program, their plan for performing safety analyses, and their Quality Assurance Program. In addition, the staff recently conducted an audit of their PRA at their offices in Corvallis, Oregon.

However, as Mike mentioned, on March 18 this year, NuScale informed the staff that, due to financial difficulties, they were requesting a suspension of pre-application activities, and unfortunately we've commenced an early shutdown of our activities associated with NuScale.

As you heard earlier from Mr. Mowry, regarding mPower, the staff has been working with B&W, or Generation mPower now, since 2009. They also have made several presentations to the staff, and submitted several reports, including a design overview, a critical heat flux test plan, and their Quality Assurance Program. The staff has recently had discussions with them regarding their physical security design approach, and their core nuclear design codes and methods.

Both NuScale and Generation mPower have been active participants in the NEI SMR Task Force that Mr. Walters mentioned earlier, and have been attending the generic topic public meetings that the staff has been having regularly since last summer. Next slide, please.

With regard to our interactions with TVA and their proposal, as Mr. Bailey mentioned, TVA did provide their key licensing assumptions to the staff in the fall, and the staff responded in a letter dated January 31 to six assumptions from TVA. I want to talk a little bit about our reaction to that. I guess the first one is coordinating the Part 50 and the Part 52 reviews will be a challenge for TVA and for Generation mPower. The staff supports the one design, one review concept, and notes that TVA and Generation mPower must work closely to coordinate the reviews to take advantage of this process. In our letter we note, for example, that the Part 52 design certification document must not contain information that conflicts with that contained in the Part 50 construction permit, or

operating license applications. We also note that, if TVA introduces changes to the Clinch River site-specific design basis information that affect the design certification application they will cause uncertainties in the review timeline.

Next, in light of the currently proposed methods of manufacture and construction of mPower modules, the staff recognizes that the NRC programs and implementing procedures would need to be reevaluated and enhanced to provide effective oversight of the assembled components and systems prior to final installation at the construction site.

In addition, due to the increase in activities that are expected to be performed at the vendor site, the number and comprehensiveness of the staff's inspections would need to be reassessed. The staff has begun discussing with TVA how they plan to identify and resolve gaps that exist between regulatory guidance associated with Part 50 licensing of a new nuclear facility, and the regulatory requirements found in Part 52.

The staff expects to continue discussions with TVA regarding the gap analysis that they call the Regulatory Framework Document. This should help us reach agreement on the key issues associated with review and construction permit application. Several public meetings are planned over the next several months on this topic, and initial discussions have been promising, with TVA. Next slide.

The final topic is the risk-informed review guidance here. On February 18 of this year, the staff issued SECY-11-0024. This paper provides our response to the SRM issued last August on the use of risk-insights to enhance the safety focus of SMR reviews. In accordance with the SRM, the staff has developed a framework for iPWR reviews, or integral PWR reviews. This

framework builds off the work that the staff did for the passive large light-water reactor design reviews, that is, the AP1000 and the ESBWR reviews. The framework is consistent with current regulations and should enhance the efficiency of the iPWR reviews.

I'll provide an overview of the framework and discuss an example of how it could be implemented in my next few slides, but before I get to that, I'd like to point out that we also discuss in the paper our plan for developing, over the longer-term, a new risk-informed and performance-based regulatory structure for licensing more advanced reactor designs, that is, the high temperature gas reactors or liquid metal reactors. This plan involves a pilot study with the iPWR applicants, continuing discussion with NGNP, and limited interactions with liquid metal reactor designs. Of course, this effort will be coordinated with a task force that's chartered by the Chairman's February 11 Tasking Memorandum. Next slide, please.

As I've noted, the iPWR review framework is consistent with regulatory requirements and Commission policy statements. It uses the current non-safety-related determination and the current system structures and components, or SSC risk significance determination. The framework is more risk-informed in that it provides a graded approach for the review of SSCs, with the most detailed in-depth review conducted for SSCs determined to be both safety-related and risk significant, and a progressively less detailed review applied to SSCs determined to be nonsafety-related or non-risk significant.

The framework should enhance the efficiency of the SSC review process by increasing the integration of performance-based requirements into the SSC review process. This integration is possible for most SSCs because

some acceptance criteria in the Standard Review Plan, or SRP, match up with certain program requirements. Examples of program requirements would be reliability assurance program, initial test program, and technical specifications.

The staff has discussed this framework with NEI and the advanced reactor vendors have received positive feedback. We all see the potential to improve both the organization and content of submittals from applicants and the effectiveness of the staff's review. Next slide, please.

Here, as Mike mentioned, I want to talk a little bit about an example, how this process would work. And I'll focus on the Station Service Water System, here. This system, for these designs, is assumed to be a non-safety-related system that is risk significant. So if you follow the framework process, this would come out to be a B1 system.

For this system, SRP Section 9.2.1 identifies several acceptance criteria that are design-related, and several that are performance-based. One of the design-related acceptance criteria refers to the requirements in general design criteria, or GDC 2, for protection against natural phenomena. This acceptance criterion would require technical analysis and evaluation to verify that, for example, the system adequately addresses seismic design standards. This review is the same as would be done under the current process.

Another example of a design-related acceptance criterion is GDC 4, for environmental and dynamic effects. In contrast, the acceptance criteria related to GDC 45 for inspections and GDC 46 for testing may be satisfied by specific performance-based activities, for example, testing or monitoring within some programmatic requirements. For example, combination of initial plant testing, reliability assurance program, and ITAAC. No credit for these activities is

given in the current process, however, in the new framework, the reviewer may be able to gain efficiency by relying on these performance-based activities as an alternative to detailed technical analysis and evaluation.

This completes my presentation. Bill Reckley will now talk about the issues.

WILLIAM RECKLEY: Good morning, Commissioners. I'll be addressing the identification and resolution of technical and policy issues associated with the licensing and the deployment of small modular reactors. Next slide, please. Thank you.

The staff described some of the potential policy, and licensing, and key technical issues facing small modular reactors in SECY-10-0034, dated March 28, 2010. Since the issuance of that paper, there have been several issues that staff, upon further examination, have either resolved or concluded that the issue is not really likely to be a significant policy issue for small modular reactors.

So the first issue that I'll address is the annual fees. This is one that the Chairman took a particular interest in and encouraged us to try to resolve quickly, so there was a memorandum from the Chief Financial Officer dated February 7, 2011, which laid out the staff's plans to issue, through a future proposed rulemaking, a variable annual fee structure for new reactors which would, in fact, lower, under the proposal, if it went all the way through, lower the cost of the annual fee for smaller reactors.

The staff evaluated several issues in SECY-10-0034, and determined that, although we think there may be implementation challenges for the staff, they don't elevate to the point of being policy decisions for the

Commission. We're going to describe these in a paper that should be coming to the Commission within the next month or so. And they include -- the issues include the use of the prototype licensing provisions of 10 CFR 50.43(e), the use of operational programs, how they're used and what are the operational programs for SMRs, and requirements related to decommissioning funding.

The staff will be providing the Commission with a separate SECY paper on the structure of the licensing for multi-module facilities, consistent with a white paper we received from NGNP, Next Generation Nuclear Plant Program, and also the Nuclear Energy Institute. The staff will adopt the -- will prepare our guidance on the assumption that there will be one license issued for each module. That's consistent with our current practice of one license per unit. As is the current practice for multi-unit larger facilities, we would expect that the applications for a multi-module facility would be done under one application, one licensing proceeding, and one hearing. Next slide, please.

Stew previously discussed our activities related to the development of a risk-informed licensing review approach, an issue that is both a technical challenge and a likely policy issue, and one that really, as Commissioner Magwood mentioned, this one is one that really ties all of these policy issues together, is the analysis of off-site dose consequences for the smaller designs, for both design basis events and beyond-design basis events. This issue has long been discussed for HTGRs, liquid metal reactor designs. Those reactors that use different fuel forms, different coolant, different boundaries, and such that it was apparent that we were going to need to do something different because the traditional source term model developed for light-water reactors simply didn't apply.

However, in the case of the small modular reactors, there's also some questions as to whether the inherent features, some that Dr. Kelly mentioned, and others have mentioned, about the inherent features, the increased thermal capacity of the system, the lower power densities of the cores. If those inherent features could translate into relief on the operational side, lower staffing, possible enhancements to emergency planning requirements; and so that would have to translate, then, into some differences in how we do the source term calculations and the offsite dose consequence analysis.

So the staff is continuing its evaluations in this area with both NGNP and the light-water SMR vendors, and plan to provide the Commission with a Commission paper later this year, to describe our plans for that one.

I list two items on this slide that are currently being evaluated to see where the staff's going to go in terms of providing the Commission with possible approaches, and these are for the liability insurance for small modular reactors, as addressed by the Price-Anderson Act and the related NRC regulations. At this time, the Nuclear Energy Institute, through their task force, is working with the vendors, the electric utilities, energy companies, and American nuclear insurers, to assess this issue, and we expect to receive a paper in the relatively near future from the industry.

After seeing where the industry is, the staff will assess and then determine if there is a policy issue that needs Commission approval. And if it is, we would submit a paper; if there's not, we will inform the Commission of where our evaluation and that of the industry turned out.

Another issue that we're looking at to decide how to proceed, but we're still in the information collection mode, is the possible use of Subpart F to

Part 52, which is for manufacturing licenses. Through discussions we've had, and as Mr. Mowry mentioned, it's fairly clear we don't need to do this in order to go forward with small modular reactors, but we want to continue to evaluate it to determine if it makes sense and if, perhaps, the manufacturing license provisions could provide us a more efficient way of going forward, although, perhaps, again not necessarily a provision that we actually need to go forward.

I'll take a few minutes and talk in detail about three of the issues that have been discussed a couple of times today already. And these are the issues that tend to come to the top of the list in terms of people's priorities, which are staffing, security, and emergency planning. Go to the next slide, please.

The first issue relates to control room staffing. The staff considered several approaches for proposals to revise the staffing requirements for small modular reactors. The current regulations defined in 10 CFR 50.54(m) were established for large light-water reactors, and they were developed to address the industry as it stood at that time. So a limited number of operating units and limited combination of the number of control rooms. Some of the proposals from small modular reactors are for fewer licensed operators per unit than currently exists for the large unit.

And looking at this issue, the staff determined that the most likely avenue for going forward is to use an existing process, which is task analysis. And in this process, the applicant and staff, through oversight, would look at the various tasks that need to be performed by a licensed operator in response to normal operation, transient operation, accident, severe accident, what combination of things, if you're going to talk about, as NuScale had, at one point,

proposed multiple modules per operator, then you would have to bring in what was going on with the other modules, as one might be in transient condition. So, basically, just to assess those tasks and see how many operating staff are needed to address the various conditions and events that would be ongoing. There is existing guidance for the staff in this arena, it's NUREG-0711. Going forward, at least in the short term, applicants would use the exemption process. So if this turned out that we agreed that there could be fewer staff, it might be something we'd want to codify at some point in the future. But, at least for immediate licensing issues, we could use the exemption process, and we have guidance for evaluating such exemption requests in NUREG-1791.

The resolution of this issue will depend on a number of things: the ability to -- the evolution of the designs, obviously, our ability and the applicant's ability to simulate events, and simulate control rooms, and the demands on the operators.

A related issue, looking past just the number of licensed operators, is the total number of plant staffing for small modular reactors. And this would go to both the operating staff, emergency response staff, fire brigades, security staff. And just to put all of that together into what is the total staffing requirements. And this is expected to be addressed in an NEI paper in the near future, as Doug Walters mentioned.

The staff expects to provide a SECY paper later this year that basically defines this approach, and then follow it up probably in Fiscal 2012 with a subsequent paper that would address any policy issues once we've had a chance to explore that approach and interact with stakeholders. Next slide, please.

Another issue and one that was discussed a fair amount this morning already, that's mentioned for small modular reactors, is physical security requirements and how the plant designs might lessen the dependence on operating protections, namely guards. We're currently discussing the design approaches with specific plant designers, primarily Generation mPower at this point. And we're fairly encouraged with those early interactions, and how that company and others that we're talking to are trying to incorporate security into the design of the facility, as, actually, the agency encouraged them to in the most recent revision to the Advanced Reactor Policy Statement.

We are going to continue those discussions as the designs mature. We are also going to undertake, internally, a process that we have in the Advanced Reactor Program, issue identification and resolution process, where we bring in a number of experts and just do a systematic look to make sure we've identified all the issues and revised our resolution plan as needed. Next slide, please.

The staff expects to provide a SECY paper in early Fiscal 2012 that describes our assessment and, if necessary, describes an approach that we would then use to develop recommendations to the Commission on policy issues. But it's been previously talked -- we're not clear yet that there actually are policy issues. Part 73 for security is a fairly performance-based rule, as it stands, and so just the design features may provide a way to comply with existing requirements without actually having to revise the regulations.

The last issue I'll talk about is emergency planning. The staff is assessing previous evaluations, the requirements of other federal agencies, and the interactions that we've had with Next Generation Nuclear Plant Program and

Nuclear Energy Institute. And we'll be providing a paper to the Commission in the next few months that basically describes the various approaches that have been proposed, and then details the staff's plans to start interacting with stakeholders about these alternatives and soliciting views from states, locals, and other key stakeholders.

A key consideration for all the alternatives and a common theme of the alternatives that had been proposed to the staff or were developed by the staff internally is the comparison of off-site dose consequences to protective action guidelines. These are the EPA PAG's for the consideration of evacuation or other protective actions. It's realized here, and this goes back to some other issues, such as source term, that the increased reliance on calculated doses to, and a comparison of those doses to the protective action guidelines is going to mean that the NRC will have to prepare guidance and provide applicants with clear direction on how to do off-site dose consequence or at least what the staff would consider to be an acceptable means to do off-site dose consequence analysis, in terms of what events have to be considered, how to model the source term, and how to model the boundaries. This might be a vehicle for introducing level three PRA's as opposed to going through a single conservative way of doing PRA's or dose consequence by bringing in a multiple set of events. And this is consistent with the NGNP white paper on mechanistic source term. Next slide, please.

We're currently discussing this issue with various internal and external stakeholders and, as I mentioned, will be providing both a short-term Commission paper describing the approach and our interactions and then we fully expect that there'll be a longer term paper, probably in Fiscal 2012 where

we'll actually have to lay out policy and make recommendations to the Commission. Next slide, please.

This slide just basically provides a discussion of the short-term papers that we expect to be providing to the Commission. This set of papers, generally, even for those policy issues that are remaining unresolved -- the first papers will lay out the staff's plans in terms of what approach we're considering and how we expect to engage stakeholders, and then they'll be followed up with papers probably in Fiscal 2012 that would actually make recommendations to the Commission on the actual resolution of each of the policy issues. Next slide, please.

This slide is the same set of issues, but it attempts to lay out our resolution of them in comparison to the actual application schedules. It's our goal to resolve all the issues before an application, such that when an applicant provides their application, there is no big issue yet to be resolved that they have to basically take their best shot at, only to determine after the application is in-house whether the staff’s going to be amenable to the proposal.

So, you can see, most of these we do try to have resolution before the applications are planned. However, the actual implementation of these, which might be the issuance of formal guidance, or some other vehicle, could go into the application period. While not optimal, it's probably the best that we can do, and it's not inconsistent where we stood with new reactors before the applications came in 2008. Next slide, please.

In addition to the resolution of the policy issues I just discussed, the staff has, as Mike mentioned earlier, continued to interact with D.O.E. on the next generation nuclear plant program, which is a prototype for a high-temperature

gas reactor. We're reviewing numerous white papers submitted by the NGNP, and some of those white papers have actually formed the first step in our plans for the generic policy issues that I just discussed. In regards to NGNP, we're following the activities of the Nuclear Energy Advisory Council and we will respond, as Mike said, to whatever Secretarial decision comes out later this year.

The staff is having limited interactions on other reactor technologies, primarily fast reactors, through occasional interactions with vendors, attendance to technical meetings and so forth, and also in our interactions with international bodies through IAEA or several bilateral or trilateral arrangements for other countries that are pursuing fast reactor technologies.

And lastly, we are in the midst of preparing our own internal procedures and guidance, some of which do mention, in terms of how we take the risk-informed approach and build it into our existing review methodologies. So with that, I'll turn it back to Mike.

MICHAEL JOHNSON: Last slide, summary slide please, and I'll go really quickly. We are focused -- continue to focus on developing the regulatory framework in resolving policy issues, as we've discussed for integral Ps and NGNP. That includes continued engagement with applicants, potential applicants, and external stakeholders. With that, that concludes the staff's presentation. We're ready for questions.

COMMISSIONER MAGWOOD: Thank you. Very informative. We'll start the questions with Commissioner Ostendorff.

COMMISSIONER OSTENDORFF: Thank you. Well first, thank you all for your presentations. Again, very helpful. This is one of the first issues, I think, that Commissioner Magwood, Commissioner Apostolakis and I heard

about when we joined the commission last April, the SECY-10-0034 and some of the key issues there. Mike, we're not going to let you get off the hook there. I know you wanted Stew and Bill to answer the questions, but we're -- you'd feel left out if we didn't give you at least one, so I'll give you at least one.

MICHAEL MAYFIELD: All right.

COMMISSIONER OSTENDORFF: Looking at Bill's slides 20 and 21, with the summary policy issues and the potential SMR license application pieces. I go back almost a year, where we're talking about the three big issues being control room staffing, security, emergency planning considerations, and I recognize there are dates here for various papers coming to the Commission. And I know that you addressed, I believe, in your remarks today that it's a hybrid approach, you're dealing with some issues generically but also some issues that cannot be dealt with, until you receive an actual application, and so I think we all appreciate the quandary or the challenge of "Is it the chicken or the egg or the egg or the chicken?" kind of approach here. But just, big picture, if you step back from your senior position, look at where the progresses have been made in the last year and the readiness of your team to receive and act upon actual license applications, what's your comfort level?

MICHAEL MAYFIELD: I'm actually fairly comfortable, because we've done enough work and had enough engagement with the vendors that we can identify a path forward. So it's -- it might not be the optimum path, but we can identify a path forward to licensing the plants doing the design cert reviews, or in the case of TVA and mPower, the Part 50 application. So I am personally quite comfortable we can move these forward and pursue the technical reviews and the licensing reviews. We would like to be able to continue the dialogue and

bring that to conclusion with the industry, and then the staff could be fully informed and can share that back with the Commission -- where the stakeholders are and where the staff is. That's the optimum approach. Push comes to shove, we can step forward and license these plants.

COMMISSIONER OSTENDORFF: Just to kind of follow up with that, and I know that the Commissioners have all, I think, been very supportive in providing the resources you need -- that doesn't mean that sometimes we couldn't improve upon that. Are you satisfied with the level of resources you have at the staff level to deal with these efforts?

MICHAEL MAYFIELD: Well, I'm not so foolhardy as to tell you that I need a lot more -- being serious about it. We, as we prepared the 12 budget and are formulating 13, I believe we're about where we need to be. No bureaucrat's ever going to tell you, "I've got enough." But the fact is we have the resources we need to prosecute the program.

COMMISSIONER OSTENDORFF: Thank you. I'm going to ask this question. Stew and then Bill, please feel free to chime in -- or Mike Johnson, however you want to -- but one of the notions that does come up -- come out in both the previous panel as well as in your presentations, has been the emergency planning aspect, and we know that the Office of Resource has been working on the SORCA study effort for some time, and Commissioner Magwood had mentioned the off-site dose calculations, and they came up in several of your comments today. Just curious as to what you see is the relationship or nexus between the Office of Research's SORCA efforts in perhaps looking at the EPZ planning considerations for SMR's?

STEWART MAGRUDER: Well, we're certainly aware of where the Office of Research is going, I think that they haven't published a final report yet. But we have had discussions with them about that, and I think it's probably too early to say exactly how it would impact them. But I do know that the first plants that I have not talked about doing significant changes to their emergency planning requirements, simply because of the timing of the situation. But I could see -- we're hoping that we'll be able to use the information that is being developed by the study to inform our future discussions on the policy issue.

COMMISSIONER OSTENDORFF: But do you see that your team will need to do a separate kind of analysis, de novo on EPZ considerations, or will it be able to borrow in large part from the body of work that you expect to come out of the Office of Research in this area?

STEWART MAGRUDER: Well, I think as had been mentioned, certainly the iPWR designs have similar -- they use the same fuel, essentially, but there's obviously there's a much smaller source term. So I think that the technology aspects -- you know, the same light water reactor fuel, obviously we'll be able to learn something from that—but beyond that, I--

COMMISSIONER OSTENDORFF: You don't think the fact, I guess, you know, I apologize that I didn't mention this, but the underground nature of this -- would seem to have some significant or potentially significant implications on that -- didn't know how that might play into this --

STEWART MAGRUDER: --Yes, we've had preliminary discussions with the vendors about what we call a mechanistic source term or looking at different release paths, and I think that there's a possibility of taking advantage of

that, but we have to do a lot more work obviously, and they'd have to do a lot more testing to verify things.

COMMISSIONER OSTENDORFF: Okay. Bill, let me ask you a question. Did you want to add anything to that, I'm sorry if you -- feel free if you'd like to.

WILLIAM RECKLEY: Well, just basically reaffirm what Stew said. We have talked to the Office of Research about SORCA and its possible implication for SMR's, and we'll be informed by it. It was too late to really change SORCA to bring in another plant design to evaluate. However, we've gone as far as to make sure we're using some of the same vendors in terms of Sandia National labs to do some of our work, and they're very familiar with the SORCA work. So, while not totally integrated, we are trying to build off of one to inform the other.

COMMISSIONER OSTENDORFF: Okay. Mike, do you want to add something --

MICHAEL JOHNSON: -- I just wanted to -- we have the Office of Research here. I wanted them to weigh in from their perspective.

JENNIFER UHL: Hi. My name is Jennifer Uhl. I'm the deputy director for the Office of Research. And I'd like to just highlight that SORCA is a method. Essentially, it's doing a quick level three PRA to some extent. It's not a full level three PRA. It is giving you a consequence of the more probable severe accidents. So, from that standpoint, if this were to be used by NRO or the licensees it could be a tool that helps to bring into better or clear relief what the potential consequences would be. Now, we did SORCA analyses for two plants, Peach Bottom, which is a Mark 1 BWR, and Surrey, and so the answers are very

site-specific because of the fact that it is going out to consequences. So, things like external event hazard and the plant's response is a very site-specific issue. So, again, the information that we can draw from SORCA that we think is generic is that the plants -- or the evolution of severe accidents -- are longer than what we previously anticipated, and the source terms are likely smaller. We think that would be a generic finding. But to determine the actual consequences of two certain severe accident scenarios, you would have to do a plant-specific analysis.

COMMISSIONER OSTENDORFF: I understand that this -- Jennifer that's very helpful -- at a very high level, is the methodology to your knowledge -- is the methodology that's been employed so far in the SORCA study for those two specific plants -- are those general principles or methodologies? Do you see those as being applicable to, in some form or fashion, to looking at SMR issues?

JENNIFERE UHL: Yes, yes they could be applied.

COMMISSIONER OSTENDORFF: Okay. Thank you. Bill, I wanted to ask you a question about control room staffing. You made a couple of comments that got my attention. Not from the standpoint that I disagree with anything you said, but just -- having operated submarine reactors for many years, I'm very interested in how you look at meters and dials on the steam plant control panel or the reactor plant control panel, electric plant control panel, et cetera. and during the casualty or transient responses, you commented about your use of the task analysis approach to sorting out the required staffing from an operating standpoint during transients or casualty situations, and separate issues are security and fire brigade requirements.

But with respect to the operating piece, I just -- if you could maybe talk a little bit more, I'm trying to visualize my experience at sea, looking at how one operator or two operators might handle more than one reactor plant and recognizing also that some of the time responses required for operator reaction is -- as Chris Mowry indicated in his slides, there's a lot more time before you have to do something under certain casualty scenarios because the lower power and -- can you talk a little bit about that cross-unit look a little bit?

WILLIAM RECKLEY: A little bit. [laughs] In that we have probably more questions than answers at this point too. But the point would be to look, let's say, you have an example where an operator is going to be assigned to more than one module. You're going to have to go through a set of things to define the assumptions. Transients on all modules, transient on one module, orderly shutdown of another -- again, so I don't have all the answers to that. But once you define what that operator is going to be required to do, then you're in a situation where modeling the transient response or the other actions that they have to take in the time they're afforded by the specific plant designs would put the applicant and the NRC in the position to say, “Is it reasonable for an operator to do that?” And then you'll have to define things like, “What if they have to operate from outside the control room?” And so you lay out all of those questions, and in the end you'll decide whether -- is it reasonable that one operator might be able to do more than one module or not? So I don't -- Stew, based on your interactions, do you --

STEWART MAGRUDER: -- Yeah, I just want to point out that we have, like Bill said, we have many more questions probably than answers right now. But one of the things that the vendors recognize right away is that we need

to build high-fidelity simulators for their facilities, and NuScale was in the process of doing that, actually, a full 12-module control room. And we were very interested in observing the scenarios they run there and determining whether it's feasible to even approach that.

MICHAEL MAYFIELD: If I could--one thing to not lose sight of is the vendor that needed the most relief on control room staffing was NuScale. So, depending on how they do or don't move forward will put more or less emphasis on timely resolution of this issue.

COMMISSIONER OSTENDORFF: Thanks, Mike. This is an area of personal interest to me. I look forward to seeing the paper come to the Commission, and thank you all for being here today. Thank you, Commissioner Magwood.

COMMISSIONER MAGWOOD: Thank you. Commissioner Svinicki.

COMMISSIONER SVINICKI: I want to thank you for your presentations as well. I think you've also done a particularly skillful job of -- having heard the previous panel, you've tried to work in some responses to issues that were raised and touched upon. Something that I had raised with the previous panel was the list of policy issues and how we will get to closure and different issues will have different paths to closure. And I had mentioned rulemaking and that that can be a longer process. So I think now that I have a much better understanding of the staff's thinking there. I know that when we talk about the policy issues -- Bill, you presented some of the various vehicles and mechanisms -- some time frames, and you highlighted I think three specific areas, and one of the statements that you had make is that we're not sure we'll

find policy issues for the Commission. And, now Mr. Mayfield was commenting that I may or may not have a Word-A-Day calendar, and that I enjoy the beauty of language and using different words, but another thing that people know about me, or complain about me, is that I think history can be so useful in trying to sort out issues because there is generally somebody else who faced something similar historically. So Bill, we were really thinking along the same lines today. I looked at you at one point and you were making the statement, this is not very different from where we stood with new reactors before those applications came in, so I was really getting to that point in listening to the first panel, and then this panel, and having looked at the history of when the NRC predicted that they would face a large wave of new reactor applications.

When you look at the history of how did the agency prepare itself for that my interpretation of that history is that there was a strong engagement between the staff and the Commission, and when I look at the voting records, and the papers that the staff sent up, the tremendous input that they received early from the Commission and I think it might have helped the agency be more ready, sooner because the staff didn't have to go off and pursue things that ultimately the Commission was not going to endorse. And I think that it may be that that is a useful paradigm for where we stand today; so Bill when you make the statement, “We're not sure that we will find policy issues,” if you do find them I predict that someone might suggest to you that they're not policy issues so I'm sure you'll be challenged in that way.

But just as a personal appeal I would say I think the history demonstrates that the engagement of the Commission is important. I think it can eliminate things that are not going to be productive and I don't know -- I can't give

you a recipe for the right prescription of saying, you know, here is where it's too early to approach the Commission or the Commission might choke off something that would be productive versus if we approached the Commission at this point then the Commission can help us narrow a range of options. So you know, my personal view --- think expansively about what policy issues are, don't get too far down a road if it looks like you might be sent down another road eventually. So thus endeth the sermon on policy issues coming to the Commission.

I actually have some specific questions; I raised with the first panel this notion of the manufacturing orientation here and the way with the large lights it's going to be a different paradigm for a small modular. How would you characterize where we are in terms of flushing out that issue?

STEWART MAGRUDER: I'll take that since it was in my slide and you guys can jump in when you need to. We've had good initial discussions with TVA and Generation mPower about their proposed approach for manufacturing and then construction of their facilities. And then when we were preparing our response to their assumptions letter, we talked extensively with our construction inspection people here at headquarters and also the inspectors in Region II. And I think we can say that the scope of the inspections that we'll do will be about the same, but where we do the inspections will probably change, and the timing of the inspections will probably change, and we're still kind of exploring that.

COMMISSIONER SVINICKI: Is there anything that you've been confronted with so far that you just looked at it and said, “We just -- there's no way we can think of to accommodate that within our regulatory system?” Or is it just a matter of how you'll achieve it?

STEWART MAGRUDER: So far we haven't seen any show stoppers. At least I haven't. I think it's just a matter of how we do it and when we do it.

MICHAEL JOHNSON: I clicked the button, he gave the exact right answer I think --- we think all of these issues are solvable we just need to figure out how we're going to do it and we are already beginning to learn lessons based on what we're seeing in terms of fabrication for the large light water reactors, for example, for the modules.

COMMISSIONER SVINICKI: Would that be like the modules? Okay, I was going to ask about that.

MICHAEL JOHNSON: So we think we can get there it's just a matter of timing.

COMMISSIONER SVINICKI: Okay. All right. Great. There was brief mention of the congressionally mandated report regarding using nuclear power small modular reactors at defense installations. Beyond engaging and providing feedback to that have you had any other substantive engagement with any of the military services or with DOD on interest or --- I know that report was congressionally mandated so I won't even necessarily put the motivation for that on them or do you think it is really the vendors that are having more engagement with military?

MICHAEL MAYFIELD: Yes and no. And I sat on a steering committee along with Dick Black from DOE that looked at the formation of that report. The Services were all represented and were actively engaged. There was a lot of dialogue about should DOD try and, particularly Army, try to reinstitute their independent licensing capability. Representatives from the

Secretary's office said that was just a non-starter. So there is active interest from the Services and there was active interest in approaching NRC and licensing those facilities.

They've been looking carefully at the business model that would be used and I know Dick Black from DOE, again, has had a lot of dialogue with various components of the military on that so I believe there is active interest from certainly Air Force, Army, to a degree Navy, of course, deals with their own issues, but certainly from Air Force and Army there appeared to be active interest from the Services and there was active interest out of the Secretary's office. We know that DARPA has had and continues to pursue activities looking at small nuclear units for forward deployment and we've had some dialogue --- early dialogue with them. So this seems to be more driven by the Services than by the vendors, although the vendors obviously have an active interest and have been consulted and have dialogue.

COMMISSIONER SVINICKI: Beyond that report, are there any --- is there continued engagement between NRC and any of these folks or are you just going to see what kind of materializes from there?

MICHAEL MAYFIELD: Right now, in terms of --- we've had sporadic engagement with Air Force, they -- the DARPA we had our first meeting with them in the last month, we're by and large maintaining contact but waiting to see. I know DOE has had more active and more recent engagement with them --- with the Services.

COMMISSIONER SVINICKI: And my last question is that when I think about the Office of New Reactors as a whole I see that in working on the large lights as a class or maybe the design centers, there's the real opportunity

for cross fertilization and synergy both on the process side and substantively on issues. For the advanced reactors group, is there going to be enough --- kind of as a class -- within the class of technologies is there going to be so much dissimilarity that you're really not going to have the potential to kind of cross fertilize and have benefit or even to tap into NRO as a whole?

MICHAEL MAYFIELD: For the --- and this gets important to segregate the technologies -- for the small PWRs I think there will be extensive cross fertilization. I think that, certainly, for mPower we were seeing enough similarities with NuScale that we knew we'd be able to work across those and draw on the technical reviewers and engineering system, the human factors folks. So we knew for those designs we would be able to have that kind of cross fertilization. When you move to NGNP it's less clear to me. The technology is enough different, there will be enough similar interest in control room issues, digital I&C issues, beyond that it gets to be more problematic. For the liquid metal cooled, that again, the technology there is enough different that once you go beyond basic engineering, basic system features, there's not a lot of opportunity for the kind of cross fertilization we've seen with the large lights.

COMMISSIONER SVINICKI: Okay, that's helpful.

MICHAEL JOHNSON: Just to add, that degree of cross fertilization actually helps us as we try to plan budgets in 2012 and 2013 where we're relying on that cross fertilization in working on the integral PWRs to maintain a stable workforce in NRO and in addition to that when we go to oversight we see opportunities for, again, extensive cross fertilization, particularly with the integral PWR. So that's an important question.

COMMISSIONER SVINICKI: Okay, thank you. Thank you.

COMMISSIONER MAGWOOD: Commissioner Apostolakis.

COMMISSIONER APOSTOLAKIS: Thank you. The scheme you're proposing to risk inform the review process relies on the classification of system structures and components; safety related and risk significant. Which is the same that was developed by this agency in handling special treatment requirements. greater quality assurance. So some of the history of that, I think Commissioner Svinicki is right the history is always a good teacher. I remember during the reviews, you know, when the staff was preparing 50.69, the industry complained that the classification of SSC's as safety-related or non-safety-related had a lot of arbitrariness in it, and in fact, when we did risk calculations, a small percentage of safety-related components, six, seven percent, turned out to be risk significant. So that was one flaw of the system.

And the second flaw was that there were some risk significant SSCs that were not safety-related. So the question then arose at the time, why do we need to perpetuate this safety-related concept? And the answer was, "Well, you know, it's embedded in the regulations, it's all over the place. If you ask us to change this, it would be a revolution, and nobody wants to have revolutions in the regulatory system."

The question now is, why perpetuate that system? When you decide that something is risk significant, you don't rely only on PRAs. You have an expert panel that takes into consideration a lot of the defense-in-depth requirements, and classifies them as risk significant.

Now, we were told by the earlier panel that, for the first reactor, they would like to go through Part 50, which unfortunately a downside is that now you're going to have, again, safety-related SSCs. And then, again, you're going

to have the problem of having this classification that is not really very good, and we all agree is not very good, and yet we have to have it.

So I'm wondering whether we should think a little bit about it, and maybe have only risk significant and non-risk significant system structures and components. And just as the previous panel pointed out that they want, for example, to be innovative in certain areas and use this idea of security by design, maybe we can also consider, you know, through the Part 50 deliberations, the idea of not really classifying things as safety-related or non-safety-related, and regret it later. Any comments?

[laughter]

STEWART MAGRUDER: I'll take a shot at it. And I share your frustration with the older safety-related/non-safety-related classification, because I agree. For existing reactors, there are a lot of --

COMMISSIONER APOSTOLAKIS: Excuse me; we have had to live with that.

STEWART MAGRUDER: Right, right. I will say, for the new designs, we may have the opportunity to start with a clean sheet of paper. And there are much fewer safety-related components because of the way they're designed, I mean they're passive systems; they don't need safety-related electrical distribution systems as current plants do, and things, other examples, obviously.

For the iPWRs, as you've heard earlier, the deployment schedule is near term, and so they're definitely interested in conforming with existing regulations and working through the system quickly. For the more advanced reactor designs --

COMMISSIONER APOSTOLAKIS: But that's what I'm challenging Stewart. I'm not sure that this is a -- I mean. For existing reactors, I understand it. The classification has been there for decades, they don't want to change it. But in this particular case, it seems to me, instead of having a group of people deciding that something is safety-related, they can go straight to the risk significant. I mean the deviation is not significant. Now, Bill, you mentioned that we're going to have another SECY sometime with a final approach to all of these issues. So maybe you guys can think about it a little bit before that final thing comes out. I know you cannot commit now. Nobody commits to anything in a public meeting.

MICHAEL JOHNSON: Yeah, I think that the essence of Stew's comment is exactly right. I think there is some nervousness on the part of applicants that we get through all of this, that we're going to go through, with respect to the policy, and our licensing approach, and so on and so forth. So that, for example, an application that shows up in 2012 that we do an adequacy and completeness review on, we're able to accept and begin working on. So, while there's great interest in making sure that we make our review more efficient, more risk-informed, I think there also is a sense of nervousness about us not playing around with that too long. And that, I think, is the balance that we're trying to strike.

COMMISSIONER APOSTOLAKIS: And I appreciate that. I really appreciate that. But maybe what, first of all, they are still here, so I'm not just addressing you.

[laughter]

Maybe you can give them an option. And if they decide to go with it, that's great. In other words, you can show that you're willing to entertain such a concept, but you are also willing to go with a traditional one. So I don't think there's anything wrong with that. But I'm not sure that people in the new designs are very familiar with the complaints of the people who are running plants. And they see how expensive this classification has been for them, safety-related systems.

Now, another thing. I mean, as I was reading 10, what is it, 0024; it occurred to me that you could do that for large reactors, too, I mean there is nothing there that says this is unique to small reactors, correct?

MICHAEL JOHNSON: Correct, correct.

COMMISSIONER APOSTOLAKIS: Well, why don't you?

MICHAEL JOHNSON: Well, in fact, one of the things that we're planning to do is, after we've gotten through this process, gotten Commission buy in with respect to where we're headed, wrap that up, and then look at large light water reactors, along with all the other things that we committed to do in terms of lessons learned from the first time through, and perhaps make those changes.

COMMISSIONER APOSTOLAKIS: Very good, very good. Now, again, the way I understand the system you're proposing, what you're saying is that, for some non-safety-related system structures and components that are not risk significant, or maybe they are, but they're not safety-related, because that's really the heart of the matter here. You're saying there is duplication, that you are reviewing the analysis that supports that particular component. But then also there are performance-based requirements later, and there are some redundancies there, and you're willing to suppress the evaluation of the analysis

in favor of the performance-based requirements. And that's really the only change you're making, is that correct?

STEWART MAGRUDER: That's the major change, yes. Well, aside from the risk categorization --

COMMISSIONER APOSTOLAKIS: No, no, that, I understand that. So, the fact that these reactors -- yes, Bill?

WILLIAM RECKLEY: Well, I'd just clarify; one additional point is the plant designs themselves will introduce differences in how we do the reviews. The fact that the integral PWRs have no large bore piping changes dramatically how we do the licensing, and you won't see mention of that in SECY-11-0024, but it's implicit in the review method that the plant designs, some of the inherent features they're introducing, the lower power densities, all of those things they're introducing will translate into changes in how we approach the review. That's somewhat in addition to actually doing this addition of a risk-informed approach, where we try to modify our review, taking more advantage of some of the programmatic performance-based elements.

COMMISSIONER APOSTOLAKIS: But, again, we agree that this is the essence of the change. In addition --

WILLIAM RECKLEY: Yes.

COMMISSIONER APOSTOLAKIS: -- to the risk classification, okay. You are not really revising the evaluation of analysis or anything. These are the existing guidelines. And finally, again, do you see any downsides to the fact that these reactors are below grade?

MICHAEL MAYFIELD: I mean, it's, I don't know that it's a downside, but when talking with Scott Flanders for the sighting reviews, you

begin to have a shift in emphasis, from meteorology to hydrology. So there will be, it's not so much different as a change in emphasis in what gets reviewed, in doing the sighting reviews.

COMMISSIONER APOSTOLAKIS: How about severe accident management?

MICHAEL MAYFIELD: I think that's an area where we have yet to get to. I think it's a fair question. It's just, maybe six-eight months ahead of where we are with these. I think Chris Mowry talked about a number of issues with the mPower design, things that we're going to have to take a step back and look at.

COMMISSIONER APOSTOLAKIS: The final cheap shot. Do you think that a level three PRA would be useful?

MICHAEL JOHNSON: Of course, Commissioner.

MICHAEL MAYFIELD: Great answer.

COMMISSIONER APOSTOLAKIS: Thank you very much. Commissioner Magwood?

COMMISSIONER MAGWOOD: Let's see, I've developed a long list of questions, but I also recognize that I'm the only thing standing between everyone in this room and lunch, so I'll try to keep it relatively brief. Let me piggyback on some of Commissioner Apostolakis' comments, because I had the same observations. And I appreciate your answer that there really isn't anything that you're talking about doing, in terms of performance-based approaches, that you can't do with larger plants.

But, just sort of a more general observation, sort of growing out of the conversation I had with the previous panel, it seems to me that there's almost

nothing that we're talking about that can't be taken back and looked at in terms of large plants, including whatever conversation you want to have on security, or emergency planning, or anything else. I mean, all that can really be applied to anything. Is there anything I'm missing with that?

MICHAEL JOHNSON: No, I think, in general, the answer that you got from the earlier panel is true. And the premise of your question is correct. Having said that, I think it is -- we do need to look at these individual designs, and how they meet our current requirements, and where they're different, think through what that means in terms of what we do in terms of providing guidance about how those requirements are met or, in fact, raising to the Commission and suggesting changes, new policies, or whatever, to address those.

COMMISSIONER MAGWOOD: This sort of feeds my preconceived impressions that we really actually don't have classes of reactors; we have individual designs that we have to look at as individual designs. And we pretend that they're classes, but really they aren't, so it's kind of my cheap shot.

One, another cheap shot: you know, it occurs to me that listening to the other panel, that the industry envisions there being hundreds if not thousands of these reactors deployed. And I can't help but note that we have 4,000 staff and 100 power reactors. That's like 40 people per reactor, then. So if we go to thousands of new reactors, how many NRC people will it take to monitor thousands of these small reactors all over the country?

Feel free to answer that.

[laughter]

MICHAEL JOHNSON: I don't think I have an answer. We would need to grow considerably.

COMMISSIONER MAGWOOD: Thank you. I think that's true, and I don't know if I -- I'm sure we haven't given that much thought to that. I don't know if you have, Mike, but...

MICHAEL MAYFIELD: Specific thoughts, I, none of us can give you numbers, obviously. But I think if you were really going to go to a fleet concept, you can't stay with the existing paradigm. You're going to have to look at this differently. And so I think, if you really started going to that anticipation, John Kelly's fleets of reactors, you can't stay with where we are. So you're going to have to do this smarter. That's a nice thing to say, but the Commission, the staff would have to look at this differently. You just can't do it the same way.

MICHAEL JOHNSON: At one point we had, Commissioner, a notion that there would be an issue about NRC, for example, oversight, you know, policy issue related to how we would oversee, a number of resident inspectors, for example, for Small Modular Reactors. You know, the kind of thing that we're going to look at operator staffing, would be, maybe the analogous thing that we would do for NRC workload, job task analysis, and then sort of overlaying on that, what are the Commission's policies with respect to, for example, resident inspector staffing and those kinds of things, to get to the answer to the question that you're really raising, that I answered really tersely about, that we would grow considerably if those were the numbers. I think it would be a significant growth, but we would need to go about it in a systematic way in terms of understanding where that growth would need to happen to support licensing and oversight.

COMMISSIONER MAGWOOD: Okay. I appreciate that. I think Commissioner Ostendorff had a dialogue with you about the resources, and I appreciated the bureaucratic response to that. But I did note that you made a

point of saying that we will not solve, or answer all of the questions, before designs are submitted. Is that a resource issue? Is that simply having enough people to do the work? Or is there some pacing activity that simply won't get done, no matter how many people you throw at it at this point?

MICHAEL MAYFIELD: It is, I believe, largely a pacing issue with the industry, and the degree to which they can put all of the issues on the table in advance of submitting the design cert application. There are some things you just can't get to until you actually have the meat of the application and the details of the design. We're trying to limit that, but I can't, in good conscience, tell you -- I don't think any of us can tell you, “We can solve all of this before they bring in the design.”

So there will be some set of issues. I think it was Bill alluded to the issue identification and ranking projects that we've put in place, it's a pert-like process to systematically look at the issues that we've already identified. Is there some aspect we've missed? But then, to look more broadly, is there an issue we just haven't thought about yet? And so we're doing those kinds of things to flesh out as much as we can, collectively, the staff can think about. But there's only so much you can do until you have, as I say, the meat of the design.

COMMISSIONER MAGWOOD: I can't remember if this goes to Stewart or Bill, but we had a long conversation about security during the presentation, and I wonder, one aspect about security that we haven't talked about isn't the orientation of the physical plant, but it's where the plant is, and what's around it. And we're used to having large central stations where we can put a big fence around it, and there's, of course, already thousands of people involved. And we're now talking about a different model, with these -- if you have

a twin pack replacing a small coal plant in some Nebraska cornfield, that's a different security situation than anything we're facing today. And I wonder, is that something that you've started to think about?

WILLIAM RECKLEY: Well, I think that, again, as Mr. Mowry mentioned, 40 acres being basically the footprint, and within that 40 acres of being able to lay out your fences, and your building arrangements, and your reactor building to provide the necessary means to detect an intruder, to delay an intruder, and ultimately to respond. So you can't say that a particular site might not raise particular issues, and that site may need, then, to compensate, maybe, with something another site didn't need to have, an additional bullet-resistant enclosure, an additional number of guards from one site to another, as you analyze the impact of the site.

But, in general, the feeling is that, by, again, doing security by design, you're able to build that in, and so now you have to try to compensate for weaknesses in detection based on where the buildings already are. And you only have a number of ways you can do that, whereas they're able to now consider, in order to detect, where do I put my buildings? And so that's, you know, that's the fundamental difference.

MICHAEL MAYFIELD: Going to your notion of general location, the cornfield in Nebraska, whatever. That also goes to EP. So there are a couple of these things where we're going to have to get into it some more with NSIR, some more with the vendors and the utilities, and then reach out to other -- FEMA and other stakeholders, to get to the heart of what's different, and how should the staff and other agencies' posture change. Should it change? So I think there are a number of these things that, as we start planting these, that the fleet, in a lot of

different regions, different kinds of locales than we're used to dealing with, we're going to have to be adroit, and Commissioner, I do enjoy the differences in language, as a matter of fact.

We're going to have to be able to deal with that. And to be able to figure out how to make the regulations do what we need them to do to assure public health and safety without it being an undue burden.

COMMISSIONER MAGWOOD: Well, thank all of you. One final point, thinking of the previous panel. Commissioner Svinicki mentioned some -- I guess you -- I can't remember which verb you used that particular time, but there were some fuzzies as to what the actual scheduled work was going to be, and what the milestones were going to be to get us to the conclusion of these issues. And I have the same feeling that we should have a little bit more fidelity in the schedule. It may be something that we could perhaps get -- I don't know if others have, you know, have any views about the schedule. But I think it'd be good to have the, maybe the meeting SRM reflect that, I don't know if others have a --

COMMISSIONER OSTENDORFF: Commissioner Magwood, I concur in your comment. I'd also associate myself with Commissioner Svinicki's comments at the beginning of her Q and A where it is not clear to me what are the issues to bring back to the Commission. And I just know, I heard the first panel, heard this panel, on this topic and it just seems like, Commissioner Magwood on your comment about are there things that are outside the purview of our experience with the existing reactor fleet that can't be resolved, and I think the answer you got was no. But it still seems like there's some fuzziness or potential gray areas here, and so I just would like to join myself with your comments, both of you, on the need to come back to the Commission, earlier

with -- at least telling us about a particular hurdle or hiccup. And Mike you kind of referred to some of those in your last comments a few minutes ago.

MICHAEL JOHNSON: Can I just?

COMMISSIONER OSTENDORFF: Yes.

MICHAEL JOHNSON: I also listened to the comment and wrote a note to be -- to try to respond to the variety of additional information for the Commission on schedule and we'll do that. I want to tell you our approach for the papers is, even in the event we figure out that we don't think we have a policy issue, our plan would be to provide an Information Paper to the Commission so you know the basis for that discussion. So that's why you see some of the interim milestones on a number of these issues where we're just talking about the approach that the staff was going to use and in fact, how we're proceeding so that you're informed as we go forward. And again, we'll communicate with respect to firm deadlines on issues as we move forward so you know when you're going to get those products and get the policy issues that you need to react to in order to be able to give the staff direction.

COMMISSIONER SVINICKI: And I think some of the distinction I was trying to make and its really my personal perspective from reading a lot of the voting papers and voting records of what came to the Commission when the wave of new reactor applications was anticipated but had not yet materialized is, I would characterize the difference as sending up Notation Vote papers to the Commission with the presumption that you will get Commission buy in some fashion and the contrast being perhaps a posture that says, "I will just send a wave of things to the Commission and make them sort through a lot of information about what is a policy issue and what isn't. When the staff -- in my

experience when the staff is presenting a policy issue to the Commission, it is done differently than when you are merely giving a status update and so, the Commission -- if things are not presented to us as a policy matter, we are deprived in my view, of the staff's expert framing of the issue, delineation of what the policy options might, and so I understand that it's become a bit fashionable to send things to the Commission as Information Papers, but we then, I think suffer a real deficiency of having the benefit of the way the staff is able to expertly put policy issues in front of the Commission, I was trying to contrast the history a little bit and I just offer that perspective to my colleagues.

COMMISSIONER MAGWOOD: Any other comments?

COMMISSIONER OSTENDORFF: If I can just look at slide 20 -- I'm just going to identify three papers but to illustrate I think Commissioner Svinicki's point here. Emergency planning scheduled for mid-third quarter, fiscal year 2011, control room staffing late-third quarter fiscal year 2011, and physical security, first quarter of fiscal year 2012. I looked at the three topical areas there; I can't imagine those not having integrated effects, one on the other topic. And that all assumes that there's a nexus, there's a connection between how many people you have on site, how many people are involved in emergency planning in the security, and so they are not in isolation, they are in a broader context, part of a more holistic framework that does necessarily have in most cases, policy implications.

MICHAEL JOHNSON: That is true and we're working those in an integrated way and you'll see that. Just on the emergency planning paper for example, we want to get -- we want to tell the Commission how we're proceeding, what our plans would be. We recognize that we won't have the full

vetting of the issue, full preparation of all of the options, and a recommended option to the Commission on that timeframe, so the Information Paper is intended to get that information in front of the Commission and we'll follow that up, once we've had a chance to interact more fully with applicants and external stakeholders, an options paper that is typical of what you would expect in terms of a fully fleshed out, well-rounded set of options, and a sound staff recommendation with respect to our approach -- proposed approach.

COMMISSIONER SVINICKI: Okay, thank you for recognizing that difference.

COMMISSIONER APOSTOLAKIS: Well, I'll just repeat that this is an excellent opportunity to revisit this issue of safety-related components and I would urge both the staff and the industry to not just go ahead and classify SSC as safety-related and all safety-related just because that's what Part 50 says, thank you.

COMMISSIONER MAGWOOD: You know it also just occurred to me this may also be a good opportunity to think about level 3 PRA.

[laughter]

COMMISSIONER MAGWOOD: It just came to me.

[laughter]

COMMISSIONER MAGWOOD: We stand adjourned; thank you

[Whereupon, the proceedings were concluded]