UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON SMALL MODULAR REACTORS

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WEDNESDAY

NOVEMBER 5, 2014

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ROCKVILLE, MARYLAND

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The Commission met in the Commissioners Hearing Room at the Nuclear Regulatory Commission, One White Flint North, 11555 Rockville Pike, at 1:00 p.m., Allison Macfarlane, Chairman, presiding.

COMMISSION MEMBERS:

ALLISON MACFARLANE, Chairman

KRISTINE SVINICKI, Commissioner

WILLIAM OSTENDORFF, Commissioner

JEFFREY BARAN, Commissioner

STEPHEN BURNS, Commissioner

EXTERNAL PANEL:

JOHN KELLY, US DOE

RICARDO G. PEREZ, Tennessee Valley Authority

ANTONY IANNO, Morgan Stanley

ALEXANDER GLASER, Princeton University

NRC STAFF PRESENT:

MARK SATORIUS, Executive Director for Operations

GLENN TRACY, Director NRO

MICHAEL MAYFIELD. NRO

DEBORAH JACKSON, NRO

STEWART MAGRUDER, NRO

JOSEPH COLACCINO, NRO

ANNA BRADFORD, NRO

P R O C E E D I N G S

1:01 p.m.

CHAIRMAN MACFARLANE: Okay, good afternoon. I'd like to welcome everybody, industry, staff, public who are here for today's meeting on small modular reactors.

Before we begin, I want to take a moment to recognize, we now have a full Commission. We have with us Commissioner Jeffrey Baran who has been with us now for -- this is already his fourth or fifth Commission meeting, and we have as of 10 a.m. this morning, Commissioner Steve Burns. And you can see here we are not slouches. We go to work right away. The poor guy is working immediately, so we just want to welcome Steve to the NRC. He's no stranger to the NRC. He worked for the NRC for 30 years leaving as General Counsel to go and work at the Nuclear Energy Agency, but now he's back with us as a Commissioner, so just wanted to note that. And now we can get on with our meeting.

So, small modular reactors, they represent a relatively new concept in nuclear power reactors. Unlike the current fleet of Generation 3 or 3+ reactors that we've licensed in the past, SMR reactors are those that produce less than 300 megawatts electric, of electricity, power.

Today we're going to have the opportunity to look at the anticipated licensing activities associated with small modular reactors, the status of actions and activities to resolve key generic policy issues associated with SMRs, and activities and plans for SMRs on part of the industry and other government agencies. So, we're going

to have two panels, an external panel, and then our own Staff panel.

On the external panel, we're going to hear from Dr. John Kelly, who is Deputy Assistant Secretary, Nuclear Reactor Technologies at the Department of Energy in the Office of Nuclear Energy. We have Mr. Ricardo Perez, Rick Perez who is Chairman of the NEI's working group on small modular reactors, and Senior Vice President and Operations Support for TVA. I don't know if you were here the other day.

MR. PEREZ: I was.

CHAIRMAN MACFARLANE: Yes, okay, so you're making many trips to us. We have Mr. Anthony Ianno, Managing Director of Global Power and Utilities Group Investment Banking at Morgan Stanley, and we have Dr. Alexander Glaser, who is Assistant Professor at the Woodrow Wilson School of Public and International Affairs, and the Department of Mechanical and Aerospace Engineering at Princeton University. Yes, a mouthful. And then we're going to hear from our Staff panel.

In between the two panels, we will take a short five-minute break to switch out folks. And remember to keep your remarks to 10 minutes, and try to avoid the use of acronyms. And before B- yes, you didn't hear that one before or you B-

COMMISSIONER BURNS: Oh, rats.

CHAIRMAN MACFARLANE: I keep trying to beating the drum of no acronyms. It's a Sisyphean task. Anyway, let me turn to my colleagues to see if they have any opening remarks.

COMMISSIONER SVINICKI: I would like to add my

personal welcome to our new Commissioner, Commissioner Burns. I guess I'm living proof that if you stick around long enough, you'll not only see them come and go, but you'll see them come back again. So, welcome. But in all sincerity, I'm really thrilled to see that you will be here now continuing to contribute your insights to the Commission's important mission in this new capacity as a colleague, so I welcome you, and I'm really pleased to see you here today.

COMMISSIONER OSTENDORFF: Steve, I'm glad to have you back. Welcome.

COMMISSIONER BURNS: Thanks.

COMMISSIONER BARAN: I can't compete with that but I'm delighted to have you here, Steve. Welcome.

COMMISSIONER BURNS: I've got to get used to the buttons I guess.

CHAIRMAN MACFARLANE: Yes.

COMMISSIONER BURNS: Yes. No, thanks, Commissioners, it's very nice of you. It is a strange feeling being back, but I'm looking forward to it.

CHAIRMAN MACFARLANE: Good. Are you tempted to scoot one chair over and push Margie's?

(Laughter)

CHAIRMAN MACFARLANE: I guess if we don't have a General Counsel, Steve can pitch hit. Okay. All right. Well, we'll start with our external presentations, and we'll start with Dr. Kelly.

DR. KELLY: Okay. That's on, I think. Thank you, Chairman Macfarlane and Commissioners. It's really a pleasure to be

here. Looking back, I think the last time I briefed the Commission on the small modular reactors program was in March of 2011, a very busy month for many of us, and I'm happy to report and I'll go over today that there's been a lot of progress in the last three and a half years, so I'd like to share with you what we've been doing at the Department of Energy with our partners, both the current industry, as well as looking future to advanced concepts in the SMR area. Next slide.

So, both the President and Secretary Moniz have strongly spoke on the need for nuclear power to be a key part of our ability to meet our clean energy goals. In fact, we can't meet the goals the President has set for us without a significant contribution from nuclear power.

Now, when we look at the small modular reactors, we're not looking at them as somehow competing with large. The large reactors will find their place in the market, but we currently believe that there are certain areas in the country and internationally where large reactors probably cannot penetrate for a variety of reasons. These are, first, the capital cost and the risk of the project. There are safety concerns, and we see small modular reactors as being able to improve the paths of safety of the technology. And we're also seeing needs for replacing aging fossil plants to meet our climate change goals. And we really see in the B- after 2025, a growing demand for clean energy technologies. And this program is really based on the premise that by 2025, we need to have a cadre of clean energy technologies available for deployment for the U.S. and the world to meet their clean energy goals.

Domestically, we see the small modular reactor program as providing the opportunity for jobs, high-paying, high-quality jobs within the U.S. And if we look internationally, by having the U.S. brand on SMR technology we really hope to be able to influence not only the safety, the security, but also the international safeguards of nuclear power globally. Next slide, please.

So, what have we been doing? So, in 2011 we did not have a program. That program was actually initiated in fiscal year 2012, and in late 2012 we made our first selection, but we've taken the path of developing public-private partnerships. The main purpose here is to reduce both the regulatory and financial risks to our partners. When we talked to the partners before we launched the program, regulatory risk and the assumption that it could be very expensive was one of the major concerns of the industry at that point, so one of the key reasons for putting in place this program is to reduce those risks.

The program itself is paying for the engineering design, testing, certification, licensing through cost-sharing agreements. We really hope to accelerate this technology. Many think that it would come in on its own but, again, we're looking at having it ready to have large-scale deployment in 2025, and that's going to require some acceleration.

The program began in 2012. It's slated to be a 6-year, $452 million program, so we're in basically the fourth year of that program now, looking to continue it for another couple. And we have agreements with both NuScale, or mPower and NuScale teams and the work on their designs is progressing.

Now, just to give you an idea of how the government's funds are being used, I just show sort of here a collage of photos of some of the major B- the more significant activities that have been going on in our projects. Basically shown here are some of the large-scale testing facilities that have been stood up, and the testing programs are underway. So, in my view this thing that was a paper reactor probably in 2011 is really now progressing to a concrete reactor through the demonstration of the technology by these large-scale testing facilities drilling at the Clinch River site to begin to understand the geology for potential future deployment. So, I really see us moving down the path of taking the technology from the paper stage to the real stage. Next slide.

So, in addition to supporting our industry partners, we've also been doing some other things to try to help advance the technology. First, we've been working with the Electric Power Research Institute on a document called the Utility Requirements Document. This document was put together back initially in the 1990s to support the deployment of the gigawatt-class reactors that we now see today. We're updating that to reflect the utility needs with respect to small modular reactors.

We've been doing a number of economic viability assessments. Lots of questions; we don't know yet all the answers, but we have been engaging institutes such as University of Chicago, Stanford, Illinois Institute of Technology, and Wall Street firms to basically help us understand what the economic perspectives will be for SMR.

Most of these point to the fact that SMRs could be competitive, could, is still to be proven, but there's a number of factors that would need to come into play, including the ability to have learning through replication of designs both in terms of the design process in the manufacturing; the fact that moving forward a number of utilities seem inclined to develop a portfolio analysis rather than a simple metric economic analysis to determine the mix of clean energy technologies that they would want to have in their portfolio, and SMRs look like they could be a very important point there. And that there'll be a continued need for government involvement through, perhaps, loan guarantees or other incentives to really incentivize the first movers of this industry.

In area of source term, which is going to be I think a key question for SMRs, we've been working with EPRI to help define what the aerosol deposition could be in case of an accident, and we're proceeding down an analysis and potentially an experimental path there.

We've been looking at sites, and we've been looking at federal sites, not any particular agency, but sites across the country that have large electricity demand by the federal government, because the President has set clean energy goals for all the agencies of the federal government. So, we're looking at SMRs as potentially supporting that. And we've seen several states, such as Washington and Iowa conduct feasibility studies within their states on the merits of SMR technology.

And, finally, we've engaged NNSA, National Nuclear Security Administration, that really looks at the non-proliferation aspects of nuclear technology. They did an assessment of the

international safeguards and security of the technology, and basically based on their comparative analysis they did not see the SMR technologies, at least the light-water versions differing significantly from the large reactors in terms of international safeguards and security. Next slide.

Turning now to advanced reactors, this is something that I think has been gaining momentum over the last few years that I've been in government, certainly, and we're seeing a number of designers supported by a variety of organizations coming forth with ideas that are using coolants that are not light-water reactor-based.

We recently conducted a Request for Information from industry. We had seven companies submit concepts to us for evaluation. Those were evaluated, and then based on that we distilled down the critical research needs to support the furtherment of those technologies. And from that, we issued a funding opportunity and had 14 applications received for that award opportunity.

And just by coincidence, last Friday we made our selection. I think there were four or five awards totaling $13 million that the DOE is awarding to a set of companies on a cost-shared basis to further the research and development on advanced reactor concepts.

And we're also seeing a number of industry groups form up. One is this National Infrastructure Council, and another group headed by Argonne National Laboratory sponsoring workshops on advanced reactors heavily attended by industry.

I'd also like to point out I think an effort that both of our agencies have been really embracing and that's looking at the licensing

framework for advanced reactors, and working together to look at how we could develop General Design Criteria.

DOE has had the lead on the initial phases of this, and we're getting ready to turn this over to the NRC Staff for further work, but during our initial phase we've had over 80 industry, university, and national laboratory participants in helping us formulate a topical report on this subject, so we're looking forward to the continuance of that activity.

Then within DOE we have our own R&D program looking at fuels, advanced materials, testing of components, in-service inspection, a whole set of R&D activities that we think generically will support a wide variety of advanced reactor concepts.

And I would hate to leave here without acknowledging over the last three years really the immense support that NRC has given to the SMR activity. Without your help, I don't think we could be in the position today to be thinking about applications for an Early Site Permit in a year, and perhaps Design Certifications two years.

Your staff have been laying the groundwork both with the engagement with our vendors, as well as establishing basically the framework to allow them to move forward in their licensing activities. And very important here I think has been engaging on design and risk-informed approaches which many believe will be important for the ultimate licensing of SMRs.

So, in summary, I would just like to reiterate that nuclear power is a key element of the President's all-of-the-above strategy. DOE stands behind our SMR program, and will continue to

look for efforts to improve the market potential for SMRs both domestically and internationally. And as you can see, both our Secretary and the President are strongly behind this program, so thank you very much.

CHAIRMAN MACFARLANE: Great, thank you. Mr. Perez.

MR. PEREZ: Well, thank you, Chairman Macfarlane and members of the Commission. Good afternoon.

I'll start with slide 1. I really appreciate the opportunity to present the nuclear industry's view on small modular reactors, their development, and the licensing going forward.

I've had the honor to work with a lot of you in the reactor development and licensing area for many years in my career, and I see the small modular reactors as a continuum of that progress that the industry has made to bring new reactors into the U.S. and international marketplace. These reactors are providing new options for non-carbon and non-intermittent sources of electricity generation throughout the world.

The launching of the new projects at Vogtle 3 and 4, and at Summer 2 and 3 represent only one facet of what many of us believe is needed for nuclear generation to really make an impact in our nation's long-term need for non-CO2-emitting sources of electricity. So, today I'm going to provide you a very high-level perspective of why the nuclear industry sees the clear need for the SMR option. Number two, why we believe the industrial capability clearly exists to deploy the technology safely and successfully. And, finally, how important the

NRC and industry's interaction plays in a very important facet in the future of being able to develop that as an effective tool in the United States. Next slide.

It's clear that today's fleets of nuclear power plants enables the nation to produce a large tranche of electricity without CO2 emission. This is becoming extremely important as both societal and governmental trends move toward reducing coal fueled generation sources.

With this trend, the whole spectrum of how reliable 24/7 electricity is being generated in the United States is changing. At the same time, gone are the homogeneous markets and simple generating schemes that allowed for quick evaluations and equations to be solved for planning, building, and operating power plants. Now, much of the country has unregulated economic electric jurisdictions. Additionally, with the onset of sources of intermittent renewable generation and efficiency programs this has significantly increased the need for agile and lower capital cost projects to produce electricity throughout the country.

In these environments, generation flexibility, small capital costs, diversity all become hugely valuable and important, more than it had ever been. The expansion of natural gas domestic supplies in the United States and the agility of gas-fueled power plants have moved them in to be the short-term option of choice throughout most of the nation's power jurisdictions; especially where gas is needed to follow intermittent sources of renewable generation.

Unfortunately, with all the great things that the power

generation from natural gas has brought us, it still has challenges for us. As a nation, it still produces large sources of CO2, stresses our pipeline assets, and limits our overall generation diversity mix.

Now, certainly large-scale base load generation will still be needed throughout the nation, but more and more smaller-scale highly reliable and agile electricity projects are becoming a priority need. It is in this segment where we think the SMR option has a great potential.

Many U.S. generators see clearly the need for smaller electricity generation projects that do not emit CO2, and that can provide both certainty and agility to respond to a very variable load demand. In fact, it can be argued that the impact of renewables on climate change without viable energy storage and without a matching source of reliable 24/7 non-CO2-emitting partner source will be greatly lessened. So, the SMR option we believe delivers an agile, safe, and non-CO2-emitting electricity that has a clear fit in this evolving energy landscape.

The lessons being learned today through the Part 52 licensing process and the Vogtle and Summer construction process have really, coupled together with new safer safety system designs, we believe provide a solid platform for developing the SMR.

These projects have stimulated engineering thinking throughout the country, and a refreshed look at how we leverage U.S. indigenous strengths in modeling, testing, I&C, fuel design, and marine fabrication to really generate a new, innovative SMR design.

It's these proven American industrial strengths that are

the heart of the light-water SMRs being designed and developed today. And it's at the heart of that that we believe has the confidence to be able to positively deploy these reactors in the United States.

The proof of this aptitude can be seen in the rapid and timely ramp-up of investments being made by industry, and by government. These are depicted in some of the photos you saw on the slide, and in the next slide. Next slide, please.

As you heard from Dr. Kelly of the DOE, the economic and technical investigations they have made support the potential for the SMR option to make a positive impact on the nation's energy picture. But an equally important aspect of the developing of the SMR is the licensing process.

The unquestionable value of the successful Nuclear Power 2010 Initiative coupled industry and the DOE to advance and improve the Part 52 process for advanced reactors that are now being built was invaluable. This success, the learnings from it, the improvements in licensing efficiency must be leveraged as we engage in the light-water reactor SMR licensing applications that are targeted over the next 12 to 24 months.

Now I'm going to give you a personal perspective. I strongly advocate for a transparent, early, and aggressive engagement between the NRC Staff and the upcoming applicants. My personal and professional experience has convinced me this requires steady pressure on timelines, dedicated resources, and clear communications with both sides; that means the Agency and the applicants.

No party wins into a blame game on why technical

difficult issues and schedules, and policy items are not tackled efficiently. The proven construct for success is based on a strong and reliable regulator that's matched equally by a capable applicant, and that environment where transparent communication can exist and interact with each other. It was that kind of environment that carried the day on the Vogtle and Summer applications, and that is what we have to build on for a successful and constructive SMR licensing process.

Now that requires that both parties in the licensing process provide the technical B- the prerequisite technical resources and an engagement brings clarity on technical and policy issues very early on. The upcoming SMR applications will challenge the Agency to manage both new, and also some lingering old issues.

On the new side specifically, scalability and appropriately designed regulated issues like source term, emergency planning, staffing, the treatment of multi-modules will bring some of those new challenges.

Conversely, some of the old issues surrounding clear thresholds for conducting reviews, the level of specificity needed in design acceptance, and related impacts of those things are still an area of efficiency that will have to be worked on between the Agency and the applicants. Next slide.

Now, the future of the SMR development may seem a little far away for most people, especially for the public, but most of the prototype SMR reactors that are being discussed, and that John referenced to, are looking at targeting the first prototype deployment in the 2020 time frame. But let me remind the Commissioners that those

reactors in construction today started with design concepts in the early 1990s. The first AP-600 Design Certification Rule was issued in December of 1999.

Now, those lessons from those reactors clearly gives a path for delivering these SMR licenses and reactor designs in a much more efficient fashion this time around. A large base of the nuclear plants cut across the country with 60 years of operation and the decades of the 2030s.

Now, it's yet to be determined what the impact of those plants will make after 60 years. Nevertheless, it's evident that if nuclear is to maintain an important role in non-CO2 electric generation in the United States, various new technical and economic options will be needed. The SMR option targets to provide utilities and other generating companies and entities with a new arrow in their quiver to attack climate change while at the same time meeting demands of a very variable electricity market across the nation.

So let me close with this. The President had an important thought the other day, which I think we need to keep in mind. He said, "We have to be guided by science, and by facts." Following his advice, I'm very comfortable and confident that the NRC and the U.S. industry are up to the challenge for licensing an SMR that will provide the American public with a safe product that can be used to decarbonize our energy future for when it's needed for this country.

Chairman Macfarlane, thank you for your time and your attention, and that concludes my remarks, and I look forward to answering any questions later on.

CHAIRMAN MACFARLANE: Thank you, good. Mr. Ianno.

MR. IANNO: Thank you. Is this on?

CHAIRMAN MACFARLANE: You turned it off, I think.

MR. IANNO: I just turned it off. Thank you, and thank you for having me here today. I really appreciate it. I'm honored to be here today. I think uniquely on Wall Street, I actually have a background working in a nuclear plant before I became a banker, so I was B- worked at Indian Point 2 back when Con Ed owned it, and I'm a huge proponent of nuclear power and what you do to support it. So, thank you for having me here today.

Let me just start off by saying I think that, clearly, as Rick said, I think that nuclear power has to be a huge part of energy policy going forward if we're going to meet our emissions targets that we've outlined. I think, however, there are some significant challenges that we're facing today, and maybe turn to the first slide.

What I'm going to attempt to do today is give you just some thoughts and an overview of how investors are thinking about nuclear power, and what the implications are to financing for SMRs.

I think existing nuclear power is valued today both for its fuel diversity, the environmental advantages; however, it is economically challenged in many markets. And when I mean many markets, I mean the regional markets across the country. It's really hard for new-build nuclear construction to be economic relative to combined cycle gas plants. And that is, I think, the biggest challenge that we all face with respect to nuclear today, even for some existing nuclear

plants, we're seeing when they have decision points on large CAPEX, it's a very difficult decision given the economics associated with gas. And, unfortunately, we're in a position now where we have more plants that are shutting down than actually plants that are coming on line.

Obviously, that leads to the huge importance of the completion of the new nuclear units that are under construction, and in particular with respect to the NRC, how the testing associated with the new licensing regime is going to play out. I think that's a critical point that investors are looking to, to make sure that that's a risk that they can take on going into the future.

Now, saying all that, I think that as competitive markets today do not support the development of new nuclear plants, which means that in order to develop plants they either need to be in rate base or in B- under long-term power purchase agreements. And I think that's B- those are the types of support from a market perspective that will be needed in order to finance nuclear power going forward.

Turning over to the next slide, and I think maybe slide 3 here in the financing implications for SMRs. Investors are going to focus on the total production costs, including operating costs and risk-adjusted return on capital in appraising the economic viability. So, I know a lot of the focus has been SMRs obviously are something that offers a benefit because the initial capital costs will be lower than for a larger-scale nuclear facility. That being said, it still has to be economic, and we need to figure out that given the small size, that the total cost on a dollar per kilowatt-hour basis is going to be appropriate for the markets.

There is from an investor standpoint, SMRs do bring new technology and, therefore, new technology risk. And particularly where we're talking about potentially putting this into rate base, there's a concern if there is that technology risk, will there be prudence reviews going forward, will there be disallowances, and all of that needs to be factored in as companies think about investing and looking at the costs of capital, because they'll be looking, as I said, on a risk-adjusted cost of capital.

So, the construction and regulatory risks will need to be addressed, and that can be addressed through fixed-price turnkey contracts, but then really the risk that goes to the new developers, and I think really emphasize the importance for some of these prototypes in minimizing the risk and demonstrating the ability to build some of these at reasonable economic cost. Turn to the next slide.

So, investors are going to look for protection for some of these unique risks that we're going to see associated with SMRs. They're going to be concerned, like I said, with the potential disallowances or write offs, and looking for some support there; and whether that's through energy policy or other programs, I think importance for sessions like this to think about how to protect investors for those type of risks.

I think the mechanisms like the DOE loan guarantee are going to be hugely important for the debt financing associated with this. Clearly, someone who's looking for a debt-like return is not looking to take that risk so, therefore, a DOE loan guarantee would be one way of obviously providing that protection. But as we've seen, the DOE loan

guarantee actually comes with a cost, which under most current programs that's absorbed by equity investors. And now you're asking equity investors to pay for that in addition to getting returns for maybe taking some technology risk; that's the area I think that really needs to be addressed, is have the equity investors in this new technology which will be hugely important I think for energy policy, how are they protected?

So, those are all the things that investors are looking to. I think from my clients, the investor-owned utilities, the independent power companies, and then from the investors, whether that's institutional investors, or individuals who invest in these types of companies, that's what they're looking to. And from their standpoint at this point it's kind of early days. They need to monitor this and then figure out over the long term how they're going to be protected. But I think it is on their minds, it is something that they see the opportunity here, and they see the ability of scalable nuclear power which will reduce the initial up front costs and allow companies to maybe invest over time; how that could be hugely important going forward. So, early days from an investor standpoint, but I think both the clients that would invest in this technology and the investors see the long-term opportunity.

CHAIRMAN MACFARLANE: Great, thank you. All right. Dr. Glaser.

DR. GLASER: Yes. Good afternoon, everyone, Commissioners. It's a great honor for me to be here and share with you some of our work on SMRs. So, before I begin, let me briefly give you

some background about our project in Princeton on the first slide, or second slide.

So, in a nutshell the main objective of research in Princeton is to review and analyze proposed SMR designs with particular focus on resource requirements and proliferation risks. We've been working on this for a couple of years now, and some of our work is supported by neutronics calculations, and we focus on notional reactors, so we're not so much interested in specific designs that a vendor might be proposing, but we try to organize them by different families or categories, and look at them from a more kind of high-level perspective.

Today I'd like to kind of spend a couple of minutes on kind of two topics, one on technology choices for SMRs; and two, siting and deployment options, or deployment choices for SMRs. Next slide, please, and one more.

So most concepts today are based on light-water reactor technology, and the main reason for this choice, of course, is the desire to demonstrate SMRs as early as possible, and perhaps also to leverage first-to-market advantage. We've already heard about the designs on the table today, and you can see them here on this, in this table again.

Now, the reason for this, if you move to the next slide, is that PWR technology, of course, is mature. There's a lot of experience with PWRs large and small, so in that sense it's a practical next step. But let me make a few additional observations relevant for the fuel cycles of these reactors.

We think it's worth noting that small light-water reactors like PWRs would have significantly higher demand for fuel. Overall, we'd be looking at 55 to 65 percent increase in fuel and this, obviously, translates into a similar increase in enrichment demand. And, of course, also a similar increase in the volume of spent fuel generated. And the reason is the lower burnup that this fuel would achieve in these reactors.

Now, we don't think this is a major problem for the viability of the technology but, nevertheless, it's something to keep in mind when assessing the pros and cons of different reactor options, especially when one thinks about SMRs on a larger scale, perhaps on a global scale. Next slide.

The second category that I'd like to mention at least very briefly are the SMRs with lifetime cores, or reactors without onsite refueling, because I think they already mentioned, and Dr. Kelly actually did mention them in this forum. It's important to remember when you look at the next slide that it was the idea of lifetime core reactors that actually generated most of the interest in SMRs in the early 2000s. There was a 2007 report by the IAEA that listed 30 different concepts for reactors with lifetime cores, but very few of them actually survive today. And some of the more prominent ones are listed here.

Now given this technology spectrum for SMRs from very mature PWR technology all the way to more radical reactors with lifetime cores, we believe the big questions for the SMR debate is what type of reactor, what types of reactors should we have in mind when we think about SMRs in the longer term, and on a global scale? And to be

clear, you know, the current emphasis on LWR-type SMRs carries some, or carries a certain risk of technology lock-in, which may or may not be suitable for global deployment.

With that, I'd like to move on to my Part 2. This would be slide 10 in the briefing, Siting and Deployment Choices, Part 2. Right, here we go. Which, again, we think it's a very important dimension of the SMR debate. Among the most intriguing features of SMRs is the possibility of siting and deploying them in new and more flexible ways. And I wanted to say a few words about both these aspects.

Now if you look at the next slide, this is a busy one. It shows coal-fired power plants in the United States. This idea B- one idea that has been around for quite some time is the possibility of deploying SMRs at sites that currently host coal-fired power plants. And in the United States there's still today 560 coal sites with almost 1,400 generators, coal generators, and an installed capacity of more than 300 gigawatt electric. And as you may know, a significant fraction of these plants are old, very old, and they're small, and they will have to be closed down soon. And if you do the numbers, overall we may be looking at roughly 250 coal sites with about 600 generators that could potentially host SMRs, so that's based on our estimates.

Now in the next slide, there are now two ways of looking at the situation. On the one hand, it's true that coal-fired power plants are generally located closer to urban areas. And I believe this is partly why we're talking about the scalable EPZ, the Emergency Planning Zone today. But it's also true that there are many coal plants,

old and small coal plants in relatively remote areas, combined we think we're looking at roughly 60 percent of the candidate plants have, for example, a population of less than 100,000 within a 10-mile radius. And if you add those up, there are about 150 sites with a total capacity of 70 gigawatts that are in relatively sparsely populated areas.

In other words, and that's kind of the bottom line here, one could site 200 to 300 SMRs in the U.S. at sites that are not very different from those where nuclear power plants are today. So, the bottom line, and an important question is, can we perhaps site the first wave of SMRs at sites that are just like any other nuclear sites, perhaps even without revising some of the relevant regulations.

Next and it's my final point about the deployment modes. As you know, another characteristic feature of SMRs is the proposition to deploy them in new ways, and I have a few cartoons here on the slides on barges, underground, and under water. And, essentially, all SMRs currently considered for deployment in the U.S. envision underground siting. The idea is not new. In fact, it's rather old, it comes from the 1970s, but it has attracted for obvious reasons new attention, especially since 9/11.

Now, if we move to the next slide, the question then is are SMRs better suited for underground siting than large reactors are? And you can see here the excavation volumes, these are estimates that we've done per megawatt electric installed for different types of reactors. On the left you have typical large reactors, Generation 2 and the AP-1000, and two prominent SMR designs on the right-hand side, or three I should say. And as you can see, based on our estimates, and

these are rough estimates, there is really no relevant difference between excavation volumes per megawatt installed if you compare SMRs with large reactors.

If you move on to the next slide, underground versus above-ground siting. Now, there are many open questions with regard to the advantages and disadvantages of underground siting, but we think the concept does have appeal. Obviously, underground siting would certainly offer enhanced protection against aircraft impact. There may be other advantages even for earthquakes and so on, but there are obviously also some drawbacks, and has to be much better understood.

I will only mention one, which is the economics. I think there's no doubt that underground construction will be more expensive, and estimates range somewhere between 20 and 60 percent plus. And SMRs are already challenged to compete with large reactors today, so we believe one critical question is, you know, will the idea of underground siting survive as a characteristic feature of SMRs once we actually start building them. Or to put it differently, if the security and safety benefits of underground siting can be demonstrated, I believe it's very important for the SMR industry to agree early on that this deployment mode is, in fact, a central feature of the new technology. And, you know, it would be important for standardization because SMRs, everything is about serial production, but I think it's also important for public acceptance of the technology.

So, perhaps let me stop here and I am, and I guess we all are, happy to take questions. Thank you.

CHAIRMAN MACFARLANE: Great, thanks. All right. We're going to start questioning off with the new guy, and we do that here. Did it to me, and we did it to Commissioner Baran, and now it's Commissioner Burns turn, so we'll turn to Commissioner Burns.

COMMISSIONER BURNS: Okay. Thank you, Madam Chair. I was intrigued by the comment that Mr. Glaser made about the potential for a technology lock-in. And I might ask Dr. Kelly and Mr. Perez to respond. I know Dr. Kelly talked about both the light-water technology, and I know he's very much involved with the Gen4 issues. And I'd be interested in how do you see a transition, or how do you avoid that potential problem?

DR. KELLY: Right. So, if we're interested in clean energy, and the means of producing clean electricity, then we see the light-water technology as being the first movers. And, again, in about a decade as B- really when we see the order books filling up for the clean energy technology broadly, and we think SMRs and large gigawatt class reactors should be part of that portfolio.

But moving out into the latter part of the century, there'll be other factors that come into play. Process heat currently emits a lot of carbon dioxide in the atmosphere, and there's opportunities with high temperature reactors, small high temperature reactors such as the B- what was in the NGNP activity, as a means of replacing natural gas as the source of that high temperature heat. And then if uranium resources become an issue, certainly fast spectrum reactors have huge advantages in extending the uranium resources. So we see both of those drivers as coming on the horizon, probably lacking by 5 to 10

years after the electricity mission for the SMRs.

MR. PEREZ: Thanks for that question, Commissioner. I may take a little different tact than Dr. Kelly. I do agree that there is some benefit relative to insuring that technology keeps moving. If anything, I will generally tell you after B- this is my 34th year in the nuclear industry, and what I think I've seen stimulated by continued reactor development is the idea of thinking, thinking about how do we create better levels of safety, creativity, and passive safety, so the idea of continuing to innovate is a must do.

But let me also tell you my other part of my experience, and that is the deployment of civil nuclear power to make an impact on quality of life. You know, when you look at the development B- the use of, especially US-based, safeguards-driven light-water reactor technology, and how that impacted the quality of life in places like Europe and Asia, a lot of it was fundamentally locked into a concept that said we're able to take some of the operating experience, the safety ethic that occurred in the United States and was fostered and nurtured in the United States and we're able to deliver that safely and effectively to many other different continents. And you clearly see today the ability of economies like in France, or economies in Korea to be able to develop electricity safely and effectively without emitting CO2, part of it was tied to the ability of taking light-water reactor technology and deploying it there.

So, my only comment to you is B- and I'm not here to talk about the ability of where do I see that deployment in the next phase, but I will tell you we would miss a point if we do not learn from

the past and the history that this country was able to show leadership throughout the world by leveraging its light-water technology experience, both from some core naval experiences that came out of the nuclear propulsion system, to civil generation, and then the ability to deliver that safely. Even in small countries, you take today a country like Slovenia where 60 percent of its electricity is generated B- a population that's probably smaller than most of the states in the United States, it's been able to produce electricity safely and efficiently in that country for the last 25 years. And I would say we'd lose something if we don't try to replicate that same kind of concept. So, I'm not talking about locking in technology for the future. Let's lock in on what's worked.

COMMISSIONER BURNS: Thank you. Sort of going off under that theme is, I think you may have mentioned in terms of lessons learned from Part 52. What do you think those lessons are, and their particular application for the SMR development?

MR. PEREZ: Yes, it's B- I could take the whole day, but I won't do that. As most of you know, I was very involved in the design certification of the AP-1000, not 600, AP-1000. Some of it is programmatic, Commissioner. I would generally tell you coming down with some clear specificity on design review standards and acceptance was critical in bringing the ball over the goal line on the AP-1000.

I would also tell you, and I think I've shared this with the Staff, a lot of it, and I know I've talked it over with several of the Commissioners here that were here at the time, the ability to engage the Staff effectively and understand the threshold of the Staff. I am very B- and I know I've said this to many of the Staff before, I am very

respectful of the fact that Part 52 requires the Agency to make a determination of public safety that is at a different threshold than it was in the Part 50. Fundamentally, you're giving the licensee a license to operate that plant at the time of construction, so, we are respectful of the fact that that is a large threshold.

The only thing we would ask, I think in that process was a very clear communication of where that B- how could we clearly help the Staff make that determination efficiently? And that is not a simple send me a rock, it's the wrong rock, give it back. It really required a level of interaction, especially on a new safety system design, like we were talking about the AP-1000 or here. It requires a level of engagement, technical, public transparency that, frankly, doesn't even look like Part 50. Even on the design application amendment for AP-1000 we had over 60 public meetings, and that was just for an amendment.

Now, the positive of that was it brought an unbelievable amount of transparency and interaction with the public. But I'll also tell you behind the scenes it also required a level of interaction that is much different than we saw in the Part 50 regime.

COMMISSIONER BURNS: Interesting. I guess one other question B- well, along those lines, I guess another question I would have is then, you may have touched on it, but any of you in terms of what are then the pacing issues? I heard part of it is in terms B- even though we're dealing with light-water technology, there are some B- I take it some technological issues that may be what I'll call pacing issues, or the things that sort of, I don't know if you want to say hold it back, or basically those things that need to be resolved. But I also

heard, I think, the emergency planning and the security thing. Where B- sort of where does that sort of sit from your standpoint?

DR. KELLY: Yes. Well, let's see. So, for several years now we've been discussing what we'll call a set of generic issues. Some are we'll call policy issues that are working their way through the process, such as indemnification, and fees, and things like this that really are not technical. There's a set, though, that I think involve some technical inputs. And if they require things such as analysis or experimental work, that work needs to be done. So, we're trying to address those things generically so that they can benefit all.

Each technology vendor then will have their own set of specific technologies, control rods, or within heated zones, or whatever the specific design feature is. That's why we're glad to see that the vendors have been building up their testing capabilities to provide the data that will help answer those questions early on.

So, you know, it's not B- I think there is a pattern for how the review will go, and getting the data and information in advance I think is going to be important. You know, we've heard that the applications need to be complete, that that will expedite the review. We've enforced that concept with our partners, and hope that they will be able to deliver on that. And we'll hold back on timing, on schedule in order to have a more complete and thorough design.

MR. PEREZ: The only thing I'll add to that is I think you're starting with the end in mind, so some of the comments that Anthony made relative to the economics and the ability to deploy these effectively in the kind of economic schemes we're talking about are

things that are the end in mind. So, when you talk about the appropriately sized EPZ, staffing issues, security issues we talked about, the industry has a pretty good idea what that B- pick what good looks like in that perspective and getting a red thread from those ideas to policy is clearly one of the things that I think we're talking about with John, and with the Agency on how to get there.

COMMISSIONER BURNS: Okay, thanks.

CHAIRMAN MACFARLANE: Okay. Next. All right, we'll start off with Alex. Why do the light-water SMR designs require lower burnup?

DR. GLASER: They don't require lower burnup, but they based on our estimates achieve lower burnup for the same enrichment level of the fuel. And the two main reasons, one of them is the cores are smaller so there's more leakage. But more importantly, there's no fuel shuffling generally kind of envisioned for these reactors, and the fuel is replaced, you know, drop in/drop out so the burnup is more homogenous.

CHAIRMAN MACFARLANE: Okay.

DR. GLASER: Axially, radially I should say.

CHAIRMAN MACFARLANE: Right, right, right. Okay.

DR. GLASER: So overall we B- based on our calculations that a 50 megawatt days per kilogram you will get 30 to 35 megawatt days per kilogram. And, you know, that's exactly the ratio, 50 over 35. That gives you a plus 50-60 percent.

CHAIRMAN MACFARLANE: Okay. So, let's talk internationally here, because the United States is just one market, and I

know that a lot of the SMR manufacturers are also envisioning selling around the world. So, I want to understand more about the foreign markets, if any of you know anything about that. And, you know, Alex, you mentioned some of the B- a few foreign designs. Are there other ones that are out there that are viable, that are competitive that we should be aware of? You know, is somebody else eating this lunch already, and we're just listening B- we're in our little fishbowl here, or echo chamber. What's going on? So, who wants to jump in? I don't care if a bunch of you respond.

DR. KELLY: Well, I don't mind telling you what I know from our perspective. Certainly, if you look at the IAEA documents, there's a whole set of small reactor designs that are out there, but there's probably three or four beyond the U.S. designs that are, I would say real.

CHAIRMAN MACFARLANE: What are they?

DR. KELLY: China has a small reactor that they are progressing in the designs, have plans to construct a demonstration. The Koreans have something called SMART.

CHAIRMAN MACFARLANE: Right. Which Alex mentioned, right?

DR. KELLY: Yes, the regulator has already done the B- whatever their process is, certification.

CHAIRMAN MACFARLANE: Right, it's licensed.

DR. KELLY: They're now looking at trying to build that. The Russians have a barge-mounted unit which is probably meant for specific applications, not broad applications. And, you know, basically, I

think that's probably it, although Argentina has a model called CAREM that they're in the actually construction phase for the prototype of their small module reactor.

In terms of B- those are the suppliers. In terms of the markets, lots of interest, lots of countries signing up. You know, most of those are going through IAEA milestone process where they're actually trying to develop the infrastructure in their country, so they're not all B- they're not ready to sign up and buy. Most of them want B- would like to see the country of origin actually have the first operating plant. So, they recognize that that's sometime out, but there is certainly a lot of interest in the technology, just because in many countries it would fit with their grid infrastructure probably better than the large units.

CHAIRMAN MACFARLANE: Anthony, do you have a view on this?

MR. IANNO: Yes, I would just add that from a market perspective, I think obviously there's a lot of countries out there that are de-emphasizing nuclear right now. I think, obviously, Germany, Japan, and I think that's economically disadvantaging those countries, and it's escalating their cost of power having B- dealing with what they're dealing with.

I would say clearly from a competitive standpoint that China offers a unique advantage in developing this technology because they don't need the public investing to B- whether it's from institutional investors, or whether it's from investor-owned utilities, or whether it's from individuals, China can obviously just put in place a policy and start developing this. And I think that would be the fear that they would be the

most advanced from both a technology standpoint, and from an implementation standpoint.

CHAIRMAN MACFARLANE: Okay, anyone else?

DR. GLASER: I guess I agree with everything that's been said. I mean, I did mention the lifetime core reactors, the idea of a nuclear battery that you would supply, and the customer would use. And when it's depleted it would be picked up and away. And I guess part of the attractiveness, at least from the non-proliferation perspective, was a couple of B- many B- or a couple of years ago that you may actually have a different fuel cycle architecture where you have a hub and spoke system where you have very few vendors who make these batteries, so to speak, and then they get shipped to the customer and picked up afterwards. And the idea was maybe that has non-proliferation advantages in the longer term.

Now, gaps remain, technology gaps. I mean, if you want to irradiate fuel for 30 years, we haven't really done this very much except perhaps for the Navy. So, you couldn't really deploy them today, or tomorrow, but I wanted to make that point. You should keep in mind that this was partly why we started thinking about SMRs in the first place.

CHAIRMAN MACFARLANE: Okay. For Alex and John, are there particular sites that are not appropriate for SMRs? And maybe you want to say B- one of you wants to say more about flooding, and the risks associated with that? Go ahead.

DR. GLASER: Well, you know, the flooding comes in B- I did mention underground siting, which I think has important

advantages, but I also mentioned drawbacks. Economics is one of them, but in terms of security there are issues with what if someone takes the plant hostage, how do you have access to the facility. And after Fukushima, of course, there's also the question about flooding in underground sites, so I think at this point it's too early to say, you know, underground siting is definitely a go. But I think it's worth looking into, and really kind of balance the pros and cons.

DR. KELLY: Yes, and I don't think the B- you know, there's been that kind of detailed evaluation on specific sites based on that. I think there's general understanding that if you understand the geology of the region and the meteorology, and those aspects of what is possible and build that into the design basis for the plant, that the civil engineers can figure out how to waterproof, how to build up weir walls, whatever is necessary. So, I don't think we've come to the point in those designs of actually getting to the point of how you would B- what kind of maximum flood could you survive and that. But certainly I think that, you know, everyone is very much aware of these unintended or rare events that need to be considered in the design base, and appropriate measures taken.

CHAIRMAN MACFARLANE: Okay. So, let's go back to economics. A number of claims have been made about the smaller size reducing the initial up front costs. Will it really reduce the initial up front costs?

MR. IANNO: Well, certainly, from a total dollar standpoint it should be a lot less expensive to build a 50 or 200 megawatt SMR than it would be to build an AP-1000 unit. And that B-

CHAIRMAN MACFARLANE: But you're excavating the same amount of material kind of thing. I mean, you know B-

MR. IANNO: Well, I think the point was per megawatt.

CHAIRMAN MACFARLANE: Per megawatt, yes.

MR. IANNO: So, the initial dollars B- and for AP-1000 we're talking seven-eight billion dollars. It will be something less than that, so clearly that will be helpful from a dollar standpoint. But as I started with, if there is technology risk, then investors are not going to be looking for the typical 8-10 percent ROE that we see for some of our regulated utilities. They're going to be looking for some other higher rates of return to compensate for that.

CHAIRMAN MACFARLANE: Yes. Any other views?

DR. KELLY: Well, just that for the SMRs we B- you know, it depends if you're thinking first of a kind or later in the kind, and the fact that we are really looking at a model where you get the factory fabrication, which can improve both the economics of each individual unit delivered, but also the quality, and safety of that. So, we're thinking that that actually goes together. It's not just big versus small, but it's small plus factory fabrication that are really the two ingredients that have the potential to be competitive, whether that means lower price, we're not sure of that yet, but competitive is in a range that a utility would consider for something in their portfolio because of the overall value that it provides to that portfolio.

MR. PEREZ: Let me just make a comment. I am not familiar with Dr. Glaser's work, but I am familiar with AP-1000 excavation costs and it is extremely small amount of the overall relative

project cost.

DR. GLASER: What I showed was if you were to build the AP-1000 underground completely.

MR. PEREZ: Okay. But I generally will tell you the excavation costs were extremely low.

CHAIRMAN MACFARLANE: Yes, it was about putting it underground.

MR. PEREZ: And the B- and in general I can say to you that if you recall, the excavation at Vogtle 3 and 4 were actually commenced before economic rate making was made by the State of Georgia. So, the reason B- I only give you as a data point. I'm not certain that that is the litmus test on the economics. There is a lot of other challenges to the technology, a ton, which is clearly part of the things that need to be developed and matured. But right now, the underground issue from at least the perspective we have in the industry is not the tipping point to the economics of the reactor design.

CHAIRMAN MACFARLANE: Okay.

DR. GLASER: And one quick comment, perhaps. Combining the economic argument with the lock-in, risk of lock-in. I mean, I think there's B- I wouldn't be surprised if the first SMR units are more expensive than B- per megawatt as kind of the large reactor, and that's not a problem. And the first of a kind will be more expensive, I mean, in a realistic world.

The question really is, you know, how quickly would these B- will this cost come down? How much do you learn per unit, the learning rate from first of the kind to nth of the kind. And that's where I

think we really need to understand much better how this will play out, and how many IPWRs would you have to build to actually understand where you will end up? And that's where the lock-in argument may come back. Do you need 10, or do you need 100? And at that point you might have said well, you know, we keep building those because we know how to do this. And that's the tradeoff, how many do you have to build before you know what the economics are?

MR. PEREZ: Let me make a comment, though. One thing we can't B- if we're so locked into LCOE and the old way of thinking B-

CHAIRMAN MACFARLANE: LCOE?

MR. PEREZ: Sorry, Levelized Cost of Electricity, sorry, Chairman. That's an old way of thinking. Fundamentally today, if you look at some of the nuclear plants that exist in the United States, what tips the economic case is when they're able to be dispatched.

CHAIRMAN MACFARLANE: It seems what tips the economic case for nuclear plants right now is whether they're in a regulated market or not.

MR. PEREZ: Well, I think there's B- if you look at them, half of them are not in regulated markets.

CHAIRMAN MACFARLANE: I'm talking about new builds.

MR. PEREZ: Yes. The B-

CHAIRMAN MACFARLANE: Correct?

MR. IANNO: No, but definitely for new builds whether they're rate-based or not, but I think what Rick's point was on, if you

look at existing plants, the merchant plants.

MR. PEREZ: Merchant plants.

MR. IANNO: And, obviously, a big subset of the existing nuclear plants are outside of rate-base today. You wouldn't build a new one today, but the existing ones, is I think what Rick was getting to.

MR. PEREZ: Right. The issue is in non-regulated markets, I think we all are actually in agreement, the big gigawatt size reactors, it's a tough lift. The question becomes in unregulated markets where agility and diversity matters, and let me just be sure that means. That's what all economics is based on. You're able to dispatch at the right time for the right amount of money, and that's where we think there's a real play for non-CO2 generation from an SMR.

CHAIRMAN MACFARLANE: Okay, great. Thank you. Commissioner Svinicki.

COMMISSIONER SVINICKI: Thank you for your presentations. It really has been interesting, some of the topics are not strictly in our Atomic Energy Act purview here, but it's very interesting to understand these broader dimensions of some of the regulatory issues in front of us.

Dr. Kelly, I didn't realize that it had been well over three years since the Commission had met on this topic. That's almost as long since you and I have gotten together to complain about Michigan football, but there's not really a whole lot of good news stories there this season, so B- but to be fair, I think one of the reasons that it might have not been at the top of the Commission's list the last few years is that

over the last seven or eight years the timeline of anticipated submittal of designs for review at NRC have slipped pretty consistently out to the right, so it has been something where based on larger things that have happened economically and otherwise, there's been some change of plans in terms of our anticipated receipt of designs for review. But, nonetheless, as Dr. Kelly and others have made clear, there are a number of very important initiatives that we can be engaging in, resolution of issues, other technical work that can be done as that B- as the vendors continue to work on their design submittals.

One of the issues that has been worked on is the set of what we call policy issues. Commissioner Burns asked about this, as well. It's been a pretty static list of those issues, one of which is security. I know that the NRC Staff has concluded that the NRC's current security regulations provide a framework within which one could license an SMR.

To me, though, the question on the policy issues is a little bit different. The framework that we have for regulating, of course, adopts itself most seamlessly to large light-water reactors because that's what it grew up around, and has evolved to regulate. So, on the policy issues, I might ask, this is a very broad question, but is the community of practice here in terms of defining and putting forward, and resolving policy issues, is the community of practice where you anticipated we would be in the year 2014, or do you think that we've been a bit slow in scoping those issues and getting them resolved? Anyone who would like to respond on that.

MR. PEREZ: Yes, I think we have moved the ball

forward, Commissioner, relative to some of the policy issues, but the old adage, the proof is in the pudding and eating it. I think it's application. Now, there is some highly innovative ideas on security staffing and security items that are being woven into the design concepts from the start that should allow us to I think really understand if we can appropriately downsize some of the staffing and security, but it has to be hand in hand. So, I think that the B-

COMMISSIONER SVINICKI: It's not so much in security, that Part 73 is written in a way that you'd have to kind of regulate by exemption. It's that when we get into the application of it, which as most of us know, the regulatory language is written at a very high level, so you will apply to B- you will basically have a security plan that proposes to comply in a certain method, and so your point is you need to submit one of those plans and get an NRC Staff reaction to really know that that's B- your phrase of the proof is in the doing.

MR. PEREZ: That's correct.

COMMISSIONER SVINICKI: Okay, so we are B- but in terms of what we can do notionally and generically you feel that we are advancing the ball on the policy issues.

MR. PEREZ: Yes, we have. I know at least one of the designers has brought that up, and gotten pretty good engagement with the staff on the concepts.

COMMISSIONER SVINICKI: Okay.

MR. PEREZ: But that's still just in a very preliminary fashion.

COMMISSIONER SVINICKI: And something that's

helpful, as you said, specifics are really how we resolve issues. And, of course, we don't have any designs under review right now, but we do have very substantive engagement with the vendors. Design-specific review standards, I know I've been told by the vendor community are extremely helpful in that they aren't regulations, but they give a strong communication of what the NRC Staff is likely to find acceptable or unacceptable in terms of proposals to comply with those regulations.

We will hear from the Staff, and I've been aware for some time that they target having a design-specific review standard available 12 months prior to the submittal of the design itself. In talking with designers, I think somewhat not surprisingly, they've indicated that the earlier they could have that knowledge, they could improve the quality and thoroughness of their submittals.

The Staff, I think B- I shouldn't speak for them, but I think would rebut well, but the better design specifics you can have for me, the better design-specific review standard I can write. So, there's a little bit of finding a sweet spot here. Would you like to, any of you, like to react about the 12-month target, and whether the community, the regulated community or vendors, what's their view on that?

MR. PEREZ: Well, I'll start and be brief. I do think that 12 months is imperative. It's my experience, I will say B-

COMMISSIONER SVINICKI: Is it insufficient? Imperative sounds like well, we have to at least have it then.

MR. PEREZ: That's B-

COMMISSIONER SVINICKI: Are their lost opportunities in the quality of the submittal by not having it done earlier?

And do you take the Staff's point, that it's difficult for them to develop a high-quality, design-specific review standard?

MR. PEREZ: Right. I will say this, I'll be very succinct. I think it is sufficient. My perspective would be, there's a devil in the details in what you just have described, and that is B- and I know the Staff's very aware of this, design acceptance, especially the use of design acceptance criteria in areas that are difficult.

COMMISSIONER SVINICKI: Well, I was going to ask about that. The Staff has said that their notional time frames for reviewing an SMR, one of the assumptions is critical that could blow the estimate is minimize the use of design acceptance criteria. And I was going to ask a question, is that reasonable? Is that B- are we going to see a lot more design acceptance criteria than we would for like an AP-1000 or something?

MR. PEREZ: It becomes an issue of the level of specificity that you're able to fund and deliver at this part of the process. Let me give you just quick insight. The reason why there was a lot of design specificity on the AP-1000, it was very much tied into providing the economic structure that the supplier did to Georgia Power and to South Carolina Electric and Gas relative to design B- price certainty. So, the question becomes without fundamentally yet a direct customer as to knowing who's going to actually build one of these things, the supply base has to always balance that issue, is how much B-

COMMISSIONER SVINICKI: But if you don't have customers that you can identify now, would that lead to a kind of, I don't want to call it a laziness, but a greater willingness to have DAC in there,

because your customer is not driving you. They're not saying I've got to make the business case, so you can't just have a box that says we designed something inside this box.

MR. PEREZ: I think we have a robust debate with the Staff. There are certain technologies that lend themselves, I would argue, to design acceptance criteria. When we're talking about piping analysis, the state of piping analysis in the country isn't like it is in digital technology on I&C. It's a known entity that is something that I believe, in fact, does lend itself to design acceptance criteria.

I recognize that there's differences of opinion on that, so my only comment to you is that's a kind of interaction B- when I stated that we need to have a robust discussion with the Staff, it would be to achieve those things, what are reasonable B- because I am sensitive to the fact that Staff needs to be able to make that determination.

The question is, if you have to get down to one-inch-line piping designs, that level of specificity is very difficult in this phase of maturity of the design. That's clearly more in the certified for construction type of phase, that would argue would be in a COL type of discussion.

COMMISSIONER SVINICKI: And, again, I really appreciate the discussion of some of the economic questions, not strictly in our wheelhouse here at NRC, but obviously has a huge influence on what will end up in our regulatory sphere, so I think it's really interesting to be informed by that. So, we're having some back and forth about excavation costs are not, I think as one of you put it,

maybe it was Dr. Kelly, a litmus test in the economics here in terms of SMRs.

One of the things that I do here thematically, and have heard over the course of years is, a litmus test in terms of the economics is going to be the ability to have confidence in the estimated regulatory review time frame. Now, the NRC Staff will begin with a statement, as they should, which is there is no instance in which an estimated time frame is going to compromise safety and their review, and that is as it should be.

But that being said, if 39 months is 80 months, my sense as not a business person is that probably blows the business case, but I don't know. Does an overrun of, you know, 20 percent of schedule, or 30 percent of schedule, you know, how much confidence does there need to be in B- if NRC says we will review this in 39 months, is 45 a killer, is 80 definitely no-go? I don't know. How will that be monetized in an analysis?

MR. IANNO: I think I started off my presentation talking about the process for the licensing of the new AP-1000 that are coming on line. And I think that will be the litmus test on how that works.

Now, obviously, there is some B- there's B- in developing the technology, there is some incremental risk associated with that. And, therefore, all of that needs to be factored in, in analyzing the cost of capital. And, therefore, I do think that it's going to take some of these B- I think in some of these early projects that B- which aren't necessarily going to be economic if they're going to get built. We'll all have a learning process associated with that, and then we'll all get more

comfort around the time frame for the review. But I think, certainly, the public markets couldn't take that open-ended risk around how long a review process is going to take.

MR. PEREZ: I would just add one thing. Keep in mind what we're talking about. This is a reactor that has significantly less source term, significantly less complexity, significant, 60-70 percent less piping, much more simpler levels of design safety that are orders of magnitude more than any other operating units in this nation. So, the reason I say that to you, Commissioner, is I would think that you add that, you add the experience we had, the ability from the other reactors that have been designed, and we've got to be able to hit those dates.

It's somewhat a credibility issue from both a design perspective, and also from a regulator that, you know, the ability to bring a safer reactor into the public domain, and do it in efficient fashion I think is an important test for us to be able to demonstrate that we can deliver these kind of new technologies the country needs.

COMMISSIONER SVINICKI: Again, I appreciate all of your insights. Thank you, Chairman.

CHAIRMAN MACFARLANE: Okay. Commissioner Ostendorff.

COMMISSIONER OSTENDORFF: Thank you, Chairman. Thank you all for being here today.

I want to kind of pick up B- let me start off with where Commissioner Svinicki was in the latter part of her questioning. In my discussions with Glenn Tracy and Mike Mayfield, and Stu Magruder out in the audience there, I've been impressed and encouraged by the

extent of the prelicensing application meetings between our Staff and industry, vendors, et cetera. I think there's been a lot of dialogue which has been extraordinarily helpful. And I think, Rick, you made some commentary on that with respect to your experience with the AP-1000, which I thought was a key point.

What I hear from our Staff, and like Commissioner Svinicki, I've not be here as long as she has been. We've been watching this now for some period of time. I know, four and a half years for me since I got here in the Spring of 2010, the sense I have from our staff, and when I ask really Rick and John to respond to this. The sense I have from our staff is that NRC Staff has gone about as far as they can go absent an actual detailed written application for an SMR design certification. Agree or disagree?

DR. KELLY: Well, I'm not in the business of B-

(Simultaneous speech)

COMMISSIONER OSTERDORFF: And it's framed because I continue to hear in some of the trade press, and other speaking events that we participate in; well, there's this regulatory uncertainty. There's this big policy question, and I'm not being defensive here, but I do believe that our Staff has really done about as far as they B- gone as far as they can go without saying okay, here's a detailed design. So, that's B-

DR. KELLY: I guess what I've heard is that, you know, have we reached the point of diminishing returns on the pre-application discussions. I think not. I think there's always some opportunity there. We're still looking to be a couple of years away, so continuing the work

on the generic, on the design standards for the B- NuScale has not been completed, so that's B- the B&W one has been put out so there's, I think B- but continuing that kind of work, and continuing the discussions on the generic issues, it has to continue because they're not going to go away in two years time, I don't think.

In terms of the design, you know, specific reviews, that's B- you know, it's going to take time. It takes time to meet the expectations, and I think we have to wait and see on it.

COMMISSIONER OSTENDORFF: Okay. Rick?

MR. PEREZ: Yes, I'd like to bring you back to something which I think has a lot of logic, and even though I in the previous reactor regime, we may not have followed as exactly as industry. I think so far what we've put in the queue relative to the SMR helps answer your question.

The initial targets are for early site permits in the end of 2015. DCA Design Certification Applications in the end of 2016 followed by COLs in the 2017 time frame.

The reason I say that to you, I do think they provide a progressive graded type of approach to dealing with the issues you talked about. So, very pointed in our case. The Tennessee Valley Authority's application for early site permitting of Clinch River, we decided to take the ball on the concept of appropriately sized EPZ. And that clearly, and I think the Staff would agree, that is something that's going to require strong engagement with the Staff. So, I do think there's still much more discussion on that.

COMMISSIONER OSTENDORFF: Just let me

interrupt, because that's a great example. It's my understanding that NRC is still waiting on a mechanistic source term calculation from a licensee here. Is that a fair statement?

MR. PEREZ: It is a fair statement, but we've discussed this to be sure that we have the right methodology when we provide that to you.

COMMISSIONER OSTENDORFF: Okay.

MR. PEREZ: It's not super high science.

COMMISSIONER OSTENDORFF: No, I understand.

MR. PEREZ: We believe that it's very doable. We want to be sure going back that we deliver a product that Staff is confident in. So, to answer your question, you're right, but the B- how that's framed, how that dovetails with policy that has to come to the Commission. Those are the kind of discussions we've having.

COMMISSIONER OSTENDORFF: Okay, thank you. I want to turn to Anthony. I really, like Commissioner Svinicki, I think there's a lot of value in us having awareness of the business economic environment even though it's not "necessarily in our direct responsibility as a nuclear safety regulator." I note you made a comment that new nuclear absent being present in some type of rate-based environment or long-term power purchase agreements that some new construction is not likely.

I have a couple of questions. I'm going to maybe two or three questions and then let you respond however you'd like to, because I think it's helpful to get these out on the table. So, one question deals with absent some change in carbon emission policy in

this country, absent some premium value being placed on 24/7 base load generation, is it likely that there will be a cost competitive argument to be made for SMRs? That's one question.

And the second is, you know, looking at natural gas. Is there some magical number for long-term natural, shale natural gas, natural gas future prices above which gas price that looks like this is more of an economically viable technology to consider? So, I'll stop right there and let you digest those.

MR. IANNO: Sure. And you hit on the key issue, gas prices are lower than we all expected them to be, and the abundance of gas to be found leads to a belief that gas prices will stay low for a significant period of time. So, clearly, to the extent B- unless that changes, it's uneconomic for us to think about SMRs purely for economic reasons. There obviously are going to be other policy reasons. There might be changes in emissions, and there might change in policy around capacity, but today there's nothing that points to SMRs being economic. But I think clearly what the people on this side of the table are thinking about is okay, well, if we wait until we have those economics to support it, then we're too late. Then we're talking about another 10 years before we were able to deploy a significant amount of this, so I think everyone here is trying to figure out how do you move the ball forward while we have this type of environment? I think that gets maybe to your question earlier about are things developing as quickly as we would have expected? Well, there isn't obviously the urgency for that development, which I think slowed down a little of the development side of it, as well, you know. And that's not necessarily a bad thing, it

allows us to do things more carefully and without a panic approach, and safely which I know we're all interested in, so it's not necessarily a bad thing, but today we don't have those signals.

Yes, there is a gas price, it's significantly above where we are today. And I think more importantly, it has to be a long term gas price, and that's the problem with relying on purely markets, is they're volatile. And, you know, as Rick was talking about before about profitability, profitability on a lot of technologies happens during those real peak periods. But you can't go out and build a 40-year asset based on polar vortex and the ability to make profit in a three-month period in the beginning of 2014.

COMMISSIONER OSTENDORFF: Okay. I'm going to stop you right there because I want to ask you another question, but I want to get B- I'm going to ask John also to respond to this. So, John Kelly, Pete Lyons, Secretary of Energy have done a lot of investment in nuclear reactor technology. And I really commend John his efforts with his colleagues at DOE. And the funding opportunities that have been provided already for SMR, or license development, R&D have been significant. Some in the private sector could make the case that that's not enough, that if we really are trying to achieve the clean energy goals, one could make the argument from a policy standpoint that the U.S. Government needs to further, and perhaps invest in X number of SMR applications, and commitments to build actual SMRs in different places around the country.

Does the private sector have a view towards what B- whether there should be an expanded U.S. Government role in

moving SMRs forward above and beyond what's already been done? I'll ask both of you all to respond, whoever you want to.

DR. KELLY: Well, let me just tell you what we're thinking. You know, the first big risk is the regulatory risk, and there's an implied financial risk associated with that. That's what we're tackling first. And until we get a design application submitted, you know, we'd be hesitant to go out and start proposing new incentives for technology that's still not even gone to the first phase. So, we think once it's in the regulatory review, once the application has been accepted for review, I think that's a big hurdle. It points the direction positively. It will, I think, point the financial markets, at least give them an indicator. And then I think we can have that serious discussion about what's out there. The Energy Policy Act outlined set of incentives that are working both for nuclear and other renewable energies, and the question is what will we need in 2017-2018 time frame looking forward to what the country will need in 2025 for deployed technology. So I think right now we're beginning the discussions with various think tanks on that subject with the idea that the formulation of the policy to meet our ultimate objectives is going to really B- in terms of when we would want to make those proposals, it's still a couple of years away.

COMMISSIONER OSTENDORFF: Do you have a response, Alex?

MR. GLASER: Maybe one quick note related. I showed this map with these coal plants that are, you know, shutting down in the next few years because new EPA regulations will kick in. I mean, these are, you know, 250 sites or so that will be uniquely suited for SMRs.

They have real access, they have water, they have transmission and so on. The big challenge really for SMRs will be B- I mean, if SMRs are not on the table they will just transition to gas. Right? Most of these sites, and the challenge will be, or the question will we have SMRs kind of available to kind of capture some of the market which, quite frankly, is a historic opportunity. I don't think we're going to see many of those coming more frequently. That's the big challenge in terms of timing, you know, 2018, 2020, that's where the transition occurs.

COMMISSIONER OSTENDORFF: Okay.

MR. IANNO: And I would just add, clearly the private sector has a view, but I don't think there's a uniform view. I think that the private sector clearly hasn't focused on SMRs being the solution, but I think the private sector is focused on the fact that yes, with all the renewables that we're building that we do need some incentive for stable base load generation to support that in order to help the sustainability of the grid. So, I think there's lots of different opinions out there, but there clearly is a consensus I think for strong signals going forward.

COMMISSIONER OSTENDORFF: Yes. Thank you all, thank you, Chairman.

CHAIRMAN MACFARLANE: Okay. Commissioner Baran.

COMMISSIONER BARAN: Thanks. Let me add my thanks for being here, appreciate it. The conversation so far is naturally focused, I think on light-water reactors SMRs. Dr. Kelly, I wanted to ask you just for a minute about non-light-water reactor SMRs.

The NRC Staff has said it would be a challenge to consider a non-light-water reactor SMR design application in the next five years. Based on your interactions with potential applicants, when do you think NRC could realistically see a non-light-water reactor SMR application?

DR. KELLY: Well, certainly, the vendors C-the designers have their views out there right now. We think that there's some long poles in the tent, fuel qualification for advanced reactors which involve long life fuel, or fuel exposure to both neutrons and different coolant chemistries. You know, it could take several years, maybe even a decade for fuel qualification, so you know absent that, you would probably be hesitant to try to license a reactor where you don't have a qualified fuel. But that's just sort of one metric that I use.

Certainly, some of the vendors such as TerraPower are understanding that, and are beginning those programs to do that testing, but it still takes - it is very difficult to accelerate that testing, so it's basically a year by year kind of thing. But the - so, that's progressing, so that's one aspect of it.

I think when NRC says that they're ready, you know, they've told us that they could review by exception, you know, take exceptions to the current regulations. That's certainly a possible thing. I think that introduces some uncertainty in the process, so it's desirable to try to look at the design criteria, general design criteria, safety design criteria, and look at how do you keep, basically, the essence of the criteria while putting it in a format that allows someone with non-light-water reactor technology to respond to that appropriately. And

that's the activity that we're engaged at the NRC, and that's I think in its second year, and it's probably a couple of more years before we at least get that we'll call small step forward in terms of that.

And then there's a third aspect of just the technologies in general. These have been deployed in a few kind of B- you know, on a handful of basis, so we've built sodium fast reactors in this country, elsewhere, high temperature gas reactors. It's been several years, so there's a general lack of familiarity with the technology, so there's really an issue with the human capital resource development to bring people in to both the industry and the regulatory side that are knowledgeable about the technology, and move that forward.

So, on our part, on the DOE's part, we've been investing heavily in the universities, putting about 20 percent of our R&D funding into the university program to try to train the next generation of scientists, engineers, and a lot of that work is directed towards advanced reactor technologies. So, we think the time is coming, that's why we're making the investments now. But as I said, it's probably five, sorry, 10 years before I would say that we've done enough testing that you could really seriously consider that, but I think the vendors would probably be more optimistic than I am.

COMMISSIONER BARAN: Mr. Perez, do you have anything to add to that?

MR. PEREZ: No. I think the main focus I can tell you in the industry in the short term, that being the next I would say 12 to 60 months is on light-water reactor technology. I think just to jump on Dr. Kelly's point, I think in general we see the support of advanced reactors

very much hand in hand with whole concept of supporting STEM B- you know, science, technology, and engineering type of capabilities for the nation. So, don't lose that aspect of it. It's really an investment in that depth and that capability for the future.

COMMISSIONER BARAN: Dr. Glaser, you discussed in your presentation reactors with lifetime cores. And do you see any renewed interest in the U.S. nuclear industry with respect to lifetime cores?

MR. GLASER: Let me just maybe back up a minute. In the beginning when I B- in my opening remarks, I mentioned that in my group, we focus mostly on non-proliferation aspects. Nuclear has several key questions, safety is one of them, nonproliferation is another one. We happen to work on this. And if you believe that nuclear will or should make a big difference in mitigating climate change in the future, you would have to deploy a lot of nuclear power, not only domestically but internationally.

And if you also believe that SMRs kind of will be part of that picture, and if you do the numbers, there will be hundreds, or possibly thousands of them. And so the question really is what type of technology do you want to deploy. And kind of the worst thing you want to happen is it turns out these SMRs that we exported were kind of proliferation prone and involved a lot of, you know, separated fissile material and so on, which is why, you know, we always try to emphasize, let's go back and look at these concepts, lifetime cores without processing of fuel and maybe these hub and spoke architectures. Again, I understand this is not typically what B- for the

domestic U.S. market. That's not the key aspect of SMR development, but it may be one that is relevant for the export market. And, again, the U.S. has been the leader in many of these issues, non-proliferation policy. And I think it would be important to kind of keep that part in mind. I was pleased to hear from Dr. Kelly that DOE does put quite some emphasis on this type of technology.

COMMISSIONER BARAN: Mr. Perez, what are your thoughts about that, lifetime core, is that something that B-

MR. PEREZ: I would be B- come in line with Dr. Glaser's comments. I think it's B- the market in the United States would be very, very limited, Commissioner. I know there has been some discussions in very, very remote areas, but I think that's a one-off, so my guess would be, as Dr. Glaser indicated, probably outside the United States.

COMMISSIONER BARAN: Okay. You mentioned that successful large reactor licensing programs provide a regulatory policy roadmap, that that's an important thing here.

MR. PEREZ: Right.

COMMISSIONER BARAN: The NRC Staff is proposing to address certain key regulatory and technical issues, such as operator staffing, decommissioning funds, and security with exemptions. What are the industry's thoughts about that exemption approach?

MR. PEREZ: Well, I think it's workable, especially for the first tranche of these reactors. Obviously, we would hope that as the exemption processes occur that there would be more codification of

those things, but in general I think we can live with that type of structure. I just can't emphasize, I must sound like a broken record. I think it does require a lot of interaction with the Staff to be sure we understand what good looks like in that exemption area, and to be transparent to the public. I mean, let's be clear, transparency is key in this kind of activity, so I would generally tell you that if there is one thing that clearly came out of the projects at Summer and Vogtle was that whole concept of transparency. We had a huge amount of debates with the Commissioners in this room about the amount of public interaction, but it's clear, and I'm not putting myself in your shoes, but when we had the public hearings on Vogtle and Summer, the fact that there was a huge of amount of public discord added unbelievable value. I remember talking to the former Chairman. He equated public discourse with the public's perception of safety. So, just to make a point, I will just generally tell you that was a lesson that I learned, and I think we need to carry that going forward.

COMMISSIONER BARAN: Following on that point, one of the major issues, policy, regulatory issues on SMRs is the B- is whether emergency planning zones for SMRs should be scalable. And one could easily imagine how that would be a very controversial thing among the public.

Are folks in the industry thinking about how the public will react to that kind of approach, and whether it could impact community interest in having SMRs located in their communities?

MR. PEREZ: I'll take a shot at it. The answer to your question is yes. I mean, but it goes hand in hand with the cost of

increased safety and increased confidence. They don't B- there's no way to separate the two ideas. And it clearly is an issue of the ability to demonstrate that the community that's going to be accepting the potential project has that security in the safety of the design. So, I'm actually very confident that we can do that. I mean, it was B- I can just tell you, I mean, it was always a delicate balance, but the Part 52 process and, in particular, on the new AP-1000s that are being built in Georgia and South Carolina, we spent a lot of time with the public telling them why, one, the existing reactors at both Vogtle and Summer were safe, but why the addition of two new reactors at those sites actually didn't decrease their safety, but actually provided a confidence level for the long term for stewardship of those sites. That's another 60 years of operation. So, Commissioner, I'm not telling you there won't be challenges, there will be in the public realm, but I'm very confident that we can demonstrate and make the public confident that those units are safe, and that they can feel comfortable with them being there.

And to Dr. Glaser's point, I think the engagement of non-CO2 generation in some of those regions where they could potentially replicate big carbon emissioning type of facilities is actually a positive environmental statement for those localities and those communities.

COMMISSIONER BARAN: Thank you.

CHAIRMAN MACFARLANE: Any further questions? No, all right. All right. Well, I thank everybody for coming, some of you for traveling a distance to get here, and appreciate all your thoughts and the discussion, and we will now take a five-minute break.

(Whereupon, the above-entitled matter went off the record at 2:38 p.m., and resumed at 2:45 p.m.)

CHAIRMAN MACFARLANE: Well, we've got a full compliment here, don't we?

MR. SATORIUS: Well, you've got an extra one now, so we had to bring a couple of extra ourselves.

CHAIRMAN MACFARLANE: Yes, you're just trying to, you know, protect yourselves here.

Now, it's seven to five, I don't know.

All right, well, we will start the afternoon's second panel when we'll turn things over to Mark Satorius, our Executive Director of Operations.

MR. SATORIUS: Thank you, Chairman, and good afternoon and good afternoon, Commissioners. And to Commissioner Burns on behalf of the staff, I welcome you to the Commission. It rounds it out to an even five, now all the seats are filled. And it's good to see that you were busy at work at your first Commission meeting less than three hours after having been sworn in.

COMMISSIONER BURNS: Thanks.

MR. SATORIUS: So, welcome, sir.

COMMISSIONER BURNS: Thanks.

MR. SATORIUS: The Commission was last briefed on the topic of small modular reactors, or SMRs, in March of 2011, as you may have heard from the earlier presentation.

At that time, the staff was actively involved in licensing activities with a very strong support from the Office of Nuclear

Regulatory Research, the Office of Nuclear Security and Incident Response, the Office of General Counsel and the Offices of International Programs.

Since 2011 in that briefing, those offices have continued to provide support to SMR activities to include infrastructure development and pre-application interactions.

I would like to acknowledge the dedicated efforts and the accomplishments of the Office of New Reactors and also it included the Division of Advanced Reactors and Rulemaking who are represented at the table here today.

Today's briefing will provide you with an update of the activities that demonstrate the staff's readiness to review light water SMRs.

Today's briefing will also touch on the strategic planning for non-light water reactors.

I will now turn the presentation over to Debbie Jackson, the Deputy Director of the Division of Advanced Reactors and Rulemaking. Debbie?

MS. JACKSON: Thank you, Mark. Good afternoon Chairman and Commissioners.

We are here today to inform you of the Office of New Reactors readiness to conduct safety and environmental reviews for small modular reactor applications under 10 CFR 50 and 10 CFR 52.

As Mark stated, this briefing will include light water reactor, small modular reactor designs and briefly discuss strategic planning for non-light water reactors.

The Division of Advanced Reactors and Rulemaking has successfully completed a number of tasks since our last briefing. These tasks include development of a baseline review schedule for small modular reactor designs, completion of interim staff guidance for light water reactor review and international small modular reactor regulator forum and a comprehensive report to Congress on advanced reactors.

Today's briefing will focus on three main areas, licensing, guidance and policy. With me at the table today are the Division of Advanced Reactor and Rulemaking's branch chiefs responsible for this work, Stewart Magruder, Joe Colaccino and Anna Bradford.

The branch chiefs will discuss their role in each of these three areas to demonstrate that NRO has the infrastructure in place to conduct reviews of small modular reactors.

I'd also like to state that in late summer of 2014, the Office of New Reactors staff completed SECY-14-0095 entitled Status of the Office of New Reactor Readiness to Review Small Modular Reactor Applications. That SECY became public in August 2014.

With that, I'd like to turn the presentation over to Stewart Magruder.

MR. MAGRUDER: Thank you, Debbie, and good afternoon Chairman and Commissioners.

I will spend a few minutes now providing an update on staff activities with some of the SMR vendors, ideas about improving the timeliness of design certification reviews, our interactions with the

first utility that has discussed building SMRs and our collaborations with international partners on SMR issues.

Slide five, please?

Consistent with the Advanced Reactor Policy Statement, we have engaged the SMR designers in effective pre-application activities.

The two designers we've had the most engagement with are NuScale and mPower. As Dr. Kelly mentioned, these designers are receiving funding from DOE and we have given them top priority.

On average, the staff has met with both designers once a month for the last three to four years.

One of the results of these meetings is that we have mutually identified some critical licensing, policy and technical issues that we'll need to develop positions on before we begin the reviews. Anna will cover several of these issues in her presentation.

Both of these designers have also done testing over the last several years and the staff has taken advantage of the opportunity to inspect and observe some of the most important tests.

The staff has gained a lot of knowledge of the designs over the last several years from these pre-application interactions.

Per Commission direction, the staff has been developing individual design specific review standards, or DSRSs, for the mPower and NuScale designs.

These DSRSs will be used by the staff in lieu of the standard review plan and will allow the staff to conduct a more

risk-informed and integrated review. Joe will talk about the DSRSs and other review guidance in his presentation.

I believe that the process of developing these DSRSs has been very helpful to the staff and have provided more insights into the designs and better interaction with the designers than we have had in previous pre-application interactions.

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We expect that the first design certification, or DC application, that we'll receive is from NuScale. They've told us their planning to submit their application in the second half of calendar year 2016.

As I mentioned, the staff has been drafting the DSRS for the NuScale design. We expect to publish a draft version for use and comment next summer, more than a year before the expected application.

Until their announcement in April of 2014, the B&W mPower design was expected to be the first SMR DC application. The staff published a draft DSRS for mPower in May 2013 and received nearly 2,000 comments from the industry and the public. The staff continues work to resolve public comments and reflect changes in the DSRS documents.

We expect to issue the final mPower DSRS sections prior to receipt of the mPower application but we are uncertain of that date.

Holtec has had very few high level discussions with the staff about their design. They have told us they are not ready to

engage in pre-application activities and they're uncertain of the submittal date for their DC application.

And Westinghouse had previously expected to send NRC an application for DC earlier this year. We have had some pre-application activities with them. However, after reassessing the marketplace, they decided to put their SMR work on hold and we are also uncertain of the submittal date for an application from them.

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The NRC recognizes the need for providing timely application reviews, however, safety remains the NRC's top priority and it will not be compromised to achieve schedule success.

Using lessons learned from recent reviews for large light water designs, and after reviewing potential time saving suggestions, NRO has developed a best-case baseline review schedule for SMR DC applications under optimal conditions.

The traditional six phase review model shown here was determined to continue to provide the best review framework. This 39-month schedule includes the six phase activities and rulemaking.

As we have said before, the staff's acceptance review must first conclude that the vendor's application is complete and technically sufficient to conduct the full DC review before the review can begin.

In addition, as Joe will mention, the staff has updated guidance for acceptance reviews and has demonstrated that it will complete the acceptance review in two months.

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This optimal schedule is based on critical assumptions and key stakeholder actions that must be satisfied. Some of the assumptions are, number one, all Requests for Additional Information, or RAIs, are issued and answered by the end of six month long phase one.

Number two, the DSRS is complete at the time of docketing and results from productive pre-application interactions.

Number three, NRC has developed positions at all critical licensing, policy and technical issues prior to docketing. Appropriate guidance to the staff reviewers is also in place.

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Number four, the Advisory Committee on Reactor Safeguards review duration assumes that the Safety Evaluation Report is complete with open items for phase three reviews.

And, number five, the use of the design acceptance criteria, or DAC, is minimized. Related to this, DC's supplemental applications are for addressing open items only. That is, an applicant design freeze is in effect.

Satisfaction of all of the baseline assumptions will be critical to achieving timely review success.

Next slide, please?

TVA is currently planning to submit an early site permit for ESP application for the Clinch River site near Oak Ridge, Tennessee in September 2015. TVA had planned to submit a construction permit application for up to four mPower SMRs there.

However, this plan changed as a result of the April 2014 decision by B&W.

The ESP is not expected to use a specific design but rather bound all four of the SMR designs that I have mentioned.

The staff is actively observing TVA's site preparation activities and has held several well-attended public meetings on pre-application topics such as subsurface characterization and their approach to the ESP application.

This picture shows Diane Jackson, the chief of one of the geoscience and geotechnical engineering branches at NRO observing core borings at the Clinch River site.

The staff has also begun our normal extensive environmental pre-application activities with TVA.

Next slide, please?

The NRC has encouraged collaboration with our international partners on SMR and helped established a forum for SMR regulators. The goal of the forum is to promote understanding of each member's regulatory views on common issues to capture good practices and methods, enabling regulators to inform changes, if necessary, to their requirements and regulatory practices.

This photo shows attendees at a dialogue forum on SMR issues held at the IAEA in July of 2013.

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The objectives of the forum are to share regulatory experience among forum members and strive to reach common understanding on discussed issues, to document and disseminate the

results of these discussions and to interact with key stakeholders where possible to effectively inform forum activities.

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Within a two year pilot project, the forum will address the following issues for both light water and non-light water SMR designs, emergency planning zone signs, defense in depth and grading approaches to reviews.

Besides the United States, countries that have expressed interest in participating in the forum are Canada, China, France, Finland, Germany, Korea, Russia and the United Kingdom.

This concludes my remarks and I would now like to turn the presentation over to Joe.

MR. COLACCINO: Thank you, Stu and good afternoon.

As you know, the NRC produces a tremendous amount of guidance for our applicants and staff to use in the preparation and review of new reactor applications.

Our current guidance is sufficient to conduct the review of an SMR related application. We continue to update and optimize our guidance to facilitate a timely review of applications related to small modular reactor designs.

Please turn to slide 15.

A number of guidance products have been completed to support SMR reviews. As Stu said earlier, a draft of the DSRS for the generation mPower design was completed in May of 2013. This draft included significant new guidance for applicants such as pilot of

guidance for conducting digital instrumentation and control reviews.

This DSRS would have been completed had the vendor not discontinued pre-application interactions.

In January of 2013, a new introduction section was added to the light water reactor standard review plan, NUREG-0800 also referred to as the SRP which provides guidance on the use of the SRP for SMRs, included a method to risk-inform the application review.

Regarding the environmental reviews, the staff issued two interim guidance documents in September of 2014. The first provides updated guidance based on new reactor reviews conducted over the last several years for the applicants to prepare environmental reports for combined license, early site permit applications and for the staff to prepare and submit an environmental impact statement.

The second provides specific guidance for an early site permit or combined license application that references a light water small modular reactor design.

Finally, the staff completed just last month an office instruction to support the pre-application readiness assessment of the safety portion of an early site permit, design certification and combined license application. This readiness assessment is planned to take place approximately six months before the submission of an application and is voluntary. We plan to make this instruction public in the near future.

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The baseline document of any DSRS is this SRP. The Office of New Reactors is responsible for updating the SRP. A

major revision to the SRP was issued in March 2007 to support the review of large light water reactor applications submitted under 10 CFR Part 52.

Since the SRP provides review guidance for both operating and new reactors, NRO coordinates updates with both the Offices of Nuclear Reactor Regulation and Nuclear Security and Incident Response.

The approximately 4,500 page, 19 chapter SRP contains over 300 individual review sections. It should also be noted that most SRP sections reference one or more regulatory guides which are managed by the Office of Research. It is not efficient to update the SRP all at once, instead it is updated by section, groups of related sections or entire chapters.

Each draft package is noticed in the Federal Register for public comment. Final sections are posted on the NRC public website.

During this process, we may also have public interactions on proposed updates to the SRP. For example, we have had a number of public meetings this year on revising the guidance for staff review of proposed inspections, tests, analyses and acceptance criteria, or ITAAC, which are unique to the Part 52 licensing process.

For the two DSRSs that the staff is engaged their respective applicants on during pre-application, the staff determines which SRP sections will be superseded by a corresponding DSRS sections or used in their entirety.

For the draft mPower DSRS, two-thirds of SRP

sections have been either superseded by DSRS sections or omitted because the design does not contain the specific features that are covered by the SRP.

Regarding the NuScale DSRS, slide 16 shows that today, approximately half of the 256 sections that could comprise the staff guidance for the NuScale review are either updated SRP sections or drafted DSRS sections ready to go for public comment.

The completion of the draft NuScale DSRS is an NRO safe closure item for fiscal year 2015. As the staff continues its pre-application interactions with NuScale, it is expected that the mix of DSRS and SRP sections will change.

Next slide, please?

As I sated previously, the staff continues to engage NuScale in the development of a DSRS for their design. We anticipate that the development of this DSRS will be less resource-intensive because of the experience the staff gained with the development of the mPower DSRS.

The staff is also close to completing an Office Instruction to conduct acceptance reviews. The Office Instruction incorporates in part the assumptions used to support the optimum 39-month review schedule discussed earlier for an SMR design certification.

It also incorporates insights gained from the acceptance review of the Korea Hydro Nuclear Power APR-1400 Design Certification Application. This acceptance review Office Instruction will be used by the staff to determine whether to docket any

new reactor license application received by the NRC. We plan to make this instruction public shortly after its completion.

Next slide, please?

One of the actions from the licensing lessons learned report, which was referenced in the September New Reactor Business Line Commission meeting with the Commission is to update the combined license application regulatory guide, or Reg Guide 1.206 for light water reactors.

Presently, we are updating and expanding the content of the guide. We are adding a more complete standard format and content section that is based on what the industry design center working groups developed for the submittal of design certification, early site permit and combined license applications in 2008.

This will ensure that applications are more consistent and that guidance for electronic submission of applications is updated.

We are expanding the policy and regulatory topic section to include guidance on how to submit an application that uses the DSRS as well as the guidance on readiness assessments and acceptance reviews discussed earlier.

Finally, we are updating the Final Safety Analysis Report portion to incorporate the lessons learned from our large light water reactor reviews. One of the techniques we are using to inform our update is an extensive review of the questions we asked on those reviews and determining whether our application guidance needs to be updated or enhanced.

We have already begun planned interactions with the

industry on the update of Reg Guide 1.206.

Next slide, please?

As I stated earlier, we are ready now to review an SMR related application with existing guidance, whether it be a design certification, early site permit or combined license application.

The staff guidance is being updated to incorporate lessons learned from large light water reactor reviews. We are optimizing the guidance needed to support an SMR related application and timing our activities based on the applicant's submittal schedules that are currently known to us.

For example, we have been informed that NuScale's design certification application is scheduled to be submitted to the NRC in the second half of 2016. By that time, we will have completed the NuScale DSRS.

In addition, any update of SRP sections that are identified in the NuScale DSRS as “use as is,” will be finalized six months before the application is scheduled to be submitted to the NRC.

We will also ensure that necessary updates to regulatory guides referencing in the DSRS and SRP are coordinated.

Finally Reg Guide 1.206, including the Appendices that support a design certification review will be issued as draft for use and comment to facilitate the preparation of the NuScale design certification application.

The staff will continue to engage with the prospective applicants to keep informed of their of application schedules and adjust our plans to support preparation of staff and applicant guidance as

necessary.

I would like now to turn the presentation over to Anna.

MS. BRADFORD: Thank you.

Slide 21, please?

As you've heard, the staff has been planning for SMR applications for several years now and we've used that time to make progress on many difficult technical and policy issues.

In SECY-10-0034 in 2010, the staff identified 17 issues that we planned to review to determine whether changes to the regulatory framework or to NRC approaches would be needed.

These issues included emergency planning zone size, control room staffing levels, security approaches, annual fees and licensing of multi-modules.

After evaluation, several issues were determined to be adequately handled under current regulations and guidance. Other issues are currently still being actively addressed internally and with potential applicants.

This slide shows a partial listing of some of the publically available documents that discuss the progress and conclusions that we've made on each of those issues.

The current status of those 17 issues are also each summarized in the recent SECY paper that we sent to the Commission regarding our readiness to review SMR applications SECY-14-0095.

Next slide, please?

Now, I'll individually cover four major subjects that have been characterized by industry as being critical to deployment of

SMRs.

The staff has assessed all of them to ensure we have the framework in place to protect public health and safety.

Two of them are now essentially closed in terms of not needing any additional work on our part at this time, and the other two are still a work in progress and may require Commission direction before final resolution.

Next slide, please?

The first one is the use of a mechanistic source term, or MST, approach by the potential applicants to evaluate the design basis accidents, or DBAs. MST is the result of a design specific and scenario specific analysis of fission product release based on the amount of fuel damage and cladding damage resulting from the specific accident sequences being evaluated.

Use of an MST approach allows industry to approximate more realistic releases for DBAs when compared to the current DBA source terms that result from bounding deterministic modeling.

Industry will likely propose to use MST to show compliance with siting and safety analysis regulations without needing to request exemptions.

NEI submitted a white paper on this topic in 2012 and both NuScale and mPower submitted proprietary reports in 2013 regarding their approaches for using mechanistic source term. We've met with NEI, NuScale and mPower to discuss their approaches and to provide feedback.

As we summarized in a publically available memo to the Commission this past June, the staff is currently evaluating the overall approaches proposed by the industry and we have indicated during those meetings that more specific information is needed. For example, for estimated deposition inside containment for a particular design.

This may require Commission input on issues that have a strong technical element but that also have a policy element embedded in them. An example of a policy element regarding this issue could be whether the agency would allow credit for the operation of an Emergency Core Cooling System during an accident. We will continue to keep the Commission informed of progress in this area.

Next slide, please?

Mechanistic source term can be used as an input to the size of the emergency planning zone for SMRs. As you know, emergency preparedness and emergency planning zone size requirements have a long history behind their development.

With respect to SMRs, the industry has indicated that it believes the SMR design smaller cores, passive safety features and slower accident progression should require smaller EPZ sizes than those required for currently operating plants.

It's important to note that these assertions have not yet been evaluated in detail by the staff.

In 2011 the staff sent up a Commission paper that discussed the idea of a scalable emergency planning zone size which would use a dose-distance approach to determine the EPZ size needed

for SMRs.

That was an information paper and, therefore, the Commission did not directly speak to this issue.

Last December, NEI submitted a white paper on its proposed generic framework for determining the EPZ size for SMRs and we held a public meeting to discuss it in April. Their approach is described a high level in the white paper and would use, among other things, probabilistic risk assessment and severe accident information to determine the appropriate EPZ size.

In June, we sent NEI written questions on the proposal and we had a public meeting with them use last week to discuss their possible responses to our questions.

We're currently in the early stages of developing a vote paper for the Commission which will provide options on how extensively, if at all, the staff should potentially revise the EP requirements for SMRs. This paper is due to you in early June and we look forward to getting feedback from the Commission on this important topic.

Next slide, please?

The next specific approach that may be unique for SMRs is the one for control room staffing. Based on the use of automated control systems, the passive safety features and the slow progression of accidents, SMR designers are considering changing the number of operators they would have in the control room.

For example, one vendor is evaluating whether having one operator for every three modules would be sufficient or they may

want to control up to 12 modules from one control room.

We have recently updated the guidance in NUREG-0711 regarding human factors engineering and we believe this guidance provides the basis for us to evaluate requests for exemptions from the regulations regarding control room staffing.

Next slide, please?

Since we have appropriate and updated guidance in place, we believe we are prepared to successfully evaluate the proposals of vendors and no further action is needed on our part at this time.

As experience is gained by the staff and if it appears there would be frequent requests for exemptions from this part of the regulations, then we would consider whether a rule change is needed.

Next slide, please?

The next issue is security. It is our understanding that the industry has been incorporating security considerations into their designs as they evolve.

Some SMR design features may improve both safety and security aspects of a design. For example, our reactor core and spent fuel pool that are located underground may result in improved safety and security.

The applicants may use this built in increased security as a basis for a request to decrease the number of guards on site.

Along with NSIR, we have had discussions with potential applicants about this, but have not yet received concrete proposals.

Next slide, please?

The staff has reviewed our current security regulations and guidance against possible approaches used by SMR applicants and decided that because our security framework is comprehensive and robust, it is adequate to successfully analyze the applicant proposals as we understand them, therefore, no further action is needed on our part at this time.

Next slide, please?

For my last topic, I want to switch gears and instead of talking about light water SMRs, I'm going to talk for a minute about non-light water reactor designs.

There has been low-level but consistent domestic interest in designs that do not use water for cooling, for example, sodium fast reactors and gas-cooled reactors.

Although it will be several years before we receive a non-light water application, the staff is being proactive now. We're thinking strategically about what changes might be needed to our current regulatory framework to be ensured that we will be prepared to efficiently and effectively review any such applications and ensure public health and safety.

We've undertaken and completed several activities lately to make progress toward this goal. For example, in 2012 we developed an issue to report to Congress titled Advanced Reactor Licensing. This report presents our near term and long term strategic approaches for both light water SMRs and non-light water reactors and discusses needs in such areas as research and test facilities.

Last year we initiated and are now implementing a two part joint initiative with the Department of Energy to look at each of the general design criteria in Appendix A of 10 CFR Part 50 and determine which ones might need to be revised so they would be relevant to non-light water designs.

Also last year the Generation 4 International Forum issued a document with proposed safety design criteria for sodium fast reactors. We reviewed this against our regulatory requirements and transmitted our comments in January of this year.

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In July of this year, we completed a multi-year interaction with DOE regarding the Next-Generation Nuclear Plant which is focused on a conceptual high temperature gas reactor design. We transmitted our final assessments to DOE on such topics as fuel qualification and mechanistic source term.

Lastly, we've increased our efforts to engage internationally on this topic. For example, we've participated in recent IAEA meetings and international conferences regarding non-light water reactors.

This completes my part of our presentation and I will now turn the discussion over to Glenn.

MR. TRACY: Thanks, Anna.

Slide 31, please?

In closing, I'd obviously like to acknowledge the progress made by the NRO staff and our partner agency offices in continuing to prepare for small modular reactor applications.

We've identified the policy issues that require Commission interaction and we look forward to continued work with our stakeholders and engaging with you in the future on these important issues.

As part of these efforts, the staff is participating in and leading strategic international interactions consistent with our forward looking vision for multi-national cooperation.

In summary, our preparations and ongoing interface with our stakeholders and the industry will ensure that the agency continues to be ready for small modular reactor applications when they arrive.

We look forward to your questions.

CHAIRMAN MACFARLANE: All right, thank you very much. We'll turn to Commissioner Burns.

COMMISSIONER BURNS: Thank you and thank you for the presentations.

I'd like to start perhaps on the international sphere. I'm trying to understand what we see at least the benefits from the participation in the IAEA's SMR regulators forum will be, partly because I say when I look in context the time lines for it and also knowing having just come from an international organization that things, not that they move slowly because people want to move slowly, but because you're, unlike a lot of the organizations, you have to reach consensus on things.

And when I look at the time lines, it's talking about 2017. So what I'm trying understand is, where do we see the net

benefits to us from that participation? Because if we're talking about having us start to reach decisions and applications and things like that in the 2015-16 time frame, I'm not sure what that's going to do for us.

So, I'd like to get some ideas about or an idea about where you see the longer term benefits from that participation?

MR. TRACY: I'll open and then turn to Mike and Stu who'll be leading the effort.

Commissioner, obviously we have extensive experience through the multi-national design evaluation program. They're moving along in progress in pacing ourselves associated with decisions as we do reviews.

So using that, we're not going to slow down associated with the policy matters that we put on the plate and would be presenting to you including the emergency preparedness paper in the near term.

But, every time that we come before you, we want to have a sense of where our international partners are and where they would be thinking with regard to what we're presenting and that's the approach.

Mike, if you'd like to clarify, Stu will be leading.

MR. MAYFIELD: Well, it's simply that we always benefit by understanding more about what's going on in the international community. As Glenn said, we're not going to pace ourselves based on consensus building at IAEA, however, if there are new ideas come up out of the discussions that is going to come out of Stu's forum, then we think we would benefit from those, understanding and we might end up having to reverse something we

had started down. While I think that unlikely, we want to be better informed as what's going on.

The other piece of it is that we have had just a parade of international entities interested in what we are doing with SMRs. When you do those one at a time, it really gets to be resource intensive. So this gives us an opportunity to bring all of those interested parties together to discuss these issues one time in one setting and therefore, improve better understanding or improve understanding around the world on what we are doing, why we're doing it and then gaining benefit from their insights as we go.

Stu, if you have anything?

MR. MAGRUDER: I can't add much to that, but I will say that the goal of the forum is not to necessarily reach consensus opinions or consensus views on things, it's more to share information. This was kind of a natural progression from discussions with other regulators who just decided that it would be helpful to share experiences.

We're all dealing with similar issues so we thought it would be helpful to talk about them to understand where each country is coming from, why they made those certain decisions and that would benefit us, we hope.

COMMISSIONER BURNS: Okay, that's fair enough.

Would you say that there are some countries that might actually, put it this way, sort of get it now with respect to the SMRs? Are there some of them who are dealing with this who probably already have insights that are perhaps a little more advanced than we are or are

we all sort of in the same boat which is, in some ways, the impression I have?

MR. MAGRUDER: I personally think some countries are ahead of others. In speaking with the Russians, for example. I mean they are building their barge-mounted reactors now and they've had interesting discussions with us about EPZ and other issues related to that.

So, the countries that -- in Korea also has, obviously, designed and certified a reactor. They're a little bit ahead of us. Other countries are kind of just very interested in where we might end up.

So, there are variations and I think we can learn, we can all benefit from them.

COMMISSIONER BURNS: Okay, good. One of the things I heard I thought was interesting, particularly thinking about Part 52, which is now about 25 years old and it's hard to call it a new reactor license process anymore.

But, I heard the reference to ESPs and help me out, early site permits. What benefit do they have in the context of where we are now?

If we're, again, because I think of the early site permits as clearing particular sites, not designs. And they often use a site envelope, you know, we know that it might be an AP1000 or it might just be a large light water reactor.

So, I'm trying to understand why would somebody go for the ESP in this circumstance? But that -- unless I misheard.

MR. MAGRUDER: Yes, I'll take that. TVA is now considering an early site permit. As I mentioned, they had been considering a construction permit application, actually, at the site but changed their mind based on the timing of the vendor's design certification applications.

I think in TVA's case, they want to capture all the work they've done, the site preparation, environmental monitoring and things like that at the Clinch River site and kind of capitalize on that investment.

COMMISSIONER BURNS: So, it sounds --

MR. MAGRUDER: I can't speak for other utilities.

COMMISSIONER BURNS: Yes, so it sounds like it's -- that's really the more the site specific, it's not that it has particular benefits to SMR unless they did the emergency planning which it doesn't sound like we're really quite ready on.

MR. MAYFIELD: There is a potential for opening some dialogue on an approach to early site permit based on the enveloping approach for, you know, that they're going to use for the Clinch River site.

So, we're interested to see how that's going to evolve, but TVA pursuing the early site permit at least offers an opportunity to engage in some dialogue that we wouldn't have if we were having to pace things.

COMMISSIONER BURNS: Okay, okay. When we talked about non-light water reactors and potential changes to the regulatory framework, where are the disconnects now between what

we have? What are the gaps?

MS. BRADFORD: I think in a broad sense, most of our regulations are based on our 40 years of experience with light water reactors and they're written that way and all of our guidance is written that way.

So, like if you look at the general design criteria in Appendix A of 10 CFR Part 50, specifically says these are for light water reactors. They really only kind of, I think it says provide guidance for non-light water reactors. So even that fundamental part of the regulations would need to be tweaked a little bit I would say.

If you look at the GDC, some of them specifically say coolant water. Well, if you have a sodium-cooled reactor, you don't have coolant water.

So maybe that's just a wording change, but you want to keep -- you want to make sure you keep the safety basis that's underlying those GDCs in the first place.

COMMISSIONER BURNS: Okay.

MR. MAYFIELD: I think Anna's point, the underlying safety bases for the existing regulations, we are LWR centric in the Part 50 regulations, the general design criteria and the overall regulations.

We need to move from that LWR centric approach and address specific technologies while we're maintaining the focus on the underlying safety considerations that are embedded in the regulations.

So, disconnects, it's more moving from a light water centric set of regulations and guidance to things that are more appropriate for other technologies and not losing sight of the safety

pieces we were trying to assure in the regulations.

So, its not like there's a fundamental disconnect, it's we need to get things in a way that everyone can understand and move forward.

MR. TRACY: Commissioner, I'd just add we'll be able to even further respond to you with more clarity as we are looking forward to the report from the DOE and the applicability of the of the GDC and we'll be happy to share.

COMMISSIONER BURNS: Okay. Another question I had and I think -- well, just follow-up the question I had for the first panel with respect to how would you reflect on the lessons learned from the implementation of Part 52 and you heard their response, how would you see what we've learned and its implementation and what needs to applied here?

MC. COLACCINO: So, when -- after we completed the first -- the licensing of the combined license applications, Vogtle and Summer, we actually did do a licensing lessons learned report.

From that, seven recommendations came and I hit on almost every single one of them in my presentation, whether it be the quality of the applications and the updating of the guidance, whether it be the application guidance or the staff's review guidance.

One thing that I didn't hit is the update to the Part 52 regulations. That's a paper we hope to have to the Commission in the next couple of weeks that will outline updating Part 52 applications to the lessons learned from our large light water reactor reviews.

COMMISSIONER BURNS: Okay, thank you.

CHAIRMAN MACFARLANE: Okay. Thank you very much for all your presentations.

I think this is a very helpful discussion that we're having this afternoon on SMRs. I think it's important for us as an agency to be aware of the variety of issues that are out there with SMRs as we are planning our own resources, whether, you know, whether it's the domestic market issues, the global market issues, other technical issues associated with this technology and it's, I think, absolutely essential for us not to be listening to one source of information.

That has caught us out in the past and that is why we are now venturing down the Project Aim road.

So I think it's absolutely essential that we hear from a variety of sources and that's why I think the variety on the external panel was so important and I'm happy you're all listening to that and I'm very glad that your participating in the international group and going on with it and I think you guys made a great case for why we have to go forward with that. It's absolutely imperative that we continue that.

It's important to know what other regulators are doing if we're going to be an outlier on something, we had better damn well have a good explanation of why that is.

So, I'm wondering, you know, I know this is sort of in its infancy, but with MDEP and whatnot, there have been discussions on a variety of these issues. And so I'm wondering what the thinking is on a couple of the important issues out there like EPZs. If you could share some of that, that would be great.

You know, as we pointed, out, the Koreans have

licensed one of these already. What were they thinking? What are others thinking?

MR. MAGRUDER: So we are, as you mentioned, we are at the early stages of these discussions with other regulators, in particular EPZ and in each regulator is being presented with cases form vendors claiming different safety claims.

The Canadians, for example, are getting or are having discussions with vendors that want a site, very small reactors in the northern part of Canada, same with the Russians.

So the EPZ issues are different there than they would be for siting in new relatively populated area.

I think, you know, as Anna mentioned, the source term issue is really the key and we've had initial discussions about how we're each approaching that, what technology we're using, whether we can share codes and assumptions and things like that.

So, the EPZ group will consist of experts from each of the regulators and their TSOs if needed to actually get down into some of the technical discussions about how we're going to evaluate what other policies are associated with that.

CHAIRMAN MACFARLANE: Anybody else want to add anything?

MR. MAYFIELD: If I could, Chairman, there does -- I think Stu's trying to be polite here. There's no consensus in the international community on how to deal with emergency preparedness and so that's part of -- I doubt that we're ever going to achieve an international consensus.

But to better understand the stressors in the different regulators and why they're making the decisions they're making, and for some of the new entrant regulators to help influence their thinking. Not that they're going to do what we're doing, but to help them understand the underlying considerations, why you worry about this. Is it ten miles? Is it five miles? Is it the site boundary? Understand what's driving those decisions.

We think that's an important step forward in helping others understand particularly the new entrants understand what it is, what emergency preparedness is and why they need to consider it and consider it carefully.

So, it's a little different spin on it but there isn't a good international consensus.

CHAIRMAN MACFARLANE: Good. So, what are, for you guys, I mean you gave us a nice presentation, but what are, in your view, some of the main challenge areas? What are the areas of particular challenge for us as an agency and what do you see as areas of particular challenge for this technology?

For us as an agency, you know, there are some features that are going to be new and different, putting it underground would be one.

So, you know, what are those? I just want to put them on the table.

MR. TRACY: Well, I'd like to take it to the detailed level like you just went specifically to going underground. But, at the highest level when we say 39-month review, we have to mean it and

then try and to do everything we can to honor that so the credibility of our reviews and how we conduct them efficiently effective are, in fact, strengthened and ensured.

With that, though, we have to have the design, good engineering leads to good licensing. Every applicant, every vendor in front of the Office of New Reactors has heard that and understands that. So I believe the challenge will be conducting this dance effectively and that the readiness for their detailed level at the proper level as Perez indicated is, in fact, in front of us and then we're able to have these dialogues with our DSRSs intact in order to conduct this view and do it methodically.

And you asked which is the highest challenge, that is in the forefront of my mind. Then secondly, having things like emergency preparedness in front of the Commissioners so that you can help guide and shape -- it's not that they couldn't do a ten mile EPZ at this time, but what is the right thing to do and having the staff's efforts informed by international colleagues to be able to present that to you with the best thinking.

Those are the two on my mind.

CHAIRMAN MACFARLANE: Anybody else? Mike?

MR. MAGRUDER: Yes, let me just get to -- I've covered some technical issues.

CHAIRMAN MACFARLANE: Yes.

MR. MAGRUDER: I mean the staff has had really --

CHAIRMAN MACFARLANE: I like the technical stuff.

MR. MAGRUDER: Okay, me, too, actually.

We've had some really good interactions with the vendors and I was happy to hear Rick Perez earlier say that the industry thinks they're beneficial too, because the staff certainly does.

But some of these designs obviously have things we haven't reviewed before having control rods inside a vessel, for example, or relying totally on natural circulation for all the safety systems.

So, there's some really interesting discussions with the vendors observing their test programs, making sure that they're complete, making sure that the codes that they're using to analyze the designs are applicable for the size of the plants and things like that.

We've been working through those issues, but they're not resolved yet. So, I think getting those resolved before we start the review is going to be a big challenge because there's pressure, obviously, to submit an application but there's also pressure to have all the work done before the application is submitted.

CHAIRMAN MACFARLANE: Anybody else? Mike?

MR. MAYFIELD: Chairman, without going into too many design -- well, the vendor specific issues, we've been talking and I think we've briefed the Commission previous on multi-module licensing considerations.

The spin-offs on that are multiple. What do you do about multi-modules and if you think the NuScale design with up to 12 modules in a common pool of water? What do we do about the PRA? Do we think about PRA simply in terms of individual modules or do we think about it in terms of the facility?

That goes then to Price-Anderson considerations. Do we consider the requirement for primary and secondary entrants, how that plays out simply on a per module basis or do you go to the facility? It's night and day difference.

So there are a number of things like that. Again, for NuScale, their desire to have multiple modules under the control of the single operator.

CHAIRMAN MACFARLANE: I was going to ask about that.

MR. MAYFIELD: Exactly how that's going to play out? The level of automation they're considering in their control room, while admirable from a technical standpoint, is likely to create some challenges for the technical reviewers as they get into it.

CHAIRMAN MACFARLANE: Airbus versus Boeing, you know.

MR. MAYFIELD: Ma'am, I'm sorry?

CHAIRMAN MACFARLANE: Yes.

MR. MAYFIELD: So --

CHAIRMAN MACFARLANE: Inside joke, I don't know.

MR. MAYFIELD: So there are a number of these but we, while NuScale has been perhaps the most obvious of them, we were seeing similar kinds of considerations to a lesser degree with mPower.

Both the Westinghouse design and the Holtec design are single modules for a control room, single modules in a particular

building as opposed to multiple modules. Yet, they also were creating some interesting issues.

The Holtec design they have announced publically using a canistered fuel. So rather than individual assemblies, they lift the whole assembly out --

CHAIRMAN MACFARLANE: That's interesting.

MR. MAYFIELD: -- and put it in a cask to be dealt with in fuel shuffle outside the reactor. That's going to create some interesting challenges.

So you look at the individual designs, they are interesting, challenging technical issues that go outside just looking at the reactor design, that canistered fuel is going to raise issues for our friends in NMSS as well as what we do for the reactor design.

So, there, as you start looking at these, they touch such wide range of issues that start to affect multiple offices across the agency.

CHAIRMAN MACFARLANE: Right, right. Glenn, you know in a Commission paper that you sent up on the readiness to license small module reactors, I think you noted that there was one potential gas-cooled reactor application coming in 2017?

MR. TRACY: Possible.

CHAIRMAN MACFARLANE: Possible, okay. So, that's as much as you can say about it possible? I mean do we need to be preparing in some other way for it?

MR. TRACY: I don't like to be speculative with the agency's resources as the business line owner. We are preparing

diligently, I thought John Kelly was very articulate in providing an answer about the ability and readiness. I want to have the critical skills in place with the Office of Research and NRO and our colleagues that we can use in terms of, you know, their insights, internationally as well who are further along in some cases.

So, I'll let Mike provide any further. But I think we are still poised and aware of what needs to be done. I, again, look very forward to the gap analysis of our general design criteria and that'll help me inform my resources needs and then I'll communicate that to you.

Mike?

MR. MAYFIELD: The work we did with the DOE on the next generation nuclear plant high-temperature casks, a lot of focus on the pebble-bed technology, that's what the, as we understand, from limited pre-application engagements from this vendor. That's what they're talking about, it's a very small design.

So, we can build on the work that we did with DOE for NGNP. There would be a need for some exceptions, some exemptions from certain aspects of the regulation. The specifics of the approach they're talking about, again, that's only been very cursory discussion with us so far.

Is 2017 viable? Never say never, ma'am.

CHAIRMAN MACFARLANE: Okay, right.

MR. MAYFIELD: But we haven't had extensive activity with them to date, so I'm not overly concerned about them showing up in 2017 and us being caught unawares.

CHAIRMAN MACFARLANE: Okay, great, thank you.

Commissioner Svinicki?

COMMISSIONER SVINICKI: Thank you for your presentations. I'll begin with a couple of observations and then I will have a few questions.

The first observation is that this morning, the NRC had a recognition and a commemorative moment that we took a little time out to recognize a very significant milestone achieved, I'll say principally by the Office of New Reactor and its staff but also by all the supporting organizations within NRC.

And as much of the press of business day to day carries us all forward, I think that the history of organizations is made up of these individual milestones that are achieved over time.

The certification of the ESBWR was a very, very significant undertaking for NRO and the NRC staff who supported them in that mission and I thought it was a very appropriate and a positive recognition.

So, Glenn, I want to once again congratulate you. And these milestones are important, you know our tendency is to just pick up the next piece of paper, but it's really important that you and your staff, you know, take that moment and provide that recognition.

Thank your partners throughout the agency who make it possible and all of the administrative support that goes into something. We all know there's a lot of paper and things to be moved in this agency.

So, congratulations, once again, to you and your team and all of those who worked to support you in that. I think that that's

very important.

My other observation has to do with something that hasn't been mentioned here today but I've been impressed by and think is very important. I think many Commissioners have opportunities to be invited to address SMR gatherings and, you know, there's been a lot happening in vendor space and supply chain and there is tremendous interest in small modular reactors.

As a result, there's a lot of technical meetings, conferences, seminars and sometimes Commissioners go and speak.

What impresses me is that NRO is not sitting back and just saying, we wait until inquires come to us. You know, I will listen to a panel about the process and Anna Bradford's on that panel and she's, you know, she's giving a great overview of our readiness and where we are and open issues.

I pop into another break out session and it's about fuel qualification for advanced reactors. We've got someone from the office of NRC Office of Research there and, you know, speaking of ways to kind of have a force multiplier and get awareness and understanding of, here's what NRC's working on, here's our process, here's our readiness, here's what's still an open item.

That's a great way to talk to -- when Anna gave her talk, I think there were a couple of hundred people in that audience. So that's a real force multiplier.

And also, you know, those sessions frequently have Q&A and I want to credit the NRC staff, I think that they answer the questions when I'm in the audience, I observe great, you know,

forthrightness about, here's what we know, here's what we're still working on, here's where there's uncertainty. And I think that that's really our obligation is to be clear about that.

It's, Glenn, a little bit what you talk about of just keeping a very open state with people. It's that we're expected to have all the answers right now, but let's be very clear about what has uncertainty and what is it that we're feeling pretty sure of.

So, I just want to compliment you since we've not had a focus on these issues for three years or so. I want to say that I've, you know, I've kept a weather eye on where you are and what you're engagement is with the stakeholder community and with interested parties.

And I think you're out there, you're not shy, you're not waiting, so I appreciate that and wanted to draw some attention that that's an element of what you're doing is getting your experts out there.

You did hear my engagement with the previous panel about design specific review standards. You must know about some of the heartburn that, you know, we hear about as we're out and about is people want you to be able to provide as much clarity to them as early as possible.

A year, to me, seems like a lot of time, however, when I think about all that they prepare to submit an application or something for review, it's very, very detailed or at least it should be in order to pass the acceptance review.

How do you respond to that? You know, you're targeting 12 months, how did you arrive at that? And is there any back

and forth in terms of if you could have something out earlier, you would? Anyone who wants to respond.

Joe, you went into a lot of detail about that, maybe you want to respond to that.

MC. COLACCINO: Yes, and as I was listening to you, I was thinking about some of the other guidance that we've developed, too, and some of the natural give and take that occurs like on the readiness assessment because we did some version of that when we had the first -- when we had the design certifications and reference COLAs come in and thinking about how we wanted to come a little bit earlier than that, but they said no, we're not ready yet but if you came later, then we wouldn't have enough time to actually react to what the NRC has said.

And we went through those same things that you were talking about, too, when we developed the readiness assessment trying to get out there in six months because we did want to go as early as we could.

With regard to the design specific review standard, we think that the 12 months, it is a balancing act between the two things and it also takes the SRP into account as well as we continue to update that.

We think that that is -- it is a reasonable compromise and I'd like to defer to Stu to maybe answer a little bit more about that.

There are probably some cases where we could do it sooner, but it just depends on what kind of details that we get.

COMMISSIONER SVINICKI: Okay, thank you. Stu?

MR. MAGRUDER: Yes, I agree with everything Joe said. I also want to add that the pre-application interactions we've had with these vendors is far and away a lot more than we've had with other vendors.

So, we hope, anyway, that there won't be any surprises in the DSRS. We've had -- we would hopefully have discussed all the issues, made clear our expectations through normal discussions with the vendors. So, the DSRS should just be kind of codifying the things we've already discussed.

I agree there is a balancing act and we know that the vendors are still updating their designs so to try to capture the sweet spot. We think a year is about right, but time will tell on that.

COMMISSIONER SVINICKI: Okay, I think, yes, fair enough. I don't think there's any one magic answer on that and it sounds like you just got some give and take and that you'll probably inform future processes depending on how the first one or two go. So I appreciate that feedback loop.

Speaking of the feedback loop, Joe, you mentioned a paper on its way to the Commission on looking at Part 52 which, as Commissioner Burns mentioned, yes, is this extremely young juvenile thing that's 25 year old.

But how would that affect or impact any applications that are under Part 52 that are currently in-house? Is the staff proposing things that would have an impact on things in-house and, if so, I'm not asking you to discuss it, but would the paper say, if the Commission goes a certain course or the agency goes a certain course,

these are the implications for in-house work?

MR. COLACCINO: Thank you for the question. No, it doesn't specifically affect any of the applications that are under review right now, so that's a very important point, so thanks for that.

The paper has two things I can talk about just at a higher level.

One thing is, is that we're looking at the Part 52, the requirements for Part 52 applicants and when we were looking at having a potentially a construction permit application come in. We wanted to say, hey, we have 52 requirements, do they apply to Part 50? And so that's one of the topics it's going to cover.

And then the other topic will be, we've been carrying for since the last time that Part 52 was updated in 2007 a number of things that we would like to adjust or to fix and there are more -- some of them are administrative in nature, some of them are a little bit more than that.

So, there's another piece of the paper that will talk about, though, in a higher term to try to sell why this is a good thing to do and we're actually, we're hoping that the Commission will approve us to go forward with rulemaking on Part 52.

COMMISSIONER SVINICKI: Okay. And I, again, mention it because to the extent certain applicants were flat lining over the earlier comment about we're going to change Part 52, I think we can turn the ambulances around of the heart attacks that might have been created on that.

Finally, Anna, I would ask -- you talked about the status of the technical and policy issues. In the staff slide deck, but not

presented, is a B1 and B2, but it had listed the same issues that were presented by the staff.

And for a whole lot of them, it says no further action. It's things like control room staffing and stuff like that.

So, what does that indicate? Because you still need to -- you said we're looking at, you know, someone to operate 12 modules with one operator and things. So, there's obviously some live discussion going on.

MS. BRADFORD: Yes, these are the 17 issues that we discussed in SECY 10-0034 when we were -- I think of it as kind of brainstorming of policy or technical issues that might affect SMR licensing.

And we looked at each of these since that SECY paper and decided whether adjustments needed to be made to our regulations, to our guidance, or some kind of framework.

Some of these when we look at the example, for example, licensing of multi-module facilities, that was a paper we sent up to the Commission, it was just an information paper about how would you license modules? Would you license each one individually? Maybe we could do a master license type of thing like we do with materials licensees. Maybe you would have one license for all 12 modules.

And it said we think our preference is to license each module but we were going to wait until we heard something back from industry in case they had some sort of compelling reason to do it differently.

So, in our mind, we've looked at that, we know what we think our path forward is. There's no more action we can take on it at this time. If they came in with something that wouldn't be able to be handled under what we think is the path forward, maybe we'd have to rethink it.

COMMISSIONER SVINICKI: Okay. So, you'll evaluate and react to things that come in.

MS. BRADFORD: Yes.

COMMISSIONER SVINICKI: No further action doesn't mean that you're not willing to discuss the topic or engage it or something.

MS. BRADFORD: No, absolutely.

COMMISSIONER SVINICKI: I just wanted to clarify what that meant.

Okay, thank you, Chairman.

CHAIRMAN MACFARLANE: Okay, Commissioner Ostendorff?

COMMISSIONER OSTENDORFF: Thank you, Chairman. Thank you all for your presentations.

Glenn, I want to commend you and your team for your flexibility and agility in reshuffling work priorities as some of these schedules have changed the last few years. So, Atta boy, Atta girl to everybody here.

Stu, I want to start out with you. I wanted to focus on slide seven, eight and nine from your presentation and I thought those were very helpful.

In particular, I thought the optimal scenario requiring satisfying key assumptions was very targeted towards, quite frankly, the industry vendors here and I thought that was good.

You know, the request for additional information, the timeliness in responding to those as well as the quality of submittals, in particular, I know have been a recurring theme in a lot of different areas of the agency, not just SMRs but across many business lines here, reactors, fuel, et cetera.

To what extent do you have a sense that industry vendors are embracing the need or are on board with this quote, program to provide quality answers in a timely manner to support the 39-month schedule?

MR. MAGRUDER: So, I guess let me first say that there is a lot of discipline required to do this 39-month schedule, both on the industry part and on the staff part and I think --

So, we both have a role to play and my feelings, based on discussions with vendors so far, is that they are committed to doing this.

As I said, the pre-application interactions we've had with them have been very helpful. We've identified the key issues, I think. I think we've made good progress on identifying what the testing requirements, what the submission requirements are going be.

As I keep referring to Mr. Perez's presentation, but I think he hit it right on. I mean the issue really is the level of detail in the application and the more we discuss that before an application comes in, the closer I think we'll get to what the staff wants. So, I think that they

are committed to doing it.

COMMISSIONER OSTENDORFF: Okay.

MR. TRACY: I'd just add sir that over the course of some many months, using a Navy term, I've seen a sea change and I think I feel it in the meetings we have with the senior leadership of our vendors and applicants of understanding.

When we did not accept the Korean Hydro and we made it clear why, we articulated 12 or so positions. We've had very professional dialogue. We'll see the return response.

And then when dealings with other vendors, I'm not going to go into names, but in terms of those dialogues and the manner in which those are conducted and the understanding, I'm just trying to echo what Stu has indicated.

Although different for the small module community, I think the entire industry, as Mr. Perez indicated, is speaking and understanding the expectations. It's on our own onus and discipline though to make sure that that guidance is clear and it's not just verbal.

COMMISSIONER OSTENDORFF: Okay, thank you. And just one follow-on question back to Stu on that on your page seven here, your different phases. I'm assuming that you've coordinated with John Stetkar and Ed Hackett on the Advisory Committee on Reactor Safeguards to ensure that we're all -- is that a fair statement?

MR. MAGRUDER: Yes, yes, it is very fair. As a matter of fact, we initially thought we might be able to do a four phase review and only give the ACRS one shot and we quickly agreed with them that that's not the right way to go. So, we've had a lot of

discussions with the ACRS.

COMMISSIONER OSTENDORFF: That's good. And I think the ACRS, when they know what they need to do and they have the big picture plan, they've been extraordinarily responsive to the staff and the Commission, so that's good. I'm glad you all have had those discussions.

Anna, I want to go to you for a minute, if I can. But it's somewhat, I'm going to ask for maybe a specific example to highlight the question I asked about -- I asked Stu about, you know, quality of information.

To date, and this is maybe somewhat of an ambiguous question, but trying to see how would you as a branch chief characterize your experience in receiving detailed information to date from perspective vendors given the fact that, you know, their design is not complete but they're working towards certain objectives time wise? Does that make sense?

MS. BRADFORD: Yes, it does. I think that, as Glenn said, it's a little bit of a dance. They move a little bit forward and they want to get a thumbs up from us on that little bit of movement so we have some discussions and some evaluation and then we give them some feedback on, yes, that looks kind of reasonable and then they take another baby step.

So, for example, from a mechanistic source term, DOE is working with EPRI to do some studies on deposition inside containments. We just had a meeting with them last week and they presented their preliminary calculations and findings and they're

interested in getting some of our informal feedback on that.

So, it's -- we do need more from them, but I don't think their pace is not incommensurate with their application dates.

COMMISSIONER OSTENDORFF: So, it's not commensurate?

MS. BRADFORD: It is not incommensurate.

COMMISSIONER OSTENDORFF: There's a big difference between the two. Okay, not in -- okay, I'm trying to get my two negatives. Okay, I think I understand that.

Okay, Mike, you mentioned something that got my attention. You were talking about multiple modules and it raises the sector of, you know, how many operators can supervise and at previous Commission meetings, at least two this year at this table, not involving you, we've had the topic of human reliability analysis brought forward, HRA.

And I think the Commission, and correct me if I'm wrong, but I think the Commission has heard from the Advisory Committee on Reactor Safeguards at a recent meeting here at this table on that topic.

And we've heard from an eternal panels that there's a lot of work in this area, but not necessarily a consensus model for what human reliability analysis methodologies might be most appropriate for certain applications.

Can you talk for a minute or two about how you see HRA applying to looking at the operator staffing sufficiency for multiple modules or for even one module?

MR. MAYFIELD: Well, yes and no. I am not an expert in HRA, so I don't -- I'm not even going to try and go down that path.

What we have said to the industry and specifically looking at NuScale because of their desire to change control room staffing, we said that we would entertain exemption requests, not that we would approve them, we would entertain them.

However, the basis for that, so they're going to have to through first the thermal hydraulics and accident analysis scenarios, identify then through a task analysis what actions the operator has to take and on what timing, the laundry list of them.

For modules in a variety of situations, for example, you may have a module that gets into some accident scenario at the same time you have other multiple modules out for maintenance, at the same time you have one on the crane hook being transported down to the refueling station.

We want to understand that set of scenarios and then look at the operator actions, the timing of them and then they're going to have to demonstrate it in a full scale simulator to the satisfaction of the reviewers that those actions can be taken with high reliability, acceptable reliability, for the range of scenarios.

We will have to see how that plays out but it's that level of detail, rather than rely solely on human reliability analysis, that will plainly be a factor but we want them to demonstrate what they're able to do with the timing.

The thesis from the vendor is that the timing for

operator actions is very long, that not much happens quickly in that design so there, one, there isn't much to do and, secondly, they have a lot of time to get around to doing it.

We'll see how that works out in the accident analyses and in the thermal hydraulics analyses that support it. So, we don't try to subscribe and agree with, yes, this thing all happens very slowly, they're going to have to demonstrate it and then in justifying, reduce or changing control room staffing, they're going to have demonstrate that.

That's what we laid out for them in some detail. I think we presented that in a Commission paper as well. That's the expectation on the industry to justify doing something different in control room staffing.

If we had a enough applications for that where we were starting to regulate by exception, we would likely come to the Commission with a proposed rule change. But for a small number of them, if it's only one vendor, perhaps not a regulation change of that sort -- would get to be fairly expensive. So we'll just have to see how it plays out. But right now, the expectation is do it through exemption by them demonstrating what the needs really are. Does that answer your question?

COMMISSIONER OSTENDORFF: Very well, it does really. No, that was an excellent answer and I appreciate it.

I just know that this whole area of human reliability, human performance has been one that if you take a cross cut across various Commission meetings here the last few years, it's been one that there's not a single set of answers and that's why I was interested in

asking the question, but thank you very much.

Thank you, Chairman.

CHAIRMAN MACFARLANE: Thank you. Commissioner Baran?

COMMISSIONER BARAN: Thanks. Let me just start by thanking you all for the work you've been doing on this.

I wanted to follow up on some of the questions that Commissioner Svinicki was asking about design specific review standards.

My understanding is that the staff was pretty near completion of the DSRSs for the mPower design earlier this year. What are the key lessons learned from that process that are applicable and presumably already being applied to the DSRS from NuScale?

MR. MAGRUDER: So I'll try to start the answer to that anyway.

I think we learned a lot from doing the mPower DSRS. We actually standardized a lot of language among the sections in the DSRS. So that was helpful.

We ran all the sections through OGC to get legal approval of the sections before we published the draft.

We also learned a lot on some specific issues. One of the major changes that we made was we completely revised the chapter on reviewing digital I&C or digital instrumentation and control systems.

So that portion, we think, can be probably directly translated to NuScale. Also on regulatory treatment of non-safety

systems, a lot of information that the staff has gleaned from actually the passive large light water reviews and applied to mPower and then we translated that to NuScale.

In addition, there was some kind of internal processes that we've learned a lot about that and we think we can improve.

So, as Joe mentioned, we think that the NuScale DSRS will be a lot less resource intensive than the initial mPower DSRS.

MR. COLACCINO: Yes, if I could add to that, the staff has learned a lot too when they created those DSRSs, not only about that but how it applies to the standard review plan in general. And as I said before, the standard review plan applies to both operating and new reactors.

The design specific review standard gives them an opportunity to apply it to that design. But what we're seeing some of the technical groups do is go back and look and see if actually the changes that they have made are actually more generic.

And so, if you talk on NuScale, if you talk to the lead project manager and he looks at the pie chart slide that I had there, that's what was yesterday as the mix, but that mix could change as the staff looks and says, well, this is actually a more generic change, we, of course, have to work with NRR on that to make sure that that change is acceptable for operating reactor reviews as well.

So there's a lot that's been learned from that and it's getting more and more efficient as we do them.

COMMISSIONER BARAN: So, we have NuScale,

are we anticipating other vendor requests in the near term for DSRSs?

MR. MAYFIELD: Let me take that one. We have -- it's not a requirement that they have a DSRS. Of course, mPower and NuScale have both said, yes, they wish to go down that path.

Westinghouse flatly said they did not. They had no interest, they fully understood Part 52, they had a lot of experience with Part 52 and they were quite satisfied to enter into a design certification review on that basis.

Holtec is still evaluating. We think they would want to go down that path, there are enough unique aspects to that design that we think it would benefit them.

It is a resource intensive activity for both the vendor and the staff. But we think they would likely go down that path.

For the non-light water designs, should we start seeing them, we just don't know yet. I think they are still early enough in their thinking that they haven't worked through that specific detail. So, we don't know.

If I could just follow-up and actually with this and it actually goes to a question that you had, Commissioner Svinicki, in Joe's presentation, he pointed out that, what, 50 percent of the DSRS would rely on existing SRP sections.

Stu made the point that a lot of what would go into NuScale, DSRS builds on what we learned from mPower. So the concern that has been expressed by some of the vendors are, oh, we've got to have our DSRS simply come in to them what's in the public domain and that the notion that, well, you need to do something earlier,

it's the design specific sections that we need to let their design mature so we can write those sections, otherwise, we stop where we are and, if you will, wing it when they actually submit a design.

We don't think that serves the interest of having a DSRS. So there is a balancing act as has been suggested but there is a lot of information where the vendors can understand exactly what the staff's going to use in reviewing their application that's already out there.

So, it's the design specific sections that we need to hang back on and see what they actually have in the design and tailor the review guidance to that design.

COMMISSIONER BARAN: I want to turn for a minute to the 39-month optimal scenario for reviewing applications.

I think we all know that sometimes in the past NRC's been criticized for not meeting licensing schedules. And so, I'd like to get an understanding kind of on the front end of how realistic do we think this 39-month scenario really is?

I know there are these assumptions or factors that were listed, the five of them, how confident at this stage do you feel that for say, NuScale, it's realistic to say 39 months?

MR. TRACY: I'll take that one. I've bene asked by various Commissioners about that over the course of, you know, when we developed it.

I recently heard on ESPN Radio that a recent coach said that I'm not going to set low expectations because I just might meet them and I thought that was a great quote.

So, the bottom line is if we're saying 39 months, the assumptions are clear, I told you that how direct we are with our applicants and vendors and I feel it in the room when we're talking to them. You heard it from Rick Perez who represents a larger forum.

We have work to do in our discipline, there's not question. But as long as we're able to have those conversations in a timely fashion at the staff's level and then when it gets more serious set mind of exactly what's going wrong in a timely fashion and be able to take corrective action or at least inform you earnestly that, guess what, it's not going to be 39, it's going to be whatever the basis, the reasons and then legitimacy of that significance. That's how I'd like to proceed, sir.

So, do I believe in it? We've said it, we do believe it. Is it a dance that requires both knowing how to do it? Absolutely or it will not be the case and we're trying to do that in every case, not just for SMRs, but obviously for our ongoing efforts.

COMMISSIONER BARAN: And I know this question is hard to answer in the abstract and not in the context of a specific application, but when you look at these five, you know, key assumptions to meeting that kind of time frame, which of these gives you the most heartburn now? Which are you worried about blowing schedules?

MR. MAYFIELD: I'll take that one. Based on the experience with the large light water reactor reviews, it's the timeliness of response to the request for additional information.

When you look at an expectation of a 30 or a 60 day

response and the average is running out in the 120 day, that's problematic. We will not make a 39 month review with that kind of response to RAIs.

When we look back at well, what led to that? The applications weren't sufficiently complete when they were originally submitted, that's why we changed the acceptance standard from complete enough to being the review to complete enough to conduct the review. It's a higher threshold.

We think that will help with not having requests for additional information that takes the vendor off having to do detail thermal hydraulics analysis and build new models that takes months and months and months.

So, by raising our standard, not trying to set low standards, by raising the bar on what's acceptable to being the review to accept the application, we think we will help that. But the one in my experience that was the most problematic is RAI response time.

COMMISSIONER BARAN: And so, you went right to that question I had in mind next which is how high should the bar be for accepting it? And you guys think you're at the right --

MR. MAYFIELD: We think we're at the right level.

COMMISSIONER BARAN: -- at the sweet spot on how high that bar should be?

MR. MAYFIELD: We think we're at the right level, we'll say it's a change in the phrasing of it that Glenn drove when we did the lessons learned report, when we looked at where we were with the KHNP application on what caused us to not docket that application, we

think if the other vendors learn from that experience, we'll get an application that we can go to work on and not have these huge time sinks in it, we think.

COMMISSIONER BARAN: I just want to quickly, I know we're running out of time, ask about the assumption of minimizing design acceptance criteria. Do you have a sense of how likely it is that applicants intend to minimize DAC and what's your sense of need for applicants to utilize DAC for piping?

MR. MAYFIELD: My background is --

COMMISSIONER BARAN: You have one second, go.

MR. MAYFIELD: My background is that piping design, they can complete it. I am, however, sympathetic to Mr. Perez's point about we don't need to get down to the one inch piping.

If you look at the threshold of what the expectation is complete enough for the Commission to make its safety findings, that typically doesn't take us down to one inch piping. But we -- there is a balance that we'll have to work through. I think they can get there, they may not want to, but I think they can get there.

COMMISSIONER BARAN: Thank you.

CHAIRMAN MACFARLANE: All right. Any further questions? No, all right, great. Well, thank you very much for your presentations and for the discussion and thanks again to the external panel. I think this was a good discussion of the situation with SMRs and we are now adjourned.

(Whereupon, the above-entitled matter went off the

record at 4:08 p.m.)