UNITED STATES

NUCLEAR REGULATORY COMMISSION

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MICRO-REACTORS: CURRENT STATUS AND MOVING FORWARD

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THURSDAY,

APRIL 10, 2025

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The Commission met in the Commissioners' Hearing Room, at 9:00 a.m. EDT, David A. Wright, Chairman, presiding.

COMMISSION MEMBERS:

DAVID A. WRIGHT, Chairman

CHRISTOPHER T. HANSON, Commissioner

ANNIE CAPUTO, Commissioner

BRADLEY R. CROWELL, Commissioner

MATTHEW J. MARZANO, Commissioner

ALSO PRESENT:

CARRIE SAFFORD, Secretary of the Commission

BROOKE CLARK, General Counsel

EXTERNAL PANEL:

BILL JESSUP, Director of Nuclear Technology,
Shepherd Power

ANTHONY SCHOEDEL, Manager, Advanced Reactors
Licensing Engineering, Westinghouse Electric
Company

DIANA LI, Program Manager, Micro-reactor Program,
Department of Energy

MARC NICHOL, Executive Director of New Nuclear,
Nuclear Energy Institute

MOHAMMED (MO) BADAL, Program Director, Installation
Nuclear Energy, Office of the Deputy Assistant
Secretary of the Army for Energy and
Sustainability

NRC STAFF:

MIRELA GAVRILAS, Executive Director for Operations

JEREMY BOWEN, Director, Division of Advanced
Reactors and Non-Power Production and
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CINTHYA ROMAN, Deputy Director, Division of Fuel

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DAN BARNHURST, Chief, Environmental Project Management Branch 3, Division of Rulemaking, Environmental, and Financial Support, Office of Nuclear Material Safety and Safeguards

JESSIE QUICHOCHO, Chief, Reactor Licensing Branch, Division of Preparedness and Response, Office of Nuclear Security and Incident Response

P-R-O-C-E-E-D-I-N-G-S

9:00 a.m.

CHAIRMAN WRIGHT: Good morning, everyone, and we're going to call this meeting to order. At today's public meeting of the Nuclear Regulatory Commission, we're going to hear from two panels.

The first will be an external panel that's going to provide us their perspectives on the deployment and use of micro-reactors, and the second is a staff panel that's going to discuss the actions the Agency is taking to prepare for the licensing of micro-reactors.

In between the two panels, we're going to take a short break, and as is our custom, we're going to hold questions from the Commission until the end of each panel. So, I look forward to a good dialogue today, I really do. And before we start, as is our custom, I want to ask my colleagues if they have any questions before we start? Any comments?

Okay, since there are none, with that, we're going to get started with our external panel. We're going to begin with Bill Jessup this morning, who is the Director of Nuclear Technology at Shepherd Power. It's good to see you again, Bill. And with that, the floor is yours.

MR. JESSUP: All right, yeah, thank you, Mr. Chairman, and thanks to the Commission for having us here today to talk about micro-reactors. Before I get into details, I wanted to give a brief introduction to Shepherd Power and our parent company, NOV. I think that will provide some good context for the bulk of my presentation, so next slide, please?

So, Shepherd Power is a wholly-owned subsidiary of NOV. NOV is an oil field equipment supplier and service provider to the oil and gas

industry primarily, but fundamentally what NOV does is it solves the global energy industry's challenges, and so that ultimately led us to Shepherd Power. So, if you go to the next slide, please?

In 2020, a large oil and gas exploration and production company brought a challenge to NOV and said we like micro-reactors. We think micro-reactors have a place in our operations. Can you figure out how to deploy these to support our remote power needs? NOV took that challenge on and ultimately formed Shepherd Power to take on a developer role in micro-reactor deployment. And so, Shepherd Power's intent is to buy reactors from reactor technology vendors and own and operate those reactors on behalf of energy off-takers. So, I'll give a use case from the oil and gas industry on the next slide, if you go to the next slide?

So, one of the areas where we see a lot of potential interest in micro-reactor deployment is the Permian Basin you see here in west Texas and New Mexico on the slide. The Permian Basin is one of the largest hydrocarbon producing basins in the world. This map shows some of the general features of the basin, including the wide distribution of oil and gas production activities.

From a regional demand standpoint, we can glean a lot from a recent S&P Global report that did a deep dive into the basin's increasing demand profile, a lot of which is being driven by the increase in electrification of oil field activities like artificial lift and gas compression. That report found that we can expect several gigawatts worth of additional demand from oil and gas production activities alone over the next 10 to 20 years.

And I think what's notable and relevant here is that a lot of demand is remotely located, and getting those loads connected to the grid has

been and will remain challenging for a variety of reasons that aren't necessarily unique to the Permian Basin.

And at the end of the day, when you look at this map, what we're ending up with are pockets of demand on the order of five to 50 megawatts electric. They're remotely located. They require reliable power for a period of several years, perhaps decades, and they require a very low operations and maintenance burden.

Micro-reactors align well with a lot of these requirements, but the distributed nature of these loads and the need for commercially viable deployment approaches, it going to require a different operating model than that which we're accustomed to in the nuclear industry. Next slide, please?

So, what enables that operating model and how do we deploy these technologies at scale? And to address those questions, I've outlined a couple of considerations here.

And the first consideration kind of in the middle of this diagram is safety focus, and it relies on some of the basic characteristics of micro-reactors that we're familiar with, inherent safety, passive safety features, smaller radionuclide inventories, and standardization, among others.

These characteristics, they suggest that, you know, micro-reactors are going to convey lower accident consequences should an event occur, and that correspondingly, they should pose a very low risk to public health and safety.

We need to validate these assumptions through design and analysis activities, of course, but ultimately what this does is it allows us to consider a different way of operating and maintaining these technologies. And

so, with that lower risk profile validated, we can move outward on that diagram and start to look at the key enablers of these operating models and what can help drive commercial viability here.

And what you see on this outer ring are some of what we consider to be the key enablers, remote operations where we can pull some of the operating duties out of the field and centralize them into one or more facilities, centralized programs that are pre-approved and standardized, and primarily that's the streamline and downstream licensing activities, using a multi-skilled workforce where perhaps the same individual is performing maintenance, health physics surveys, sampling. That's got some clear implications from an accreditation, initial training, and continuing training perspective, ensuring that facility staffing levels are commensurate with the relatively low risk profile of micro-reactors, and this extends to support facilities like remote operation centers.

Operation staffing is a significant interest here because of the existing regulations related to those positions, and then physical security profiles and postures that are also commensurate with that same low risk profile.

And then last but not least, we've got to have efficient licensing pathways that treat micro-reactors as products and not projects, and this is where Shepherd Power has probably been the most engaged with the NRC over the last year or so. Because at the end of the day, the questions we have to answer for target customers are how much is this going to cost and when can we get it?

That's it, and so viability really rests on being able to answer

those questions, and having a streamlined, predictable licensing pathway, particularly for the nth-of-a-kind micro-reactors. We really see that as essential to answering those questions.

And I think the last thing I'll add here is this is just a subset of all the enablers that we think need to be addressed for commercial deployment and viability, but these are top of mind for us right now, and fortunately, we see a lot of overlap between what the staff's working on and what other stakeholders are working on here in the policy arena. Next slide, please?

So, I'll wrap up with a quick discussion on how we're approaching regulatory engagement with the NRC. Our initial interactions with the NRC were focused on trying to understand the level of commercial risks associated with micro-reactor licensing and regulation while also explaining to the Agency what our commercial constraints are, again, you know, what drives commercial viability here.

To the NRC's credit, I think the Agency has really rolled up its sleeves. You know, the fact that we're sitting here today talking about this is just one example, but you look at things like the staff's integrated plan and all the policy work that's going on.

And there's a lot more work to do on everybody's part, our part, NRC's part, but it's, you know, it's given us enough confidence to move into more of an execution mode here where we're starting -- we submitted a regulatory engagement plan. We submitted two white papers, the first of many, and topical reports, and we also continue to engage with the NEI and others on the policy development work that's going on.

And to the point I made earlier about validating the safety

case of these technologies, I think we're going to be reliant on specific analyses and other evaluations to justify the implementation of some of those enablers, so a lot of our subsequent white papers, topical reports, things like that, they're going to become more site specific, technology specific, and all of that is in anticipation of submitting our first round of license applications.

So, next slide, please? With that, that's my presentation. Again, thanks for having us today and I look forward to the questions you all have after the panel.

CHAIRMAN WRIGHT: Thank you so much. So, next we're going to go to Anthony Schoedel, who is the Manager of Advanced Reactor Licensing at Westinghouse. Mr. Schoedel, the floor is yours.

MR. SCHOEDEL: Thank you, Chairman. Congratulations on the appointment, and Commissioner Hanson, thank you for your leadership these past years, and to all of the commissioners, it's a pleasure to be here with you today and to have the opportunity to speak with you on the eVinci micro-reactor.

So, I've got about four slides we'll go through here pretty quickly, but the theme today, I want to talk to you about a brief overview of what the eVinci micro-reactor is, technology overview highlights, share some of our experiences from pre-application engagement and how we've been conducting that for the last couple of years here with the NRC staff, and then leave you with, you know, where we see additional areas of licensing policy issues, that many of them have been noted already through various SECYs where we think we still need to see continued progress to move the needle for first-of-a-kind and nth-of-a-kind deployments. So, with that, next slide, please?

All right, so the eVinci micro-reactor, it's a TRISO-fueled heat pipe micro-reactor. It operates with an open-air Brayton power system that's capable of producing five megawatts electric in an eight effective full-power year core design lifetime. It's a graphite-moderated reactor with hexagonal core blocks that house both the TRISO fuel compacts as well as the heat pipes, you know, you start to see these differences between your familiarity with SMRs and large light water reactors and some of the physical characteristics as you go around this graphic.

The predominant means of reactivity control for this is a series of banked control drums around the perimeter of the reactor. It's all encapsulated in a canister in an inerted environment, very low pressure, approximately one atmosphere. That helps, you know, safety case analyses and risk consequences for this type of reactor profile.

The overall site is approximately three acres or less when we consider total impact to site footprint, and I think that's really key as we get into some of the other technical discussions through EPZ and siting, keeping that small site footprint.

And eVinci is, you know, being a micro-reactor, one of the things I expect we'll talk about a fair amount today is the deployment model for what these reactors revolve around, and that's really being factory manufactured, fueled in a factory, maybe some limited testing at the factory before it gets to the operating site, transporting a fueled reactor to the intended operating location and back following eight years of operation before dismantlement, or refurbishment, or reuse. So, if we can, we'll go to the next slide, please?

All right, so pre-application engagement, we've been working very closely with the NRC staff since 2021. A series of technical white papers have been going through following the advanced reactor road map for licensing from the staff. We have had, I'd say, overwhelmingly positive meetings and engagement, and thanks to the NRC staff for facilitating, I would say, on time reviews, on budget reviews, and I think that's reciprocal.

So, Westinghouse has committed through our pre-app engagements to deliver what we say we're going to deliver through our regulatory engagement plan, that way the staff can plan accordingly, and I think we have seen that reciprocity from the on-time staff reviews for these technical white papers.

What's the significance of the white papers? Really important for, you know, a design vendor like Westinghouse with a new first-of-a-kind type of technology to understand where there are potential policy issues or hurdles that we are going to experience as we move through future licensing or as potential future customers look to license this technology.

So, the de-risking in licensing space that happens through feedback through those white papers has been very important for us. How are we acting on that? So, we are taking that to the next step through what we view as really key for starting to get approvals and de-risking some of these more formally through topical reports.

So, 31 white papers in various areas, that's transitioned now into three topical reports now approved. Two of them are I&C platform, one of them on principal design criteria, another three topical reports currently under review. Those technical reviews are ongoing, but all very positive to date,

utilizing the audit process and being very open and transparent.

I think it's very important from the Westinghouse perspective that when something comes to the NRC staff in the form of a topical report in a future application, that it's not going to be a surprise to the staff.

It should not be a surprise to the staff because of what we're put forward in our technical white papers, and that's leading to some of the efficiencies that I think we need to continue to build upon as we look towards first-of-a-kind delivery and ultimately nth-of-a-kind delivery.

In parallel with topical reports and the white papers, we have a robust testing program. So, we're a big proponent of the design, build, and test philosophy at Westinghouse for this technology.

You can see on the bottom bullet there a special callout to our nuclear test reactor we envision in operation in the near future at the DOME complex at Idaho National Lab. That's an integrated nuclear test working through, you know, our friends and partners at Idaho National Lab to get it authorized with the U.S. Department of Energy for future operation.

So, that's an area as well that, while it's not specifically being put forward in front of the NRC staff for their technical review, it's an area where we're collaborating and sharing with them, you know, what we've been doing, so that way they understand where we're going with those tests and how that's going to potentially inform future commercial license activities.

So, I would say also thank you to the U.S. DOE. Recently, yesterday, I think a lot of us have seen the announcement on the HALEU conditional commitment. Westinghouse is lucky enough to be one of those parties for the eVinci micro-reactor, and that supply is going to directly support

the nuclear test reactor for eVinci, which is a tremendous accomplishment, so thank you to the DOE colleagues here.

As well, you know, the success is building in pre-application engagement over these past years, and the confidence that that instills in future potential customers and off-takers of this technology, I think, is most recently envisioned by as recent as February, Penn State University has put forward a letter of intent to the NRC for a research reactor, selecting the eVinci micro-reactor technology as an advanced reactor technology for their campus to foster both continued learning and building their engineering program.

So, you know, these results are both important to Westinghouse, but they are also equally as important to potential off-takers and then users of this technology to see the licensing progress. Next slide, please?

All right, so I'll wrap it up here in the next two, but I want to share some of these very impressive graphics. This is an array of different components that we're manufacturing across various Westinghouse facilities in the U.S. and Canada, and we're taking that design, build, test philosophy and building off of the lessons learned in pre-application engagement to show confidence in the de-risking that's happening in licensing to be able to turn this design into a reality.

The bottom right graphic is our manufacturing demonstration unit. It's a representative core section of the eVinci micro-reactor that was built at our Newington facility, and it now resides in that top right building that you see in this graphic.

That's our eVinci headquarters outside of Pittsburgh, Pennsylvania where we're going to be manufacturing heat pipes. So, a lot of

great work there, an 87,000 square foot facility stood up just for this technology. Next slide?

And then I'll close with this, and I expect that we'll have a fair number of questions as we get into the Q&A portion, but critically important to Westinghouse is, you know, these bulleted items on the left.

These are key enablers for future areas that we need to continue to work with the NRC staff, with you all at the Commission to drive surety in the licensing process for a first-of-a-kind and ultimately nth-of-a-kind deployment of micro-reactor technologies.

All of these were communicated to the NRC from Westinghouse in writing back as recently as 2023 in form SECY-24-0008. The fuel load and manufacturing facility is the number one licensing policy item from the Westinghouse eVinci perspective, and I would encourage that the staff, they put that SECY in front of you all for notation vote.

So, I would encourage the Commission to make a vote on that if we can. That would help us move forward with planning on not just first-of-a-kind, but ultimately nth-of-a-kind. So, I'll leave it there. I think I've eaten up a little of your time, Diana, but again, thank you all for the opportunity and I look forward to the Q&A.

CHAIRMAN WRIGHT: Thank you very much, Anthony. I got a lot of questions, so I look forward to questions with you all. Next, we're going to hear from Diana Li, who is the Micro-reactor Program Manager at the Department of Energy.

MS. LI: Thank you, Chairman Wright, and thank you, Commissioners, for this opportunity to speak about DOE's Office of Nuclear

Energy's efforts to demonstrate and deploy micro-reactors. Can I get the next slide, please? Yes, thank you.

The administration has a bold and ambitious agenda to unleash American energy at home and abroad to restore our nation's energy dominance. In alignment with Secretary Wright's priorities, the Office of Nuclear Energy is working to grow the supply of affordable, secure, and reliable American energy across the entire spectrum, from R&D, to demonstration, to deployment. Next slide, please?

The Micro-reactor Program is leveraging cross-cutting research and development activities in collaboration with our national laboratories and universities to achieve technological breakthroughs for key features of micro-reactors, which would reduce risks and timeline to deploy advanced nuclear technology, improve economic viability and licensing readiness, and enable successful demonstration of multiple domestic commercial micro-reactors.

Our R&D program is focused on four technical areas. The first is system integration and analyses in which we identify the needs, applications, and functional requirements for micro-reactors through market analyses. This technical area also includes investigation of micro-reactor supporting concepts such as modeling capabilities and research to help develop the regulatory basis for micro-reactor deployment.

Recent work includes development of a heat pipe micro-reactor model for code comparison, identifying micro-reactor transportation emergency response planning challenges, identifying manufacturing license and factory fueling regulatory challenges, and a process to develop a bottom-up

cost estimate of a micro-reactor.

The second technical area is technology maturation, which includes research into advanced materials such as yttrium hydride and zirconium hydride for high-temperature moderators, investigation of heat removal technologies such as heat pipes, heat exchangers, and deployment of sensors. This year, the program is investigating methods for detecting damage in graphite, which could be used as a structural material for micro-reactor cores.

The program also plans to demonstrate a micro-reactor start sequence using MACS, the Micro-reactor Automated Control System, to adapt and apply technologies for monitoring and controlling micro-reactors.

The third technical area is demonstration of support capabilities and includes non-nuclear testing capabilities. SPHERE, or Single Primary Heat Extraction and Removal Emulator, is a small, separate effects testing capability primarily used to support heat pipe testing.

It allows us to observe the thermal performance of heat pipes under a range of operating temperatures and transients. In the last year, SPHERE performed transient testing of heat pipes to support verification and validation of the Sockeye code.

We also have MAGNET, which stands for Micro-reactor AGile Non-nuclear Experimental Test Bed, which allows us to simulate core thermal behavior, heat pipe and primary heat exchanger performance, and decay heat removal. This year, MAGNET is working to integrate a gas Brayton cycle power conversion unit, as well as a graphite test article with heat pipes.

And the fourth technical area is micro-reactor application, and the main focus in this area is our Micro-reactor Applications, Research,

Validation, and Evaluation, or MARVEL reactor. Next slide, please?

So, MARVEL is a very small micro-reactor that will produce both electricity and process heat. It is designed to use natural convection of sodium-potassium to remove heat from the core, and the fuel will be comprised of uranium zirconium hydride with high-assay LAU, similar to TRIGA fuel, which is known to have a high pedigree of safety.

This reactor will be located in the storage pit of the transient reactor test facility at Idaho National Laboratory, and we will co-locate the controls for the MARVEL reactor in the TREAT control room.

Fabrication of the guard vessel is complete and contracts have been issued for fabrication of the primary coolant system and fuel. As a result of the development of MARVEL, the micro-reactor industry could benefit from demonstrated use of environmental assessment, which took approximately six months to develop, as opposed to environmental impact statement, which could take as long as two years.

They will also benefit from reestablishment of reactor design, fabrication, and demonstration capability at Idaho National Laboratory, and demonstration of a micro-reactor with a microgrid for a range of end-user applications. Next slide, please?

The National Reactor Innovation Center or NRIC is funding the establishment of demonstration test beds, and this includes support for micro-reactor development by repurposing the old, experimental Breeder Reactor-II facility to make the Demonstration of Micro-reactor Experiments or DOME facility. Most recently, NRIC awarded $5 million to Radiant Industries and Westinghouse to progress their micro-reactor designs for testing in DOME.

The funds will support the detailed engineering and experiment planning process, which is the next phase of a larger, multi-phased approach to support nuclear developers in planning for the design, fabrication, construction, and testing of fueled reactor experiments. Next slide, please?

So, recognizing the importance of advanced reactors to meeting the nation's energy security goals, NE has focused over the last decade towards private-public partnerships to develop domestic advanced reactor designs.

Since 2018, NE invested more than $400 million into more than 50 projects through various industry funding opportunity awards, and awardees included micro-reactor developers like Westinghouse, X-energy, and BWXT.

Additionally, we have the Gateway for Accelerated Innovation in Nuclear funds, which, sorry, GAIN, which funds micro-reactor developers in the voucher program to access technical, regulatory, and financial support needed to accelerate commercialization.

Many developers are building upon decades of R&D from DOE for advanced technologies like TRISO fuel and materials, as evidenced in their designs, and due to these investments, we now see industry taking the lead.

To be competitive though, an order book of micro-reactors is necessary, and DOE is looking at what is needed to achieve that, including the potential to leverage federal lands to demonstration the technology or support critical end users. One example already underway is the work being done at

Idaho National Laboratory to identify sites and issue site leases for reactor developers.

DOE also recently released an RFI that looked across the DOE complex and identified 16 sites that could support rapid data-centered construction with innovative energy generation sources like nuclear. Next slide, please?

So, many reactor vendors plan to demonstrate their technologies by the end of this decade and will need HALEU. Currently, there is no domestic commercial HALEU supply, so NE's near-term strategy is to provide recovered HALEU to vendors for reactor demonstration, and our long-term strategy is to incentivize domestic HALEU market development.

As with all activities, this is subject to congressional appropriations and administration support, but as mentioned yesterday, DOE issued its first round of conditional commitments to five U.S. nuclear developers to meet their near-term fuel needs.

So, in closing, we are working diligently to enable the rapid deployment and export of next generation nuclear technology, and we're focused on reducing barriers and bringing down costs to start building advanced nuclear projects here in the United States. Thank you.

CHAIRMAN WRIGHT: Thank you so much. So, next is Marc Nichol, who is the Executive Director of New Nuclear at the Nuclear Energy Institute. Marc?

MR. NICHOL: Thank you, Chairman and commissioners for being able to speak to you today. So, going onto my first slide, I want to start with the projects that are being planned and considered in the United States.

The U.S. map, next slide, please, shows over 60 here. Key things to note from this, this is double what we saw this time last year. Some of these points represent more than one reactor or more than one site, like the Permian Basin, and so this is indicating a wave of applications that we're projecting, and the demand is expected to increase over time.

That led us to realize we need to have a more efficient and effective way for these advanced technologies if we're going to be able to respond to the demand and lean into the differences in the business models and the technologies. Next slide, please?

So, as we looked at that, there were a couple of things we tried to focus on. One is the safety aspects of these advanced technologies, particularly micro-reactors, and so this shows relative potential consequences of the different reactors, and it shows that micro-reactors, which was the starting point of our proposal from July of last year, are much more similar to research test reactors than they are to the large light water reactors. Next slide, please?

And so, as we looked at that, we asked ourselves well, why then are we continuing to try to adapt the large light water reactor regulatory framework for these technologies? Wouldn't a better place be to start from the research test reactor regulatory framework?

And as we went through that, we actually found we had many more creative ideas and being able to develop alternatives, and the reason is because you're tethered to your starting point, and so you're not going to get very far from where you start. So, if you start from something that looks much more similar to these technologies, you'll actually end up in a better spot. Next

slide?

And so, the other thing we looked at is, well, how can we take -- this will advance a little bit, so advance? How do we take the current scope of what the NRC reviews for a reactor and site, and this is represented by what the NRC would review traditionally, how can we break that up such that we can cover the same amount of scope, have the same amount of regulatory clarity and predictability, certainty, but do it in a more efficient way? And we really leaned into the idea of standardization, so advance one? Actually, advance a few until you get a full rectangle on the right side. Thank you.

And so, we broke it up into several different areas. One, there are things that the NRC could do generically across the board through things like rulemaking. The new nuclear GEIS is a great example of that. There are things that you can do within a particular design, whether it's a standardized design approval, design certification, or manufacturing license, and do it once for the design. In fact, as we looked at this, we thought to lean into that and go even beyond what was imagined before in order to incorporate site aspects into that approval of the design, and if you can do that, then what's left is just confirming that the site conforms to what the NRC has already approved and determined is acceptable from site considerations.

And so, there would be two more pieces to that. One is that there are many, especially programs, related to the owner-operator that the NRC needs to approve. Well, the owner-operator would implement those programs for a particular design the same way whether it's Site A or Site B, and so those could be approved generically.

And that leaves us with that small little box which is particular

to the site, and as I mentioned, the scope of that is really confirming that it conforms to what the NRC has already approved as acceptable. You're within the bounds, sort of a site perimeter envelope type of concept.

And if we can do that, then the repetition over and over and over for each site, for using that reactor that's already been approved, becomes much smaller, much more efficient, and we can get to higher volumes of deployment. Next slide, please?

And so, it has an effect. The size of the application and the amount of information the NRC has to review has an effect on the schedule. Now, there's important things to keep in mind, that there's the NRC's direct review schedule, but there are also NRC requirements that impact the overall deployment schedule and we know that we need to shrink all of that.

And so, if you look at this schedule, this is particularly for a micro-reactor, what we might expect today, and it's important from an industry perspective that we look at from when a site is identified to when it's in operation, not just the NRC's portion of the review, but look at the whole life cycle.

That's how you're going to look at it from a business aspect. And so, it's about 49 months today for that entire process, which we know from some business models, that's way too long. Next slide, please?

So, if we apply some of the concepts that were in our rapid high-volume deployable reactor or RHDRA paper from July, we think that that schedule can actually collapse to about five months, and the NRC would still have the same level of review, same level of confidence because it's just been done in a different, more efficient way. Next slide, please?

We do address other topics in our RHDRA paper like operations, staffing, and this is just a high-level concept. We have several different operational concepts in there and one is a site that might only have one staff member on site to do operations plus other things.

Another is you might not have anybody, but you could have remote operations. And then maybe long term, you know, we should ask the question, could you get to a place where you don't have a human operator at all? That's autonomous operations.

And so, we've proposed a methodological way where you actually evaluate -- it's based on the design. You evaluate the design. How many functions need operator actions? How many can be taken care of by automatic features?

How many can be outsourced to a different site and how many remain onsite? So, it would be dependent on the design. It's not a, you know, a preapproval for designs. They have to demonstrate that they can meet it. Next slide, please?

Within our RHDRA proposal, we have 31 topics. This is a prioritization that we had laid out in terms of urgency and what is most impactful to business planning, and we overlaid it with the NRC's more recent work on what they call the NOAK white paper that's still being updated, and so there was a lot of good overlap with that. There were also some of the other items that were in prior NRC papers as well. Next slide, please?

So, from here, what are the next steps? Well, we want to coordinate with the NRC and other stakeholders on developing the details. We received the NRC's response in December to our proposal. We're very pleased

with the response. It laid out that there were no showstoppers identified, that they all looked feasible.

There was agreement that these concepts, although they originated for micro-reactors, could be applied to other larger advanced reactors, SMRs, some exactly the same way and some in graded approaches depending on the performance standard that needed to be met, and so the NRC has been moving and you'll hear from them later.

We want to make sure that they're developed in performance-based ways. We want to avoid developing things that have an artificial power level that determines whether you can or can't use these. We want them in performance-based ways.

One of the performance-based ways that we leaned into was a site boundary emergency planning zone, because it's been well-established and understood, and it actually defines a level of public health protection that is very stringent that could enable alternative approaches.

Some don't necessarily need that. So, for example, meteorology, we think it's more based on the pedigree of the alternative data that is the justification, and that could be used even for large reactors.

And then finally, there are some additional topics we're looking into and we may propose those as we go along. Thirty-one is comprehensive, but it may not be all-exhaustive. Thank you.

CHAIRMAN WRIGHT: Thank you, Marc. So, finally, we're going to end the first panel with Mo Badal, who I remember seeing at the RIC and we did talk, who is the Program Director for Installation Nuclear Energy in the Office of the Deputy Assistant Secretary of the Army for Energy and

Sustainability. Mr. Badal?

MR. BADAL: Thank you, Chairman Wright. Commissioners, good morning. It is my pleasure to be here and talk about Army's project, Advanced Nuclear Power for Installations.

As you know, the U.S. Army led the nuclear power technology between 1954 and '77. Since, it has been five decades that we have not talked nuclear energy, but here really we are here to talk about today and in the future, so next slide, please?

I just want to say this first, that we cannot do this alone. So, what we did, we began the planning for this project July of 2023. What we did, we integrated some of the lessons learned from the Air Force's Eielson project, Project Pele, early learning and exploring advanced reactors.

And so, what we learned is that it's going to take an entire village to deliver micro-reactors for installations. So, we began initial planning. We formed early partnership with the Department of Energy, the Department of Energy's national labs.

Currently, we have a partnership with six different labs where we can access their expertise. We also worked with, Jeremy is in the room here, John is here also, with early engagement with the Nuclear Regulatory Commission to make sure we understand the need and how to deliver this technology for our installations. Next slide, please?

The program scope is basically, it is a commercially-owned and operated technology we are driving for, and of course, it will be regulated by the NRC.

The reason I'm mentioning that, early on the planning stage,

we did look into our 91b military purposes authorization ability to permit our installation nuclear projects, but after a thorough analysis, we have concluded that the NRC has the right expertise to help us deliver this technology.

We are really seeking a full lifecycle nuclear power plant, from design, construction, and operation, deconstruction and returning it to the unrestricted release state, so it's a full cycle nuclear power plant we are striving for.

What we were trying to do, achieve, is that we achieve mission readiness through this with additional sorts of energy, and then beyond what is available today, and also we want to make sure it's onsite, so it's protected from some of the physical and natural disruptions that is happening today.

Again, of course, we were looking for the safe, secure, and reliable technology, and then simultaneously, we want to really help to stimulate the nuclear reactor deployment in the United States. Next slide, please?

Our application and concepts that we want to employ micro-reactors are twofold. One, the micro at the scale from three to ten megawatt electric that is behind the meters specific for our critical facilities, and then the beyond critical facilities for whole installations. That's the partnership with the utility providers, or we're discussing data centers that provide that additional power capacity for the installation and the DOD.

So, in this case, I want to highlight a couple of things, our partnership with the Defense Innovation Unit that is enabling us to pursue this with their other transaction authority, and then with this approach, what we have been able to do is talk to multiple vendors at the same time.

And I just want to make an announcement. Today, you will hear Defense Innovation will announce the down selection of the vendors that will proceed into the phase three. Next slide?

I really especially wanted to highlight our relationship with the Nuclear Regulatory Commission Chairman. So, when Commissioner Hanson was the chairman, we did meet with our senior leadership with the DOD to discuss this, and he has told us about the NRC's support for our program. We have been holding biweekly meetings.

Currently, we have an MOU we are working on for NEPA activities in conjunction with the DOD, and then we have an existing MOU with the Army Reactor Office that is strengthening up our partnership. And then, of course, NRC's involvement in our acquisition process in the OTA has been helpful as we look to the down selection of our vendors. Next slide, please?

This is my last slide, Chairman. This is really highlighting some of the things that we are thinking through. How do we identify a technology readiness level that can meet our timeline and mission, and also, how do we match that with the regulatory path? That's been key conversations we're having.

The other one is the cost burden for the first-of-a-kind. I know we have been talking with the vendors. They're trying to come up with creative financial models to deliver the first-of-a-kind and overcome that burden.

And one of the things that you will hear within the DOD community, the regulatory path uncertainty. There is no, I would say, clear published documentation identifying the micro-reactor licensing path yet. It's still a work in progress, so we want to get some clarity on that in terms of how

we go forward.

On the fuel, we're working with our DOE, you know, partners with the fuel, but there is not really unobligated fuel for commercial space yet, so we understand those challenges, and then also the fuel form that we want to pursue for safety for our installations, so there are some challenges there.

And then, of course, as we went through our vendor down selection process, we learned the limited ability to manufacture the proposed design and there's the challenges that exist. With that, Chairman, I conclude my briefing pending your questions.

CHAIRMAN WRIGHT: Thank you so much, Mr. Badal, and thank you all for your presentations this morning. So, we'll now go into questions, and first up today is Commissioner Crowell.

COMMISSIONER CROWELL: Thank you, Mr. Chairman, and thank you to all of our panelists. That was all very informative and complementary presentations. The scope of micro-reactors is, you know, an area where, in my short time, a couple of years on the Commission, I did not see us being this far along, so these are positive developments, and it requires the NRC to keep up and establish a safe regulatory pathway to commercialize these technologies.

I'm going to try to get through a couple of questions, and Mr. Nichol, I'm going to start with you. From a technical perspective, what's the difference between a micro-reactor and an SMR?

MR. NICHOL: So, there's no firm definition of a micro-reactor. Generally, people divide it at 50 megawatts electric and less. A lot of the characteristics of a micro-reactor is its very small size and its ability to be

transported as a complete reactor with or without fuel.

And so, that small, small size and ability to locate it in remote areas is really more the defining feature of a micro-reactor. In terms of safety, it would have much fewer potential for accidents. The consequences would be much, much lower than an SMR.

COMMISSIONER CROWELL: And Ms. Li, I was going to ask you the same question, but I saw you nodding your head yes. Would you agree with that distinction?

MS. LI: I do. I think the emphasis on ability for micro-reactors to be deployed in remote locations is one of the defining features that separate a micro-reactor from an SMR. They all have passive safety systems, but yes, being more factory fabricated and being more transportable, I think, is the correct response.

COMMISSIONER CROWELL: Okay, and then, Mr. Nichol, back to you, now from a regulatory perspective, what is the difference between a micro-reactor and an SMR in terms of how it should be treated from a regulatory perspective?

MR. NICHOL: So, there's a couple different ways to look at that. If you look at it from a potential consequence, and if they both have a site boundary EPZ, whether it's a micro-reactor or an SMR, there's a lot of things that you can do similarly in terms of that.

There are things that micro-reactors will be able to do that SMRs likely won't be able to do. So, if you look at fully remote operations, that may be very difficult for an SMR to do. If you look at the ability to transport with fuel, that's something an SMR is probably never going to be able to do. So,

there are certain things that, in regulatory space, micro-reactors enable that won't be available for SMRs, but there are many that are going to be shared.

COMMISSIONER CROWELL: Thank you, and I asked that question just for the sake of the audience who may be listening in and people who aren't as familiar with this to understand these distinctions and the different applicability.

Mr. Schoedel, let me turn to you for a second and go to your last slide, which begged lots of questions, but I'm most interested if you could give a little bit more background and insight on disposal and decommissioning? This is a topic related to both SMRs and micro-reactors that doesn't get enough attention, so I'd love to hear what Westinghouse, how Westinghouse sees this dynamic.

MR. SCHOEDEL: Thanks, Commissioner. So, I think it's going to play off of the responses to your previous question as well. It's going to come down to the deployment model for a micro-reactor. Westinghouse, with eVinci, is looking at the full gamut, right?

So, we're looking at the beginning where you're factory manufacturing, we're looking at the transportation to and from the operating site, and then what happens post-operation when it comes back to a facility for refurbishment or refueling, or ultimately decommissioning.

You know, from our view, one of the sentiments I'd like you all to take away from these last couple of bullets on decommissioning is that under the current regulatory regime, we perceive there are multiple licenses that are required to enact such a deployment model where, as we transition beyond first-of-a-kind to nth-of-a-kind licensing, we need to find a way to make it much

more efficient.

Get down to one license application. Can we do this under a Part 70 like we're contemplating with receiving fresh fuel at the facility on the front end and ultimately loading in the reactor, coupled with a manufacturing license.

Can I do it under a Part 72 license at that type of a facility instead of, right now, I would appear to have to have some type of an operating license, as well as a spent fuel license, as well as a Part 70 license? So, how do we simplify this as we navigate first-of-a-kind to nth-of-a-kind deployments?

The name of the game from my perspective on first-of-a-kind is finding a path for those first few, right, eVinci micro-reactors that do not require regulatory policy change or rulemaking, but that might be something that we consider or contemplate through you all as we look to really enabling efficient, high-volume deployments for nth-of-a-kind.

COMMISSIONER CROWELL: So, when we think specifically about the back end of the life cycle of a micro-reactor, you know, once the unit needs to go for refurbishment and it's used all of its fuel, what happens? Does the unit with the irradiated fuel stay onsite for a period of time? Does it go back immediately to the manufacturing site? And how is that spent fuel treated either at the operational site or at the manufacturing site?

MR. SCHOEDEL: Yeah, great question, and thanks for it. So, let me elaborate a little bit more specifically on the eVinci micro-reactor deployment model, and I think this will shed some light.

So, eVinci, and I didn't mention this in my opening presentation, but in addition to the facility that you see outside Pittsburgh for

heat pipe manufacturing, we're also going to be looking to announce the establishment of a manufacturing campus where we envision at least a manufacturing license like we coupled with Part 70 following the staff's risk-informed recommendations for SECY-24-0008.

That complex, we envision to have a series of multiple buildings, a heat pipe building, a final assembly building where you're going to be integrating all of the piece parts into a reactor module. It will have also a refurbishment building, and we envision it to have an ISFSI.

COMMISSIONER CROWELL: So, how long will the irradiated fuel or spent fuel remain onsite before it goes back to the refurbishment facility?

MR. SCHOEDEL: Right, so there will be a cool-down period of upwards of, you know, as much as a year of cool down, but that's also being considered in the upfront design of what we consider a standard eVinci deployment.

So, eVinci, when it's sited at an intended operating site, it will be a two-bay standard model where reactor bay one will house the reactor module one that operates for eight effective full-power years, a power conversion system in the middle between the two bays, and there's a spare bay.

So, this gets a bit also into maybe the middle of this slide with licensing of replacement reactor modules where the vision is not to do onsite fuel handling, minimize that impact to the site to help keep dose consequences small.

So, to enable that, we have to be able to transport back to a

facility the fully-fueled, but now irradiated micro-reactor at the end of life. So, to accomplish this, it would be the spare bay.

We would transport a fresh eVinci off of the assembly line, put it in the new spare bay for, say, cycle two. It will do a power conversion switch over, and that first operating reactor will cool down in place in its reactor bay for upwards of a year until it's safe to transport.

And part of that transportation story, which, you know, I'll mention now, is we are also designing and seek to license through Part 71 a specialized transportation cask that would house the entire reactor and be designed for the limiting case with end-of-life transport.

COMMISSIONER CROWELL: So, for the Westinghouse model, do you anticipate needing an ISFSI license both at the operational site and at the refurbishment facility or where do you see the licensing connection for spent fuel?

MR. SCHOEDEL: Another great question. So, I'd love to minimize the number of licenses on both the vendor as well as the end user. The deployment model envisions bringing the reactor back for interim spent fuel storage on an ISFSI.

We perceive that as a license under Part 72 that the Westinghouse manufacturing campus would have, and while the reactor is still onsite in its reactor operating bay, it's just, call it in no mode, right? You've done a power conversion switch over and it's resting idle in its location, but we would pursue not having a Part 72 license in addition at that operating site to minimize the churn.

COMMISSIONER CROWELL: Thank you. With the little time

I have left, Mr. Jessup, I'm going to turn to you. You know, I asked the irradiated fuel question intentionally because it's an important thing to figure out, but Shepherd Power has talked about deploying micro-reactor technology in the Permian Basin, and that could potentially be lots of small micro-reactors, and therefore maybe lots of units with irradiated fuel at those sites. This is in the same area that there's been a proposal for an interim waste storage facility. How do you square those two things?

MR. JESSUP: Thanks, Commissioner Crowell. That's a good question. I think I would play off of what Anthony was just talking about here, is we wouldn't necessarily -- I wouldn't consider each of these facilities to be its own interim storage facility.

If you have a shutdown micro-reactor, it is, in effect, shut down. I would expect that through a license condition, technical specification, LCO, something to that effect, that would control the number of reactors you have onsite in operation at one time.

So, that takes care of the operational piece, but we also envision an operating model where we're not storing spent fuel. You're effectively storing a shut down module that then gets transported to a vendor's location where they would hold some form of a Part 72 fuel storage license.

So, I don't think -- it's a good question, but we wouldn't envision that each one of these is an interim storage facility, so I don't think there would be a conflict with the ongoing litigation related to that matter.

COMMISSIONER CROWELL: Okay, appreciate it, and Mr. Chairman, I appreciate the extra time. Thank you.

CHAIRMAN WRIGHT: Thank you, Commissioner Crowell,

and good questions. Commissioner Marzano?

COMMISSIONER MARZANO: Thank you, Mr. Chairman. Good morning, everyone. This is a great crowd that we have in the room today, and I just want to start by saying that I am incredibly excited for this conversation, this topic.

I've been chomping at the bit to get my questions out, and I can probably spend, you know, triple, maybe five times the amount of time discussing all of these topics, but I do want to just thank the staff for their work to prepare and execute important meetings like this one.

Also, I want to thank the panel for their presentations and for being an essential part of this discussion on the future of nuclear energy in the United States, and the work that you do and the people in this room do on a daily basis to advance the safe deployment of this versatile technology contributes to our nation's energy, national, and economic security.

As this panel has acknowledged, the deployment of micro-reactors represents an evolution in the way that we utilize nuclear energy systems, and they have the potential to not only provide clean electricity, to meet increasing demands, excuse me, but they also offer a potential solution to achieve deep decarbonization of our larger energy system that powers our industries and our manufacturers.

Proposed micro-reactor designs are far simpler, incorporate passive inherent safety features, and present reduced radiological risks through lower source terms compared to their larger counterparts. These may lead to significant cost savings, reducing manufacturing and construction time, and leveraging economies of scale.

I appreciate your ongoing interactions, coordination, and collaboration with the NRC staff, and your bold visions for the rapid deployment of micro-reactors. This engagement is crucial to the NRC's ability to respond effectively to these novel deployment models in a timely manner.

The deployment and operating models for micro-reactors from factory fabrication, operational testing, to transportation for operation at multiple sites, are a drastic departure, as I mentioned, from the large light water reactors.

So, we must look at new ways of doing business, especially when access to this power provided by these systems can vastly improve lives, and I think about remote rural communities that currently rely on things like diesel generators to supply their energy needs.

Your continued input and sharing of ideas are fundamental to the modernization of NRC's regulatory frameworks, and will help the Commission fulfill its mission of enabling the safe and secure use and deployment of civilian nuclear energy technologies through efficient and reliable licensing, oversight, and regulation.

All right, now that we're through that, I can get to the fun part. Mr. Jessup, we had a conversation yesterday, and it wouldn't be me if I was not having a discussion about the operational side of these things, right?

So, you mentioned kind of this multi-skilled workforce to support operation. What kind of specific challenges do you anticipate to the management of the training, the qualification, and accreditation for individuals that kind of serve in these cross-functional roles?

MR. JESSUP: Yep. No, thanks, Commissioner Marzano, it's

a good question. Let me start from a practical place.

If you look at just basic functional requirements, analysis, function allocation, the makeup of some of these micro-reactor technologies, I don't think we can envision there being teams of INC technicians, mechanical maintenance techs, electricians, like you see at a current plant.

You have full departments for kind of each of those things. It just doesn't make sense just from a practical perspective.

And so, you come back to a point of, okay, well it makes sense for these folks to, you know, be multi-skilled, be able to do a lot of things.

But, then you do have to look at what do the regulations require, particularly 10 CFR 51.20, the training rule. Put aside Part 55, operator licensing stuff for now.

But, you look at what the training rule requires, how would you get a program like that accredited for a jack of all trades? You know, what you might have there.

And so, we wonder, initial training, how long does it take this person, you know, to go through a training qualification program?

Continuing training too, does this person spend eight out of their 12 hour days, taking CBTs to re-qualify, computer-based training to re-qualify and keep their skills up?

This is an area where we've had a lot of good engagement with INPO. They perform a, you know, their goal of promoting excellence, you know, all the things that they do under that umbrella, I think, the biggest overlap with the NRC's accreditation. And, they've leaned in here.

And so, maybe that's, that's the feedback I'd give you is,

INPO is trying to help us a lot with this to figure out what does accreditation for these, you know, multi-skilled folks look like?

COMMISSIONER MARZANO: Well, you must be reading my mind, because my follow up to that question was, the fact that the Institute of Nuclear Power Operations, you know, provides these vital services to the existing fleet, the management of OPEX, the training accreditation, kind of a standard bearer for the industry in that kind of self-policing environment there.

So, I mean, we already, you kind mentioned a little bit of INPO's involvement. But, how do you see it, their involvement kind of progressing into the advanced reactor space?

And, what kind of challenges do you see for the specific operational needs of micro-reactors?

MR. JESSUP: Yeah, no. Again, it's a good follow up. And so, they've been very proactive. Let me say that.

They want to understand what the new nuclear industry is doing, micro-reactors in particular, because there are so many different operating models, business models.

And so, we've been engaged through their new nuclear accreditation working group, where we're talking about these issues. Not just the multi-skilled workforce, but also the centralization piece I talked about.

It looks a lot different to go and accredit the training programs that are done from a central location versus going to every plant, you know, where kind of INPO typically operates.

So, those are the two areas we're working with on them of, what does accreditation look like from a central delivery standpoint?

And, you know, just from a general accreditation standpoint, you know, INPO accredits 12 programs at the current sites. Does that make sense for the new fleet? Not just micro-reactors but otherwise.

So, a lot of work going on there. INPO's been very proactive. I mean, my personal experience, you know, from the operating fleet, you know, their promotion of excellence and everything that comes along with that, you know, I think, the new nuclear fleet is going to benefit from that.

COMMISSIONER MARZANO: Well, thank you. Yeah, it's certainly a lot of work to be done there. A lot to consider about vastly different operational models for these micro- reactors.

Now, I want to turn to Ms. Li and Mr. Schoedel, Schoedel? Sorry, how do you pronounce your name?

MR. SCHOEDEL: Schoedel like yodel.

COMMISSIONER MARZANO: Schoedel, there we go.

MR. SCHOEDEL: It's really easy.

COMMISSIONER MARZANO: Yeah, nice and easy. All right. Well, this is going to be kind of a little bit, I want to feed a little bit about the interaction between DOE, INL, eVinci, the DOME, and the NRC's involvement.

So, Ms. Li, thank you for your remarks. And, I am certainly appreciative of DOE's continued collaboration with the NRC to enable the deployment of micro-reactors.

Can you kind of share a little bit of your thoughts on how we can enhance our engagement, especially considering the existing MOUs between the NRC and DOE that were established under the Nuclear Energy

Innovation Capabilities Act, and kind of expanded under the ADVANCE Act?

And, how, you know, DOE envisions the cooperation through the National Reactor Innovation Center Program?

And, you know, in part of your answer, and Mr. Schoedel, would like you to kind of comment specifically on your experiences with the NRC related to the DOME.

But, you know, are there other kinds of practices from previous collaborations in our MOUs that we can expand this work?

MS. LI: Thank you, Commissioner Marzano, that's a good question. And, we do also appreciate the continued collaboration with NRC.

I think, I can think of several possibilities. For example, with the MARVEL micro-reactor that is in development, we could potentially have details from NRC that's similar to what's being done with NRIC.

I believe, there's two details from NRC for NRIC, and we can, through that relationship share more details.

We've had recent meetings sharing our thought basis for how we documented our preliminary documented safety analysis for MARVEL, and, what the thinking was for that and how we could simplify that process.

This is all, again, based on whatever support we have Congressionally. But, we are always open to more conversations and we look forward to whatever we can do through the ADVANCE Act.

MR. SCHOEDEL: Yeah, thanks Commissioner, for the question. So, I think, this plays very nicely into, you know, some of the sentiments I had during my opening presentation.

So, Westinghouse very eagerly seeks to keep open,

transparent, clear communication between us, our partners at Idaho National Lab, BEA, U.S. DOE, and Idaho office, and headquarters on our progress on authorizing the eVinci nuclear test reactor for eventual operation and test in the DOME.

How are we doing that specifically? To date, it's been through one, you know, contractually organizing this through our safety design strategy with INL and the DOE, to acknowledge that we fully intend to cross-communicate and collaborate with NRC as well as CNSC in Canada.

Because, we recognize the importance of the results and outcome of this test reactor application for eventually validating, you know, and verifying the safety analysis codes we seek to use for commercial license applications in the U.S. and abroad.

So, contractually, it's built into our licensing authorization package paperwork. More practically, how do you disseminate this good information, and the knowledge, and the lessons learned as we go through exercising the licensing modernization project process for our application framework, not just for future eVinci commercial licensing, but, as well for our nuclear test reactor authorization with DOE?

We're doing that through presently a series of technical exchange workshops where we'll host NRC staff, CNSC staff, DOE representatives, INL representatives. You know, most recently, we held one last summer at our facility outside Pittsburgh.

We intend to host another one later this year as we continue to make progress in the next authorization submissions on that test reactor.

COMMISSIONER MARZANO: Excellent. Thank you. And,

I'm well over my time. But, I do want to say that, you know, I leave with this, that this cooperation is essential for the NRC, not just for, you know, this near term work, but also as we look to adopt a more forward looking approach.

And, I'll kind of just leave with a little bit of looking for opportunities for us, and right-sizing at what technical readiness level, you know, the NRC should be stepping in and engaging to support our licensing mission.

So, thank you, Mr. Chairman. Apologies for going over. And, I appreciate the panel's presentations. Thank you.

CHAIRMAN WRIGHT: Thank you, Commissioner Marzano. Yes, so, before I get to my questions, I had like to address a little bit about how the NRC's work on micro-reactors fits within our new mission statement.

You know, our new mission statement, and the guidance that will follow that implements it, is going to refocus our entire staff. And, it's already beginning to do that.

As part of the refocusing and doing our part to move forward the nation's goals for nuclear, by enabling, by advancing, deploying safely, we're working to try to do our work a little differently, because, we're going to have to.

And, more efficiently as well, so that we can get things through the regulatory process and out the door, right?

They've heard me say this before here, and I've said it at the RIC as well, this isn't about safety, right?

Because, safety is and is always going to be, our strike zone of our home plate. It's the north star that we're chasing. But, it's about process

and about adapting.

So, as we've heard this morning, there's a desire to manufacture reactors in a factory, and pre-load them with fuel. And, transporting them to site and then moving them back to another facility after they've gone through their life.

You know, by themselves, the desire of the oil and gas sector to deploy hundreds of units, may require a regulatory paradigm shift just by itself.

But, there's also industrial users, there's data centers, floating reactors, commercial shipping, you name it, they're out there. And, they're all active right now.

So, they're looking to us at the NRC, not just to meet their needs, but to anticipate where they've got to be, and be ready for them when they come.

Which means we've got to have a lot of communication, and a lot of collaboration, right? And, coordination, which I've heard. On top of that, all of these applicants want to go today.

So, I mean, we're really behind even when we talk about it now. I know that we can deliver here. The NRC can do it. I know it. I believe, it.

In fact, I've already heard you say here in this panel this morning, words like flexible, the NRC staffs leaning in to be flexible. Timely, the comments are beneficial, and there's been good cooperation. Right?

And, those are really good words to hear. Because, we're not who we are being accused of being sometimes, right?

Because, we have made mistakes in the past. I will sit here and acknowledge that we've been slow in some areas and we've been our own roadblocks at times.

But, that's not happening today. All right. And, I think, it's important for us to speak to that.

So, with that, thanking you for your presentations and stuff, I want to get to a couple of questions.

Bill, good morning to you again. One thing that I haven't heard, and maybe you and Anthony, and maybe even Mo, could address is, so, first let me say we're not going to be this long pole in the tent.

The NRC is not going to be that. Okay? But, what I haven't heard is supply chain. Right? Can you talk a little bit about supply chain?

And, are you ready for, if we were to grant a license in, like, I mean, five months or six months, if we had to have an EA, I saw that Marc, and the goal that you would have and suggest to us, would you be ready if we were able to meet that deadline?

MR. JESSUP: I'll take that first. So, it's a good thought exercise. If we had a license today, could you do it?

And, I think, my perspective is that's going to be a function of the technology, in particular, maybe the fuel type. Because, if you look at the front end of the fuel cycle, I break it into five steps, right?

The concentrates, the conversion services, enrichment services, deconversion, fuel fabrication. There's a lot of discourse that gets you up too typically the enrichment. It was good to see that the INL had, you know, deconversion as kind of a long-term strategy.

But, where we are today, particularly for some of the HALEU-based fuels, and then fabrication of the fuel itself, the commercial scale of that just, it's limited.

I don't want to say it doesn't exist, because, you know, it is being made. But, that is where I see probably the biggest risk from a supply chain perspective.

I would say we're in a unique position, because, NOV parent company, we make lots of things. We make lots of heavy machinery.

And so, you know, we also engage with the vendors on that front as well when they call us and say, hey, you know, does NOV have the capability of making X, Y, and Z?

And so, we have a window into that. But, I would still say that fuel likely remains the long pole in the tent, at least from where we sit.

MR. SCHOEDEL: Yeah. Thanks Chairman. And so, I strongly echo what Bill is saying on fuel.

Maybe I'll give a flavor of other things that, you know, we see as obstacles that we're actively working through, notably around areas of materials that are intended for, you know, high temperature applications for these types of reactors where, you know, we are today, maybe not fully covered within existing code cases. Right?

So, that's an area that we've been, you know, doing I think, meaningful pre-application engagements around, you know, metallics, composites, and the like.

So, I think, one of the things though that Westinghouse has as a value, as an established technology vendor, is we have a large supply

chain, you know, established already.

Many of the vendors for some of these, maybe more or less groundbreaking, first of a kind, type of applications in code space, that's pretty well established already on our end, people on our qualified supplier list or our approved supplier list. So, I think, working through those issues on our materials qualifications, as we communicated to you all in our White papers, as we intend to communicate to you all on our methods for qualifying these types of things in future topical reports, that's all in the details in our regulatory engagement plan. Known areas where we're going to work through it with you all.

MR. BADAL: Thank you, Chairman. So, I just want to say from an end-user perspective, just going through engaging at least ten leading micro-reactor vendors in the nation, I want to echo with you is that there is no clear pathway right now for multiple areas that can build a reactor.

The fuel, the factory assembly for major components, materials, data points, the code you had just mentioned for safety basis for a new novel solution or idea, because the temperature parameters are different than existing data points.

So, those are the challenges that we are considering as we pick our next winner, I would say. Who will be our first, you know, technology that built a reactor on our installation?

And then, of course, I think, I must mention our relationship with NRC, it's critical in this area, because a vendor without a regulatory path will not be doing business with the DOD.

So, I just want to be very clear about that. So, as we identify

the technology, we have to figure out those challenges.

CHAIRMAN WRIGHT: Thank you. I've got a couple of minutes left. I'm going to come to you, Ms. Li.

So, first off, please tell Secretary Wright that his cousin from the Southeast said hello. And, I look forward to meeting him. I think, I'm meeting with him in May. Hopefully I'll get to see him earlier than that.

And then, Ted Garrish, I know you probably know him over there as well. So, please tell him hello.

You were talking a little bit with Commissioner Marzano, about relationships and how we can work better together and things like that. I want to take that a little deeper maybe.

As you sit here today, right now, are there any regulatory changes you would maybe suggest or are looking at that could aid, you know, in the advancement of the rapid and safe deployment of micro-reactors?

Stuff that we could work together on, or you talked about that collaboration and stuff?

MS. LI: Thank you, Chairman. I think, I would recommend we could have additional conversations about that since I'm not the expert. But, we have many technical experts in that area.

We continue to work on identifying, you know, the regulatory basis for supporting micro-reactors. We have put together a couple of reports about, you know, what kind of challenges to consider.

But, I am not of a position today to recommend specific changes to regulations.

CHAIRMAN WRIGHT: Yeah. Well, I'm confident that we're

already working together on this over there already.

But, I didn't know if there was something that had been through the, just the relationship and engagement that we've had so far. Is there anything that we need to be looking forward at?

Because, you know, we're looking at the micro-reactor letter that you sent in last June, and, I think, we responded to. And, I think, there's something else coming maybe this June.

So, you know, maybe we can, I know this is a hugely important area for everybody, from the President on down. And, we need to be ready to move, right?

So, look forward to working with you.

MS. LI: Yeah. We have, we are very much appreciative. We, just for example, for Part 53, we have seen that NRC has been open to input from industry.

And, as that is aligned with DOE's efforts to deploy micro-reactors and advanced reactors in general, we see that that is very helpful for us.

CHAIRMAN WRIGHT: Yeah. Thank you so much. And, thank you for taking my questions. And, for now, I'm going to turn it over now to Commissioner Caputo.

COMMISSIONER CAPUTO: Thank you all for being here, and for contributing to the conversation. I also want to note that all of you complimented the NRC staff on their work that they're doing in this area.

And, I just want to thank you for those compliments and that recognition. There is a lot of work that is underway and a lot that remains. And

so, I just thank you for, on their behalf, for recognizing their progress.

I also want to say that a lot of great questions from my colleagues this morning. I'm going to come at this from a little different direction.

People of a certain generation may remember a commercial from years ago where a child hands a Tootsie pop to an owl and says, how many licks does it take to get to the center of a Tootsie pop?

So, I'm just going to take a leap here and give a little pop quiz to you speakers. How many licks does this take?

How many different regulatory approvals do you see before we get to that first unit?

MR. JESSUP: I will take a first stab, Commissioner Caputo. For the first unit, likely on the order of six to eight regulatory approvals.

And, I would say that excludes some of the materials, specific approvals, Part 30, Part 40, and maybe Part 70, since those typically get bundled with kind of the primary application.

And, that would be what I suspect when you include manufacturing licenses. If you want to do in factory testing, site licenses, transportation certificates of compliance, and interim storage facility.

So, and, that's probably a function of what the deployment cycle looks like as well, do you want to do in factory testing?

And, I'm excluding throughout the life cycle at the site as well, because, that's going to come along with more regulatory approvals, at least the way we're envisioning right now.

Depending on whether you go the part 52 route, or the two-

step Part 50 route, that will determine what regulatory approval you need at the site every time you want to replace that module, so.

MR. SCHOEDEL: Yeah, thanks. I'm smiling here, because I think, you're really hitting the nail on the head, or addressing the elephant in the room, from my perspective on the stark contrast between us, you know, with eVinci trying to get first of a kind available to market.

But, acknowledging what efficiencies, we may want to try to drive for future, nth-of-a-kind solutions along the way.

I think, we're going to learn a lot going through the first application process for delivering this technology beyond just our nuclear test reactor. To answer your question specifically, I would just walk around the eVinci deployment model from my last slide.

You know, so, if we look to assemble in a factory, and these are all things that we're contemplating now as we go through, how do you bring this new technology to market, you know, by 2030, for what our customers or potential customers are looking to see?

And, by the way, they are no longer operating on a five to ten-year window of business planning. They're operating on a 48-month business window planning in many cases, where the best I can show right now is a CPOL under Part 50, or, a COL, you know, extending out to beyond those timelines for their planning.

So, Commissioner, or Chairman Wright, as you acknowledged, won't be the bottleneck here. This is exactly where I think, we need to start focusing on how to use shrink it effectively?

But, stepping around the deployment model, assembly in a

factory would require, from our perspective, a manufacturing license as postulated in the SECY in front of you, while for votes.

Maybe you couple that with a Part 70 to allow fuel load. Without that, I still need some type of an operating license if I want to load fuel as it is today, either a CPOL or a COL.

So, I'm already up to three licenses just to enable the first step in that deployment process. Short of some type of risk informed, you know, type of a process that is envisioned in 24-0008.

That also includes other things like byproducts, et cetera, that I'm lumping in, but not specifically naming.

Transportation, as Bill mentioned, would require a Part 71 CoC, as well as some route-specific licenses through states and different territories and localities.

You tend to go through the customer, or end user, owner/operator is going to require their own CPOL or COL, based off of the technology design that I would have approved through my ML. So, that's another set of an entire licensing process to that intended operating location.

The transport license would, under our paradigm, support back-end transportation. But then, as we talked earlier from your question, you know, I would need a Part 72 type of a license application for my refurbishment or storage activities, you know, whether it's at my manufacturing facility or somewhere else.

So, you know, just hitting the highlights, all of those are right now perceived as necessary. But, I think, the challenge first-of-a-kind, nth-of-a-kind, is going to be minimizing the replication on all of those.

I don't want an operating license at my manufacturing facility, in addition to my manufacturing license, and have every customer have an operating license for every module that comes off that assembly line.

I need to start getting this into like, a Ford assembly line mentality where you call, you place an order for a vehicle, it takes a few months to come off the assembly line, and you are limited by your manufacturing time and the delivery time, not necessarily the licensing time and needing duplicate, or in my view, duplicative licenses, just to accommodate regulation.

COMMISSIONER CAPUTO: Marc, I'm going to get to you in just a minute. I think, both of you have mentioned a lot of items.

I have my own list. I think, some of us overlap. I probably have a couple here that weren't mentioned.

But, I'll just start at the beginning. Reactor design approval, manufacturing facility license, which Mr. Schoedel discussed, verification that the unit was built according to requirements, transportation canister, but also, transportation of the unit with fresh fuel.

Operation on location, sighting approval, transportation canister and transportation with used fuel, license for a refurbishment refueling facility, license for storage and disposal, decommissioning at the end of life.

And, that is in addition to what was just mentioned in terms of fuel qualification and fuel manufacturing.

So, as Mr. Schoedel was saying, not all of these steps are going to be repeated for each unit. Most of them are probably necessary for the first unit.

Several of these steps involve ACRS reviews, environmental

reviews, and hearing opportunities. So, this is a rather torturous path for the first unit, but also for, nth-of-a-kind, and, as you were just saying, whether it's for one or 20.

So, recognizing that, you know, the way to eat an elephant is one bite at a time, what I'm -- I'm raising this, because as the Chairman just mentioned, you know, a paradigm shift, I believe, we need a paradigm shift here.

Because, our principle of efficiency states, regulatory activity should be consistent with a degree of risk reduction they achieve. And, for micro-reactors, the risk profile is dramatically lower than what this agency has typically licensed.

And, the nature of micro-reactors is very, very different from what would have been envisioned in the Atomic Energy Act 60 years ago.

So, at a basic level, we need to ensure the manufacturer of a safe reactor, safe operation and maintenance, safe transportation, safe storage and disposal.

The NRC staff has identified 36 issues that need to be addressed. I'm searching for a strategic approach that's going to effectively navigate the necessary issues, but also ensure that the regulatory burden is aligned to micro-reactor size and risk profile.

So, Marc, I'll start with you. Do you have suggestions as to how we could go about workshops, or structuring workshops, to sort of get at a strategic approach?

I know you mentioned earlier in your remarks, how the approach that we take is going to be tethered to our starting point. And, I agree

with you that that starting point, based on the risk profile of a micro-reactor, is -- should be a lot closer to starting point for a research reactor or a non-power facility.

But, even if we all agree that that's a starting point, how do you work your way through these issues in a strategic manner?

Not necessarily what's most urgent and swatting the nearest snake, but, go through this in a strategic manner that's going to sort of create the predictable licensing path that Mo is highlighting as needed here?

MR. NICHOL: Yeah. That's a great question. I think, in your question you had the answer, which is workshops.

This is, that's the fastest path to getting to some regulatory conclusions. And, one of the points I made, is focusing on the regulatory basis for these topics.

Because, what the regulatory basis affords, is an NRC conclusion that this approach is safe.

Now, steps after that, we'll identify how do you implement that under Part 50 and 52 today and in the future, exemptions and rulemaking?

How do you do it in part 53? Is it enabled now? Do you need additional changes? Those things can be worked out.

But, if we don't have the foundation, which is the NRC concluding that that approach is safe, you can go off and do that approach. Until we have that, there's a lot of business risk and uncertainty.

And so, getting to that regulatory basis is key. And, how we get to that is through workshops. Now, the NRC is embarking on a lot of work.

Industry and other stakeholders can embark on a lot of work

as well. Some of those topics, we've already submitted papers on, meteorology, fire brigade, we have others coming.

And so, we can contribute to that. All the work doesn't have to fall on the staff. The NRC ultimately has final decision making on that. But, we can provide a lot of the details and input to help move this forward faster.

COMMISSIONER CAPUTO: Okay. Thank you. I just want to note that clearly given what we've heard this morning, given the investment that's underway, that's a clear demand signal here for micro-reactors.

So, I appreciate everything you're doing, all of you, to advance the ball and make progress here. Because, I do think, this is going to be a technology that's important to meeting the country's energy needs.

So, thank you.

CHAIRMAN WRIGHT: Thank you, Commissioner Caputo. That was very good.

Commissioner Hanson?

COMMISSIONER HANSON: Thank you, Mr. Chairman. Thanks for everybody for being here.

Mr. Schoedel, I really appreciated your kind of, breaking down the various regulatory touch points, right?

And, Mr. Nichol, I appreciated your presentation too, about what's the starting point and how do we kind of move out from that, right?

But, even in the case of like, RTRs, I think, that's a really, I think it's a great insight, right?

But, they're kind of things that don't quite necessarily line up and match, and the analogs aren't entirely the same. And, yet, I completely

agree with the principle that how do we kind of adjust or change the regulatory touch points that we have, right?

So, maybe we're touching that manufacturing license and we don't have to touch everything that comes off the assembly line. I love the, as a Michigan guy, I love the Ford metaphor, okay?

Right, I mean, you know, if we're comparing, you know, micro-reactors to F-150s, you know, there's something to that, right?

Because each F-150 is, you know, there's a quality assurance program that that manufacturer has. Each thing gets a VIN number. You can trace that VIN number. You can trace the whatever kind of quality things that go along with that.

I think, Caterpillar is another really great example for all of their machines. Their machines basically talk to their headquarters in Peoria, from all over the world.

They've got 1.5 million machines out there that, as a friend of mine said, tweet like teenagers. You know, like basically text headquarters like teenagers on everything that they're doing.

There's a lot of advancements in other manufacturing and heavy equipment industries that I think, really have a lot of comparisons here that we can also kind of draw on while we're, as the Chairman quite rightly said, focused on our mission, keeping the safety piece of that front and center while we're thinking about what the right regulatory footprint is.

And, I think, as we think about the chicken and egg problems, right, that the Chairman also mentioned. I know chickens and eggs are a very sensitive topic these days.

But, the regulatory kind of clarity and efficiency, is really one of those. And, that's clarifying that, and getting that under wraps, is going to be really important for the NRC, not only from an efficient standpoint, which I think, you know, Bill, you emphasized. But, also from kind of a reliability thing.

And, I think, what I'd just like each of you to kind of touch on is, I completely agree, Mr. Schoedel, with your thing about, you know, what are the policy things?

What can we do by exemption? How do we get that first of a kind thing? But then, how do we establish the reliability and predictability about that pathway?

And, where does, if it needs to rulemaking or even potentially, heaven forfend, statutory changes to the AA, where do those come in?

Because of, Mr. Nichol, as you pointed out, that there are a lot of good analogies here. But, there are some also things that don't quite fit.

MR. NICHOL: I'll start off, in terms of how do we get to that basis. I think, it's in that regulatory basis that I was talking about.

So, that would be the NRC's conclusion decision that this approach, if done this way, is safe.

Now, it's not saying that it's currently allowed under the regulations. It may not be currently allowed under the regulations.

But, we have the approach of taking exemptions if the NRC determines it's safe. So, it's determining ahead of time that this particular approach is safe, recognizing that exemptions may be needed near term, rulemaking longer term.

That gives the ability for industry to come with those

approaches, with predictability that the NRC would accept them.

COMMISSIONER HANSON: Okay. Thanks. Anyone else?

MR. SCHOEDEL: Yeah, thanks Commissioner. So, a bunch of thoughts. And, I'll try to keep them coherent here for the sake of time.

And so, I think, your emphasis on both safety and reliability, so again, that's probably something I glossed over at the end of my presentation. But, my last slide, that's the vision, right?

It's incumbent upon, you know, us as a technology vendor, as we go through our design development test programs and processes, that we address both safety and reliability in our design.

And, we make that apparent to you all and to your staff, through things like pre-application engagement, White papers, through topical report, piecemeal approvals, and ultimately in these first of a kind applications.

The affordability is the other piece of this, right? And, that's where some of the licensing efficiencies we're talking about here are going to have a direct play for not just first of a kind, but specifically our nth-of-a-kind.

Where we drive licensing efficiency to really help keep nth-of-a-kind affordability specifics, right?

So, I think, my opinion, SECY-24-0008, again, I'm a broken record on that, it was partly informed by input that Westinghouse wrote to NRC staff.

But, in there, as you contemplate those three topic areas, the risk-informed options one, two, and three Bravo, I think, the staff did a nice job at highlighting areas where implementation would have both risks and disadvantages for long-term rulemaking concerns.

I think, you see similar aspects around that on the nth-of-a-kind white paper that was developed last year, when we talk about operational programs or environmental review efficiencies.

But, those are good areas where we have examples in front of you now, or soon come to you, on these areas, where it seems like, you know, we could be making progress on putting out, you know, guidance, you know, assuming, you know, favorable outcome from your votes, through the staff to industry on some of these areas.

The consequence of piecemeal approvals and guidance, is just that. That you don't see the big picture. And, there may be long-term implications or rework or churn on that guidance, because you don't see the entire thing at once.

But, you know, the more we can do to not handcuff the industry, having to consider the entire elephant now, and give us some piecemeal progress on items that I've been communicating through the eVinci team since 2021, would unlock, just continued de-risking, and start, I think, to yield more progress.

COMMISSIONER HANSON: Yeah. Super helpful. Yeah, go ahead, Bill.

MR. JESSUP: Yeah, I would just add, I think, the way to increase reliability, and drive down uncertainty in kind of the licensing approach here, is just to start exercising the process.

There's clearly a willingness on the part of the NRC to explore these areas, all these enablers we're talking about.

But, I think, we're going to have to start exercising the process

to see, to drive -- because, there's kind of an uncertainty band on all of them.

Some of them, it's like, okay, we feel pretty good about this. But, collectively, we're going to have to start exercising the process.

It's going to take some incremental implementation, I think. I think, you know, the operating model is going to have to evolve.

And then, the technology is going to iterate as well. I think, we're going to learn things.

And, you know, by the end of it, I expect that the licensing process will have evolved with it and, you know, we can get there.

COMMISSIONER HANSON: Yeah. No, I think, that's a really great point. There's a great opportunity for learning on kind of both sides of the table here as we move forward.

So, thank you all for your questions. I'm going to try and squeeze in one more here. Obviously, because Mr. Schoedel was here, and you guys presented your concept around Westinghouse, that was really helpful, right?

Because, it was a specific thing that we could kind of drill down into. But, there are other concepts for micro-reactors too, right?

We're going to have a focus on the transportable ones this morning, just kind by nature of the panel that we have.

But, there are others where it's kind of modular construction, or -- and fueling onsite. And, a lot of other things.

And, I guess, as we think about both the strategic, as well as getting down into the details on some of these things, how much difference does that make in regulatory space?

And, Marc, maybe I'll just start with you. And --

MR. NICHOL: Yeah. So, we can look in two directions. We can look at maybe larger ones that are more constructed onsite.

And so, those would, in comparison to the micro-reactors we have been focusing on, would have a smaller subset of issues that they would look at.

Many of them would be able to implement the exact same strategies. Some might have a different performance level that would only be able to implement parts of the strategies.

If we look at the other direction, which would be much more transportable, these might be things that you would want to deploy within days or weeks rather than months.

The RHDRA paper that we proposed, isn't enough for them. They need additional considerations. They need -- because, we got what we think is the NRC's site license process down as small as we think is feasible, that's about four to five months.

To get down to days or even a few weeks, that's going to require something like a general license, where the NRC doesn't need to pre-approve a site. You could just go wherever you want, as long as you can confirm that that site is acceptable.

And, this may be very important for emergency response activities, for example.

COMMISSIONER HANSON: Thank you. Anyone else? Yeah, Bill?

MR. JESSUP: I'll share a perspective. It relates to the very

last bullet I had on my slide deck, not the thank you slide, but the other one.

Which is, I think, across especially advanced reactor technologies, a lot of those characteristics, inherent safety features, passive safety systems, they're shared.

But, certainly for us, we do feel like we are quickly getting to a point to where you do need to pick a technology to get regulatory certainty.

Remote operations may be a good one. I wouldn't expect the agency to approve that as an operating philosophy, absent some rigorous human factors engineering that demonstrates, yes, this is what your function allocation looks like, you know, for this specific technology perhaps on this specific site.

I think, you could do it at a technology level. You know, you are going to have to do the work. And, we would expect that, you know, for the NRC to actually approve something.

So, that's how we see the regulatory nexus here.

COMMISSIONER HANSON: Yeah, sure.

MR. BADAL: So, I was going to make a comment about like, larger modular fueled onsite. For end-user perspective, we would be interested in what's the timeline look like, mobilizing or, you know, deploying something like that over time.

And then, like onsite fueling, what are some of the risk factors maybe involved if we're deploying something like a military installation, right?

So, those considerations also may have to be thought through.

COMMISSIONER HANSON: Okay, good. Thank you.

Thank you, Mr. Chairman.

CHAIRMAN WRIGHT: Thank you, Commissioner Hanson. And, thank you again. This has been a great conversation. We could probably go a lot longer too. I know that.

So, we're going to take a break. We're going to endeavor to try to be back and set up for the second panel in about a quarter till.

So, with that, we will recess and come back, and convene in a few minutes.

(Whereupon, the above-entitled matter went off the record at 10:39 a.m. and resumed at 10:47 a.m.)

CHAIRMAN WRIGHT: Welcome back, and good morning again. Our next panel is going to be kicked off by the NRC's Executive Director of Operations Mirela Gavrilas. Mirela, good morning. The floor is yours.

MS. GAVRILAS: Good morning, Chairman, Commissioners. The topic of micro-reactors is very dear for me on a profoundly personal level. I decided to be a nuclear engineer because as an undergrad, I started working at the University of Maryland Research Reactor.

I became an SRO for that reactor in my sophomore year to get to Commissioner Marzano's question about the level of training. And I found small scale reactors, research reactors fascinating throughout my career. I actually started my career as an executive in research reactors and the first manifestations of micro-reactors of which SHINE is certainly a lead.

But I don't think at any point throughout my career have micro-reactors have the strategic significance that they have today since the very early times of our industry. And with that, I'm going to pass the baton to

Jeremy who is going to introduce the panel and lead our conversation. Jeremy.

MR. BOWEN: Thanks, Mirela. Good morning, Chairman. Good morning, Commissioners. Thanks for the opportunity to present to you this morning. So my name is Jeremy Bowen. I'm the Director of the Division of Advanced Reactors and Non-Power Production and Utilization Facilities.

As you've already heard this morning, over the past few years, there's been an increasing interest in the licensing and large-scale deployment of micro-reactors. Their simplicity and scalability have the potential to greatly expand the use of nuclear power. Whether they will operate as part of the electric grid, serve as an independent power source, or provide thermal energy for industrial applications, the NRC is engaged with the micro-reactor community to enable their safe, secure, and timely deployment. Next slide, please.

Staff has worked closely with micro-reactor developers and potential end users to better understand the various technologies and planned deployment models. These interactions led to the identification of potential policy issues, infrastructure enhancements, and communication tools that would further facilitate reliable licensing and oversight of micro-reactors. Pre-application engagements resulted in development of several Commission policy papers with the first one in October 2020 where staff provided an early outline of potential regulatory considerations and an initial licensing approach.

Further, stakeholder interactions indicated widespread alignment that the regulatory issue of highest importance for developers was the ability to load fuel and perform operational testing in a factory. In January 2024, the staff provided the Commission with policy options and

recommendations to enable that business model. A related information topic in that paper dealt with transportation considerations.

Cinthya Roman, Deputy Director for the Division of Fuel Management, will touch on this unique aspect of micro-reactors in a few moments. Further interactions reinforce the timeline from application to deployment is a vital area and needed creative thought, particularly for high volume licensing. Staff is currently finalizing a paper that identifies policy and process changes that would better support licensing subsequent or nth-of-a-kind micro-reactors. Duke Kennedy, a senior project manager in Division of Advanced Reactors, will tell you more about that shortly.

The staff is coordinating these efforts for the development of Part 53 to support micro-reactor licensing. The stakeholder interactions also identified the need for further enhancements beyond policy and regulation changes. Additional clarity was requested around how various processes would apply to micro-reactors.

So to support those discussions and track progress on a large scale of regulatory topics, the staff recently developed a micro-reactor public website and an integrated micro-reactor activities plan. The website and plan can be accessed by scanning the QR codes on the bottom right-hand corner of the current and the next slide. The plan also supports the staff's response to direction in the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy or the ADVANCE Act. Next slide, please.

Section 208 of the ADVANCE Act directs the NRC to develop and implement risk informed strategies and guidance to license and regulate micro-reactors in eight topical areas. These are annotated on the left-hand side

of the screen. Dan Barnhurst, an environmental projects branch chief, and Jessie Quichocho, a branch chief in the Division of Preparedness and Response, will discuss two examples of the staff's approach for these areas.

Overlapping and extending beyond the ADVANCE Act are the suite of the regulatory topics identified by the staff and the micro-reactor community. The staff's integrated plan provides a mechanism to facilitate a systematic approach to ensuring common understanding of the various issues, identifying actions to achieve the desired objectives, and tracking progress of all the activities. An initial workshop was set on February 20th to obtain feedback, and stakeholders expressed appreciation for the staff's efforts in development of the plan and support for the proposed list of actions and their prioritization.

The staff will continue to engage with the micro-reactor community through a series of future workshops to address these topics and others outlined in the plan. Adjustments will be made as needed, and progress will be communicated through the NRC's public website and public meetings. The staff is excited to license micro-reactor designs in various deployment models, and we are committed to further innovation in a manner that provides additional flexibilities without inhibiting future evolution by the micro-reactor community. I'll now turn it over to my colleagues to elaborate on these topics. Next slide, please.

MR. KENNEDY: Good morning. I'm going to discuss the NRC staff's recent policy recommendations and strategies for licensing and regulation of micro-reactors, Section 208 of the ADVANCE Act, and the staff's integrated micro-reactor activities plan. The NRC staff's focus in these activities is on increasing the flexibility of NRC's regulatory framework to enable

deployment of developer's diverse micro-reactor technologies. Next slide, please.

In SECY-24-0008, the NRC staff developed three policy recommendations related to high priority topics for factory fabricated micro-reactors and provided information and near-term strategies related to ten additional topics. The first policy recommendation is an approach in which a micro-reactor that includes features to preclude criticality would not be in operation and loaded with fuel. An operation would begin with the removal of those features.

Under this approach, an operating license would not be required just because the reactor is loaded with fuel. Because the reactor would not be in operation and an operating license would not be required, this would enable the staff's near-term strategy to use the existing transportation regulations for fueled micro-reactors which Cinthya will cover next. The second policy recommendation is an approach for authorizing only fuel loading into a micro-reactor that includes features to preclude criticality.

Instead of requiring an operating license to load fuel, the licensee would possess the reactor under a manufacturing license and possess and load the fuel under a special nuclear material license. The requirements for special nuclear material licenses better match the technical and safety aspects of loading fuel into a micro-reactor with features to preclude criticality. And this approach will reduce administrative requirements and improve timeliness of licensing just fuel loading.

The third policy recommendation is to apply most of the safety regulations for non-power reactors to authorize fuel loading and operational

testing in a factory. The NRC staff recognizes that the operational characteristics and safety considerations for micro-reactors operated only for testing would be like those for currently licensed non-power reactors. The safety regulations for non-power reactors are well established and will reduce the need to tailor power reactor safety regulations on a case-by-case basis for operational testing. Next slide, please.

So this slide shows the staff's strategy for reducing the schedule and cost of licensing nth-of-a-kind micro-reactors. It includes a policy recommendation to enable the staff to review and afford technical and regulatory finality to standardize operational programs at the design phase in connection with the review of the standard design. The strategy also includes alternative approaches for environmental reviews which Dan will discuss soon and the staff's near-term strategies for other topics related to nth-of-a-kind licensing.

The main drivers for the schedule and cost productions are standardization and regulatory process enhancements. Standardization of the design, operational programs, including security and emergency preparedness, and generic environmental reviews will allow the NRC staff to focus its review of an application for an nth-of-a-kind reactor on site-specific factors and simple verification that the design is identical to one already reviewed by the NRC. This will result in streamlined license applications and NRC licensing documents that can be processed through an online portal to automate many administrative processes.

The staff is also pursuing approaches for grading the level of site characterization and scaling construction inspections based on experience

to focus on areas most important to safety and the environment. However, departures from the standard design, selection of sites with significant environmental impacts, and activities outside of the NRC staff's control could limit the effectiveness of the staff's strategy. In the case where an applicant makes a modification, the staff will perform a delta review as was recently done for the Kairos Hermes 2 application.

The NRC staff anticipates that the first few deployments of a standard design will take longer but still much less than recent first-of-a-kind reviews. The benefits of nth-of-a-kind licensing for applicants and the NRC will be realized and accumulate with success of deployments of the standard design. The staff's policy recommendations and strategies described in this slide and the previous one provide the regulatory flexibility to enable early deployment of transportable first-of-a-kind and nth-of-a-kind micro-reactors.

The NRC staff chose to pursue options and strategies that use the existing regulations to provide near term clarity on foundational aspects of micro-reactor deployment models. However, as developer's designs and deployment models mature, the staff will consider additional policy recommendations and rulemaking to reach an optimal regulatory framework for micro-reactors. Next slide, please.

Section 208 of the ADVANCE Act covers eight topical areas related to regulation of micro-reactors and directs the staff to -- the NRC to consider unique characteristics of micro-reactors and opportunities to address redundancies and inefficiencies.

The staff are already addressing the ADVANCE Act through completed and ongoing activities. To name a few, the Part 53 proposed rule

addresses topics such as staffing, operational programs, and decommissioning funding assurance. The staff has also communicated to the Commission its path forward to develop the Advanced Reactor Construction Oversight Program and the proposed rule on alternative physical security requirements for advanced reactors would apply to micro-reactors.

Ongoing work on transportation, environmental reviews, and emergency preparedness that will address the ADVANCE Act with be covered by Cinthya, Dan, and Jessie. The staff is taking many additional actions to fully address the ADVANCE Act. Notable focus areas are remote operation and autonomous operation, oversight and inspection during an operation, siting in relation to licensing mobile micro-reactors and the population density criteria, and alternative licensing approaches for deployment of fleets of micro-reactors.

As directed by the ADVANCE Act, the staff is consulting with the Department of Energy, other federal agencies, technology developers, and other stakeholders. This includes through public meetings and workshops on specific topics, pre-application engagement, and memoranda of understanding in cooperation with other federal agencies. As examples, public workshops and licensing mobile deployment and alternative approaches for fleet licensing are scheduled later in April and May. Next slide.

This slide shows the depiction of the prioritization of topics included in the staff's integrated micro-reactor activities plan. The plan provides a comprehensive view of current micro-reactor topics and their integration to support internal and external communication and engagement on priorities and actions to address them. The plan considers feedback from interested and affected parties such as industry stakeholders and the public, direction in the

ADVANCE Act, ongoing rulemakings and guidance development, and engagement with developers and prospective applicants.

Since 2020, the staff have updated and prioritized micro-reactor topics considering stakeholder feedback. And this guided the decisions on the policy recommendations and information topics to include in the papers that I discussed earlier. Finally, at the bottom of the slide is a list of micro-reactor policy topics.

The four on the left have already been or very shortly will be addressed in policy papers. The staff are developing policy recommendations for the two on the right largely in response to the ADVANCE Act. And what aren't shown here are the policy topics that are already being addressed in ongoing rulemaking activity such as staffing, security, decommissioning funding assurance, and others.

As micro-reactor technologies and deployment models continue to evolve and mature, topics being covered under the existing regulatory framework in the near term, such as transportation of fueled reactors, may in the longer-term benefit from policy decisions. And new topics may arise that involve policy matters. The staff will engage with the Commission as appropriate as it adjusts its priorities and takes actions to enable the deployment of diverse micro-reactor technologies. With that, I thank you for your time and turn the presentation over to Cinthya.

MS. ROMAN: Good morning, Chairman Wright and Commissioners. Today, I'll cover transportation considerations for micro-reactors. Next slide.

The current regulatory framework for the transportation of

radioactive materials supports the licensing needs for the near term micro-reactor applications.

At this time, we have not identified the need for policy changes for the transportation framework. So how it works, a vendor can request a certification of a transportation package for a micro-reactor under 10 CFR Part 71. And if safety is demonstrated, the NRC will issue a certificate of compliance.

There is no rulemaking involving the process like we do for storage cask systems. Once the package is certified, it can be manufactured multiple times and used by the general licensees at no additional cost because no additional approvals are needed as long as the general licensee follow the conditions of the certificate of compliance for each shipment. Also, since there is no additional wait time for regulatory approval, this supports the rapid high deployment of micro-reactors.

While the focus of my presentation is on the transportation package, as you can see in the picture, there are many other aspects of transportation, including effects of the environment, physical protection, and emergency planning. Also, it is important to note that the NRC is not alone in regulating the transportation of radioactive materials. It is a coordinated effort across multiple agencies, including the Department of Transportation, the Department of Energy, and Homeland Security.

Outside of the federal agencies, Tribal Nations, state and local governments are also involved in the spent nuclear fuel transportation. NRC along with all these organizations have enabled the safe and secure transportation of radioactive materials for decades. And the same structure will

apply for micro-reactors. Next slide.

So there are some key differences in the transportation approach for every micro-reactor design because micro-reactors can vary in size, fuel type, deployment model, and transportation method. So let's break down some of these key differences. Transportable versus mobile micro-reactors, transportable micro-reactors are built in a factory.

They are shipped to a specific site where they will operate. Once in installed, they stay in place until decommissioning. Mobile micro-reactors are designed to move between multiple locations as needed.

It could be deployed for disaster relief, military operations, or remote communities that need temporary power. Please note that mobile doesn't mean that the reactor will operating during transportation. In fact, the reactor must remain subcritical during transportation to meet existing requirements.

There are different transportation modes, weights, and size. Some micro-reactors might be small enough to fit into a standard shipping container and travel by road. However, larger designs might require rail transport due to size and weight constraints.

In some cases, transport might involve maritime shipping and requiring additional considerations for port security and specific maritime regulations. The chosen transportation method, weight and size will impact the regulatory approvals, route planning, and package certification needs. There's also new fuels.

Micro-reactors will use a range of different HALEU fuel designs which might include TRISO and metallic fuels. And then the end-of-life

transportation micro-reactors might not store spent fuel at their site of operation. Instead, they might be transported back to a manufacturing facility as we heard this morning. Next slide.

So fueled micro-reactors will likely need to meet Type B transportation package standards. As shown in this slide, Type B packages must pass impact, puncture, fire, and water immersion test in sequence. The test sequence encompasses more than 99 percent of possible vehicle accidents. Computational models are allowed to simulate these accident conditions. Next slide.

Some micro-reactors might need to employ novel packaging strategies and approaches such as the package or portions of the package being integral parts of the reactors versus the package surrounding the entire reactor. Transportation regulations will work for different designs, including self-contained designs for the entire reactor as support systems feed into a single container and other designs where the core module is manufactured and shipped to a different site to support systems are constructed in place.

While some micro-reactor vendors have indicated that they can meet the same test and conditions that I showed you before, for some of them demonstrated that they can pass similar tests can be challenging. However, Part 71 requirements allow for exemptions, alternative test method, and special package authorizations when compliance with the standard regulations is impractical. In fact, we have been implementing this requirement, and I want to provide some first-of-a-kind examples. Next slide.

So the first example is the NAC OPTIMUS-L package for TRISO fuel. This is the first NRC certified transportation package for fresh

TRISO fuel with HALEU up to 20 percent for Uranium-235. We demonstrated that NRC can certify packages for new fuel types under the existing framework. For this example, engagement and pre-application discussions help to ensure a high-quality application, and their review was completed in 13 months and using 40 percent of estimated resources.

Most recently, Project Pele, a micro-reactor from the Department of Defense, needed an exemption from some of the provisions in Part 71. The NRC review and endorse risk methodology that demonstrated that the exemption would not compromise public safety. This methodology is adaptable and could potentially be integrated into future transportation certification applications. Next slide.

NRC also has experience approving special package authorization for complex shipments involving large, contaminated objects. For example, in 2015, we authorized a special package for a large vitrification melter used for nuclear waste processing at West Valley. And more recently in 2023, NRC certified a package to enable the transportation of a large reactor component from the Crystal River Unit 3 nuclear power plant.

So why do these examples matter? Some micro-reactors might need similar special authorizations, particularly if they are transported as a whole unit rather than disassembled. End-of-life transport might involve moving an entire micro-reactor for disposal, requiring an approach similar to the examples for Crystal River or West Valley. Next slide.

In closing, while our regulatory framework is well established, we can always improve. Collaboration with developers, international stakeholders, and other federal agencies allow us to share research insights

and prepare for the future. We're also focusing on knowledge management programs to ensure our reviewers can continue to meet our important mission. Thank you for your time, and I'll turn now the presentation over to Dan Barnhurst.

MR. BARNHURST: Thank you, and good morning, Chairman and Commissioners. Today, I'll present the steps the staff have taken to develop a micro-reactor-specific environmental review approach to support efficient, timely, and predictable licensing of micro-reactors. I'll provide an overview of considerations that inform these efforts, outline the environmental review alternatives developed by the staff, and present the staff's next steps for development and implementation.

The staff developed a flexible approach that allows applicants to select one of four review alternatives that best aligns with the design, deployment model, and degree of anticipated impacts of the proposed project. Staff began by assessing how previously identified and implemented efficiency gains developed through a comprehensive evaluation of the entire environmental review program could support efficient micro-reactor environmental reviews. These gains stem from actions taken before and in response to the Fiscal Responsibility Act and the ADVANCE Act, many of which are still ongoing.

They include maximizing incorporation by reference and tiering prior environmental studies, integrating requirements from recent acts related to timeliness, page limits, optimized consultation, and enhanced coordination with other agencies, expanding the use of environmental assessments where actions where a finding of no significant impact can be

reached, and leveraging the new reactor generic environmental impact statement or NRGEIS which if finalized could yield resource savings from micro-reactor reviews when combined with other process improvements. Staff then tailored the environmental review approach to reflect the reduced scale and environmental footprint of micro-reactors and consider factors such as variability and design types, reactor size, deployment models, and siting characteristics, all of which ultimately influence the extent of the environmental impacts in review.

The figures on the slide illustrate some of those variables. Current designs range in size with deployment models including factory manufactured transportable systems and stationary modular designs. Siting approaches also vary from single reactors with minimal footprint and disturbance that may be used to replace a diesel generator to multiple units at a single site that may be used to support a grid.

This variability introduces a range of factors to be considered during the NEPA review. Staff is continuing to develop planning resource models for micro-reactors that incorporate efficiencies and account for this variability. This effort will guide more efficient resourcing and management of micro-reactor reviews and will be refined over time.

While we expect cost and time savings for each of the approaches, use of environmental assessments and categorical exclusions if applicable and approved would provide the highest efficiencies. Staff are developing an online portal to streamline the process and enhance communication. Next slide.

On the left is the first environmental review alternative which

continues the use of the current streamline process scaled for micro-reactor-specific reviews. Alternative 1 may appeal to applicants submitting an application for a single unit at a complex site or multiple units at a proposed site. This approach involves no additional development or implementation cost, and resource needs are expected to decline annually as current and future efficiencies take effect. Reviews may tier from the new reactor GEIS if approved and could result in either an environmental impact statement or an environmental assessment if a finding of no significant impact or FONSI is reached and an exemption granted. This process is available now.

Under Alternative 2 on the right, the staff would develop a design-specific generic environmental impact statement for each new standard micro-reactor design at the applicant's request. This approach may suit applicants planning to deploy a standard design at multiple successive sites. For example, an applicant might use the same design to power data centers, remote communities, work sites, military bases, or similar locations.

The initial review would include a design-specific GEIS analyzing general environmental topics and resource impacts along with a supplement addressing site-specific issues and demonstrating compliance with the plant and site criteria. Subsequent applications would be significantly streamlined requiring only a supplemental environmental impact statement or environmental assessment tiered from the initial review and focused on issues not previously addressed. Staff are ready to implement this approach upon receiving a design-specific application. Next slide.

Alternative 3 presented on the left allows an applicant to demonstrate minimal environmental impacts by meeting a bounding set of plant

and site criteria, developed specifically to envelope micro-reactor designs. This is potentially the most flexible approach, enabling the streamlined review of any micro-reactor and site combination that falls within those bounding values. It may be especially attractive to applicants planning deployment across many sites for the purposes listed earlier but who have not selected a design or considering multiple designs or are working with a design that is not yet fully mature.

This approach supports banking of sites and is modeled after the general permit process used by other regulatory agencies such as the U.S. Army Corps of Engineers. At both the initial and nth-of-a-kind stages, applicants would submit information through an online portal to demonstrate compliance with the bounding values. Staff will use this information along with a template to develop a streamlined NEPA document which may be an environmental assessment if bounding criteria are met. Reviews of subsequent submittals would be further streamlined by tiering from the initial NEPA review.

Finally, Alternative 4 presented on the right would allow for the use of categorical exclusions. This option would be viable once review experience demonstrates that certain categories or combinations of designs and deployment models constructed and operated on specific types of sites results in no significant environmental impact.

From this experience, bounding plant and site criteria would be developed. A categorical exclusion would be available to any applicant whose project meets these criteria, offering the fastest and least resource intensive review option. However, implementation would require rulemaking under NRC regulations.

It's important to note that while Alternatives 2 through 4 involve initial development costs, these are expected to be quickly offset as additional applications are received. Next slide.

Staff have already begun developing and implementing new review alternatives and will prioritize and resource these efforts. In the near term, staff will continue NEPA streamlining efforts and utilize the NRGEIS once finalized, complete development of the online micro-reactor portal, collaborate stakeholders to develop bounding sets of values for use with Alternatives 3 and 4, and develop templates and environmental screening worksheets to support the streamline process.

When an initial design-specific application is submitted, staff will refine the template and tailor the portal for submission of design-specific information. Staff will further assess use of categorical exclusions and develop the necessary infrastructure and, when feasible, initiate rulemaking to support this approach. In closing, staff have consistently completed environmental reviews within established project time frames and more recently have done so on or ahead of deadlines set by the Fiscal Responsibility Act.

We expect this strong performance to continue. First-of-a-kind reviews will meet or beat NEPA time frames, 12 months for an environmental assessments, 24 months for an environmental impact statement. As relevant criteria and assumptions are developed and then met, nth-of-a-kind reviews could be completed in as little as 180 days, benefitting from the efficiencies built into each alternative.

The NRC's optimized environmental review approach for micro-reactors will result in environmental reviews that are efficient, timely, and

predictable and enable the scalable and streamlined deployment of micro-reactors across a wide range of uses and sites. With that, I'll turn the time to our next speaker, Jessie. Thank you.

MR. QUICHOCHO: Thank you, Dan. Good morning, Chairman and Commissioners. I welcome this opportunity to describe to you what the NRC staff is doing in emergency preparedness.

The staff has been working on emergency planning for new reactors for some time now, and I look forward to describing specific actions we have taken and will take for micro-reactor licensing. Next slide, please.

As Jeremy have pointed out earlier, the emergency preparedness staff is ready to conduct reviews of micro-reactor applications under current regulations. With Commission approval of the new rule for small modular reactors, non-light water reactors, and other technologies, our regulatory framework provides a flexible graded approach for applicants to develop emergency plans commensurate to their facility risk and hazards.

The staff looked ahead during the development of the rule and took into consideration the characteristics of new design, including those of micro-reactors. The new framework establishes a performance-based approach which goes beyond a review of written plans and focuses on demonstration of responsive capabilities to performance necessary functions. The rule is also technology inclusive and scalable in recognition of the low radiological risk these micro-reactors inherently have based on smaller source terms and advanced safety features.

Applicants may choose to comply with 50.47 and Appendix E instead of 50.160 and seek exemption from certain requirements based on

differences in design characteristics and low radiological risk. If potential applicants indicate that they intend to take this approach, the staff would evaluate whether there is a need to develop guidance to allow for more efficient exemption request reviews. Such guidance could be analogous to the use for emergency planning exemption request for decommissioning nuclear power plants which was issued to collect the staff experiential review and exemption request for emergency preparedness for decommissioning plants and thereby enhance the efficiency and consistency of future reviews. Next slide, please.

I'd like to discuss the activities the staff has been working on that supports licensing of micro-reactor technologies. First, I want to point out that the staff issued regulatory guidance in 2023 that describes the acceptable methods for how applicants can meet the 50.160 rule. And staff are now working to update this guidance to add clarity in support of licensing of micro-reactors in particular.

Additionally, the staff is currently developing interim guidance for conducting technical reviews for new applications which will ultimately be added to the standard review plan. A public meeting is expected in the near term to facilitate external stakeholder feedback as far as developing this guidance. The staff is also working on new inspection procedures to support the 50.160 rule which will be scaled to the radiological risk of the facility and focus on performance-based results.

In addition to these near-term guidance updates, the staff continues to take a holistic look at readiness for micro-reactor licensing within emergency preparedness to identify potential streamlining opportunities. For example, staff is pursuing templates that applicants can use to standardize

emergency preparedness plans. Our staff is also working with the Office of Nuclear Regulatory Research in the performance of analyses to support simplified emergency planning zone determinations and use of existing emergency plan organizations and planning for micro-reactors.

Finally, NRC continues to engage our partners at FEMA to develop federal guidance for offsite preparedness that is right sized the emergency hazards. Next slide, please.

Now I want to take a moment here to describe what we mean by standardizing emergency planning. The staff has evaluated past technical reviews and identified key functional areas in emergency preparedness that are common across multiple sites.

Examples of common functions that could be standardized include emergency response organization staffing, emergency action levels, and emergency response facilities. Standardized functions that are the same from site to site would facilitate nth-of-a-kind licensing that Duke described earlier. In addition, based on previous licensing experience and industry engagement, the NRC staff believes that the use of bounding assumptions for information such meteorological data or seismic parameters can provide predictability of licensing emergency preparedness at various sites.

Another commonly used regulatory tool is a topical report process where applicants can submit for NRC review and approval the methodologies that may be applied across similar reactor designs. We have seen success in approving emergency preparedness topicals to support efficient licensing and will continue to encourage these approaches. To summarize, the staff are considering many options to support deployment of

approved technologies. Next slide, please.

Similar to what Jeremy mentioned earlier, stakeholder interactions are key to identifying enhancements or clarity needed in the regulatory processes for micro-reactors. This is an important component to ensure emergency preparedness is effective and contributes to a safe and secure use of civilian nuclear energy with micro-reactors. The staff has met with applicants to discuss the regulatory framework and processes for conducting emergency preparedness reviews.

These meetings are of great value because they provide applicants with necessary technical information needed to address and meet emergency preparedness regulations. These engagements also build public trust in our regulator processes. The NRC and FEMA have worked together for decades to maintain reasonable assurance in emergency preparedness planning for the operating fleet.

For micro-reactors, the NRC and FEMA stand ready to work together in effective planning for future facilities and its surrounding communities. The NRC staff is committed to hearing from stakeholders and to discuss any proposal to facilitate micro-reactor emergency preparedness. Thank you for your time, and I'd like to turn over the presentation to our executive director for operations.

MS. GAVRILAS: This concludes the staff's remarks. We're ready for your questions.

CHAIRMAN WRIGHT: Thank you, Mirela. And panel, thank you for your presentations. And for those people, thank them as well that backs you up to get you ready. And with that, we will start questions, and we'll begin

with Commissioner Crowell.

COMMISSIONER CROWELL: Thank you, Mr. Chairman. Thank you to all the presenters. I think it was very complementary to the first panel, and I think we're all getting a better appreciation for the big picture here in some of the stickier issues that need to be resolved and timelines associated with that.

Mirela, I'm going to start with you. And first, I'll say I enjoyed my recent visit to the test reactor at the University of Maryland mostly because I got to see a photo of you in your sophomore year operating that reactor. And I know it's true, your story.

But given your long experience in this area and your current position, I'm going to ask you kind of a big picture question here. As we look at micro-reactors and the whole life cycle from front end manufacturing, transportation, operation, the back end of fuel management and transportation decommissioning, in your view, where do you have the most concern for protection of public health and safety? What is the most acute public health and safety element of micro-reactors that we should be focused on?

MS. GAVRILAS: Tough question, but I'm going to be -- I think we need to pay attention to security. They're small. They're going to be every place. And while the consequences are modest, we still need to pay attention to security aspects.

COMMISSIONER CROWELL: I appreciate that, and I did not know what your answer is going to be. But it leads nicely into the question I was going to ask Jessie next on security. For emergency planning zones, how are you looking differently at a micro-reactor located in a very rural setting like

out in an oil field versus in a more urban setting? And what does that distinction mean for EPZ requirements?

MR. QUICHOCHO: So for micro-reactors, we expect that the majority of the EPZ would be at the site boundary. And with that, no necessary impact to the external community, the local communities. And we will continue to work with FEMA on communicating the applications of micro-reactors. The --

COMMISSIONER CROWELL: So you see no distinction from a security or safety perspective between a 49 megawatt reactor in a dense urban area, Manhattan, versus out in the Permian Basin? I mean, why is there no difference there? Seems like it's an obvious thing that there'd be a different parameter or at least a different response plan.

MR. QUICHOCHO: Yeah, so these micro-reactors, as mentioned earlier, reduce radiological risk. They're smaller in megawatt and power level. I worked at the University of Missouri research reactor. It's a 10-megawatt reactor, probably a little size higher than what was mentioned earlier with the eVinci. And the response from the community and the local areas are just like a normal hazard. So that's the -- it's not necessarily based on the local population, whether it's urban or rural but more on the radiological risk that are associated with these facilities.

COMMISSIONER CROWELL: I think for the average person, it's hard to get their head around that idea that there is no distinction. So I would just in our public engagement really encourage you to articulate why that is an applicable safety -- why that parameter is applicable in both scenarios and that we're thinking about it holistically. Duke, I'm going to turn to you next here.

In the slides, you say that, quote, the NRC staff anticipates

that the first few deployments of a standard design will take longer but still much less than recent first-of-a-kind reviews. Can you tell me a little bit more about what you mean by first few deployments? Is that, like, Reactors 2 and 3 of a standard design? Or is it the first model? What are you getting at there?

MR. KENNEDY: Yeah, thanks for the question. So this is a topic that we discussed a lot amongst the staff is when do you actually get to nth-of-a-kind in the deployment cycle. And I think it's going to depend on a few things first, the method for the review and approval of the standard design, whether it's through a manufacturing license or a design certification or the first-of-a-kind application review. And then how do the actual developers or the licensees that are deploying the reactor take any departures from that?

And what we've seen in the past is that the first-of-a-kind takes some departures from the standard design. So I think looking at the historical context, there's a chance that if there's some departures, those would have to be reviewed again because they would be different than the standard design that was reviewed. And then those departures could be incorporated the standard design through the normal change control processes for manufacturing licenses or design certifications.

Or additional applicants for operating licenses or combined licenses could choose the same -- take the same departures. And we would have a precedent for the review of those. So I think there's just a little uncertainty about how quickly -- how many reactors exactly, I can't say. But we're just anticipating that there's the possibility that it could take a few reactors before we really reach steady state.

COMMISSIONER CROWELL: But the moral of the story is

that the more standardized you can be, the less of a time frame -- a shorter time frame you're going to have. And so resist the temptation on Reactors 5 and beyond to keep tinkering with things that will undermine the efficiencies of having a standard design. Is that fair to say? Okay.

Cinthya, I want to come to you with my last question. I'm going to read it because it's a little bit challenging and you may want to phone a friend. So I'm obviously concerned about the full life cycle here of micro-reactors as I am about all of our reactor technologies.

And there's many people working on how to safely build, test, and deploy a very large number of micro-reactors. But it may not be clear yet what we'll do with the hundreds or even more than that of used up micro-reactors. So for example, if a vendor offers refueling services at a factory, then micro-reactors containing spent fuel will be transported back to the factory.

There was a paper delivered to the Commission in August of last year that was explaining a recent risk assessment by the Pacific Northwest National Lab supporting the idea that the NRC could grant the necessary exemptions from the current NRC transportation requirements in such a scenario. But it's notable that they limited this endorsement to just one transport per year, one away from and then one back to a specified location. So you or anyone else on this panel, would you be willing to speculate on the risk associated with transporting more than one? And should a large number of reactors eventually to be deployed, would micro-reactors would have to remain in place for extended periods of time to reduce overall transportation risk to an acceptable level? So could you comment on that?

MS. ROMAN: So I'm pretty sure that all the risk experts in the

back are not going to want me to speculate. But what I can say is that, yes, for Project Pele, we did consider one-time shipment. We think that methodology could be adapted for used for multiple shipments. But additional information would be needed.

Definitely, it's not the same to look at the risk of one shipment versus having 20 reactors transported five times a year. We would have to look at the cumulative impact of transporting the material during that time. So we will also have to look at the dose.

We would have to look at if the transportable micro-reactor is passing the same area multiple times. What would be the dose? So yes, there is additional analysis that can be used and we could expand that methodology for Project Pele. But I cannot say that we have looked at that level of detail, like, why would we if we have multiple shipments.

COMMISSIONER CROWELL: So I know you mentioned a little bit. But what additional kind of data would you need to make those assessments? Is it just dose and routes, or is it performance under accident scenarios? I mean, what kind of stuff do you need to give some assurance of having more frequent transportation, particularly of irradiated fuel back to the factory?

MS. ROMAN: I think it would be expanding our risk assessment, kind of PRA information in terms of what type of information. We would have to look at honestly dose and look at the --

COMMISSIONER CROWELL: Is NRC doing any of this research themselves and should we be doing any of it if we're not?

MS. ROMAN: Can consider it.

COMMISSIONER CROWELL: Seems valuable. Thank you. I appreciate it. Thank you, Mr. Chairman.

CHAIRMAN WRIGHT: Thank you, Commissioner Crowell. Commissioner Marzano.

COMMISSIONER MARZANO: Thank you, Mr. Chairman. And staff, thank you for your presentations today. Your discussions kind of demonstrate how the NRC is adapting to the changes in technology and its development in fabrication, testing, transportation, operation in real time.

So as the industry looks beyond the tradition fixed site construction of large reactors and identifies opportunities to factory fabricate, load fuel, and to perform operational testing at manufacturing facilities as an imperative for the NRC to ensure that its regulatory framework is responsive to this evolution. I commend the staff and appreciate your efforts to explore these specific flexibilities that we're considering here, among many others to facilitate novel licensing approaches demanded by these micro-reactor deployment models. That said, in my view, I think this mindset exemplifies the model through which we will achieve the shift in our culture toward accomplishing our updated mission statement.

I encourage the staff to continue to embrace being more proactive and agile to make us a more proactive and agile regulator in all of our work to be responsive to the needs of the 21st century and embody the spirit of the ADVANCE Act. Along those lines, let me turn a little bit to the ADVANCE Act and some of the mechanics that are going on here. Jeremy, as you mentioned, Section 208 of the ADVANCE Act specified several issue areas for the NRC to address.

I'm glad that the NRC staff has incorporated and prioritized these activities into its integrated plan for micro-reactors. So I want to ask a couple of questions along these lines here. First, just kind of briefly and feel free to weigh in and other folks here. Has that direction of the ADVANCE Act changed staff priorities or focus areas for continued micro-reactor regulatory framework development? And if so, do you see any resource challenges as a result?

MR. BOWEN: So thank you for the question. I think the short answer to your question is it's helped us focus to make sure that we've captured the suite of activities that are necessary, helped us engage with stakeholders to prioritize to make sure that we're capturing everything and kind of reinforced that this is an urgent issue that we need to address now.

COMMISSIONER MARZANO: Okay. And then maybe kind of turn to -- we'll go back and forth with some of the language in Section 208 specifically. But I understand this integrated plan that's being developed, and this is kind of discussed a little bit at the external panel just before. And we have this wealth of issue areas that we need to address.

Addressing them individually over a longer period of time is in my view not really supportive of what the need is today. And so you look at what we're doing right now, the integrated plan, these issue areas. We have the elephant, and now we have to discuss how to eat it and the particulars of that.

I won't extend this analogy any further. But can you speak a little bit to the staff's plan to kind of hit those important topics to give this sense to the developers and that folks are going to be deploying this technology?

What can we look to today that's going to inform how we move forward, especially with some of the -- instead of serializing a lot of this work, how can we take the most advantage of what's being done to kind of show where our thinking is and we want to proceed?

MR. BOWEN: Thank you for the question, Commissioner Marzano. That's exactly what we're trying to do. I think hopefully you took that away from the panel this morning is we've got approached by stakeholders with specific questions, specific concerns, specific need for certainty in the regulatory process.

So our desire was to provide that certainty now so that they can move forward with their business models, so that they can continue to advance the technology, and that the regulatory is not the impediment. All of these individual questions and issues that are coming up as you rightly point out and I think as some of your colleagues have mentioned as well in their questions to the other panel. It necessitates a paradigm shift.

It necessitates a what do we do next. We can address these individual issues. We can provide some certainty and help them move forward. But that doesn't mean we should stop there. And so I think we all recognize from a safety standpoint, from a security standpoint, emergency planning, everything you're hearing from this panel is this is a different technology. We can address the individual questions, but then we have to think more broadly about, okay, what's the next step? And we're trying to do those two things in parallel to make sure that we're given that certainty but also trying to enable a future that's a little bit easier.

COMMISSIONER MARZANO: Duke, do you want to

comment on that at all?

MR. KENNEDY: I'll just add that we're looking to provide solutions now and also recognizing that as developers' deployment models change, as new technologies come up, there will be more work to do in the future to get to that optimal state. And so that's why we're trying to engage with stakeholders as often as we do and provide as much -- lean as forward as we can as to what it is we think that we can accomplish so that we have that dialogue immediately. And we keep it ongoing to make sure that we're focusing in the right places.

COMMISSIONER MARZANO: That's great. Thank you. And so that's a good segue to my next line of questioning here. So Part 53 proposed rulemaking closed -- their comment period closed the end of February. Can you comment on whether or not we have received any comments specific to the micro-reactor regulation? And if so, do any of these comments impact kind of the near-term approaches or recommendations to the Commission on how to best license these facilities?

MR. BOWEN: So yes, we did receive some comments related to micro-reactors. There were some specific questions that were provided in the Federal Register specifically around micro-reactors. The short answer to your question is, no, the staff is working to make sure that there is no delay in licensing, providing Part 53, and making that a viable licensing path.

We're trying to do as much as we can to enable the language that will be in Part 53 and to develop complementary guidance to support micro-reactors just as the previous question that we talked about, providing that pathway now. But also recognizing there might be something in the future that

could make it the next iteration a little bit more clean, a little bit simpler, the process a little bit more easy to navigate. But the short answer to your question, no, we have no plans whatsoever to delay Part 53.

COMMISSIONER MARZANO: Okay. Well, that's where I was going with at next. So thank you. Cinthya, I want to turn to transportation topics. And I just want to set the scene here a little bit.

Last week, I had a chance to visit Sandia National Laboratories. Those researchers out there have access to world class test facilities to characterize these transport packages and the capability to perform substantial research related to all of this, transportation issues surrounding fuel irradiated micro-reactors, including the drop scenarios, severe accidents, et cetera, that are going to inform our safety decision on those. So can you talk a little bit about how we are coordinating with the Department of Energy utilizing National Lab resources on some of these things that may otherwise require kind of a special exemption or whatever the term? I might be getting it wrong here, so yeah.

MS. ROMAN: Yes, so we spend a lot of time coordinating with DOE. We have periodic meetings with them. We have technical exchanges to try to understand the work that they are doing, especially working with the National Labs. We also work with the Office of Research. They spend a lot of time working with the National Labs, making sure that the research that they are doing help us to get the information that we need.

I know that recently, DOE has been working on the performance package demonstration. Maybe I changed the name. But I know that that's going to be looking at potential accidents or kind of the regulations

that we have for spent fuel and transportation and seeing -- they have reached out to see how that project could provide beneficial guidance for NRC like validating codes and things like that. So we do leverage the relationship that we have with DOE and the National Labs.

COMMISSIONER MARZANO: Excellent. It's quite impressive, the facilities out there. I'll say that. Jessie, I want to turn to you last here. I kind of want to just make a general statement and acknowledge the difference between looking a large light water reactor kind of regulatory envelope, especially with NRC planning, and then kind of scaling down from there versus the kind of mindset of going from non-power reactor regulation and scaling up to the needs of the system.

So I just want to kind of keep that as a focus of how to potentially move forward as these things are evaluated. But my question for you is, why 50 megawatts? When we're thinking about consequence, source term, et cetera, all these kind of risk calculations, in general, I get the understanding that we're moving away from just determining, well, this power level means this, right? So maybe a little bit of back story on that value itself or kind of the concept in how you're thinking about it.

MR. QUICHOCHO: I appreciate the question. It's a starting point, right? Fifty megawatts is a starting point. And as we conduct the research on the 50-megawatt thermal power level, we'll adjust. Keep in mind that for, like, NPUF regulations and the EPA regulations, they both use the same threshold of 1 rem.

The difference is that for NPUF, it's less than 1 rem. And for the EPA regulations, it's greater than 1 rem to consider as part of the spectrum

of accidents. So this is kind of why we're looking at some research on seeing how we can do what you've heard with expert panelists and today here is bounding conditions so that we can provide additional flexibility to applicants and vendors.

COMMISSIONER MARZANO: Thank you very much for that, Jessie. And again, I could probably go on and on and on, on this. But I will give it time back -- well, time I've already taken. Thank you, Mr. Chairman.

CHAIRMAN WRIGHT: Thank you, Commissioner Marzano. It's been a good day. This is a great meeting. So Mirela, I've got a couple of questions and maybe Jeremy might chime in too if you want to. We heard in the first panel from Mr. Schoedel and from Mr. Jessup in a way near the end of that panel when Commissioner Caputo was talking to them. Did you hear anything in the first panel that was new information for you or something you and staff were not aware of?

MS. GAVRILAS: From my perspective, I have not. I wouldn't be surprised if Jeremy has, however. But that's an indication not of necessarily that information develops quickly. But the fact that we have the connections within the community to actually get the information pretty much live as people think of it. Jeremy.

MR. BOWEN: Thanks, Mirela. No, no, sir. We didn't hear anything new to Mirela's point. This has been a good dialogue. It's been a quick dialogue with our stakeholders, but it's been a very good dialogue. And it's helping -- I think it's helping with the paradigm shift that you talked about. So every time we have another topic, another conversation, it's, okay, how can we move this whole project and community and thinking forward?

CHAIRMAN WRIGHT: I'm going to stay with you and primarily for the next few minutes here. What is our strategy going forward to handle what appears like it's going to be many more applications coming in? I know there's several policy and technical issues, either in front of the Commission or on their way as well. So I mean, how can we assure ourselves that our proposed solution for one issue doesn't conflict or interfere with something else?

MS. GAVRILAS: Let me take it first. The question that I ask because there are so many issues, technical and policy issues that we have to consider. My first question is, let me know if the interface between these issues becomes strong at one point.

Right now, we look at the issues and they're pretty much standing on their own. In other words, they're very loose if any ties to any adjacent issues, which means they can be handled individually. So we're all paying attention when that's not going to be the case so that we can raise the flag. Jeremy.

MR. BOWEN: Yeah, and I could go on. This is a topic I could go on for days. So I'll try and keep it brief. But I think it's a combination of what Mirela said about making sure we're looking at topics. Are they standalone or how can we leverage it?

It's also looking at process and technical decisions and learning from all of those. And how can we leverage that to make the next one better, make the next one quicker, make the next one more efficient, making sure we have the right staff in the right place at the right time? How do we fulfill the principles of good regulations in the best way that we possibly can?

We're looking at staffing for our core teams for all the activities that are coming in place. We're looking at budget models, and we're constantly refining all those things and then trying to figure out, is there a new and different and better way of doing everything that we're doing? So I think as long as we're asking those questions, as long as we're willing to challenge ourselves, we're moving in the right direction.

I don't know if we'll ever be perfect. But that's, I think, kind of a weird answer to your question. But I think our desire to always be evolving is what's making sure that we're going to be ready.

CHAIRMAN WRIGHT: Right. I'm going to stay with you for a second, Jeremy. Earlier, I brought up the updated mission statement, how that -- what we're looking to try to do. And I know that your team especially has been out front and working to live up to that. You're an example -- a really good example of what can happen inside this agency that can be hopefully -- it's transferrable to other business lines to do it and approach it the same way. And what would you tell people who are saying or who claim that were unwilling or unable to license micro-reactors or other advanced reactors in a timely and efficient manner?

MR. BOWEN: Thank you for the question, sir. It's something I think about a lot. I know you're a fan of sports analogies. So I'll say when the game is on the line, we want the ball.

I can understand where those comments come from. I acknowledge that the NRC has not always adhered to the principles of good regulation. We have certainly had missteps in our past.

We still have missteps today. But that doesn't mean that

we're the same agency today as we were 20 years ago. We've not even the same agency as we were five years ago.

And we have demonstrated our willingness, our ability to think differently, to change, to move forward. They're not aberrations. They're not anomalies.

We have multiple examples of success. I think we are continuing to demonstrate that. And like I said, we have new and different ways of thinking about things.

We have examples right now where not just in micro-reactors. We're thinking about recognizing that some regulations are not suited for the designs that we're looking at right now. And the staff is initiating how can we interpret these regulations for these types of designs.

How can we either take exemptions or move on? And what can we do in the future? So again, I'll come back to what I said. Give us a chance. Come talk to us.

Find out how we can -- tell us your challenges. Present the information that you see as a way to move forward and let us work with you. We have an independent safety mission to accomplish, but there's a lot of ways to achieve safety. And so give us a chance.

CHAIRMAN WRIGHT: Thank you for that answer. You like everybody else, you've got a lot on your plate, right? And all of it's important, every bit of it.

And there are a lot of -- there's a number of micro-reactor policy issues that you're working on in parallel too. And I recognize that. What I'd like to maybe have you tell me a little bit about and my colleagues here, how

are you organizing your work so that staff activities are coordinated across the large number of micro-reactor topics you have before you and making sure that the Commission is properly engaged?

MR. BOWEN: Yes, thank you, Chairman. So the Micro-reactor Activities Plan, we came up with a name, but it's so hard to say. I think that was a key for us in trying to make sure that we had a good understanding and a good connection between all the different organizations.

As you said, this is touching so many things. And to make sure that we have those relationships and those connections and that ability to track and make sure we're making progress on all those activities. So that was a good step.

And we already thought we kind of had a sense of what were policy issues, what were stuff that the staff could take on. We're trying to -- that plan also gave us an opportunity to reflect and make sure, are we identifying all the policy issues? Is the picture clear for everybody?

I think Duke in his presentation tried to lay out, like, these are the policy issues that we think are before you. Here's the ones that we know of today that are remaining. So that's our intent with that plan.

As I mentioned, it's intended to be a living document. We're already engaging with stakeholders. We just put it up yesterday in a kind of searchable format on our website. We're intending to iterate and make that even a more productive dashboard tool available for everybody to understand. Make sure that you can connect the dots in layman's terms.

CHAIRMAN WRIGHT: Thank you so much. I wish you the best of luck as you go forward too. Anything we can do to support. Cinthya,

how are you? And I appreciated your discussion with Commissioner Crowell just a few minutes ago on the transportation part of things.

And recognizing that, I believe micro-reactors are different as Commissioner Caputo pointed out in the first panel. How do NRC requirements apply to situations that involve different modes of transportation, I mean, for example, road to rail, air, maybe even by sea? And I guess really to drill a little bit, how is the transportation in the micro-reactor space? How is that different than what we do today, or is it?

MS. ROMAN: Thank you for the question. It's no different from what do today. So the regulations in Part 71 apply to all the different transportation modes.

So for us, it's in the plan. And we really focus on the transportation cask. So on the other hand, DOT regulations, those are the ones they regulate the carriers.

So our regulations point to the DOT regulations. And that's how the micro-reactors would decide what method of transportation to use. But our regulations are independent of the transportation mode.

CHAIRMAN WRIGHT: Thank you. I've run out of time, and I'm going to turn it over to Commissioner Caputo.

COMMISSIONER CAPUTO: Good morning. Thank you all for being here. Thanks for your preparations for today. Clearly, you heard my comments this morning about there are a lot of issues here and a lot of good progress is being made, a lot of hard work by the staff.

But I'm concerned about just the need for a strategic approach as to how we're going to navigate that. So I guess my first question

would be given everything that you've discussed and given what's underway, what does it take to hit six-month deployment of micro-reactors? What does it take to actually get to the point where NEI is discussing in their RHDRA paper and et cetera? What does it take for us to get to that six-month?

MS. GAVRILAS: So I think your question is two-fold and we'll have two answers, one is how can we expedite what the NRC has to do today. And you heard a lot about that. But I just wanted to lean forward a little bit and say that the conversation that we've had about micro-reactors and given the very unique risk profile of micro-reactor have made us think and the directions from the ADVANCE Act have really made us think, is it time for us to look at a cohesive regulation that would deal specifically with the risk profile that's presented by micro-reactors? I think we've tried to, the graded approach, risk-informed because we wanted to be technology neutral. But micro-reactors because they have such limited needs, perhaps make us ask the question, what do we need to assure ourselves of the safe and secure operation of these facilities?

And it's an opportunity to think, how can we cater to their needs which are fixed versus mobile, manufactured versus built on site, the number of licenses that they need, and all the questions and issues that came up this morning. Because what we do now is we ask ourselves do they need this. And could we move from do they need this and an exercise in proving a negative to what do they actually need in order for us to become comfortable with their license?

So that's becoming front and center in our thinking. And it will build on everything that you heard us talk about today, all the issues that we're

walking through carefully. Jeremy.

MR. BOWEN: Thanks, Mirela. Commissioner, I loved your analogy of the Tootsie Roll, Tootsie Pop. And I remember the commercial well. And certainly we have to talk the bite. We have to take the advice of the owl and just take the bite. And I think the work -- to Mirela's point, I think the work that we're doing right now is going to provide that technical safety basis for us to say taking the bite is okay and providing the stakeholder confidence to say that's the right approach to get to the center of the Tootsie Roll.

COMMISSIONER CAPUTO: Okay. I guess I hear you. But there are so many moving parts. And I think having workshops to address particular issues or even groups of issues is one thing.

But I believe the staff should really have a workshop that looks at everything that's underway and takes a strategic view about what does it take to actually achieve a paradigm shift here and to get down to that six-month time frame given the nature of what's involved. So I would very much encourage you to think about that. Yeah, I've mentioned in various presentations just about batch licensing.

How do we -- given the framework that we have, given the statutory language on utilization facilities, how do you get to a point where someone has a license to operate a technology not to operate a particular reactor and particular location? How do you get at that from a strategic direction? How do you make that simpler?

Whether we can do that under our regulatory framework, whether there might be a need for a legislative change to sort of streamline the nature of how we go about that decision making. But in the end, what can we

do to bring our decision making into a time frame that's going to suit deployment while still ensuring the maintenance of safety and security. I also have a particular question, having to do with start of operations and the use of loading of fuel as a proxy for when operations start.

That was how the staff went about it in the micro-reactors paper that's pending before the Commission. So staff proposed that we adopt something, sorry, other than loading fuel as the start of operations and features to prevent criticality. Westinghouse is asking us for how we are going to treat refurbishing and refueling of a micro-reactor under a Part 70 license. Under the staff's approach, it kind of puts us in the position where we're going to have to consider a micro-reactor that's been returned to a factory for refueling as not having commenced operation which I'm kind of struggling with.

So I feel like we should be able to find a different way to categorize this because it's going to make sense for the first one that leaves the factory when it's got fresh fuel. But the nature of this construct gets pretty difficult after that when it's -- after initial fuel load and the initial operating cycle. So saying that it's commenced operations and then not and then it has I think becomes a difficult approach for us. Are you looking at a different way to categorize operation that is going to make low power testing easier in line with what Westinghouse was talking about but also something that is going to be flexible enough to handle the nature of refueling and refurbishment?

MR. BOWEN: I can start and you can jump in. Short answer, yes, Commissioner. You're right. It's a challenge from -- and this is an issue I think that maybe to go back to your previous question.

We find when we're able to -- first question we asked

ourselves is, what's safe? What's appropriate for safety? What's necessary for safety? And then we find ourselves navigating a regulatory infrastructure of statutory requirements and trying to figure out, okay, if it's safe, if we find it's acceptable from a safety standpoint, how do we make that fit within our structure and the statutory requirements?

For this scenario, I think the staff is looking at something where the same deployment where you're introducing features to preclude criticality, to enable physics testing and deployments of the site. Kind of backing -- reversing that to bring it back to the factory, defueling and refurbishing the unit. How that -- now is that another -- is it a new unit at that point or are you testing it to send it back out?

Or is it necessary? We've engaged with other -- and Westinghouse talked about their deployment models. There's been others that have talked to us that they want a slightly different version of that model.

So trying to make sure they were providing the flexibility to the various different models is another challenge that we're facing. But I think, yes, we're trying to make sure that we're capturing all that and not introducing unnecessary -- additional unnecessary burden or challenges. Duke, do you want to add anything?

MR. KENNEDY: Yeah, I'll just add that when we had our workshop in February on the integrated Micro-reactor Activities Plan, one of the topics that came up was the post-operation aspects of micro-reactor deployment models. And we had that prioritized as low. But through the conversations in that workshop, we raised that up. And now we're looking at a specific interaction in the next couple of months to go over those topics or go

over that topic because recently this has come up as a more important topic to some of the developers.

And so while we didn't have perfect information when we wrote the SECY-24-0008, we were trying to outline generalities for what might be possible. I think now we're at the point where we're getting some more specific details. And we can dig into these issues a little more and like you suggest, try to develop strategies that really make sense for facilitating it.

COMMISSIONER CAPUTO: So is there a need for more flexibility beyond the nature of what was proposed in the paper of the Commission?

MR. KENNEDY: I don't think there's a need for more flexibility beyond what was proposed in terms of the use of features to preclude criticality to make the reactor not in operation. I think it's a matter of looking at what licensing pathways that we have. And I think there's maybe some lessons to be learned from reactors that have been taken out of operation and then decided to put back into operation recently. And also looking at -- excuse me, looking at ways that we can restructure the license that would be for particular sites to facilitate reactors moving in and out of a site for a placement more easily, for example.

COMMISSIONER CAPUTO: Okay. Thank you.

MR. KENNEDY: Thank you.

CHAIRMAN WRIGHT: Thank you, Commissioner Caputo. Commissioner Hanson.

COMMISSIONER HANSON: Thank you, Mr. Chairman. Thank you all for your presentations this morning. This is really a great

discussion. And I completely agree that it complements the first panel quite well.

I want to just take a couple minutes at the beginning of my remarks to associate myself with some things that the Chairman said during the first panel as well as Commissioner Marzano during this panel about really kind of the remarkable work that the staff have done, right? This has been a methodical and ongoing effort now I think for a couple years. We got SECY-24-0008.

Last year, that represented kind of the way I think of the first tier of effort, right? What are those decisions that can be made within our existing authority where we have those flexibilities? We're seeing -- as an enclosure to that paper, we saw the identification of some really -- I don't want to call them thorny, but kind of tough issues around environmental review, around siting, around operations and some other things, right?

Already teeing those up for kind of the next steps in that paper. And while the staff have waited for that paper to resolve, you guys haven't let any grass grow under your feet, right? And moving ahead with the nth-of-a-kind white papers that were issued, I think, last fall, the interactions with the staff, the really constructive engagement with NEI through their comments last summer on this subject.

And while there are a lot of issues that kind of need to get worked out, I think leaning in and showing how we can be proactive about this and how we can be flexible about this to tackle those tough issues has been really important. And I think like a lot of people these days, I'm glued to business news. Because apart from whatever policy changes are going on out

there, I'm really interested in how the markets are reacting.

Because the markets represent real actors, serious players with real money-making real investments across a whole range of areas, not just nuclear. But what we've seen today is actually a couple of really -- we had a couple of real data points sitting at the table that represent real investment. One company saying that they've heard enough from the NRC. They're moving into project execution phase.

Another company saying they've got major investments in facilities and technology that are going on based on, in part, not just the broader market out there and demand for energy but actually on the work that you all are doing. And so as we move forward and continue to tackle these and whether it's on an individual level for some of these things or as a more broad and cohesive approach on individual regulation, I want you all to kind of hang on to that and to keep going and to keep going further. So thank you all for what you've done.

I'm sorry, Cinthya. You've gotten a lot of love today, Dan, not so much, and Jessie, just a little bit. But boy, I want to pick up on Commissioner Crowell because he touched on a lot of things. And of course, he and I share a lot of -- share interest in the spent fuel issue and the analogies there and the kinds of the things that we've learned.

Of course, we've got a great track record in this country of moving spent fuel safely and reliably over many, many decades, right? Hundreds and hundreds of shipments on the part of our operating licensees, the Department of Defense, DOE, and others. So we know how to do this.

And Cinthya, your point about how there not really being any

difference on some of the stuff is really important. And yet on the spent fuel issue, as you noted, right, there are other agencies that are involved in this, right, particularly Department of Transportation. Department of Transportation actually regulates transportation on these things.

And while maybe we didn't see the higher volume of spent fuel transportation that may have once upon a time been envisioned, the micro-reactors provide us an opportunity to revisit some of that engagement, particularly that DOE had, the Department of Energy had with DOT and state governments, et cetera. So how much interaction have we had so far? And with, say, DOT or the Federal Railroad Administration or the National Highway Traffic Safety Administration, et cetera, how much engagement have we had with those entities?

MS. ROMAN: So we do have periodic meetings with DOT very frequently because we are co-regulators. But I have to admit on the topic of what the actual carrier is going to be, we haven't engaged as much. We have been talking about micro-reactors.

But the focus has been more on the transportation package itself. So yeah, so we engage with them. But it hasn't been the topic that we have been discussing often.

COMMISSIONER HANSON: Yeah, it almost seems like -- we've seen some models here for, say, factory production of a micro. Then we had NOV Shepherd tell us about kind of the infield concept of operations. But there's, like, this middle piece, right, of getting it from the factory to the place where maybe we haven't seen as much proposals to us for concept of operations. Is it useful -- are we kind of waiting for someone to bring us what

those concepts might be? Or is it useful to us to kind of have a generic concept that we can kind of evaluate somehow?

MS. ROMAN: I would think it would be helpful for people to bring these concepts to us because there is so many possibilities when we talk about micro-reactors that the more we hear from what the plans are from the industry, it help us to prepare. We cannot prepare for every possible scenario. But we want to prepare for the credible ones. And having those engagements and people come along and talking to us will really help us to prepare.

COMMISSIONER HANSON: Yeah. Well, the chairman had it right. We were talking about multimodal transportation and the different connections there and so forth. And of course, it is partly about the package.

But I wonder if we might as we engage with our interagency counterparts kind of bring in other areas of expertise like security and emergency planning and other kinds of things for that package while it's in transit. Is there a -- Cinthya, I've got a specific question for you on this. And it's something Commissioner Crowell actually brought up.

He mentioned you're shipping the reactor from the factory and it's got unirradiated fuel in it. You've got the measures in there to prevent criticality while it's in motion. It goes. It operates for some period of time.

And then you're starting to ship it back. Well, now that fuel is irradiated. So on the front end, there's one kind of source term and risk hazard. And on the back end, there's another kind of risk hazard.

Is there an opportunity there for flexibility around certificates of compliance for packages? Is that a single package? Are we looking at vendors to propose things to us? How are we kind of starting to get our head

around that?

MS. ROMAN: So part of the reason why for my presentation I was presenting Type B packages is because our use for spent fuel. And part of the assumption is that they're going to be doing some testing at the facility. And depending on the type of testing they do, they might have to consider the fuel spent fuel by the time they're going to ship for the specific location.

There are still possibilities for some licensees to consider the fuel fresh fuel and used a Type AF package. Let's say that they do some testing at low energy levels or that there is a low burn up. Maybe they can still justify a fresh fuel package, AF. But yes, I think right now my assumption would be that the -- many of the applicants would be interested in Type B. And maybe I'll add that the type of testing that -- the video that I showed, the testing is kind of similar for Type B and Type AF. But for Type F, it's a little bit more robust, the type of analysis. So --

COMMISSIONER HANSON: Yeah, thank you.

MS. ROMAN: -- there is some benefit for transporting fresh fuel --

COMMISSIONER HANSON: Yeah.

MS. ROMAN: -- versus spent fuel.

COMMISSIONER HANSON: But the Type B provides kind of a boundary, right? That kind of provides almost the --

MS. ROMAN: Yes.

COMMISSIONER HANSON: -- extreme case, right? We know things are safe. We've got a lot of experience with Type B packages, et cetera.

MS. ROMAN: Is that F, B, F, yes.

COMMISSIONER HANSON: Okay. All right. Fair enough. All right. I'm down to my last 30 seconds. And Dan, I mean, look, man. So I appreciated your presentation, particularly kind of the four alternatives around this.

And I guess I just wanted to ask there was the RIC session on high volume licensing and the modernizing of environmental reviews. And so what did you hear from those sessions on what you heard at the RIC? Kind of how has that influenced the way you guys are approaching this?

MR. BARNHURST: I appreciate the question. One of the RIC sessions specifically was presented by Dr. Don Palmrose who's here with us today. And it was on this approach.

And so we received comments in the session, both of those sessions, and also live polling that we've looked at since then. And so what we heard was this. I think there's general focus of the importance of what we're doing. I think there's general support for how we're doing it which I would hope is no surprise because we've been working with other stakeholders in order to kind of inform this approach.

And there are practices that are widely used from outside the agency to do it in a neat and efficient manner. I guess the last thing I would add to that is there's a sense of urgency, and that's no surprise. But a sense of urgency for us to now go from a list of alternatives that we feel like are flexible enough to handle anything that we might see from a design, a deployment site characteristic standpoint to getting that framework pulled together, implementing and developing it.

And I would add that we're already in discussions with micro-reactor applicants or potential applicants, pre-application space, where we're running through these different types of alternatives with them, deciding which one we think works best for them. And kind of we'll be developing and implementing as we do in some cases. But this has been done before in other places. We're learning the lessons from that, and I think we're well positioned.

COMMISSIONER HANSON: Great, thank you. Really appreciate it. Thank you, Mr. Chairman. I'm sorry for delaying everybody's lunchtime.

CHAIRMAN WRIGHT: That's okay. We're okay. Thank you. So it appears that we've come to the end of our time together. I don't know about you, but for some reason, I'm craving a Tootsie Pop.

(Laughter.)

CHAIRMAN WRIGHT: Seriously, it's been a great first Commission meeting on micro-reactors. And there are going to be more because this is a critical topic. And we're going to have to have more as we go forward focusing on everything micro, including what we need to do, what needs to happen to enable possibly a six-month review as Commissioner Caputo paraphrased from Marc Nichol's presentation from NEI this morning.

So I want to thank each of you for your presentations and everybody today for their participation. It was very informative. We got a lot more questions probably now than we did when we came in which is a good thing too. So before we close, I'd like to ask my fellow Commissioners if you have any comments. Okay. With that, hearing none, we will adjourn this meeting.

(Whereupon, the above-entitled matter went off the record at 12:18 p.m.)