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UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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709TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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OPEN SESSION

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TUESDAY

OCTOBER 3, 2023

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The Advisory Committee met via hybrid In-Person and Video-Teleconference, at 1:00 p.m. EDT, Joy L. Rempe, Chairman, presiding.

COMMITTEE MEMBERS:

JOY L. REMPE, Chairman

WALTER L. KIRCHNER, Vice Chairman

DAVID A. PETTI, Member-at-Large

CHARLES H. BROWN, JR., Member

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member*

GREGORY H. HALNON, Member*

JOSE MARCH-LEUBA, Member

ROBERT P. MARTIN, Member*

THOMAS E. ROBERTS, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

ALSO PRESENT:

AMY CUBBAGE, NRR*

JAMES DOWNS, NMSS

WILLIAM KENNEDY, NRR

STEVEN LYNCH, NRR

TAMMIE RIVERA, NSIR

JESSE SEYMOUR, NRR*

JIM TOMKINS, Duke Energy

BRUCE WATSON, NMSS

BERNIE WHITE, NMSS

* present via video-teleconference

CONTENTS

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

1:21 p.m.

CHAIR REMPE: This meeting will now come to order. This is the first day of the 709th meeting of the Advisory Committee on Reactor Safeguards. I'm Joy Rempe, Chairman of the ACRS.

Other members in attendance are Vicki Bier, Charles Brown, Vesna Dimitrijevic, Greg Halnon, Walt Kirchner, Jose March-Leuba, Robert Martin, Dave Petti, Thomas Roberts and Matthew Sunseri. Member Ron Ballinger has been excused for part of today's session, but he will be joining us later.

I do note we have a quorum today. And today the meeting is meeting in person and virtually.

The ACRS was established by the Atomic Energy Act, and it is governed by the Federal Advisory Committee Act. The ACRS section of the U.S. NRC public website provides information about the history of this Committee and documents such as our charter, bylaws, Federal Register notices for meetings, letter reports and transcripts of all full and subcommittee meetings, including all slides presented at the meetings.

The Committee provides its advice on safety matters to the Commission through its publicly

available letter reports.

The Federal Register notice announcing this meeting was published on September 18, 2023. This announcement provided a meeting agenda as well as instructions for interested parties to submit written documents or request opportunities to address the Committee.

The Designated Federal Officer for today's meeting is Mr. Derek Widmayer.

A communications channel has been opened to allow members of the public to monitor the open portions of the meeting. The ACRS invites members of the public to use the MS Teams link to view slides and other discussion materials during these open sessions. The MS Teams link information was published in the Federal Register notice and agenda on the ACRS public website.

Periodically, the meeting will be open to accept comments from participants listening to our meetings. Written comments may be forwarded to Mr. Derek Widmayer, today's DFO.

During today's meeting, the Committee will consider the following topics. Draft white paper microreactor licensing and deployment considerations, fuel loading and operational testing at a factory.

A transcript of the open portions of the meeting is being kept. And it's requested that speakers identify themselves and speak with sufficient clarity and volume so they can be readily heard. Additionally, participants should mute themselves when not speaking.

At this time, before we start our first topic, I would like to ask other members if they have any comments.

Okay. If not, I would like to ask Member Vicki Bier to lead to lead us in our topic for today's meeting. Vicki?

MEMBER BIER: Thank you very much, Joy. As people probably know, the staff issued SECY-20-0093 in October 2020 to alert the Commission to several policy matters related to nuclear microreactors that might require departures from current regulations, guidance or precedence and to identify potential policy issues relating to licensing of microreactors.

Using feedback from potential developers and licensees, staff has addressed some of these matters with recent regulation revisions and other actions.

Today we will hear from staff about three of these matters that need to be addressed for

microreactors, specifically to support licensing of transportable microreactors that might be fabricated at one location and then transported to a different location for deployment.

Staff will explain and discuss the issues involved in this and potential regulatory options for addressing those issues.

The Committee is addressing this topic solely as part of this full Committee without a prior subcommittee meeting to accommodate the staff's request that we be brief and attempt to finalize a letter report during this meeting rather than the usual format of a subcommittee meeting first and then considering the letter at a future full committee.

I've requested that our consultants, Dennis Bley and Steve Schultz participate in this session. I believe that Steve is online. Dennis will hopefully be joining us shortly.

We can now proceed to the staff's presentation, and I would be happy to call on Steve Lynch from the Office of Nuclear Reactor Regulation to provide opening remarks.

MR. LYNCH: Great. Thank you. Again, my name is Steve Lynch. I am the chief of the Advanced Reactor Policy Branch in the Office of Nuclear Reactor

Regulation.

As part of the staff's effort to establish a technology inclusive and predictable regulatory framework for advanced reactors, the staff is preparing policy papers on topics associated with the licensing of factory fabricated microreactors.

In contrast to larger power reactors, microreactors may be fabricated and tested at a factory prior to deployment at the final operations site. This introduces unique licensing and policy considerations associated with fuel loading, testing and operation.

In recognition of deployment strategies that seek to operate microreactors in the near-term, the NRC staff has developed innovative strategies to facilitate the licensing of these technologies within the NRC's existing regulatory framework using tools such as exemptions and license conditions as appropriate.

Additionally, the staff has identified a number of topics, such as transportation of fueled microreactor modules and remote and autonomous operations that are discussed in this paper but will warrant further discussion and dialogue both internally and with external stakeholders, including

microreactors developers, prior to any further engagement with the Commission.

The topics discussed today have been shared with external stakeholders through the release of the staff's draft white paper on these subjects in August and in three public meetings held since March of this year.

The updated white paper shared with the ACRS last week reflects a refinement of the NRC's staff's transformational thinking on these important topics achieved through ongoing staff discussions and feedback received.

We thank the ACRS for working with us on addressing the key issues associated with the licensing and deployment of factory fabricated microreactors, and we look forward to a productive dialogue today. Thank you.

CHAIR REMPE: I have a question.

MR. LYNCH: Sure.

CHAIR REMPE: I've looked through your stores as well as the updated white paper and the original one. And there's not a really good place to do it, you know, I think this is the best place to bring it up. But what is the staff's definition of a microreactor? Can someone with a 77 megawatt thermal

reactor design come in and say it's a microreactor, a 30 megawatt? Where is the cutoff for whether it's a microreactor or not?

MR. LYNCH: So I'll start with the response and then I will ask Duke to supplement as needed.

So the staff is not drawing a firm power boundary on what constitutes a microreactor. If we look to the Department of Energy and the technologies that they are funding and helping develop as microreactors, a rough upper limit is around 50 megawatts thermal. And that is consistent with the proposals that we are seeing come to the NRC for potential microreactor designs.

Part of what we are considering beyond just the thermal power level is what the actual radiological consequences for these facilities will be in general. While we have not set any limits in our regulations, our expectation is that the hazards associated with these facilities would be similar to currently operating or proposed non-power reactors. So this would typically mean a facility that would be looking to have accident consequences of one rem or less.

CHAIR REMPE: So in SECY, the older one,

the 20-0093, it has a sentence in there about the consequences. And that didn't show up in this one, this white paper, and I just was puzzled why the staff backed off from saying that one rem total effective dose equivalent.

MR. LYNCH: Duke, do you want -- okay. Well, so I think for this, I don't think there was an intent to shy away from that. I think rather it was more -- the focus of this paper was less on the operational characteristics of the facilities once they're at the final deployment site and more on activities that are going to be happening at a factory, which are going to include fueling of the reactor and potentially some low power testing.

So for the purposes of this paper, looking at the consequences of these facilities wasn't as pertinent to the discussions that we needed to have.

CHAIR REMPE: I just think it would be nice to have that discussion in anything. I mean, this is the first time. But anyway, that's just --

MR. LYNCH: Understood. Understood. No, I appreciate that.

MEMBER BIER: If I can make a brief follow-up on Joy's comment, I think part of the reason that I think that's important is because whatever

licensing options get established here, you will need to specify who can use those options or which designs can use those options, and so it's helpful to have that clearly spelled out.

MR. LYNCH: Sure. Absolutely.

MS. CUBBAGE: This is Amy Cubbage, NRC staff. I'd like to just chime in one this, I think, just to follow on to what Steve said.

For the purposes of this paper, with factory fueling and then transporting of fueled modules and the potential for operating a reactor for testing in the factory, it's more practical considerations on the part of the developer that would dictate the size at which they feel that they could, you know, technologically have a reactor that's small enough to be transported in its fully fabricated state and fueled state. The actual size wasn't a factor for us on the safety considerations.

VICE CHAIR KIRCHNER: But it's clear that you mean power reactors here.

MR. LYNCH: Yes.

MS. CUBBAGE: Yes.

MR. LYNCH: Yes.

VICE CHAIR KIRCHNER: Therefore, but you made the comment that these were being considered as

similar to non-powered reactors? Did you use that magic word that sounds like less regulation, less oversight?

MR. LYNCH: So I think, and some of this we'll get into in the details of the presentation. And the context of the remarks I was just making, I was making a technological comparison for the sake of expected power levels. So all of our currently operating non-power reactors operate at 20 megawatts thermal or less.

VICE CHAIR KIRCHNER: That's like in every --

MR. LYNCH: Yes.

VICE CHAIR KIRCHNER: -- test reactor --

MR. LYNCH: Yes.

VICE CHAIR KIRCHNER: -- and so forth.

MR. LYNCH: So that was the comparison I was making here. We do have a proposal in this paper looking at potential utilization of non-power reactor licensing frameworks in order to help facilitate low power testing at a factory, which we believe is one way of scaling appropriate requirements for safety for these facilities that will be doing limited operations at a factory.

VICE CHAIR KIRCHNER: Licensing operations

at a factory is one circumstances whereas operations in whatever site they are going to be located in would be --

MR. LYNCH: Correct.

VICE CHAIR KIRCHNER: -- I would think would be some other consideration.

MR. LYNCH: Yes. So at the ultimate deployment site, the NRC staff is not suggesting that anything other than power reactor requirements would be applied to these facilities.

VICE CHAIR KIRCHNER: Thank you.

MR. LYNCH: I guess to close that, the point is well taken and the staff will consider whether it makes sense to add a more definitive classification of what is considered a microreactor in the context of this paper. Thank you.

CHAIR REMPE: I would like that. The expectation is not written down as to which. Anyway, thank you.

MR. LYNCH: All right, Duke. I think we can turn it over to you now.

MR. KENNEDY: Okay. Thank you very much. Is this audible for everybody? Just closer? All right. I'll get set up here.

Okay. So good afternoon, everybody. My

name is Duke Kennedy. I'm a senior project manager in the Advanced Reactor Policy Branch in the Office of Nuclear Reactor Regulation.

I'm very happy to be here today to speak to the Committee about this paper. It's been a large effort of collaboration with many divisions in the NRC to get this paper together. It covers a very broad variety of topics that touch on many of the programmatic areas across the NRC.

And so I'm happy to have with me here today Bernie White from the Office of nuclear Materials Safety and Safeguards. So he's authored the section on transportation and on storage of irradiated fuel that you will find in the enclosure to this paper as well as helping out with the development of the vote options as well as the regulatory approaches that are presented in the main part of the paper.

On the line, Jesse Seymour authored the section on remote and autonomous operations. He will be presenting to you remotely on that topic in the enclosure as well as Tammie Rivera from the office of Nuclear Security and Incident Response, who also contributed to that section on information related to cybersecurity.

There are too many others to name, but

this is a great effort of collaboration. I believe there are another 15 or 20 staff on the line who are here to help answer questions related to the various topics in the paper. I have a couple more staff that are here in the room here as well.

Next slide. So my presentation will cover the motivation for the paper, Conceptual Deployment Model for Factory Fabricated Transportable Microreactors, and information about the draft white paper that we provided.

These slides are meant to help us have a common understanding of what are these microreactors, what does the deployment model look like and what are some of the NRC staff's assumptions in the paper.

And then we'll move on to regulatory approaches or features to preclude criticality, fuel loading at a factory and operational testing at a factory. And this is where we will discuss most of what's in the body of the draft white paper.

After that, we'll move to the topics that are included in the enclosure to the draft white paper. We'll talk a little bit about stakeholder engagement and then the next steps.

Next slide. So this question has already been partially answered, but I will just reiterate

here that in this paper, we are discussing commercial microreactors that would be licensed under Section 103 of the Atomic Energy Act.

We expect that they would primarily use non-light-water reactor technologies, have power levels in the range of few to several tens of megawatts thermal water, and have small site footprints as well.

These factory-fabricated microreactors would be a subset of microreactors. They would rely heavily on standardization and be designed such that they could be produced and manufactured in a factory. This would ultimately have the goal of simplifying licensing and deployment for multiple reactors of the same design.

The staff's information paper that was sent to the Commission on policy and licensing considerations related to microreactors introduced, I believe, 10 topics related to microreactors. That was in 2020. And so the paper that we are presenting on today revisits some of those topics and introduces some new topics and focuses some of the previous topics on factory-fabricated microreactors.

The staff has also undertaken a number of activities since the publication of that information

paper, including the development of the Part 53 proposed rule on risk-informed technology inclusive of the regulatory framework for commercial nuclear power plants, a proposed rule on alternative physical security requirements for advanced reactors, a proposed rule under advanced nuclear reactor generic environmental impact statement, a recently approved rule on emergency planning for small modular reactors and other technologies as well as some other guidance development activities that are currently ongoing.

The point of these technology inclusive rulemakings is to have requirements that are scalable to meet the potential risks of the various reactor technologies that could be subject to those rules.

So one motivation for this paper has really been that there is growing stakeholder interest in the deployment of these reactors. And we're seeing from three years ago to now formal engagements with the NRC staff through the review of white papers. I'm seeing submission of regulatory engagement plans.

We have more and more developers that are approaching the NRC in the very early stages, notifying us that they are interested in this area and considering developing designs. So we are really seeing things ramp up.

And so we feel it's important now to take the proactive approach to provide regulatory clarity on what these developers can do under the current regulatory framework and what things might require additional policy decisions or rulemaking.

So we have prioritized in our paper three of these topics that were previously mentioned, the fuel loading at a factory, operational testing at a factory and the topic of features to preclude criticality. We see these as important topics that developers need to have some level of certainty on as they start to develop their licensing documentation.

So many of these developers would rely on a manufacturing license. And so just to prepare that manufacturing license application, some of these issues are important for them to understand. And based upon their estimated deployment type of time frames, development of that documentation is starting very soon.

So, next slide, please. Okay. So on this slide, we have a depiction of what we're calling the generic deployment model. And it will include numerous activities that involve NRC licensing oversight.

So the generic deployment model considered

by the staff in this paper is a combination of features that we've heard from various developers and things that the staff believes may be included in the deployment of factory fabricated microreactors. So this doesn't represent some particular developer's model, but the idea is that it encompasses any of the models that might be proposed by the developers.

It is also entirely possible that other microreactors developers would not choose to load fuel in a factory or to operate for testing in a factory. But those deployment models don't raise the same types of policy issues that fuel loading and operation of the factory do.

So if we start on the left here, we have the depiction of a factory. And so when you think of a factory, a factory under this deployment model could have various parts. So a manufacturing facility is where a reactor will be manufactured. And the manufacturer of that reactor would be covered by a manufacturing license.

In addition to that manufacturing license and manufacturing area, there could be an area in the factory where fuel is loaded into the reactors. And that would be covered under a Part 70 license or an operating license, depending on the options that are

presented in this paper.

And then the factory could also have another location where the reactor is actually operated for testing. So while you may have one larger factory, you may have distinct areas within it that are subject to different licensing requirements. They may be overlapping to a certain extent, but they also may be distinct areas.

So the next step on the graphic here is the transportation to the deployment site. So reactors would be loaded onto a truck or a train or some other approved transportation means and taken to the deployment sites.

So at the deployment site, there would be separate licensing. So licensing that happened at the factory would not be carried over to the deployment site. It would go through a separate licensing process at the deployment site that is specific to that site.

There may be some things that happen during licensing at the factory that can be carried over. For example, if there is a manufacturing license at the factory, there may be final design information in the manufacturing license. That final design will not need to be reviewed in the same way at

the deployment site. But I want to be clear that there is licensing in the factory that happens, especially for fuel loading and operational testing, separate licensing that happens at the deployment site.

So in this figure, you can see that we have depicted factory fabricated microreactors as having one of two general designs.

The first at the top there is what we call standalone or a self-contained microreactor. And this is where everything needed to operate the reactor to produce the power is contained in one package or one container that would just more or less be hooked up to the load. So that's an electrical load or a requirement for process heat.

The other design is what we are calling a core module where the core module would contain things like the control rods, the fuel, core support structure, maybe some instrumentation or other things. And that core module would be plugged into some structures and systems that were constructed at the site. So the distinction between those two different designs.

Next --

CHAIR REMPE: Before you leave that slide,

I know that you only have things on trucks here, but your enclosure talks about other types of deployment scenarios where the module is put on a ship or something where it's flying in the sky.

And I'm wondering if we go forward with this white paper in SECY how we assure that the design has adhered to principles, fundamental principles, that are not only applicable in the U.S. but for other scenarios overseas that are not in the U.S.

And I'm aware of there was a joint CNA, NEI and WNA publication that talks about a framework for international regulatory efficiency to accelerate nuclear deployment. And they emphasize fundamental tenets like defense-in-depth that IAEA has always advocated.

And I'm just wondering if we do this and say, okay, yeah, you can load fuel at the site and put it on a truck if we're not stepping into something where some designs that if you have a little more control in the U.S. if it's only going on a truck, it's not a big deal, but if you start expanding to other scenarios, it could be big deal.

And how does what you're doing consider those other options and where you might have something is okay and maybe it's not okay because the design

didn't have defense-in- depth and multiple systems for control or something?

MR. LYNCH: Sure. So I'll start with a few high level thoughts. One of the things with this paper is we're only looking to come up with strategies for these transportable microreactors within the existing NRC regulatory framework. So this is in either 10 CFR Part 50 or 10 CFR Part 52 for the reactor regulations or the requirements as may be required for materials under Part 70 or transportation in 10 CFR Part 71.

So at this point, we're not recommending modifications to these regulatory requirements that currently exist to ensure the safe transportation of material or hardware as it may be for these reactor modules.

But also in the context of this paper, we identify transportation as one area that is going to require further consideration. So we only introduce the topic in this paper so as to help identify what are the many areas that the staff need to explore in greater detail.

So this paper is not meant to be definitive on everything that we need to do when it comes to transportation. We identify some of the

ideas that need to be considered for this.

And when it comes to harmonizing with particularly other countries and how, you know, work may be done between the U.S. and outside of the U.S., that is something that the NRC staff is currently taking on as part of greater initiatives through Part 53 and looking at how our regulatory framework says we reimagine them for the future could better harmonize internationally.

So with that, I will give Duke or Bernie an opportunity if you had anything you wanted to add to that.

MR. WHITE: Thanks, Steve. So I'm Bernie White. I'm a senior project manager in the Storage and Transportation Licensing Branch in the Division of Fuel Management in the Office of Nuclear Material Safety and Safeguards.

It sounded like you were touching on transportation and transportation overseas in other countries and how that is accomplished and whether, you know, our packages can be used over there and safely transported as opposed to, you know, the operational piece, which is NRR.

NRC rules for transportation are harmonized with the IAEA standards in Safety Series 6

or specific Regulation Number 6. Sorry. We have harmonized through the 2009 edition. We've got a current rulemaking going through 2018.

If one of our packages -- and currently, this is the current framework for transportation. If one of our packages is going to be used in a foreign country, the NRC would issue approval for the package, typically a Certificate of Compliance.

The DOT then would issue a Certificate of Competent Authority for International Transport. In whatever country that package is going to go to or through, but also perform what's called a revalidation. And so it would do its own independent review of the application it got from the certificate holder along with the DOT Certificate of Compliance and actually issue their own certificate for transportation.

CHAIR REMPE: So if I have a design and I want to deploy it down in Puerto Rico, and I go through this refuel loading. And it's not just going to be staying on a truck. It's going to have to get in the water, and it may go by international waters or something like international locations, you're saying that the package will be fine. And the measures to ensure that you don't have criticality will be

adequate -- to prevent criticality will be adequate with respect to fundamental tenets like defense-in-depth and things like that.

MR. WHITE: For transportation, absolutely.

CHAIR REMPE: Okay.

MR. WHITE: Our rules are generally modal independent. So if we issue an approval you can ship it by any mode with exception of fissile by air. If you want to ship fissile by air, there are specific requirements for that. Or if you want to ship plutonium by air, there are other specific requirements for that. But otherwise our rules in Part 71 are mode independent.

CHAIR REMPE: Okay. Thank you.

MEMBER BIER: If I can make one more clarification. My understanding is that the section on maritime applications in the enclosure was for maritime deployment of the ultimate reactor, that it's on a ship that can go from place to place. But that this diagram includes not just truck transportation but also say barge transportation or similar. Is that correct?

MR. WHITE: Yes, that's correct. This diagram is meant to represent what happened and be

domestically licensed.

MR. KENNEDY: Okay. I think I have covered the points I want to cover the points I wanted to cover on this slide. The only thing left is that you can see on the right there we have a decommissioning or a refurbishment facility, which I will discuss a little bit later when we talk about the topics in the enclosure.

But this would represent the end of the lifecycle for microreactors that were designed to just be single use or had gone through several fuel cycles and would now be ultimately decommissioned or there could be a refurbishment of reactors multiple times and then redeployment. So this facility could be where they remove the fuel. They perform some maintenance or refurbishment activities. They put new fuel in. They redeploy it.

There is nothing to say that the refurbishment facility couldn't also be the factory or co-located with the factory. And one that's important to keep in mind is there are many iterations of how these different parts of the deployment model could be licensed, and who would be licensed to do the different parts.

It is possible that one entity would not

only manufacture the reactors, fuel them, test them, but also be the ones who operate them in the field, also be the ones who decommission them and refurbish them or there could be a different licensee that's the deployment site operator. We just don't -- we don't know exactly what all the developers are going to do. So we are trying to keep this at a more generic level.

Next slide. Okay. This slide covers our draft white paper that we provided. So just very quickly, it describes regulatory approaches that the NRC staff is developing for consideration by the Commission related to three main topics. The first in the paper is features to preclude criticality, which I will discuss more on the next slide.

The second is fuel loading at a factory. The third is operational testing in a factory. And then, again, we have an enclosure that covers a number of other topics, including some near-term strategies that we have which would utilize the current existing regulatory framework to address those topics and also next steps, which may include longer term activities that would require further Commission engagement. I also have links here to where the paper can be found.

So I just want to mention here that based on the early feedback that we have received from

developers, one of the main assumptions in this paper is that there will be a manufacturing license for the manufacture of the reactors at the factory.

The manufacturing license accomplishes several things. One, it would actually allow for the reactor to be possessed by the owner of the factory. You are not allowed to have a utilization facility unless you have a license to have it.

The manufacturing license allows you to have the utilization facility. It also allows for, as I mentioned, final design approval and some regulatory finality about that design. You are also required to have a license in order to manufacture or construct a reactor. So this license would authorize the manufacture of the reactor.

And in the manufacturing license, it includes the design of the reactor. It includes some quality assurance provisions. It includes some provisions that are related to the management and oversight and technical control of the manufacturing process. But what it doesn't include is where the reactor will be manufactured or what the building is like that the reactor will be manufactured in. So those aspects are not included in a manufacturing license.

MEMBER MARCH-LEUBA: Does the manufacturing license include one reactor and what if I'm working on 12 in power move, clearly, criticality and safety becomes an issue.

MR. KENNEDY: So the manufacturing license provisions in the regulations right now cover unfueled reactors. The manufacturing license doesn't include anything about radioactive material, special nuclear material. So any criticality control provisions are going to be under a different license, whether it's a Part 70 license for the material or it's a Part 50 or 52 operating license for the reactor.

MEMBER MARCH-LEUBA: And then it will build in SSEs, a vessel, control rods maybe, instrumentation but not fuel?

MR. KENNEDY: Under the manufacturing license, yes. The manufacturing license would cover everything in the design of the utilization facility. So it could be an entire reactor for a self-contained design or a core module design, it could just be the vessel.

MEMBER MARCH-LEUBA: You must keep in mind that for this to be economical, it would have to be a Model T type factory, right, where you are making it by the vessel.

MEMBER PETTI: Jose, we can't hear you.

MEMBER MARCH-LEUBA: Well, sorry about that. Can you hear me now better? I have the microphone in my mouth.

MEMBER PETTI: Yes, that's better now. Thanks.

MEMBER MARCH-LEUBA: So when we do this, you have to consider this like a car factory, where the model moves along the line, and you are aligning all these components.

MR. KENNEDY: Yes, exactly. And maybe I didn't answer your question quite right the first time. So there is nothing in the regulations for a manufacturing license that would prohibit 1,000 reactors being manufactured under the one license.

There is the duration of the license in the regulations and requirements for renewal, but it doesn't anywhere say you can only make up to 100 reactors or up to 10. So it would be up to the developer to design their manufacturing facility to be able to put out the reactors that they wanted to produce under -- you know, of a specific design.

If they want to have reactors that are produced en masse, stored at the manufacturing facility or at the factory and store loaded with fuel,

then there are criticality control measures that would need to be specified in a Part 70 license or a facility operating license for those reactors such that that would be done safely. But those criticality control concerns are not in the manufacturing license itself.

VICE CHAIR KIRCHNER: So, Bill, along those lines, then what's different here is with the 52 manufacturing license, as you said, that doesn't include loading fuel. And taking one step beyond, if some of the applicants actually proposed to operationally test the reactor, that is take it critical and up to some power, that then puts other requirements on the manufacturing facility that go beyond just say making a reactor vessel that would not be fueled at that facility.

So what are -- it strikes me, and it feels like, for people that take that step to go further not only allude to but actually test, then right now as I understand the regulations, they would need a construction permit and an operating license. Is that a correct interpretation? And therefore have designed that facility for the radiological hazards and shielding of personnel, et cetera, et cetera.

I presume any applicant that proposes to

do all three things you list has to be thinking along those lines. Or is it your intent to write guidance that would make it clear the scope of what is going to be required? Because it changes the manufacturing license considerably from just making components like -- I'll pick on some reactor vessels.

MR. KENNEDY: Yes, that's correct. The manufacturing license would not include any provisions related to fuel loading, nothing related to operation.

And when I was talking through the deployment model, when you think of the factory, don't think of it as having to just be one building where everything happens. So the manufacturing license proves the design, that could be -- the manufacturing could be done in one building.

A separate building where they load fuel, they have to abide by all the requirements that would be, you know, under Part 70.

Wherever they operate the reactor, they would need to have a construction permit like you said or a combined license to be able to fulfill all of the requirements for operating the reactor.

So it's certainly -- we're not extending the provisions of a manufacturing license under this approach. But what we are adding is the ability to

load the fuel under a Part 70 license.

VICE CHAIR KIRCHNER: I was going to make a suggestion later that it would be nice to have some kind of roadmap for a number of reasons that would point people as you -- just take the three bullets that are up there. Obviously, there are going to be requirements with criticality safety and also with fuel loading and then the actual operating. Testing ups the requirements even further and such.

So I was thinking, you know, the previous slide or a slide back or two showed a notional deployment strategy. But I was thinking it may be useful to have some kind of notional roadmap of if you're doing this, then these regulations pertain. If you're doing that and complicating a much more aggressive strategy to actually go into operational testing and perhaps build up fission product inventory, then you're going another step, and these are the requirements.

And beyond that the other -- this is Walt Kirchner. And the other thing that I think is critical, and I know you're coming to it, and you discuss it quite a bit in your white paper and enclosure, the timelines that go with other aspects of this may be the dominant consideration.

And I scratch my head very hard to think of a way that I could show simply in a tabular way or some illustrative way the timelines that are involved, particularly with the environmental requirements, which in many cases may dominate the schedule considerations and also hearings.

So I'll plant that seed now that I think -- it may be also useful for you and your stakeholders as well as presenting to the Commission to have that information in some compact format.

We had requested that of your counterparts over in the digital INC branch because we felt that trying to understand digital INC implementation, with all the regulations and all the codes and standards and all the ISGs, was really complicated.

So they found a nice way to present the regulatory roadmap and all the guidance for codes and standards or other requirement that were necessary to go through getting a digital INC license on that.

MS. CUBBAGE: This is Amy Cubbage. I just wanted to chime in. That is a wonderful idea. The one challenge we have is that right now there are options that we are presenting, and we really need Commission direction before we could definitively lay out whether or not a developer, for example, could

load fuel with a manufacturing license and a Part 70 license or whether they would also need a construction permit and operating license or a combined license.

So there are a few too many options on the table right now to probably make it as clear as you envisioned. But I think down the road that would be a great suggestion as we continue to engage stakeholders with implementation of whatever commission direction we receive.

MR. LYNCH: And to build on Amy's response there, I think it is absolutely a prudent idea to think about when we develop guidance how we are identifying the appropriate regulations that need to be followed for this. And as part of that implementation of Commission direction, the staff does plan to develop guidance. So we can take that into consideration when we develop our guidance.

MEMBER BIER: I can expand briefly on Walt's questions. This is Vicki Bier. It sounds like one of the, you know, goals or options of this whole discussion is that you could have operational testing at a factory without an operating license or a combined license. Am I correct?

MR. KENNEDY: No.

MEMBER BIER: No.

MR. KENNEDY: No, no. This is Duke Kennedy.

MEMBER BIER: Yeah.

MR. KENNEDY: No. There would not be any operation of a reactor without an operating license or a combined license.

MEMBER BIER: So is that under Part 50 and 52 or --

MR. KENNEDY: Yes.

MR. LYNCH: Yes. In order to --

MEMBER BIER: I may have misunderstood something on the way.

MR. LYNCH: So there are -- let's see. Maybe it helps if I go back a slide to -- well, we don't get into enough refinement here. But in that first column here on this slide where we talk about fabrication, fueling and testing at the factory, there are different types of licenses that would be needed for these various activities at the factory.

Duke was describing the manufacturing license under Part 52 that would just -- that would be needed just to cover the physical manufacturing of the utilization facility.

In order to fuel that reactor module, it would need a Part 70 license. If you want to do

testing of that module, then you would need to apply for either under Part 50 a construction permit/operating license or a combined license under Part 52.

MS. CUBBAGE: Just one clarification. Under the current status quo, to load fuel you would actually need an operating license or a combined license. But we are offering options to the Commission where they could do it with the Part 70 license and not need the operating license or combined license.

MEMBER MARCH-LEUBA: This is Jose. Once the reactor fuel is loaded, did you need an operating license in the truck when it's moving? Because the fuel is loaded.

MS. CUBBAGE: Because part of the paper is to establish that, you know, asking the Commission if features to preclude criticality are installed, then the reactor would meet "not in operation" and would not need an operating license that would cover the transport. But it would be going to an entity that has either a combined license or a construction permit on the receiving end.

MEMBER MARCH-LEUBA: So before you can remove those additional reactivity controls, you need

to have a license. But the only things you have --

MS. CUBBAGE: The license, again -- yeah, a license and authorization to operate by the Commission is a proposal in the paper. So you will see that voting matter one explains all of that, the options for the Commission.

MR. KENNEDY: Okay. Thank you for the comments. So one thing I want to just mention before we move on is that this paper does not address matters related to nuclear security, emergency preparedness, fitness for duty, access authorization related to the factory, the deployment site, the decommissioning facility, refurbishment, the fueling facility or transportation.

So those topics we would evaluate and consider the need for further Commission engagement. And a big driver for how we would evaluate those considerations is the direction that we are given on this paper.

So if fuel could be loaded in a factory with a manufacturing license and a Part 70 license, we might have a different approach than if an operating license were required.

So this paper, again, asks for a few -- it's a policy direction that are really fundamental to

starting the process of really addressing all of the issues that are related to the deployment of these types of reactors.

Next slide, please. Okay. So here we will get into features to preclude criticality. And so staff has developed an approach for features to preclude criticality for Commission consideration.

So I will start by saying the point of the features to preclude criticality is that they would make a utilization facility incapable of sustaining a chain reaction. So that's not just saying that it has all of its normal control rods inserted. It would be to say that even if its normal systems were operated, it would still be incapable of sustaining a nuclear chain reaction.

VICE CHAIR KIRCHNER: Would it help, Duke, to use the word additional features? Each reactor is designed -- this is Walt Kirchner. Each reactor you design normally to be able to end the conditions of cold shutdown.

Usually if you're following the general design criteria, you have two diverse ways to do that. That's just part of good design approaches and such. And I think that precedent is firmly established.

Here we are talking about additional

features. I mean, I'm quibbling a little bit with the language, but maybe it will show up better in your guidance that what you are talking about now is something that goes beyond, just as you verbally said, beyond the normal control mechanisms that you would design into a reactor to operate it under normal circumstances.

This is something that goes well beyond that and probably includes actually physically -- I haven't through a succinct way to say it, but physical mechanisms to prevent controlled drum rotation, physical mechanisms to prevent inadvertent rod withdrawal, additional control mechanisms that would have to compensate with say transport considerations like water ingress or whatever the reactor design is.

I don't know a very generic way to say this. But clearly what you're talking about, and you just said verbally, is something that goes way and well beyond that can be verified that there is substantial shutdown margin in the system when it's actually put together in the factory and moved anywhere, particularly when it's moved.

MR. KENNEDY: Okay. Well, thank you for this --

MEMBER HALNON: Can I chime in? This is

Greg Halnon. While I was thinking about what you're saying. And actually I kind of like features that preclude criticality. There are kind of three separate types of features we're talking about.

There are features that control reactivity. There are features that maintain a reactor shutdown. And those are operating features.

The transportation feature is one that precludes criticality. I would not want to mix those together in the same sentence. So this is more in my mind a transportation issue.

And, you know, if you have solid features that preclude criticality, then to me that makes the reactor, even though you label it a reactor, it's really just a transportation cask at that point in my mind. And maybe I'm wrong and maybe the staff can straighten me out. But that's kind of the way I'm looking at it. So I kind of like keeping them separate out of the same sentence.

MR. KENNEDY: Well, thank you for the comment. This is Duke Kennedy. We do mention in the paper that with features to preclude criticality installed that fuel loaded into the reactor would be similar to fuel loaded in a storage container or a storage location.

However, because the module or the reactor will actually be a utilization facility constructed to eventually be a utilization facility, we chose to take the approach that we would consider this to be a utilization facility at all times so that it remains the utilization facility when it's manufactured, when it's possessed in the factory, when it's loaded with fuel, operated for testing, transported to the deployment site and so on. So it always remains utilization facility.

There are other approaches that could be considered where with these features in place it would not be considered a utilization facility, but that's not the approach that we chose to pursue as favored.

MEMBER HALNON: If you evaluate when the features preclude criticality are installed, it's a transportation cask. If you remove those features, it turned into a reactor utilization facility. Putting them back in, of course, you would have to deal with the spent fuel or irradiated fuel. But, again, it turns into now a spent fuel cask transportation cask.

So it seems to me that pathway should be evaluated for the simplicity in how it works through the regulations. And maybe you did, and this is the best way to go. But I just wanted to make that point

that when I was reading through the paper, that seemed like a clean path. And maybe some behind the scenes stuff makes it unclean, but it seemed clean to me. But thanks. You can move on. Unless you have a specific comment on what I said, I'm good.

MS. CUBBAGE: This is Amy Cubbage. Those are really good observations. And we definitely put a lot of through into this. And one of the bounds that we are trying to stay within in this paper is not needing rulemaking, not needing any changes to legislation. So looking to do what we can do near-term under the current regulations, minimal exemptions could be considered. But ultimately not trying to build a new framework, but to support near-term deployment.

And then over on the Part 53 side, things may be different over there where there is rulemaking in play. So thanks for your comments.

MEMBER HALNON: Yes, thanks, Amy. But, you know, my point is, I guess now we have time now. Once you start getting deployment, you're not going to really have the time. Maybe it's a parallel path that we look at.

MS. CUBBAGE: Yes. Yes, it's a parallel path. We are trying to come up with things that we

could do today that don't need rulemaking, and then, the parallel path of Part 53 is in play, where the staff has proposed that The Federal Register notice, should it be approved by the Commission, would have questions for the public on these matters. So, there is an opportunity for stakeholders to comment on that front. And then, you know, maybe rulemaking could be done on some of these things.

MEMBER HALNON: Okay. I just hate to have establish a position that's not maybe ideal, but it is near-term, and then, we sit on it for five, six, seven years waiting for someone to deploy. And we could have been doing a much cleaner path that whole time. So, that's the point I was trying to make.

But thanks.

MEMBER ROBERTS: Yes, this is Tom Roberts.

I was looking for a little clarification on what the term "preclude criticality" means. Is that a .95 k-effective, like the existing Part 72 rules? Is it some larger margin? And I think it's, typically, about first-of-a-kind reactors where you may not have the kind of quality benchmark data on the particular configuration with the Halo or some exotic reflector or modern materials, or something of that like? So, what degree of margin are you thinking when

you use the term "preclude criticality"?

MR. KENNEDY: I think this is something that we would want to engage more with stakeholders on to really understand, based on different designs, what types of features could be developed; how they would function. And so, the paper doesn't set any kind of a limit, and that's something I think we would need to explore further. But it would preclude criticality by some margin, and that would be something that we would need to develop.

VICE CHAIR KIRCHNER: Would you also be thinking double contingency? And I bring that up because Greg just mentioned something. You know, you could rely in the transfer mode on the cask to provide neutron absorbers, and such, to ensure criticality. But if the module for whatever accident transport scenario or moving situation evolves where you don't have that absorber, do you have a second backup means to ensure you're still below .95? I'll just say .95, but --

MR. LYNCH: So, one clarification with this is that the Part 70 requirements for criticality control would be still applicable. So, double contingency principle would be applied. What we're looking at here are specific features to preclude

criticality that would be required on the reactor module itself under the Part 50 or 52 license.

MS. CUBBAGE: Yes. And this is Amy Cubbage.

I think a key point in the first sub-bullet is making it incapable of sustaining a reaction. So, we're, basically, needing to take something that's designed to be a reactor and temporarily make it incapable of being a reactor in order to say it's not a reactor in operation. Because if it's a reactor in operation, then, you know, you would be back to option 1A, where to load fuel, you would need a license.

MEMBER ROBERTS: So, what I think I'm hearing is, if there's a principle being incapable of sustaining a nuclear k-reaction, but there's no real use case yet or going through an actual example of what it might take to get you there?

MS. CUBBAGE: Right. So, if this option were to be approved by the Commission, we're committing that we would engage with stakeholders to develop guidance. And we need to be thinking technology-inclusive. And so, that's where we're headed.

MEMBER ROBERTS: All right. And it might

be beyond existing requirements in Part 72 or Part 70?

MS. CUBBAGE: Yes.

MEMBER ROBERTS: Or it might exist with them? But you haven't figured that out yet. Okay.

Thank you.

MS. CUBBAGE: Right. Right. Some features could be used to fulfill obligations for this requirement and, also, Part 70 and 71. They don't necessarily have to be mutually-exclusive.

CHAIR REMPE: As you explore that, if they did operational testing at the facility, I would have more confidence on how much margin would be required than if they didn't. Because I have lived a lot of years in Idaho, where they tried to start up EBR-I and it couldn't go critical. And they had to ship it back to Chicago, and then, try again.

But, anyway, yes, I just think that that is something that would give me more confidence. Fuel loading/misloadings occur. And so, anyway, operational testing could enhance safety, as well as improve economics.

VICE CHAIR KIRCHNER: But it could complicate life for all if you actually build up any fission product inventory.

Now, for the purposes of this discussion,

it's really an approach to criticality that you would want it over a novel design. So that you were sure that, as Tom mentioned, you know, if there were a unique or novel feature in the design, you are still confident you went 95 or less, you know. But that part you could do with criticality, approach to criticality. You don't need to operate.

CHAIR REMPE: You're right. I meant (audio interference).

MS. CUBBAGE: The other piece we need to remember is that the manufacturing license would require final design information, similar scope and level of detail to a design certification. So, we would have required that the applicant met 50.43(e), which would require that the safety features of the reactor had been demonstrated; all methods that they're using would have been appropriately validated with test data, as needed. So, you know, it could be that, before they even get to this point of manufacturing a reactor and trying to load fuel, they may have had to have built an initial test facility to be able to get the data they needed to support the manufacturing license.

MEMBER MARCH-LEUBA: And we keep bringing up the term "prototype."

MS. CUBBAGE: Right. Yes, it's part of 50.43(e) as well. That's an option.

MEMBER ROBERTS: And, Joy, I think you were making my point, that if you transported a completed reactor that's a first-of-a-kind reactor without having done some criticality testing at the facility, or, yes, some sort of critical test, then how do you know that it's incapable of withstanding a nuclear chain reaction in transit? And that doesn't seem like an obvious -- you know, it doesn't seem like it has an obvious answer. You have a lot of margin, I would think. And coming through an average margin, that is, and how you convince yourself you have it, doesn't seem trivial.

MR. KENNEDY: Okay. Thank you for the discussion.

So, I just want to hit on a couple more points on this slide before we move on.

So, I just want to emphasize that the features to preclude criticality would really perform the regulatory function of the staff being able to consider that the reactor is not in operation and loaded with fuel. So, this would be a change in the Commission's historic position that fuel loading is part of operation.

So, what that would allow is that reactors that were loaded with fuel would not be considered to be in operation and could be transported under the current regulatory framework for transportation; whereas, the current regulatory framework for transportation is not set up for reactors that are in operation.

So, if reactors were -- if the use of features to preclude criticality are not allowed, then there would need to be some other regulatory changes to allow these reactors to be shipped from a factory to a deployment site when loaded with fuel.

So, the other thing I wanted to mention was that the removal of the features to preclude criticality could function as a milestone, similar to initial loading of fuel under the current regulatory framework. So, there are some provisions in the Atomic Energy Act and some regulations that use initial loading of fuel into the reactor as a milestone. And so, the removal of those features to preclude criticality would function in a similar way to accomplish the underlying purpose of those provisions of law and those regulations.

MEMBER PETTI: So, I think, Members, this is a key issue that we have to cover. This is sort of

seminal to the whole approach. I mean, I think it's a pretty good metric to substitute, but I think it's something we want to talk --

VICE CHAIR KIRCHNER: I think you're right, Dave. It's really key to their -- one of the options and approaches they have.

Of course, what the designers are going to have to think carefully about is -- and let me just say that you're putting handcuffs on the reactor, or however you want to, rhetorically, describe what this requires, to have to think carefully now about this, because you've got to pick it up and put it in a shipping container, or something. You really have to just, if that's the precedent and that's the milestone, then you can't take the handcuffs off until you get there and you have a COL, or whatever, at the actual destination of site.

But, actually, now that I think about it, for example, it couldn't be the shipping container that provides it. It's going to have to be something in addition that's integral to the actual module or the reactor design.

MS. CUBBAGE: Exactly. Because you're going to remain with the reactor from whatever it's shipped in, if it's shipped in something, and then,

you're going to install at the site. And you have to be able to do all that with these features still installed because you can't remove them until you get authorization to operate from the Commission, either the 52.103(g) finding for a COL or the issuance of the license for an OL.

MEMBER MARCH-LEUBA: Yeah, but the engineering features to handcuff the reactor are not difficult. I mean, your control rods are seen and you will screw them in. So, you need to remove it. I mean, it's not difficult to do.

So, conceptually, we have to agree that, as long as those --

MEMBER PETTI: Be careful. Yes, you're right for making sure it doesn't go critical when you're at each facility or the manufacturing or before you start. Now, transportation, even on the impact on the transportation legs, I mean, you have to have more shutdown margin than you do just that --

MEMBER MARCH-LEUBA: Yeah.

MEMBER PETTI: And that's a new constraint.

MEMBER MARCH-LEUBA: We know how to calculate those things. You don't need to dump your reactor in the bottom of a lake before you're sure of

it. That's not difficult to do.

MEMBER PETTI: There are lots of constraints on these types of systems that don't make them -- that make them more than just simple.

MEMBER MARCH-LEUBA: But, conceptually, where we have to agree is that, as long as these, call it, handcuffs are in place, this is not a reactor; it's a shipping container. And putting the reactor into operation includes removing these devices, so that they can become critical.

Conceptually, think of it as there are some shims that prevent the control rods to go down. Then, the reactor can never go critical.

CHAIR REMPE: Be careful. I took Amy's comment to heart. They looked at saying it's not a reactor during transportation, and they said this would require a rulemaking.

You guys carefully evaluated this and said this is the most efficient way to proceed in the near-term. And I think that is something that I need to have confidence in, and I'm seeing all the heads shaking up, yes, we looked at it carefully; this can't work easily.

MR. KENNEDY: Yea, and I agree completely with these comments. The decision on features that

preclude criticality and what they would accomplish is fundamental to this paper. I believe we say so in the paper. And the other options that we're presenting, and how we're going to treat other parts of the deployment model, really hinge on what the decision is on this topic.

MEMBER BIER: One other question which is kind of related to Jose's point of how sure do you have to be is, presumably, the features, whatever they are, have to designed to withstand transportation accidents, right? There could be shocks along the way.

MR. SCHULTZ: Amy, this is Steve Schultz.

You mentioned earlier that you want to proceed in such a fashion that the approach chosen would be technology-neutral, or technology-inclusive. As you've dealt with the stakeholders, we know there's a number of different types of designs that have been proposed for the microreactor. Are you getting the feeling from the stakeholders that this is achievable?

MS. CUBBAGE: We actually haven't had any detailed conversations, frankly, on this matter. We did get stakeholder feedback that they want to have engagement as we develop the guidance, and that they were interested in performance-based, high-level, not

prescriptive requirements, because the varying nature of the designs.

MR. SCHULTZ: Okay. That makes sense. Thank you.

MS. CUBBAGE: Yes.

MR. KENNEDY: Okay. Can we move to the next slide?

Okay. So, the next topic that we'll cover is the regulatory approaches for fuel loading at a factory.

So, we have two approaches. The first approach is what I would say is, more or less, the status quo approach, where the factory owner or the factory operator would need to have a Part 50 facility operating license or a Part 52 combined operating license in order to load fuel into the reactor. This would be allowed under the current regulatory framework. This is not a matter for a policy decision. This is just how it would work now. If you want to load fuel, that's operation. You need a license to operate, and it can be done that way.

Of course, along with obtaining an operating license or a combined operating license, our environmental review, a review by the ACRS, hearings, a lot of steps that are involved in issuing an

operating license or a combined operating license.

So, the second option is what we've already discussed. It is that the factory operator would have a manufacturing license that would authorize the manufacture and the possession of the reactor, and then, a Part 70 license that would authorize possession and handling of special nuclear material in the form of the fuel. And the reactor would be in an acceptable location for them to put that fuel under the Part 70 license.

Move to the next slide.

Okay. So, we'll focus on the second option now and the Part 70 license. So, the first bullet here, you can see it says that the license application for the Part 70 license would include criticality safety controls required by Part 70 for factory operations. So, I just don't want you to be confused when we say, "factory operations" here. We don't mean operating the reactor. We mean the activities going on at the factory related to loading the fuel and possessing the fuel.

I apologize that that was a poor word choice, but I just think it's critical to make the distinction that we don't mean operation of the reactor there.

Okay. So, the Part 70 application, as we've discussed a little bit, and the Part 70 license include requirements for criticality controls. And so, again, the features to preclude criticality are not the same as the Part 70 criticality controls. Part 70 requires things more than just subcriticality. There's also monitoring and procedures. And so, all of those need to be in place still, not just the features to preclude criticality.

Features to preclude criticality have the function of making the reactor incapable of sustaining a chain reaction, but Part 70 requires more than that, more proper criticality safety. Okay.

CHAIR REMPE: So, I have a question about decommissioning funding and when the need to provide assurance that you have funding for decommissioning would become a concern for a manufacturing facility. I'm thinking about, historically, in the U.S. where there's government funding and projects get cancelled, and this machine, this factory that's going to be producing 100 modules at a time, suddenly, finds half of their customers are gone and there's no place to ship. And do they have to have funding to guarantee that, if there's no customer, they can D&D all of these reactors?

MR. KENNEDY: Yes. So, just to be careful with words, so if the reactors are operated for testing at a factory --

CHAIR REMPE: Subcritical testing?

MR. KENNEDY: Yes, if they're operated, they need to have decommissioning funding assurance.

So, in the paper, I believe there's a footnote that mentions that there may be ways that we need to control the decommissioning funding assurance, such that, if a reactor is fabricated, tested, shipped to the deployment site, and no longer under the license, that that decommissioning funding is going to be transferred over to the next reactor that's operated there.

So, there are ways that we would need to consider the particular operational scenario at the factory; how many fueled reactors can be there; how many reactors can have been tested and waiting on a shelf to be purchased. So, there are, again, a lot of intricacies in how the deployment actually works as to how we would do that. But, certainly, a reactor that has an operating license has to have decommissioning funding assurance.

CHAIR REMPE: If a facility that has a construction permit says, "Okay, I'd like to order one

from the manufacturing licensed factory," and I've already realized I'm going to have to have D&D funding, even though I don't have the module there yet, could they cover the decommissioning funding for the manufacturer? And if they were a savvy, you know, facility, could they say, "I'm only going to make modules for which I have a customer that has -- that they're going to cover?

And is there a way that -- and this is not a safety issue; more, it's a financial. But I'm just trying to think of "What if?" scenarios and what happens sometimes when we have government routine cancels. And could they do something like that?

MR. KENNEDY: So, I don't know the exact details of how the different decommissioning funding arrangements would work. Also, considering whether the factory licensee might be the one who's actually operating it at the deployment site. So, maybe it's the same entity that has the money.

Or there are just many, many potential iterations. And I think what we've encouraged potential applicants in many scenarios is to engage with us in pre-application discussions if there are interesting situations like this.

And so, this is another one where we don't

really have enough information yet from developers about how they plan to actually sequence operational testing, or if they are going to be the deployment site licensees as well, to be able to say, "This is exactly how it works." So, there are just so many "What if?" scenarios; it's almost like --

CHAIR REMPE: So, your job is just to say somebody's got to pay to decommission this?

MR. KENNEDY: Yes.

CHAIR REMPE: And they can figure out? Okay. That sounds --

MS. CUBBAGE: Yes, the other piece, just to make it clear, you know, on this slide here where we're talking about fuel, just loading fuel, and we're not into that regime, but if you get to the point of you're going to test a reactor in the factory, I'd be very surprised if a developer wanted to test, and then, put a reactor on the shelf. I think if they're testing a reactor, it's probably getting ready to go ship out the door to a site that has a construction permit or a combined license in hand.

So, some of those scenarios you're talking about, Dr. Rempe, could definitely come into play.

CHAIR REMPE: I just was curious about it. Because I'm getting to have a devious mind like Jose,

where you think of "What if's?" and how you can get it, you know -- thank you.

MEMBER HALNON: This is Greg.

Just real quick on decommissioning -- and I know you're going to probably talk a little bit more later -- but there's decommissioning the reactor and there's decommissioning the site. Are you guys looking at those two separately or as one entity in this case?

MS. CUBBAGE: Probably best to hold that question until we get to that slide --

MEMBER HALNON: Okay. That's fine.

MS. CUBBAGE: -- if that's okay.

MEMBER HALNON: I just didn't know if we were going to get to it later on.

Thanks.

MR. KENNEDY: Okay. I think the final thing that I want to mention on this slide is that one of the assumptions in this paper is, also, that the only fuel-cycle-related activity that would be happening at the factory is possession and loading of special nuclear material. So, that type of activity, typically, would not fall under the requirements in Subpart (h) of 10 CFR Part 70, which relates to additional activities like fuel manufacture or

plutonium processing.

So, if there were other activities going on at the same factory under the same Part 70 license, there may be some additional requirements to what we put on the screen here. But we're focused in this paper just on the factory that receives fabricated fuel, and then, loads it into the reactor.

MEMBER PETTI: So, just again to be clear on this slide, this really fits only under the Option B here, right?

MR. KENNEDY: Yes.

MEMBER PETTI: You're, basically, saying I don't need a Part 50 or 52 license; I can just do Part 70? If I have that premise of including criticality, it's considered as an acceptable definition on the reactors?

MR. KENNEDY: Yes. Thank you for that clarification. That's my oversight on not specifying --

MEMBER PETTI: There are so many caps here that, if you just read the slide without looking at the one before, you can easily get lost.

MR. KENNEDY: Yes. Thank you for the clarification.

Okay. Next slide, please.

In the next slides, we'll talk about actually operating the reactor for testing at the factory.

I think we've made it clear that, if you're going to operate a reactor, you need to have a license, whether it's a Part 50 license or a Part 52 license. And even under operation for testing, it would be a power reactor.

So, although we talk about non-power reactor licensing in the paper, we're not saying that one of these reactors should receive a license, say, under Section 104(c) of the Atomic Energy Act, the research and development facilities. So, we're not considering that.

These are commercial reactors that are power reactors, the design and the manufacturing licenses for a power reactor. The reactor will eventually be operated as a power reactor at the deployment site.

So, for testing in the factory, what we're saying in the paper is that you would need to have a combined license or a facility operating license.

MEMBER MARCH-LEUBA: And do you envision a license for the facility or for each core?

MR. KENNEDY: So --

MEMBER MARCH-LEUBA: Because this is a reactor that you're going to ship somewhere else. But, in an operating reactor, I replace the fuel every 18 months if I have a new core, but I don't get a new license. So, I could have a -- in my facility, I could have a room where I bring new reactors and that becomes my facility. Do you know what I'm talking about?

MR. KENNEDY: I do. I guess I think that's a slightly later slide, but I'll address it now.

So, there was a Commission paper in 2011 that was for multi-module facilities. And it was focused mostly on small modular reactors and a facility where over time reactors would be added to a site, and they may share some common safety systems or structures.

So, we looked at that paper for different potential strategies for licensing multi-module sites. But the scenario here is different because you add a reactor; you take a reactor away, but you keep some of the same systems.

And so, it becomes more complicated as to how do those systems go from one reactor to the next, because each reactor has to have its own license.

MEMBER MARCH-LEUBA: Considering, I mean, if I was designing it, I would have a room that is maybe a containment where I put my reactor, my new reactor, to test it. Take it away. Put a new one. So, I mean, the configuration is exactly the same, right?

MR. KENNEDY: Yes. So, this is a potential consideration, not only at the factory, but also at the deployment site itself, where there may be some structures, like power conversion equipment in a building that lasts for the entire life of having reactors operating at the deployment site. But, over the course of that lifetime, five new reactors come and go.

MEMBER MARCH-LEUBA: So, you're not calling it a new core; you're calling it a new reactor?

MR. KENNEDY: It's a new utilization facility, right, that requires its own license. So, we've outlined a couple of different strategies in the paper. It's discussed in the enclosure.

We did look at the feasibility of options related to other approaches, like a 50.59-style approach for changes, testing experiments where --

MEMBER MARCH-LEUBA: So, that's a mobile -

-

MR. KENNEDY: I mean, we looked at options all the way up to that. And what we ended up with in this paper, because it's focused on what we can do under the current regulatory framework -- and we covered this topic in the enclosure, which is also just information topics -- we came back to this point that you would need, under the current regulatory framework, a separate license for each reactor. And you would have to account for those --

MEMBER MARCH-LEUBA: Even though the license would contain exactly the same information as before, because you haven't changed anything? And you just need a new signature.

MR. KENNEDY: So, with the finality provisions in the manufacturing license, the final design information, the license for the first reactor would have reviewed those common structures. And so, a lot of those approvals could be leveraged for approval of the next one.

So, I'm not going to say it's just a signature, but there's certainly a lot of work/analysis that would be done that would be applicable to a reactor of identical design.

So, this is an area --

MS. CUBBAGE: Yes, and to add to that, Duke, you know, for the deployment site and for the factory, for multiple reactors, we could issue, for example, all together all the construction permits that you need at one time or all of the combined licenses you need all upfront. We wouldn't have to come back later and do them separately. They could be all combined into one hearing.

CHAIR REMPE: But the cost is per megawatt. So, you would, if they're going to have 10 modules at the site over its lifetime, you would charge them 10 times 50 megawatts for the license, right?

MS. CUBBAGE: Now, are you talking about our annual fees?

CHAIR REMPE: No. If someone comes in to have a new reactor licensed, you charge them for a reactor, right --

MS. CUBBAGE: We charge --

CHAIR REMPE: -- per megawatt?

MS. CUBBAGE: No, no. We charge --

CHAIR REMPE: For the total megawatt of the facility, is what I'm trying to say when I say, "per megawatt."

MS. CUBBAGE: Yes, yes. So, we charge an

hourly fee for the review and for the issuance of the license. We charge an annual fee for operating reactors that have begun commercial operation.

So, for each reactor, we would charge the annual fee at such time that they were ready to deploy it and hit commercial operation, and then, we would stop charging the annual fee for that reactor when it ceased to be operating.

CHAIR REMPE: Okay. I was confused. Thank you.

MS. CUBBAGE: No, no, no worries. It is confusing.

MEMBER MARTIN: This is Member Martin. I have a question probably on power versus non-power.

I would imagine, for a number of microreactor designers, they're just thinking, "I want a criticality test, a physics test." I'm not going to strap in, you know, a primary coolant system, a power system. I just want to, you know, put the fuel package together in more like a spent fuel ask and possibly do some testing.

At some point, I would think if you do it enough times, you wouldn't have to do any physics testing. You might do it five times --

MEMBER PETTI: You would think so. You

would think so.

MEMBER MARTIN: You know, you feel pretty good about it, and then, you would be done. And why can't you call that a test reactor for a few times, and then, they're just packaging? That's still part of your charter here.

But they don't want our reactor. You just want a little package. And I don't know what's the difference between a test reactor for physics testing and what microreactor designers would be wanting here, et cetera.

They're not going to be attaching coolant systems. They're not going to be attaching the turbine island. It's pretty simple.

MEMBER PETTI: Well, I mean, I was thinking the same thing. Certainly, when it's at the site, it's a power reactor. But when it's just testing, if they're going to do subcritical or some low-power, kilowatt-level testing, it seems like the power reactor license is overly burdensome for what's there.

And as I understood it when I read the white paper, Part 50, you may be able to do that. But, under 52, you don't have that flexibility because 52 was really only written for power reactors.

So, you pick your poison. Do you want two-step licensing and everything a microreactor or do you go one step and you've got the burden of the power reactor license? And it seems like what you really want, maybe maximum flexibility, is something where you could go one step with a utilization or something.

MS. CUBBAGE: Yes, so this is Amy Cubbage.

I think the issue is that it's the same machine that is eventually going to be operated as a power reactor, and it was too difficult to say this same machine is one thing over here and it's something else over here. So, we're consistently applying that it is a power reactor. However, for the purposes of the testing in the factory under option 3B, we are including an option for the Commission that they could use the non-power reactor standards --

MR. LYNCH: Yeah.

MS. CUBBAGE: -- even though it's a power reactor.

MR. LYNCH: Yeah. Agree. Agree completely with the observations that the full power reactor regulatory requirements could be over-labored in some for a microreactor that is doing factory testing. And that's the conclusion that we reached in the paper.

And as Amy said, based on our understanding of how implementation of the current regulatory framework and applicable laws are, we can't switch back and forth between the same reactor that is, ultimately, going to be operated as a power reactor at the deployment site and call it a testing facility or a research reactor, which would be licensed under Section 104(c) of the Atomic Energy Act at the site.

So, there are limitations under the current Atomic Energy Act framework and our regulations. So, for the purposes of this paper, we were looking for the most straightforward strategies within the existing frameworks we have without proposing any legislative or regulatory changes.

But we do believe that using the regulatory tools that we have, such as exemptions, license conditions, we can scale the requirements that are necessary for testing at the facility and apply regulatory requirements that are more similar in the expectations to what is applied for the non-power reactors. So, we think we can get to that ultimate goal of reducing the burden on these facilities, so that it's commensurate with the risk and safety of the facilities.

MEMBER PETTI: So, in that case, then, does the license get transferred from the facility where it's manufactured? Or is it two separate licenses? So, does it get terminated? Because there's so much complexity of it.

MS. CUBBAGE: So, two separate licenses.

MEMBER PETTI: Two separate licenses? Okay.

MS. CUBBAGE: Yeah. It could be the same entity, but it's a different location, is one of the key points.

MEMBER PETTI: Thank you.

MR. KENNEDY: Yes, I think you mentioned, also, pick your poison, which one option is to go through the power reactor licensing process according to the power reactor regulations for operational testing at the factory. And that can provide some synergy with the licensing at the deployment site. So, there's potential there, because they would be using the same regulatory framework at both places.

For operational testing at the factory under the non-power reactor or reviewed according to the non-power reactor regulations, you might not get all of those same benefits, but you might not have to have as many exemptions or demonstrate the same level

of operational programs at the factory if you're only operating at 100 watts or a kilowatt, or whatever.

So, it's there is definitely a tradeoff that's highly dependent on the actual details of the operational testing program.

MEMBER HALNON: Yes, this is Greg.

It's also dependent --

VICE CHAIR KIRCHNER: Go ahead, Greg.

MEMBER HALNON: Well, I was just going to say, it's also dependent on -- most will probably have a prototype testing for the nuclear portion of this thing. You may be testing hydraulics or other things in the factory, but, you know, the developers will take the path of least resistance, both technically and regulatory-wise. And if it's better to do a prototype testing of nuclear capabilities outside of the factory, and then, just test hydraulics, I mean, that's one way to do it.

So, my guess is that the total deployment strategy will include the path of least resistance relative to the regulatory and technical aspects of it.

VICE CHAIR KIRCHNER: I was going to say the same thing, Greg. I mean, you know, it's not all incumbent on the NRC to solve these problems. The

designer has to think carefully about their deployment strategy. And I will just give you one example.

If you have relatively inert coolants, it would be relatively easy in the factory to fill up the system and hydro it, for example. But if you are using salts or sodiums or other exotic coolants, I don't think you want to do that, and then, face the transport problems that come with it.

So, I mean, each of the different technologies are going to have to take a look at this and sort out what is the best path forward, both in schedule space and cost, to come up with a deployment strategy. It's asking a lot for the NRC to have to solve that for everyone.

MS. CUBBAGE: Yes, this is Amy Cubbage. I'd like to also chime in.

I want to make sure we're not confusing things like demonstration testing or prototype testing with pre-operational testing. So, we're not talking about first-of-a-kind testing that's needed to support the safety conclusions that we would have already made in the manufacturing license. So, the manufacturing license would be approving the design, just like we would approve a design as part of a design certification. We're going to have to have all of the

appropriate testing already be done to demonstrate the safety of the facility and any novel safety features and fuel, et cetera. So, we would have already had that conversation.

Now, we're to the point of mass producing these things, and whether or not you want to do part of your startup and pre-op testing at the factory or whether you want to defer it all to the deployment site.

So, some developers have argued that there are safety benefits to doing some of that testing in the factory because they can have specialized personnel and equipment in the factory to accomplish that, and then, not run the risk of you've transported this module the site; there's a problem. We need to ship it back to the factory. So, that's what we're talking about here.

Does that help or confuse matters?

MEMBER PETTI: Yes. No, that helps. Thank you.

MR. KENNEDY: Okay, thanks.

So, move to the next slide, please.

So, we've already discussed these options, but just to be clear that our first approach would be to use a power reactor operating license or combined

license, issued under Part 50 or Part 52, that would limit the operation to that needed for operational testing. Again, this is, more or less, the status quo. This is an option that's open to developers at this point.

The additional approach to use the non-power reactor regulatory framework is a new approach that we're proposing here. As mentioned, the choice between these two frameworks, if the non-power reactor approach were approved, would be up to the developer, and to what fit best with their deployment model.

So, the goal here is to offer an alternate approach that may be better suited to certain deployment models and certain operational testing programs.

VICE CHAIR KIRCHNER: Have you thought through what limits would govern option 3B, fission product inventory or what? I mean, at some point, you would have to say, okay, there's a hazard here, and it's contained within something that now we're getting back to the definition and the power levels, and so on, for microreactors, but it's kind of understood with the non-power reactors that you're going to have a large fission product inventory. So, how large is that inventory?

Or someone earlier -- it may have been Joy -- mentioned, you know, is it going to be based on an actual accident happens at the facility, such that the dose is below some guideline of 1 rem, PAG, or something?

MR. KENNEDY: Once again, the analysis of the safety analysis and the safety evaluation for operation of the factory will account for what's been approved in the manufacturing license. And so, one thing to look at is, in setting the actual operating limits and conditions for the factory, and what operational programs are needed to support those, things like what power level do they want to go to as compared to full power operation; are they willing to limit how many hours they can operate, so that we can develop an actual maximum source term for the operation in the factory?

So, that's how --

VICE CHAIR KIRCHNER: Or are they willing to build a containment at the fabrication facility for the operational testing, which is, seriously, it's an alternative; they could do that.

So, it's a little murky ground here, because is it going to be based on fission product inventory or is it going to be based on hazard

analysis?

MR. LYNCH: Yeah, I think, Walt, this also plays into how we, ultimately, define what constitutes a microreactor; it may play into this. I would expect, when it comes to fission product inventory, that it should be relatively low compared to when the reactor is at its ultimate deployment site. Yes, I would, for the most part, assume this is fresh fuel coming in that will have very short duration use to do this testing at low powers. So, I would expect that fission product inventory would be relatively low.

And to Duke's point, you know, we do need to have some further engagement with developers to understand what is the full nature and scope of testing that will be done at these facilities, so that we can understand what hazards could be expected and how best to apply the appropriate regulatory requirements to protect both workers at the facility and the public.

MS. CUBBAGE: We should also be clear that the non-power reactor framework is protective of public health and safety and is scalable, based on, you know, the hazards posed by the technology.

And, Steve, correct me if I'm wrong, but there's no upper limit on a testing facility, is that

right?

MR. LYNCH: That is correct.

MEMBER MARCH-LEUBA: Yeah, but for this thing to work, you should be able to ship your reactor back to a facility or a decommissioning facility after it has operated for 10 years at full power. So, I mean, I wouldn't be worrying that much about a few hours of operation at 100 watts.

VICE CHAIR KIRCHNER: No, but you have to know what's coming next in the presentation is, hey, after you do all this, you have to ship it.

MEMBER MARCH-LEUBA: Yeah.

VICE CHAIR KIRCHNER: Well, guess what? Now, you have a radioactive hazard, a source.

MEMBER MARCH-LEUBA: If you can do that instead -- you can do the previous one.

VICE CHAIR KIRCHNER: So, all of a sudden, you know, with the designers, I don't think that the NRC has to solve this as much as -- I mean, the NRC, there is a good framework in place, but the designer is going to have to make some serious tradeoffs here. Because if you run up your fission product inventory, you've got to shield the shipment.

MEMBER MARCH-LEUBA: You operate it for 10 years at full power. You have an inventory.

VICE CHAIR KIRCHNER: Well, you have a bigger problem coming back --

MEMBER MARCH-LEUBA: Yeah.

VICE CHAIR KIRCHNER: -- but it may not be the same shipping container.

MEMBER MARCH-LEUBA: It may be more expensive that you have to design, too, but --

VICE CHAIR KIRCHNER: I think we defeat the fuel criticality, the duration survey, but anyway --

CHAIR REMPE: Is there a blanket number for the total, the equivalent, the dose equivalent value in Part 70 for what a facility can release?

MS. CUBBAGE: So, on Part 70, we would just be talking about fuel load, not operation of the reactor. So, I think it's a different concept.

CHAIR REMPE: Is there a dose limit? They have to always -- any sort of accident has to be less than 1 rem?

MR. LYNCH: So, we may need to follow up with you on this, but I know, when you get into higher hazard facilities in Part 70, particularly where Subpart (h) would apply, that's where you have dose limits analyzed to 25 rem, similar to the power reactors, but there are differences in the assumptions

in terms of preventive and mitigative features in the facility.

CHAIR REMPE: And we do have staff --

VICE CHAIR KIRCHNER: The dose limits are the same for a manufacturing license.

CHAIR REMPE: Okay. Because that's what I'm kind of going by. I think that you may need something different for the microreactors if you just go with what it is for the Part 70, if they allow for higher hazards.

MR. LYNCH: Yeah. So, yeah, but --

MS. CUBBAGE: Steve, we do have staff on the line --

MR. LYNCH: Go ahead, Amy.

MS. CUBBAGE: -- that are our Part 70 experts. I don't want to stumble over this. So, could someone please chime in?

MR. LYNCH: We have a staff member in the room approaching the microphone.

MS. CUBBAGE: Great. Great. Thank you.

MR. DOWNS: So, I was only half-listening back there to the conversation because it was very difficult to hear in the back of the room with the conversation going on. Could you kind of just focus me in on what the question was?

CHAIR REMPE: Okay. During the other discussion, there was a comment made that they might be able to just use the Part 70 limits as something that would bound what the microreactor could be. And is there a limit for an accident? And I'm hearing from another member it's still 25 rem total dose equivalent.

VICE CHAIR KIRCHNER: It's 52. Part 52 is the manufacturing license.

CHAIR REMPE: Right, but you said --

VICE CHAIR KIRCHNER: Part 70 is the possession license.

MR. DOWNS: Exactly.

CHAIR REMPE: Right.

MR. DOWNS: Exactly.

CHAIR REMPE: Can you introduce yourself?

MR. DOWNS: I will, absolutely. Absolutely. I just wanted to get that.

Okay. So, my name is James Downs. I'm a Senior Project Manager with the Office of Nuclear Material Safety and Safeguards. I'm the Division of Fuel Manufacturing. I'm one of the project managers assigned to some of the Part 70 facilities.

So, the limits that are discussed for Part 70 are specific to the facility. Okay? Anything that

you're talking about as far as what's the limit of the reactor, they're apples and oranges.

CHAIR REMPE: Okay. So, if you have an ML license, it would have a Part 52 license, right?

MR. DOWNS: Correct.

CHAIR REMPE: And the operation --

MS. CUBBAGE: Oh, wait, wait. Joy, excuse me, Joy. The ML is approving the design for the deployment site. It's not authorizing any operation of the reactor.

CHAIR REMPE: Right. And so, if I want to do pre-operational testing or subcritical testing, is there a limit for that facility? And I've been hearing, "Oh, well, we'll try to do that under Part 70."

MS. CUBBAGE: No, no, no.

MR. DOWNS: No.

MS. CUBBAGE: We're loading fuel under Part 70 only. It does not authorize any operation --

CHAIR REMPE: Okay.

MS. CUBBAGE: -- of a reactor.

CHAIR REMPE: Okay. Now, I now load fuel under Part 70. Is there a limit, a dose limit, for that aspect of this process? -- is where I'm trying to get to.

MS. CUBBAGE: Okay. So, that would be looking at criticality issues.

CHAIR REMPE: And is it going to be 1 rem total dose equivalent? And I'm hearing, well, it's something depending on the facility. There's not a lower threshold that could be tied to the microreactor as it's going through this process.

MS. CUBBAGE: So, we need to separate these things just for a moment. Okay?

So, if you're talking about Part 70, you're talking about loading fuel only.

CHAIR REMPE: Okay.

MS. CUBBAGE: And you're not operating it for testing it.

CHAIR REMPE: But the most limiting value is what I'm trying to get to.

MS. CUBBAGE: Okay, but the Part 70 limit would have no bearing on operation of a reactor in a factory for testing. Operation of the reactor for testing in the factory would currently be covered under an OL or a COL.

CHAIR REMPE: Okay.

MS. CUBBAGE: The dose limit, the dose limit legally is 25 rem at this point. Now, you're asking, are we going to establish a lower threshold

for operating a reactor for testing in the factory?

CHAIR REMPE: At a microreactor. But I'm trying to see -- I don't want to be recommending that somebody define what a microreactor is. And if you say, well, it's in terms of the consequences, everything is 25 rem. And I'm wondering, is the fuel loading under Part 70 going to be less than 25 rem? And I'm not hearing any --

MR. DOWNS: It would not be, no.

CHAIR REMPE: It would not be less?

MR. DOWNS: It would not be less, right.

CHAIR REMPE: But it could bet 25 rem?

MR. DOWNS: It could be 25 rem. So, there is some nuance in the Part 70 world as far as whether those Subpart (h) requirements apply or not, you know, whether it's there are other types of fuel cycle operations going on at the facility. If the Subpart (h) requirements are applicable, yes, then, that 25 rem is actually in the regulations.

If it's a facility, kind of what Duke has been talking about earlier today, where they're just putting -- they're just fueling the reactor, right; they're bringing in fabricated fuel, inserting it into the microreactor, those requirements, they are a little less specific because it's just under the

requirements of 70.22, and those requirements focus on the description of equipment in facilities used by applicants to protect health and safety, procedures to protect health and safety. There's no prescriptive limit, then, at that point. And we, typically, refer to those as greater than critical mass facilities.

So, you're not going to be -- you're still going to be around that 25 rem. I mean, that's acceptable for a larger-scale facility. It's probably going to be acceptable for a smaller-scale facility, but it's going to be dependent upon the licensee's submittal at that point and those procedures and facility characteristics that are in place.

CHAIR REMPE: So, it's not clear to me that you're going to be limited to 50 megawatts thermal in a reactor --

MR. DOWNS: No.

CHAIR REMPE: -- that's doing testing from the current regulations today.

MR. DOWNS: Yeah.

CHAIR REMPE: But I'm trying to go to -- and I apologize for misstating some things to confuse the topic.

MR. KENNEDY: Yeah, and I'll clarify, too, to build off of -- and, yeah, please, James, please

correct me if I'm wrong here as well.

But if you're just loading the fuel at the facility and not doing any testing, so you just have that Part 70 license, for that, as Amy had stated, we are mostly concerned about criticality. And our expectation would be that appropriate criticality controls would be in place to preclude criticality at that reactor module that just has that fuel load that, then, may be transported to the final deployment site.

So, we, hopefully, would, you know, while we want to make sure that we have appropriate measures in place to protect against any inadvertent criticalities, but assuming that we have put the appropriate measures and physical protections in place, that fuel load should be done such that there isn't a criticality and it's just fresh fuel in a subcritical configuration.

MR. DOWNS: That's correct. And remember, you've still got the Part 20 requirements for radiation protection that apply, you know, at that fuel facility, at the fuel-loading facility, that factory.

VICE CHAIR KIRCHNER: So, how would you -- okay, we've put handcuffs on the facility that -- or the reactor module that's in question. How would you

treat a criticality experiment? You would have to take the handcuffs off to go make your approach to criticality.

MS. CUBBAGE: Yes. So, you would need an operating license or a combined license. You can't do that under Part 70 alone.

VICE CHAIR KIRCHNER: Right. So, what I'm churning on, Amy, and for the members here, is there's a lot of value in perhaps doing an approach to criticality experiment to validate neutronics. You can do that. You can build up a fission product inventory. It wouldn't complicate your shipping issues as much.

But I would have to take my handcuffs off, so that I could just take the control rods to a position where I'm starting to get a count and getting enough, you know, information and data.

So, I just raise that as a practical concern. Because I think in our earlier discussion, once you put these things that render the system incapable of becoming critical, then you lead them on, so to speak, until such time as the unit is delivered at the actual site that has a permit to operate the reactor. Is that right?

MR. KENNEDY: Yeah, that's right.

So, one point that you raise that I don't think is explicitly covered in the paper is trying to operate the reactor with, as you say, the handcuffs on or the features to preclude criticality installed, to verify that those features are actually precluding criticality.

VICE CHAIR KIRCHNER: Yeah.

MR. KENNEDY: We had covered in the paper the situation where the features to preclude criticality would be in addition to the normal reactivity control features --

VICE CHAIR KIRCHNER: Yes.

MR. KENNEDY: -- and that they would be -- their designed installation would be specified in the manufacturing license or in a design certification that was referenced. So that the ability of those features to preclude criticality under all conditions would already be analyzed in the manufacturing license --

VICE CHAIR KIRCHNER: Yeah.

MR. KENNEDY: -- in the final design of the reactor; and that the operational testing at the factory would be for things like ensuring proper neutron flux distribution and operational characteristics of the reactor without the features to

preclude criticality installed.

So, you would never actually put the handcuffs on in the factory if you were going to operate it for testing.

VICE CHAIR KIRCHNER: Yeah.

MR. KENNEDY: You would only put them on when you were done and you wanted to transport it.

VICE CHAIR KIRCHNER: For transfer purposes.

MEMBER MARCH-LEUBA: It makes no sense to me to do testing at a facility. You do the testing on a prototype, No. 1, and then, you build them exactly the same. Because, even if you tested my reactor in the facility, you transported it; you shaked it; you dropped it. When it gets to the final resting place, you have to test it again. You might as well test it there. That's not my job.

CHAIR REMPE: How do you verify they didn't have a misloading event or a situation, if you don't do any testing before you leave?

MEMBER MARCH-LEUBA: Oh, no, no, no. While you load your reactor, you're doing criticality testing.

CHAIR REMPE: Okay, but I thought you just said don't do any testing --

MEMBER MARCH-LEUBA: No, don't pull rods to make it go critical.

CHAIR REMPE: Okay.

MEMBER MARCH-LEUBA: But what are you commissioning?

CHAIR REMPE: Okay.

MR. KENNEDY: So again, we've heard from developers, things that they're considering, and their deployment models. And so it would be up to them to choose if they would gain a benefit from this testing. We're trying to provide a --

MEMBER MARCH-LEUBA: Is this even an expense? Plus you need a feasible license. If you can live without it, that's what I would do. But you should provide them with flexibility, the regulation. That's what you're trying to do.

MR. KENNEDY: Correct. I'd like to move to the next slide then. Just very briefly, one of the potential benefits of applying the non-power reactor regulatory framework is that this framework is already set up for low power short duration operations. And so there may be already guidance documents, standards in place that can be applied in a fairly straightforward manner to these types of operations whereas tailoring all of the power reactor regulations

to fit the specific situations may be more burdensome.

As I mentioned when you go from subcritical or zero power or low power physics testing to something like a nearly full power operational testing in the factor for whatever reason, you may get back to non-power reactor regulations and requirements that are more like power reactor requirements because the non-power regulatory framework does scale up in terms of the requirements as you go up past certain criteria in terms of power level for the reactor. So again, this option is posed for flexibility in cases where a developer decides that it would be advantageous to them. I think that is the last slide on operational testing. So now we're actually moving into the information topics in the enclosure.

MEMBER ROBERTS: I have one quick question. This is Tom Roberts. Getting to what Joy was asking earlier, NUREG 1537 has requirements for research reactors and requirements for test reactors where the research reactor requirements have a much stricter dose limit. Were you thinking about applying the research reactor requirements or leaving that up to the applicant to propose which they would use?

MR. KENNEDY: When we would apply the non-power reactor regulatory framework, we would still

consider the differences between research reactors and testing facilities. And so right now, there's a 10 megawatt cutoff in the regulations. And we've typically applied the 10 CFR Part 20 radiation standards to even hypothetical accidents at research reactors.

There is a draft final rule that would propose different accident dose limits for research reactors. That is not yet approved. And so we would continue to use the current practice in the near term. And I think -- do you want to add to that, Steve?

MR. LYNCH: Yeah, just to clarify. Currently as you've said, there are no dose limits for research reactors. Testing facilities do use the analytical acceptance criteria on Part 100 of 25 rem. And currently, that is defined as those facilities that operate at above 10 megawatts thermal or meet another subset of criteria such as having a liquid fuel loading or a loop going through the core of the reactor.

However, the currently operating research reactors have voluntarily proposed to use 100 millirem as their dose criterion. So that is not imposed by regulation but rather voluntarily adopted for conservatism by the currently operating reactors. But

as Duke said, the staff has proposed in its non-power production utilization facility rulemaking that establishing a dose criteria of one rem would be appropriate or a facility to be considered a research reactor. But that is not limiting the dose that could be applied. Basically, it's a threshold blow which you would not need to follow the 10 CFR Part 100 siting criteria.

MEMBER ROBERTS: Yeah, thanks. So which of those constructs are you thinking for this factory testing of a micro reactor? Are you thinking about using the research reactor requirements or guidelines or practices or whatever they are at the time? Or are you thinking about leaving that up to the applicant and actually accepting the 10 CFR 100 type limits?

MR. KENNEDY: I think it's up to the applicant to the extent that they choose what power level and characteristics are going to define their operational testing program. So if they kept the operation to low power levels, short duration, then the research reactor regulatory framework would be probably more applicable. If they wanted to go into the testing facility regime, then again they have to comply with Part 100, they start to get closer to the power reactor framework anyway.

So one other thing to consider when you're talking about the accident dose limits is that typically research reactors consider a hypothetical accident that occurs at full power operation until the maximum fission product inventory is built up in terms of dose consequences which is not where we would be expecting to get with these reactors operated for testing in the factory. So expect to have much, much smaller source terms that would probably not even approach the same type of consequences that we see for currently operating research reactors which have been able to demonstrate their accident doses are well below the 100 millirem in Part 20.

MR. LYNCH: Yeah, and to build on this, I think it's important to remember that going in, these reactors would be licensed as power reactors. And what we are proposing here is that we would look to use the tools that are available to us, whether that's conditions on a license that is issued or exemptions to tailor the requirements to match the risks and hazards of the facility to ensure safety. So Part 100 would likely be at the default requirement that's applicable.

And as Duke said, if the developer comes to us, describes what they want to do for testing, we

understand the doses that might be expected and hazards associated with that. Then we could use the tools available to us to scale the requirements. And they could resemble more closely requirements that we would impose upon non-power reactors.

VICE CHAIR KIRCHNER: Before you go on, I think there's a transition from your previous slide to this next phase. And I can't help but just caution anyone out there listening the two big challenges. If you go operational at the factory and build a fission product inventory, you've got some considerable additional challenges in terms of transport.

And the other thing that I think the staff has to be concerned about is essentially you would have something like ITAAC that demonstrated that host transportation, the loads that the -- whatever module or set of modules are transported. Even if they've been tested operationally will probably have to be operationally tested again to ensure certain critical functions. Certainly, reactivity control and all the rest to ensure that through transport these things haven't been damaged or otherwise enabled.

And for certain designs, things like clearances and such turn out to be very important factors that are inherent feedback and so on. And so

there are a number of things that the potential applicant should be thinking about because even if you operationally test at the factory, you're probably likely to repeat a large part of that program in situ at the actual site to demonstrate, among other things, that nothing went wrong in the transportation operation and installation of the site. And so you may -- they may find themselves repeating a good deal of their operational test program all over again. Is that right? Just I throw those two cautions out. Certainly the staff I think is going to have to be thinking about something like ITAAC that looks at, okay, post-transportation, were there any impacts on critical design, aspects of this actual module?

MS. CUBBAGE: So I just wanted to respond to that if I could. Great points. Agree with you completely. So there will be some sort of ITAAC for the site to ensure that the module has arrived and is being installed at the site, consistent with the license.

And then we also have -- we did a rulemaking back about a dozen years ago called the ITAAC maintenance rule. So any ITAAC that are closed in the factory, the licensee for the deployment site is responsible for ensuring that those ITAAC continue

to be met until the 52.103(g) is made and they have authorization to operate. So yeah, it is possible they would have to repeat things to demonstrate that the ITAAC are still fulfilled. But all great points. Thank you.

CHAIR REMPE: This is Joy, and I've discussed with Member Bier. And rather than go to the next section on the enclosure, we think it would behoove us to take a small break. I know we started late, but we kind of figured this one would be different because of combining the subcommittee into the full committee and trying to do a letter this month.

So it's almost 3:30 on the East Coast. Let's come back at 3:45 and be ready to do the second part of this presentation. And thank you.

(Whereupon, the above-entitled matter went off the record at 3:29 p.m. and resumed at 3:45 p.m.)

CHAIR REMPE: Okay. It's now 3:45, and I'd like you guys to restart your presentation or resume your presentation. Don't restart.

(Laughter.)

MR. KENNEDY: Thank you. Go to the next slide, please, Steve. Okay. So we've already covered a number of things that are in the information topics

just through our discussion so far. So I may go a little more quickly through a few items.

But the first one is something I don't think we've really talked about much yet. And this is the time frame for operating at the deployment site. Excuse me. So the time frame that we're talking about in this information topic is the time from when a licensee, a permit holder receives their construction permit or their combined operating license to the point where they're actually authorized to operate the reactor or they receive their operating license.

So the deployment time frame is really how long does it take from when I'm able to have the reactor start coming to the deployment site to when I can actually turn it on for operating and for power production. I just want to be -- I want to be clear about that. So the assumption is more or less that as a deployment site construction permit holder, for example, as soon as I get that construction permit, I can say, okay, please send me the reactor that I ordered six months ago that's been tested and is ready to come. And then one of the regulatory steps that need to happen in order for that reactor actually begin operating, so what we recognize is that --

MR. BLEY: Can I interrupt you just a

second? It's Dennis Bley. You mentioned construction permit. But if we're actually talking about a device that's been fabricated at the factory and brought out, would you really have a construction permit? Or would you just have an operating license?

MR. KENNEDY: Yes, you would have a construction permit. So each deployment site because the licensing at the deployment site is separate from anything -- any of the licenses that happened at the factory for operational testing, the deployment site licenses either have to be construction permit in an operating license or a combined license. Part of that is the consideration that at the deployment site, you may have to construct safety-related systems or do activities at the deployment site that are defined as construction. And so you need to have a construction permit or a COL to actually do those activities. So --

(Simultaneous speaking.)

MS. CUBBAGE: The other thing I would add to that, Duke, is that we would expect a level of design maturity given that you've already had a manufacturing license and the design is already -- the module has already been fabricated such that the construction permit could contain -- construction

permit application could contain final design information for major portions of the design and could have a high level of design finality if the applicant --

(Simultaneous speaking.)

MR. BLEY: That would be most likely, yeah.

MS. CUBBAGE: Yes, yes. But then the combined license is also another option.

MR. BLEY: Can you -- do you envision that you could get a construction permit and an operating license in essentially the same time and do the construction? But then when the --

MS. CUBBAGE: So you would need to --

MR. BLEY: -- reactor comes, you'd install it and turn it on?

MS. CUBBAGE: You would need the construction permit or COL to begin anything defined as construction at the site or a limited work authorization. And then you can't give an operating license until construction is substantially complete. So there would have to be at least some gap there.

MR. LYNCH: Yeah, I can build on to that. Amy is absolutely correct. The one efficiency that a developer could use, though, is by submitting a single

application for the construction permit and operating license when they have complete design information available. So they could submit that single application, but we would still issue a construction permit. And then an operating license is two separate actions.

MS. CUBBAGE: And the developer could choose in that circumstances that they would prefer the combined license option. But there are some ins and outs with regards to ITAAC and timelines and things of that nature that Duke is going to get into.

MR. BLEY: Okay. Well, we'll see how it all turns out. But I'm --

MS. CUBBAGE: Yeah.

MR. BLEY: -- thinking that's a little odd. But go ahead.

MEMBER BIER: If I can ask a follow-up question. I mean, it seems to me like the requirements of the operating site are different partially because of the timeline that something is going to be operated there for decades or whatever. You need the time for the local stakeholders to weigh in and for environmental impact and all of that kind of thing.

I'm not very familiar at all with the

requirements for manufacturing and any one reactor will only be at the manufacturing site for a short period of time. But conceivably, that site could be in operation for a long period of time, producing multiple reactors. And what are the requirements regarding the nearby stakeholders near a manufacturing site?

(Simultaneous speaking.)

MS. CUBBAGE: Go ahead.

MR. KENNEDY: So the factory, if there's a license for operational testing at the factory, each module also has to go through all of the hearing requirements, the environmental review requirements, review by the ACRS. So that was one thing that we mentioned earlier is if you require an operating license at the factory for something like fuel loading, it introduces a lot of requirements. But certainly those are necessary to fulfill the NRC's obligations under the Atomic Energy Act to involve the public and the process. And so anything that happens at the factory that involves reactor operation goes through the same types of environmental review.

MEMBER BIER: Yeah, but if you have fuel loading and some radioactive material present on east a periodic basis if not on an ongoing basis, would

there be stakeholder involvement associated with that?

MR. KENNEDY: Yes, there would be. That's part of the licensing process for either Part 52 or Part 50 license at the factory.

MS. CUBBAGE: I think she was referring to the stressed fuel load option and in which case the Part 70 license would have an environmental aspect as well.

MEMBER BIER: Okay. Thank you, Amy.

MR. KENNEDY: Thanks. Okay. So the paper discusses there are two different pathways presented which is Part 50 pathway and the Part 52 pathway for operating the reactor at the deployment site. Both pathways have requirements for hearings at the deployment site that would have to be completed before authorization to operate or an operating license is issued. And in the regulations, each hearing period is 60 days opportunity to request a hearing.

And then hearings under Part 52 are related to ITAAC closure. And those have ITAAC hearing procedures that have been approved. They specify time frames for accomplishing steps in the process of receiving information from licensees, from issuing notifications to the public that are administrative in nature.

And there's potential savings of some time in completing those steps, especially if an applicant knew they were going to receive a reactor and they knew they were going to need to have a hearing requested by a certain date. And they want to try to expedite the notification process. That's possible.

Under the Part 50 process, there's also a requirement for a hearing that covers more than just ITAAC closure because ITAAC under Part 50, the hearing covers everything associated with the operating license which includes the full design of the reactor. And the hearings for Part 50 licenses follow generic milestones that are in the regulations. So there's some possibility for shortening the time frame under Part 50.

And that relates to the time it takes to receive an application for an operating license to an acceptance review to docket it and to provide the notice of a 60-day opportunity for a hearing. So in the paper, we describe in the near term strategy some steps that we might be able to take to shorten some of those time frames. But ultimately under both processes, you run into the time needed to notice a hearing and then to conduct the hearing if it's requested.

And even the 60-day opportunity to request a hearing could be substantially longer than the time it takes for, say, a self-contained micro-reactor to show up at the site and be placed in the proper location, to be checked, and to be ready to be turned on. So we're looking for opportunities to reduce those time frames in a way that still allows for all the proper public engagement under the Atomic Energy Act. So we've laid that out in the near term strategies.

The one thing also is the environmental review that's associated with operation at the deployment site. Under a combined license, the environmental review is completed at the time of issuance of the combined operating license under the Part 50 process. There's a supplement to the environmental impact statement that happens at the operating license stage. So that has the potential to add significant time to the deployment time frame if there's no hearing requested. So do you have a question?

MEMBER BIER: Yeah, for the 60-day notice, I understand that it may be a very short time between when the reactor arrives on site and when it's really to be turned on or tested or whatever. But the

licensee is presumably going to know that they're expecting one much more than 60 days in advance. It's not, like, ordering on Amazon. Can you send it in three days? So can they start that stakeholder notification process and when they know that they're planning on this?

MR. KENNEDY: So under a COL, the ITAAC are specified in the COL. The COL needs to be issued before. Otherwise, the public doesn't know what the ITAAC are.

So there's a possibility in other cases like with the Part 50 process where you know things are going to have to be done. And you can start them much sooner and try to reduce some of the time that you might spend waiting for environmental work to be done or for a hearing to be completed. But that is one case where you really can't start that one really.

MEMBER BIER: Thank you.

MR. KENNEDY: You're welcome. Okay. So I think again we end up in the situation here where it's up to the developer to decide is considering everything is the Part 52 licensing process at the deployment site preferable or is the Part 50 licensing process preferable. And so in the paper, we lay out what takes time and how much time could it possibly

take to try to inform that decision. And then we are looking as we get more experience, perhaps, with licensing, we might find ways to adjust hearing procedures or milestones or even regulations that would allow for a more streamlined approach while still accomplishing the underlying purposes of the act to involve the public and the process and to reach all the required safety findings.

Okay, next. I think I've already covered that one. So I should advance the slides. Next slide, please. So the next topic is licensing replacement reactors. And this goes back to a discussion earlier about --

VICE CHAIR KIRCHNER: Before you go on, this is where I think something that graphically illustrated the requirements and the regulations for both the 10 CFR 50 or 52 as well as the 51 requirements for the environmental reviews, some kind of timeline that shows here's the best you can do that you don't have a contested hearing or something or you can get away -- get away isn't the right way to say it. You can demonstrate that your impact is minimal with a micro-reactor. And therefore, maybe not have to do a full blown EIS, maybe an environmental assessment with a policy would suffice and so on.

But it seems to me you do discuss all of this in the paper. But laying out a timeline so that the Commission and the potential applicants could look at this and see. I would say how much time, what the minimum time is required by regulation for each of these steps in the process so that they can then look at and then do a calculation on their own part about which strategy we want to adopt. Just reading through the entire paper, it's hard to sort out and remember all the steps and all the windows that are necessary to get from the start to the finish of each process.

MS. CUBBAGE: I think that's a great suggestion. We've kind of laid that out for ourselves. And as we go forward with developers, we can certainly walk them through that.

MR. KENNEDY: Thank you.

MEMBER MARCH-LEUBA: I said it before. But conceptually replacing a reactor that has been running for ten years and has burned up the fuel with an identical component that the only difference is fresh fuel where you just place it. That's what we do. We're refueling reactors.

We don't get a new license. Conceptually, you're refueling your site. I just think this is complicating. Requiring a new license complicates

life, even though as I said earlier that new license might just require a new signature because it's exactly the same submittal that you did ten years ago.

MS. CUBBAGE: I think this is an area where we couldn't tackle everything as policy matters in this paper. So what we were laying out is what we believe to be a strategy today without needing Commission policy or rulemaking. But what you're outline is something we could certainly look towards in the future as a next step after this paper.

MEMBER MARCH-LEUBA: If you think centrally when you refuel an operating reactor, you could reduce the spacers and put every pin in the old spacers. But you don't. You put the whole fuel element because it's easier to build it in the facility in the factor and you refuel the whole fuel element. That's what you're doing here.

MS. CUBBAGE: Right. So today we do refuelings without even an amendment if they're not changing anything. They can do steam generator replacements. They can do vessel head replacements. We just haven't taken it so far as it's a whole new reactor showing up on a truck, right? And so what we're saying is under the current framework and policy that a new reactor showing up needs a new license.

MEMBER MARCH-LEUBA: Your approach is conservative and it will work. And I'm willing to bet that it's not going to be that onerous because the license will be just a carbon copy of the previous one. And so the review will be very easy, very fast.

MS. CUBBAGE: I'll take it a step further. We could issue all the construction permits concurrently at the beginning. Or we could issue all the combined licenses concurrently at the beginning and they would just be held there waiting for such time that the new reactor would show up. So yeah, I agree with you on that. But this is definitely an area we're going to continue to engage stakeholders on and potentially go back to the Commission if we come up with additional possible approaches.

MEMBER MARCH-LEUBA: Then, of course, let me be the contrarian. I don't know of any vendor that will keep the design exactly the same for ten years. They will change something.

MS. CUBBAGE: I was going to say that but I didn't.

MEMBER MARCH-LEUBA: Okay.

CHAIR REMPE: So what about Part 53? Any chance that you could take some of these more bigger steps in rulemaking and put it in Part 53 where it's

all said and done since you guys have been studying this so much --

(Simultaneous speaking.)

MS. CUBBAGE: So Part 53 is before the Commission. And so what the Federal Register notice looks like when it goes out is out of our hands at the moment. But the staff did propose to the Commission some questions around micro-reactor licensing.

There's only so far we can go in a final rule without having to re-notice a proposed rule again if that makes sense. So you kind of have to give the public an opportunity to comment. And the changes between a proposed rule and a final rule need to be a logical outgrowth.

So it kind of depends on what the Commission puts out in the proposed rule should they approve a proposed rule, what kind of questions are in the Federal Register notice, what kind of comments received, and then seeing how far changes could go in a final rule before you'd have to re-notice another proposed rule. But your point is well taken. There's an opportunity out there now.

CHAIR REMPE: Depending on what the Commission direction is and public comments, one could have some substantial changes in it and incorporated.

Anyway, just a thought.

PARTICIPANT: I do want to acknowledge it looks like Bruce Watson from the staff may have some additional thoughts to share.

MR. WATSON: Yeah, one of the -- I guess I'll just follow up with what Amy was talking about is that, yeah, you may have a new reactor that may require a new license. But it's -- the site is not definitely going to go into a decommissioning status if they're going to replace the reactor. But there probably would be some kind of license to be used or be remaining for the rest of the site for the possession of any radioactive material that's there while they take out the old reactor, put in the new one.

And as I was mentioned I guess from one of the ACRS members that they're going to change the design a little bit in a ten-year period. So I guess the new reactor as I was looking at it would come with its own new set of tech specs. And the operating license would follow.

So we're looking at it. It's just one of those things we haven't, I guess, drawn a total conclusion on. But we're looking at the various options. So I just wanted to point that out. So

thank you. That was a good comment.

MR. KENNEDY: Okay. So just a couple more points related to this. So recognizing that developers will likely not want to have an interruption or extended interruption in power production, they may bring the replacement reactor to the site, get it ready for operation, shut down one reactor, put the next one into operation almost immediately. And so technically they may have more than one operating reactor at a site, or the site may be designed to have ten of these micro-reactors.

So one of the considerations is in licensing a site. Need to consider how many reactors are going to be there operating at any one time as well as what is the total duration of expected operation of reactors at that site. So the --

MEMBER MARCH-LEUBA: You might see a reactor in a gas field production facility. I'm pumping gas out of the ground. And ten years from now, I discover a new area. So I need two more reactors.

So I'm going to have a multi-unit. You have to be flexible enough to do that. It's not just refueling. Your power demands are going to change with time.

MS. CUBBAGE: Yeah, if they want to do that, they would have to get another license to add more capacity, unless the original license contemplated higher capacity.

MEMBER BIER: So in the interest of time, I think maybe we should try to move along a little more expeditiously in this enclosure section in part because a lot of the things here don't really require immediate feedback from the Committee.

MEMBER HALNON: Vicki, this is Greg. Just one real quick comment on the second bullet there. We put a letter November 2021 on the EP rule. You might refer back to that. There was a comment about the transportable reactors. And that kind of is irrelevant in this case along with the EP stuff.

MR. KENNEDY: So with that, I think we can move to the next topic in two slides, Steve. So I believe Jesse Seymour is on the line to discuss the next topic on autonomous and remote operations. Jesse?

MR. SEYMOUR: Thanks, Duke. I appreciate it. So my name is Jesse Seymour, and I'm an license examiner, a human factors technical reviewer in NRR. And I worked with Dr. David Desaulniers and Ian Jung along with Tammie Rivera of NSIR to develop the remote

and autonomous operations portion of the draft SECY.

So the potential for applicants to potentially seek the inclusion of remote or autonomous operating concepts in their facilities is a matter that we continue to think through and to bring to the attention of the Commission. It's something that we raised in the 2020 SECY that was discussed earlier in the meeting today. And it's also something that we've raised to the attention of the Committee and talked about as part of the development of our proposed Part 53 rule.

So with these transport micro-reactors just because of the potential for how these would look to be employed, this is an issue that we see as being tied into this potentially and therefore something that we need to be thinking about. So we envision that a combination of technological advances. And the economic -- economics I should say -- associated with these micro-reactors will continue to creep momentum between the deployment models and again these use cases.

And I think because of that, it's going to be important for us as a staff to have thought through this and to have the technical review processes that we'll need to adequately address them. We believe

that there's important matters of policy underlying both autonomous and remote operations that should be brought to the Commission's attention via the draft SECY that is presently under discussion which is why we elected to incorporate this topic into the enclosure. As we noted back in the 2020 SECY that was discussed earlier, both autonomous and remote operations raised potential policy-related matters and very important matters at that.

For example, autonomous operation could entail things like reactive manipulations being performed by automation rather than by licensed operators as well as potentially eliminating humans as a layer of defense in depth. Separately, remote operations could raise new human factors engineering and cybersecurity considerations as well too. And in the enclosure, we try to talk through and parse out some of those issues in more detail.

I should note that this Committee has previously expressed its view on the notion of unattended plant operations and that the concept of maintaining some minimum degree of human oversight irrespective of automation is important. And that's something that we incorporated into our proposed Part 53 framework. So again, we were sensitive to the

viewpoint that the Committee raised there, and that's something that we're carrying forward into our thinking on this issue.

The potential of our future reactor design to demonstrate adequate safety performance while operating autonomously may be an area in which the Commission will need to make a policy decision regarding whether some form of human oversight will be required, even if it's rendered unnecessary from a strict safety or defense-in-depth standpoint. And that would include keeping a person in the loop as a conservative measure for public confidence. So again, that's something that we're kind of calling out there in the enclosure as being an area where there may be a Commission policy call involved.

MR. BLEY: Jesse?

MR. SEYMOUR: Yes.

MR. BLEY: Dennis Bley. Now if we have a human in the loop but not at the site, you have to have some really secure means of communication. We just had some good examples today of difficult if you were making communications always work. And I know the staff -- well, I think the staff deferred to a larger government examination of geomagnetic storms. But they can interrupt almost every kind of

communications possibility and maybe inject signals into the process too. Have you been considering that aspect and to what extent?

MR. SEYMOUR: It's absolutely something we've considered. And this is something that we touch upon in the paper as well too. And a key thing and I think I've raised this in a different forum in front of the Committee before as part of the Part 53 discussion.

But realistically, any suitable approach to remote operations, to do that logically and to do it safely, you would either have to provide a very high degree of assurance and ability of operators to remotely accomplish things like credited human actions. Or alternatively, eliminate reliance on such actions for the achievement of safety functions. And the key point there is there's a fundamental philosophical question at play here is that, that you could ever have truly 100 percent full proof reliable communications with a remote site.

And if you're not able to establish that, then how are you going to account for the fact that you can potentially lose communications with it? Again, if you've got a construct where the operators intervention is not needed for safe outcomes, it makes

that technical question a little bit easier to answer there. But again, the communications piece of this is something that's key.

And something I was going to touch upon a little later but I can bring up now is just that we do have ongoing work with the Office of Research that we're doing to do a more detailed research-based treatment of the remote operations topics. And there's a few layers to that. But some of the elements, the specific questions we're digging into are how you accomplish remote monitoring, the remote control functions, and things of that nature. And a lot of this is meant to inform that question of is it something that could be done safely? And if it is, what are the ground rules going into that? So --

MR. BLEY: The other alternative you mentioned is to show that you don't have any need --

MR. SEYMOUR: Yes.

MR. BLEY: -- for intervention. And that's also in a way problematic because at least until we get some years of experience in operating the systems, we might have a theoretical claim that you'll never need intervention. But nature has a way of surprising us on those kind of things. It seems to me if I'm coming in with a design that I eventually might

want to use in an autonomous way, I ought to have a plan for somehow testing out that hypothesis that I will never need intervention over the first quite a few years of operation in my new design. And I'm not sure you've raised that kind of issue at this point.

MR. SEYMOUR: In the Part 53 work that we've done, the way that we addressed the potential, and again, we didn't speak directly to remote and autonomous in an explicit way in that rule. But we tried to bound a very wide range of technological considerations. And one of them that we considered was the need to always have a layer of defense-in-depth kind of wrapped around the entire construct.

And the reason being is because of those analytic uncertainties. If you're going through especially on the pilot built of a first of a kind facility and you're making the case that you've got inherent safety because of just the design of the fuel, things that are baked right into the engineering. One of the things that that's always kind of a specter that's out there is that you could potentially have uncertainties, right?

So how do you account for that? And again, I think this gets back to the point that under initial analysis, you may have said, well, there's no

need for human intervention there. What are the known and unknowns? What did we miss, right?

And so one of the concepts was having a layer of defense in depth that do not require human action, right, to achieve. And part of that was to help bound that. Now that's one of the things we thought about when we were considering the self-reliant mitigation facility which was kind of a separate idea that was there.

But one of the things we have kicked around in these discussions is, would it be reasonable to expect that a remotely operated facility would have to meet that type of pedigree of safety? Just to go ahead and provide some assurance that loss of communication would be acceptable. But again, self-reliant mitigation facility, and this is something we've only kind of preliminarily discussed.

What would have that additional layer of defense in depth, right, that wouldn't credit humans? So again, it's a very key point, right? Again, if we look at things -- I think you brought up the point of a solar storm, right, things that cause kind of mass disruptions of communications. Unless you're hard wiring through fiber optics or something like that, again, those types of events could be very damaging.

MR. BLEY: Even if you hard wire, there might be some interaction. Maybe with optical cable, that's different. I haven't really thought about it.

But if you go back 150 years or whatever it was, there was a big geomagnetic storm and it wiped out all the telegraph systems around the country. So hard wiring might not be the answer, at least if you're talking metallic wires. I guess where I was kind of coming from is, is there value in suggesting if you're a vendor who's looking in the future possibly to autonomous operation?

You ought to build in some kind of a multi-year test and information gathering plan into your application to build confidence that when you get to that point, it's going to work the way you planned it. And I haven't thought that through. It's off the top of my head. But something like that seems to make sense to me.

MR. SEYMOUR: It's a good philosophical point. I don't have a good answer for that because the notion of prototyping a facility and doing kind of a pilot build and run, that has its own nuances to it and so forth. But something that we've talked about is the notion that the self-reliant mitigation facility would require a fairly well established body

of supporting information to write the analyses to go through and to justify that. And even that isn't meant to be an unintended model, right?

There's still a generalized reactor operator capability to do some assessment, shut the facility down, that type of thing. So again, it's a good point. Now the geomagnetic store, I think you mentioned. I believe that was the Carrington Event. I think that's a famous one.

But again, that is kind of something that we put into our thought experiments there. What happens if you have something like that? Communications are gone.

And suddenly, things like having time critical operator actions to do things, to mitigate accidents and doing that from a distance, immediately that starts to present challenges. So Steve Lynch, I know you're on. I'm not sure if you have anything that you wanted to add about the kind of prototyping of the facility that developed a data set or whatever for it.

MR. LYNCH: Hi, Jesse. I think you've covered it pretty well. I mean, I think I'll just make that distinction that we are looking at the prototyping of the facilities. That is looking at

additional safety features that we can place upon the reactor itself under the 50.43(e) to ensure safe operations. But I think you covered everything well.

MR. BLEY: There's a point I just peripherally mentioned and maybe one of you can address it. My memory is back when President Obama was near the end of his term there was a presidential order directing that everybody who was needed, communications, that sort of thing ought to look into their own capability to withstand those kind of storms. And I thought after that, there was some agreement among federal agencies that one of them had the lead in doing that. And I haven't heard anything in quite a few years in that area. Can you tell me what's happening there?

MR. SEYMOUR: So that is something that I can't speak to myself. I know we've got, I think, Tammie Rivera I think from a cybersecurity side of things. I'm not sure. Tammie, is that something that you've dealt with on the cyber side?

MS. RIVERA: Yes, this is Tammie Rivera with security bridge in the Office of Nuclear Security in the incidence response. And Jesse, I think you covered that topic pretty well. And your specific questioning here, I do not have any knowledge on that.

And any information that I could offer would be speculative. And I want to avoid that.

MR. SEYMOUR: Okay. Yes, thanks, Tammie. I appreciate that. And so offhand, I'm not sure if that's something that we can speak to.

(Simultaneous speaking.)

MR. BLEY: Okay. There should be somebody on the staff who is aware of this program within the government. We could inform back on it.

MS. CUBBAGE: We'll take note of that. And this is a topic that we're kind of re-teeing up in this paper but not seeking any Commission direction. So as we move forward, there'll be other opportunities to engage ACRS certainly before we put up another paper on this topic.

CHAIR REMPE: So members, I just would like to remind you that we have a lot more content and we really need to try and be done with the presentation by 5:15. I know we started late, but we've got public comments and we do need to read in a draft letter today is the goal. Okay. Thank you.

MR. SEYMOUR: Okay. Thank you. And so just to go ahead and just ramp up, so again, our plan going forward as we intend to further develop our understanding of the industry's deployment models,

again, we're looking at the potential use of things like artificial intelligence, trying to better understand that. And again, really focusing in on these concepts such that we'll be ready for them at the appropriate time, have the guidance and the regulatory framework in place.

So again, what we're doing right now is we're identifying any gaps in the existing human factors engineering regulatory framework that are needed to address those deployment models. And we're developing the technical bases for new guidance that may be needed. Again, I mentioned the research project that we're currently doing. And so with that being said, I'll go ahead and turn it back over to Duke so we can move through the rest of the presentation.

MR. KENNEDY: Okay. Thanks, Jesse. And I'm going to turn it over to Bernie to discuss transportation.

MR. WHITE: Thanks, Duke. So in the enclosure of the paper, we wanted to introduce the different types of packages and the different approval mechanisms we have under Part 71 for shipment of transportable micro-reactors. So going back to the figure that Duke has showed on slide 4, there's two

potential shipments, one from the factory to the deployment site, then one from the deployment site back to potentially a refurbishment or a decommissioning facility.

Shipment from the factory is probably going to be a Type A package unless it's been operated. Then it could be a Type B fissile package depending upon how much radioactive material was generated during operations. We haven't defined that demarcation line between Type A and Type B or Type A fissile and Type B fissile. Each licensee would have to determine that and how long it wants to operate and what power level and then determine what type of package it would be using --

VICE CHAIR KIRCHNER: Bernie, at this point, is there some devotional demarcation where you would make that A/B decision?

MR. WHITE: Okay. So when I say that, I mean there's no demarcation line in terms of amount of operation. So --

(Simultaneous speaking.)

VICE CHAIR KIRCHNER: Is there an inventory?

MR. WHITE: There is in the back, Appendix -- Part 71, Appendix A. There's an A1 and A2

quantities listed for numerous radioisotopes. This would be a mixture of radioisotopes. And so the applicant would figure out how much of each isotope it has and then do one over sum of the fractions to determine what the aggregate A2 is. And then so if you're above that, it's a Type B package.

VICE CHAIR KIRCHNER: And for the uninitiated, what's the big difference between A and B?

MR. WHITE: So Type A quantities are shipped under DOT rules, self-certified on accident resistant packages that a value limits the dose to an individual. And it's all based on the Q system that IAEA developed. And so it limits the dose to 5 rem or less in an accident.

And to something like -- and I can't remember the exact numbers -- but a couple of rem at most during normal transit. Type B quantities are in -- we call them accident resistant packages. But they're packages that are put through hypothetical accident conditions and then they're evaluated for criticality safety. It's fissile dose rate containment criteria to minimize --

VICE CHAIR KIRCHNER: Would a -- I'm trying to lead you somewhere. Sorry, Joy. This is

important, though, for the applicant. How much fissile inventory can you ship and still stay under Type A? How many kilograms?

MR. WHITE: So a Type A package cannot ship hardly any fissile material. That would be a couple of grams. It's Type A fissile package. And that's -- the distinction is if it's a fissile package, Type A, comes to NRC for review.

VICE CHAIR KIRCHNER: Right.

MR. WHITE: And you can ship as much as you can show it's subcritical in that, from grams, kilograms, to hundreds.

VICE CHAIR KIRCHNER: So that's typical of, like, PWR, BWR --

(Simultaneous speaking.)

MR. WHITE: Right, right. Fresh fuel assembly packages, for example, hexafluoride, enriched hexafluoride, they're Type A fissile packages.

VICE CHAIR KIRCHNER: Right. And then B is -- you got to do your homework.

MR. WHITE: Right. So B is the dose rate. It has dose rate and containment criteria. Type B fissile package is spent fuel.

VICE CHAIR KIRCHNER: Is it -- well, never mind. I was going to say that it wouldn't take much

operation to cross the line, would it?

MR. WHITE: Probably not. A lot depends upon the parallel. If you're operating at full power, you're talking minutes. If you're talking a milliwatt, it's different. And it depends upon the operating regime that each licensee wants to do at the factory.

VICE CHAIR KIRCHNER: So when you do guidance, I think it would be enormously helpful to try and kind of -- don't just say, go to -- which I'm doing here, an appendix. But kind of, I think, you should try if you could lay out the guidance, for example, Type A is fresh fuel assemblies for PWRs and so forth. B would be spent fuel and so on. So the people are really thinking through the implications. Okay. Thank you.

MR. WHITE: Thank you. I've covered most of that by examples, what the different types of packages are. So transported on the front end to the deployment site, I mean, the real difference between whether it's a Type A fissile or a Type B fissile package is the fact that it has to be evaluated for dose rate after hypothetical accident conditions and it's got containment criteria for both normal conditions and for accident conditions.

Because both sets of packages, because they're fissile packages, they're subject to normal conditions in transport, hypothetical accident conditions, and criticality safety criteria. So next slide, please. So talking about different types of framework. So if you have a package that you can meet all of Part 71 and that's pretty. It's standard.

That's what we routinely do for fresh fuel assembly packages, hexafluoride spent fuel packages. The real issue with these packages, we don't know how they'll be damaged when subject to hypothetical accident conditions. And so if you do the hypothetical accident conditions is a 30 foot drop onto an unyielding surface and the most damaging orientation.

A 40-inch puncture test and the most damaging orientation on the most damaging spot, a 30-minute fire, and then an immersion test, right? It's 3-foot immersion for fissile packages and a 50-foot immersion for all packages. If one can't meet the criteria in Part 71 after those tests, there's three different types of package approval standards that one could use.

There's 71.41(c) which is alternative testing environmental conditions. So instead of doing

at 30-foot drop, you can do a 25-foot drop. But you'd have to have compensatory measures or something to account for that distance.

The limitation on that is, though, you'd still have to meet the containment criteria and the dose rate criterion Part 71. So there's no relief from that. There's 71.41(d). We instituted that.

We call that a special package authorization. And that was really put in there for large packages, something like shipment of reactor vessels. If reactor vessel can't meet the definition of low specific activity or surface contaminated objects, that's what we put it in there for.

It takes a one-time shipment. That one-time shipment is probably an unlikely -- would probably make it very unlikely that a transmittal micro-reactor would use it. Because you couldn't ship it from the factory to the deployment site and then back.

You can only ship it from the deployment site back. And there's the issue of what if you have multiple reactors at the same facility. Is that a one-time shipment? We really haven't exercised that to date.

And then there's the exemptions. An

exemption space, you can take exemption to anything you want in the roles as long as you can show that you don't endanger life, property, and/or common defense and security. In November and December, we'll be back talking to this ACRS subcommittee on a risk informed methodology for transportation package approval.

That takes -- that would use exemptions from Part 71 -- potentially exemptions from Part 71. We have a full committee meeting on that in December. And so you hear a little bit more about what some in the industry were thinking about their thoughts for an exemption space. Next slide, please.

Now we'll move into the topic of spent fuel. So when NRC issued its final rule in 1980 codifying the specific license requirements for an individual spent fuel storage installation under 10 CFR Part 72, we added the definition of spent fuel. That definition of spent fuel means that the fuel has been withdrawn from a reactor and has cooled at least one year prior to being placed into an ISFSI.

And that was back in the day most of the fuel and still most of the fuel today is light water reactor. It comes out of the reactor, goes into a spent fuel pool for some period of time. And that period of time used to five to seven years at least.

And a lot of licensees have shortened it now down to maybe two, three, four, five years. But there's still that minimum one-year requirement for that. In order for fuel to be placed into an ISFSI licensed under Part 72, it would have to be cold one year and has to be withdraw from the reactor.

And that's two different implications for a couple different licensees. If you have a transportable micro-reactor who wants to store the fuel at the deployment site, that would have to be stored under Part 50 and not Part 72. We have something like a pebble bed reactor where pebbles are coming out every day, and they want to be placed into a storage facility.

That storage facility would be licensed under Part 50 absent exemptions that one year minimum pool time requirement in Part 71. Next slide, please. So one point, request exemptions from a one-year requirement were from the requirement to withdraw from the reactor. However, under Part 72, we could only issue that to licensees.

If you're familiar with Part 72, we have both specific and general licensees come to NRC -- or not general licensees, storage cask vendors come to NRC for dry cask storage approvals. There's

certificates of compliance for that. And those compliances are used at general licensees. We could not issue an exemption, the certificate of compliance holder to make it generally applicable to a licensee for either of those provisions because it would violate the APA, the Administrative Procedures Act. The Administrative Procedures Act, that is NRC doing the rulemaking without going through the rulemaking process.

MEMBER MARCH-LEUBA: And the one-year decay criterion, that -- would it apply for testing of the facility if any power is reached? Or would it require an exemption?

MR. WHITE: I have to go back and look at Part 72. But I think it depends on what you consider the facility. I think it says --

MEMBER MARCH-LEUBA: If you have a Part 50 license.

MR. WHITE: Yeah, if it's not a Part 50 license, then it might not. And I think that's something we'd have to discuss with our lead counsel.

MEMBER MARCH-LEUBA: They might have to get an exemption because they really don't have any fissile products or source term or decay heat.

MR. WHITE: And so that's all I really

want to mention about spent fuel storage, just those kind of two points which are applicable both to transportable micro-reactors and advanced reactors. Thanks.

MR. KENNEDY: And I'll move into the next topic which is decommissioning process and decommissioning funding assurance. We've already discussed some of this. I won't repeat that here.

But the idea is that at the end of the life cycle of an individual reactor module, it would be removed from the deployment site and taken to another facility for ultimate decommissioning or for refurbishment and then redeployment. So that involves actually physically transferring the reactor off the deployment site and also giving it to another entity that has a license that authorizes them to receive it. So again, we may have very complicated scenarios where depending on which licensees are holding which licenses for decommissioning or for operation at the deployment site, there may be different considerations. But there are a couple underlying points.

First, the decommissioning is going to have to decommission not just the reactor but also the deployment site at the end of the life of that

deployment site. So there will need to be considerations for what activities and decommissioning are specific to the deployment site and which activities are specific to the reactors themselves. And so this -- go to the next slide, please.

This raises one complication which is related to the funding assurance. Typically, the reactor would have decommissioning funding assurance that would apply to the decommissioning of that reactor at its site where it's operated. But here we may have decommissioning funding assurance have to account for activities at two different places. And so there's just a recognition that we would need to have that accounted for in the decommissioning plan and in a decommissioning cost estimate at well.

CHAIR REMPE: So thinking about what's happening with the light water reactors today and we have a lot of ISFSIs on the sites with fuel issues. And if there's not a facility to receive the modules after their deployment, again, you may end up -- you'll have this limit about how many modules that are spent, I guess, or something in the site that would limit it. And the whole thing would just stop.

But I just am kind of wondering you can't require any assurance. And so they just need to know,

hey, you can do this for a while until you find a place to ship them off to. Or you're going to be having to shut down. Even if you can buy more modules, you can't bring more to the site. Isn't that the situation?

MR. KENNEDY: So I don't know that's necessarily the situation. If the modules could be transferred offsite and defueled and the fuel put into an ISFSI.

CHAIR REMPE: There's no place yet still to do that. And so what happens if that place doesn't exist at some point? Again, there's a lot of assumptions in this scenario. I'm just kind of wondering if that should be made clear at some point to folks that you don't have a facility to ship them off to, to refuel them, you're going to be stuck with -- you can't have a whole parking lot of spent modules on the site. You'll have a limit on how many you can have. And just I was looking at the slides --

(Simultaneous speaking.)

MS. CUBBAGE: Ultimately, when we issue a license, we need to be able to conclude that they'll be able to safely store the used fuel on site. So the reactor -- the deployment site license holder would have to have provisions for this in the eventuality

that there wasn't another place for the fuel to go.

CHAIR REMPE: So the first micro-reactors will need to have provisions for storing the spent fuel onsite unless they can identify a place to ship it to. Is that what I heard you say, Amy?

MS. CUBBAGE: Yeah.

CHAIR REMPE: I don't think I saw that in the white paper anywhere. Is it on the enclosure?

MS. CUBBAGE: We'll have to take a look back to see if we need to --

(Simultaneous speaking.)

CHAIR REMPE: Because I think that would be a nice idea. But I didn't see it, or I wouldn't have asked the question.

MR. KENNEDY: Thanks. Yeah, we'll take a look.

VICE CHAIR KIRCHNER: I could imagine hybrid scenarios of a different kind. That may be advantageous to ship the fueled reactor, especially if it's fresh, out to the site and then go through operational testing and conditioning and all the rest. And then when it comes down -- comes time to shut down, assuming this could be economically feasible, remove the fuel from the module, store the fuel separately from the module.

Would that be -- would there be anything that would preclude that. In other words, they could design for refueling so to speak or defueling. They have to anyway, de facto.

But they could design it so that could easily be done. The core module whatever is fuel -- spent fuel now could be stored separately from the rest because they don't, for example, build up a large inventory of byproducts in the rest of the reactor module. That may be much more easily dispensed with separate from the fuel. So I can see a hybrid model where they would -- and that would address also if there's no place to ship the fuel, then they could consolidate the spent fuel much more readily than trying to tuck it in a module in a vault or something.

CHAIR REMPE: Well, yeah, as long as they have provisions on the side, unless they have a place to ship it to, that would be a good thing to add to the white paper. I don't mind how they do it. But I just know what's happened with --

VICE CHAIR KIRCHNER: I don't know it's a good thing. But it's just an option that I could envision happening.

CHAIR REMPE: Well, the Reg Guide ought to think about it because we've had a different

experience with the light water reactors.

MR. KENNEDY: Thank you. So I guess the last thing is just to mention that right now the regulations have formulas for figuring out how much decommissioning funding assurance is required for reactors that are tied to pressurized water and boiling water reactors of much higher power levels. So we would be considering whether site specific decommissioning cost estimates would be more appropriate for these reactors which would be using different technologies.

And they have, again, these different decommissioning scenarios than what's typical for light water reactors. Okay. Next slide, please. So the next topic is siting in densely populated areas. What I want to cover here is that the staff is currently working on a revision of Reg Guide 4.7 which is general site suitability criteria for nuclear power stations.

And this is revisions that are consistent with recent Commission direction on a Commission paper on population-related siting considerations for advance reactors. And so the Commission approved the staff's approach to revise the population-related siting guidance in order to provide technology

inclusive, risk informed, and performance-based criteria. So we understand that some developers may eventually seek site reactors in locations that are not consistent with that Reg Guide as revised and not consistent with the underlying regulations in Part 100 where reactors may -- they may want to site reactors in, for example, population centers greater than 25,000 people.

So anytime that a developer would seek to do such a thing, we would have to further engage with the Commission on that. And so this is one of those areas where we don't have any concrete plans from the developers. But we understand that there's potential for this to happen.

And so we're thinking about it now and continuing to engage with stakeholders so that if this is something that they want to pursue, we will be ready to engage with them further and with the Commission as appropriate. So the next topic is commercial maritime applications. This was raised very early in the session today.

So this topic, commercial maritime applications, commercial space applications which is next, and mobile deployment of micro-reactors are all areas where we are aware of stakeholder interest and

ongoing activities. But there's really not enough information right now for us to start taking any concrete actions like we are proposing in some of the other topics. It's really kind of stay engaged with the community, aware of developments, and then reassess whether or not we need to take additional steps.

So I don't know how much detail you really want me to go into on these topics. But there are many different maritime applications being considered with each one having its own host of regulatory challenges or issues, things that don't necessarily fit exactly in our current regulatory framework, like, international shipping with nuclear propulsion. So for maritime, the staff was staying engaged with the Department of Energy and its maritime nuclear application group.

And so that's one area where we get information about what are some of the current developments going on in that area so that we can stay informed. Space applications, I think the main point for space applications is that in the case of fully commercial space applications of micro-reactors, the NRC's regulatory framework is adequate for its responsibilities for terrestrial-based licensing

activities. So if a reactor is operated for prototype testing and it's a commercial reactor that falls under our regulatory jurisdiction, we have the regulations to do that.

Transportation, we have the regulations to be able to have these reactors transported to the launch site. At the point of the launch site, the regulatory authority for these reactors transfers over to the FAA's Office of Commercial Space Transportation. So at this point from what we know, the NRC's regulatory framework is adequate for fully commercial space applications of micro-reactors.

And then finally -- thanks, Steve -- for mobile reactors, we've heard that there's a consideration of whether these reactors could be rapidly deployed for as needed, where needed, when needed operation to provide extra energy for disaster relief or increased temporary demands. And really the challenge is that, as we've mentioned, there's time frames that are associated with an environmental review and with hearings. And right now, those activities are tied to particular sites.

So while we could pre-license some sites for more rapid deployment by going through some of the activities, the framework really isn't set up for

someone to be able to take a reactor anywhere in the country that it's needed with only a few weeks' notice or a few days' notice. So this is another area where we'll stay apprised of what's the demand from developers for these types of facilities and reassess whether or not we need to engage further with the Commission on those types of deployment strategies. Next slide. So just to recap on our stakeholder engagement, in March, we presented proposed topics to be included in this paper and receive some oral feedback during that meeting.

In July, we went back to the advanced reactor stakeholder meeting and we laid out which topics we intended to include to get additional feedback. And then in September just recently, we held a public meeting after the release of the first draft of the white paper. I think over 200 attendees at that meeting, virtually and a few in person.

We received feedback during the meeting. I would say that it was generally favorable and was forward looking in the sense that the community wants to stay engaged in this process as we get direction on the paper and go into implementation. And as we pursue some of the other topics that are now presented as information topics but have next steps or near term

strategies that may involve guidance or additional rulemaking.

Finally, we received two letters recently from the Nuclear Energy Institute and from Westinghouse Electric Company that provided some written feedback. This was after the public meeting that we held. So that written feedback, again, largely focuses on things that would be done in the implementation of the approaches in this paper or in the next steps and provides some comments also on how the paper treats various topics.

And so there are some items that we can consider in those comments for -- in further development of this paper and in future work. Okay. So finally for the next steps, we're developing a SECY paper that we're hoping to send to the Commission this month that will include a request for direction on the three main topics that we covered in this presentation on futures to preclude criticality, approaches for loading fuel, and operational testing at the factory as well. And then it will, again, provide this enclosure with information topics that staff will continue to engage on with the Commission as appropriate.

That is the end of my presentation slides.

So thank you very much for all of the discussion and feedback during this meeting. And again, it was a pleasure to bring this paper and appreciate agreeing to meet on a shorter time frame than necessary. Thank you.

MEMBER BIER: Okay. Thank you very much. Are there any quick additional questions or comments from Committee members? Yes, we have somebody. Dennis?

MR. BLEY: Yeah, it's Dennis Bley. When you send the SECY paper up to the Commission, assuming they support the way you're headed, will this require rulemaking? Or what do you expect to be the direction you get back?

MR. KENNEDY: So the goal is to not have any rulemaking required for the options and approaches presented in this paper that would be implemented under the current regulations with appropriate regulatory vehicles such as exemptions or license conditions or hearing orders and that there would likely be guidance development related to things such as features to preclude criticality but no rulemaking.

MEMBER BIER: Okay.

MR. BLEY: I'm sorry. I lost my mic for a second. Have you -- under the assumption that

you'll get the go ahead on this, have you started laying out what kind of guidance you would need to do or actually started on some of the guidance?

MR. KENNEDY: So we have general ideas for which things would require guidance development or at least examining whether more guidance development is needed. But I would say that's still an activity that we would be looking at once we get the Commission direction on which approaches they would support. So at this point, there's more work to do on that, but not until we receive Commission direction.

CHAIR REMPE: Have you thought about in the paper including something like this is what we're doing for the short term, but we realize that in the longer term that we will need -- it would behoove us to after we get some experience to pursue rulemaking? Or that Part 53 may be an opportunity where something could be done? I mean, just a caveat to kind of say, hey, we're not just stopping here?

MR. KENNEDY: So there are a couple places where the paper does mention Part 53 may provide longer term approaches to some of these issues. But we were trying to keep this paper focused on what we can do now. And initial thinking was maybe we can include other rulemaking options also. But in

developing the paper, it became clear that it was covering so many topics. Options were needed in the near term that we decided to just focus on those near term approaches that would require just a Commission policy decision rather than a rulemaking.

MR. LYNCH: Yeah, and certainly the proposals that we will have in this paper do not preclude any future actions that the staff may take for rulemaking if we determine that it's necessary. But I think it is a good point that decisions on that will largely depend on engagement that we have with stakeholders and get a better understanding of their deployment models and any type of rulemaking activities if not covered under Part 53. It could be pursued in parallel with what we're proposing in this paper and addressed in subsequent interactions with the Commission.

MEMBER BIER: Okay. Any additional questions or --

(Simultaneous speaking.)

MEMBER BIER: -- comments? Yeah, Dennis.

MR. BLEY: One quick one, Vicki. If the Commission should tell you to go ahead with the status quo, I assume you'd still need guidance.

MR. KENNEDY: So it depends on which

status quo option, whether it would require just guidance or may require more engagement with the Commission, either through rulemaking or other policy decisions. So as we mentioned features to preclude criticality or fundamental to some of the other options. So without those, we may need to pursue a different rulemaking related to facilities that would be in operation while in transport.

(Simultaneous speaking.)

MR. BLEY: So summarizing a little, although it might seem that going with a status quo approach would not be disruptive, it might lead to a need for rulemaking which could make things even more stretched out.

MR. KENNEDY: Yes, and I believe that's described in the paper.

MEMBER BIER: Also I think part of the -- part of my interpretation at least of your answer if it's correct is that the options on one, two, and three are not really mix and match. You can't pick and choose and say we're going to do 1A but then 2B and 3B because they depend on 1B. Is that correct?

MR. KENNEDY: So Option 1B, loading fuel under Part 70 license -- I may have just mixed them up too. Under Option 2B, loading fuel under a Part 70

license with a manufacturing license, that relies on features to preclude criticality. The options related to operational testing at the factor, to actually do the operational testing don't rely on anything else. But to be able to then ship the reactor to the deployment site, then it relies on features to preclude criticality. So yes, there's definitely --

MEMBER BIER: There's some logic to which options you would go with as a package kind of.

MR. KENNEDY: Yeah, and one other thing. It may be obvious at this point. But the reason that we have Option 2 for fuel loading and Option 3 for operational testing is some developers say we just want to load fuel. We just want to get that far.

Others say we want to go all the way to operational testing. So then Option 3 is required. So they don't deal with anything in Topic 2. They just go straight to the license.

MEMBER BIER: Okay. Yes?

MR. BLEY: I have one more suggestion actually. It's just a minor thing but it's important to me. It's in the enclosure that you finish with siting in densely populated areas.

I would just suggest you move that up to the first paper at the end so that the micro-reactor

proponents don't overlook the fact that this is a power reactor. And you have to comply with 10 CFR 100 which is different for tests and research reactors. No, I didn't say that correctly. The rules are different for tests and research reactors. You still have to comply with 10 CFR.

MR. KENNEDY: Thank you for that. We'll take a look.

MEMBER BIER: Okay. If there are no further Committee or consultant comments, then we will now open up for brief public comments, whoever is out there. And you can either unmute yourself on Teams or on the phone line. I'm not sure what the procedures are exactly.

I know we have received a couple of written comments. I assume that anybody who had not provided written comments so far can still choose to do so, although maybe kind of uncritical. We're going to have a letter, but --

CHAIR REMPE: Clarification.

MEMBER BIER: Yes.

CHAIR REMPE: We did not receive written comments.

MEMBER BIER: Correct.

CHAIR REMPE: The staff received --

MEMBER BIER: Yes.

CHAIR REMPE: -- written comments on the white paper that was provided a while back.

MEMBER BIER: Given that we're hoping to write a letter this week if we get consensus, there may not be much time. But anyway, any additional public comments online today?

(No audible response.)

MEMBER BIER: Okay. If not, then thank you very much for the presentations. That was very informative, especially given all of the complexities of the issues to see how they all fit together. So I appreciate that. And do we need a short break before letter reading, or --

CHAIR REMPE: Yes, in order for the staff to come in. At this time, we are going to go off the record. And court reporter, I know this is the end of what we'll need you for, for this 709th meeting.

So tomorrow and the rest of the week, we're going to have our planning and procedures meeting tomorrow morning. But we don't need the court reporter. And we're doing letter writing the rest of this meeting.

So thank you for your assistance. Again, sorry about the problems with the link issue today.

And thanks for everyone's patience dealing with that.

And let's plan to restart at 5:10. Do you think we can get Sandra in to bring up the letter by that time? And we'll read in the letter. Thank you, and thanks for your presentations.

(Whereupon, the above-entitled matter went off the record at 5:03 p.m.)

NRC Staff Draft White Paper on Licensing and Deployment Considerations for Factory-Fabricated Micro-Reactors

ACRS meeting - October 3, 2023

William Kennedy
Amy Cubbage
Advanced Reactor Policy Branch
U.S. Nuclear Regulatory Commission

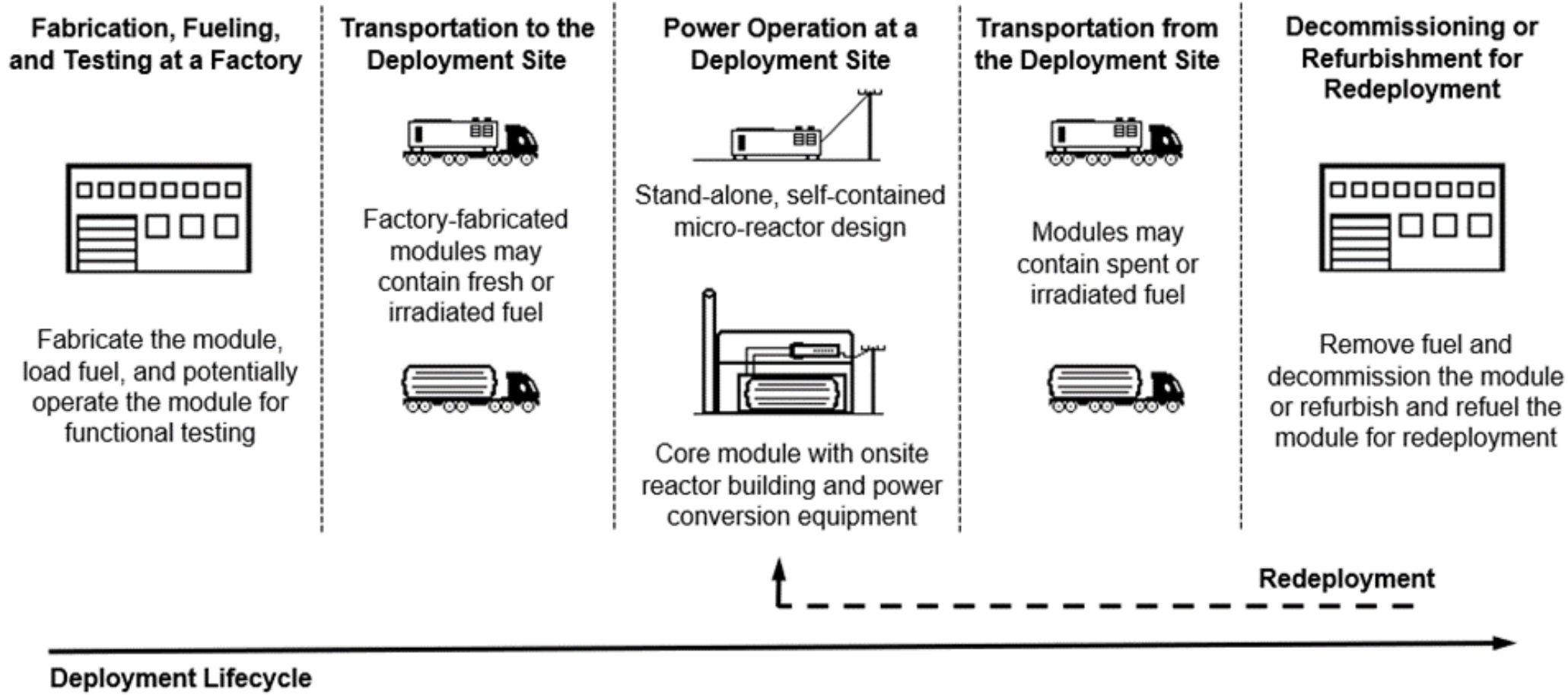
Contents

- Motivation for the paper
- Conceptual deployment model for factory-fabricated transportable micro-reactors
- NRC Staff Draft White Paper, “Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory”
- Regulatory approaches for features to preclude criticality, fuel loading at a factory, and operational testing at a factory
- Other licensing and deployment topics and potential near-term strategies and next steps
- Stakeholder engagement
- Next steps

Motivation for this Paper

- Stakeholder interest in the deployment of factory-fabricated micro-reactors is increasing
- The NRC staff is currently in pre-application engagements with several factory-fabricated micro-reactor developers that are considering novel deployment models (e.g., fuel loading and operational testing at a factory)
- The NRC staff is prioritizing development of strategies to provide for the predictable and efficient licensing and regulation of these designs and operational models, and the identification and resolution of associated policy issues

Conceptual Deployment Model for Factory-Fabricated Micro-Reactors



NRC Staff Draft White Paper

- Describes regulatory approaches the NRC staff is developing for consideration by the Commission related to three topics:
  1. Features to preclude criticality
  2. Fuel loading at a factory
  3. Operational testing at a factory
- Includes an enclosure with information on other licensing and deployment topics and potential near-term strategies and next steps the NRC staff is considering
- The draft white paper and enclosure are available at:
  - Updated NRC Staff Draft White Paper on Micro-Reactor Licensing and Deployment Considerations (ML23264A802)
  - Updated NRC Staff Draft White Paper on Micro-Reactor Licensing and Deployment Considerations – Enclosure (ML23264A803)

Regulatory Approaches for Features to Preclude Criticality

- The NRC staff is developing approaches for features to preclude criticality for consideration by the Commission
  - Features to preclude criticality would make a factory-fabricated micro-reactor incapable of sustaining a nuclear chain reaction under any conditions
  - The Commission's historical position has been that operation of a reactor includes the loading of fuel and a reactor would be "in operation" when loaded with fuel regardless of whether features to preclude criticality are installed
  - Several requirements in the Atomic Energy Act of 1954, as amended (AEA), and 10 CFR Parts 50 and 52 must be satisfied before the reactor is placed into operation or are premised on the reactor being in operation. Also, several requirements are tied to initial fuel load or to initial fuel load by a combined license holder
  - Under this approach, removal of features to preclude criticality would also serve as the best analogue to initial loading of fuel for reactors without such features to accomplish the underlying purpose of requirements tied to initial fuel load
    - The staff plans to recommend an approach in which a factory-fabricated module that included features to preclude criticality would not be "in operation" when loaded with fuel and operation would begin with the removal of those features

Regulatory Approaches for Fuel Loading at a Factory

- The NRC staff is developing approaches for licensing fuel loading at a factory under the existing regulations for consideration by the Commission:
  - Option 2a: Facility operating license issued pursuant to 10 CFR Part 50 or a combined license issued pursuant to 10 CFR Part 52 that limits operation to fuel loading
  - Option 2b: Manufacturing license issued pursuant to 10 CFR Part 52 for manufacture and possession of the utilization facilities and a license to possess special nuclear material issued pursuant to 10 CFR Part 70 that authorizes loading fuel into utilization facilities that include features to preclude criticality
    - Staff plans to recommend Option 2b

Regulatory Approaches for Fuel Loading at a Factory

- The license application would include the criticality safety controls required by 10 CFR Part 70 for factory operations (e.g., fuel storage, fuel handling, loading fuel in a module), which may be different than or in addition to the features to preclude criticality included in the factory-fabricated module that would be described in the 10 CFR Part 52 manufacturing license application
- The application for the 10 CFR Part 70 license would include the technical qualifications of the manufacturer to engage in fuel loading activities in accordance with applicable regulations
- The 10 CFR Part 70 license would specify the quantity and form of special nuclear material allowed to be possessed and place requirements on areas, structures, and equipment within the factory where the fuel is handled and stored

Regulatory Approaches for Operational Testing at a Factory

- A power reactor facility operating license or combined license is required to operate a power reactor for testing at a factory
- The safety analysis for operational testing would leverage the approved power reactor design in the manufacturing license and be tailored to the proposed conditions for testing at the factory
- The application for the license for operational testing would include the testing program, maximum power level, cumulative operating time, factory-located design features, technical specifications, and operational programs necessary at the factory

Regulatory Approaches for Operational Testing at a Factory

- The NRC staff is developing approaches for licensing operational testing at a factory under the existing regulations for consideration by the Commission:
  - Option 3a: Facility operating license issued pursuant to 10 CFR Part 50 or a combined license issued pursuant to 10 CFR Part 52 that limits operation to that needed for operational testing (status quo)
  - Option 3b: Facility operating license issued pursuant to 10 CFR Part 50 *based on the regulations for non-power reactors*, that limits operation to that needed for operational testing
    - Staff plans to recommend Option 3b to provide an alternative licensing approach in addition to that available under Option 3a

Regulatory Approaches for Operational Testing at a Factory

- Under Option 3b, the applicant would prepare its construction permit and operating license applications and the NRC staff would conduct its reviews primarily using the guidance in NUREG-1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors”
- The NRC staff would assess the appropriateness of and apply the necessary non-power reactor regulations (e.g., through exemptions, license conditions, and/or hearing orders) and guidance for operational programs to account for a wide variety of designs and operational testing characteristics

Regulatory Approaches for Operational Testing at a Factory

- Under Option 3b, the NRC staff would focus its review of the construction permit and operating license applications on:
  - factory-located design features not covered in the approved power reactor design
  - operational programs
  - technical specifications
  - operator licensing
  - emergency preparedness
  - physical security
  - siting
  - environmental considerations

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Timeframe for authorization to operate at the deployment site

- Factory-fabricated micro-reactors may have significantly simpler and shorter construction activities at the deployment site compared to large light water reactors and could be ready to begin operation in days to weeks to a few months after obtaining a construction permit or combined license
- Several requirements in the AEA and 10 CFR Part 50 and Part 52 that are related to the environmental review, the schedule for intended operation, public notifications, the opportunities for hearing, authorization to operate the facility, and others include timeframes that could add up to many months in total

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Timeframe for authorization to operate at the deployment site

- For licensing under 10 CFR Part 52, the NRC staff plans to clarify the circumstances under which the schedule for intended operation and initial fuel load can be accelerated and is considering ways to streamline public notifications, hearings, and the authorization to operate, as appropriate
- For licensing under 10 CFR Part 50, the NRC staff is considering opportunities to expedite steps in the processing and review of applications for facility operating licenses, such as acceptance review and docketing, milestones for hearings, and the supplement to the environmental impact statement

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Licensing replacement reactors

- Factory-fabricated micro-reactors might be periodically replaced with reactors of the same design at the end of their lives or fuel cycles, and each reactor would be required to have its own combined license or facility operating license
- A licensee might have multiple fueled reactors on site in various states of operation and shutdown to allow for transition from the operating reactor to the replacement reactor with minimal downtime. This would need to be considered in the safety and environmental reviews

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Licensing replacement reactors

- The NRC staff previously addressed similar concepts and considered licensing options for multi-module facilities in SECY-11-0079, “License Structure for Multi-module Facilities Related to Small Modular Nuclear Power Reactors,” dated June 12, 2011 (ADAMS Accession No. ML110620459)
- The NRC staff is considering approaches under 10 CFR Part 50 and Part 52 where the construction permit application or combined license application would cover all reactors envisioned to be operated at the deployment site and each reactor would be authorized to begin operation under its own facility operating license or combined license once the Commission had made the required findings

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Autonomous and remote operations

- Proposed designs for factory-fabricated micro-reactors (and potential designs for other types of reactors) might include autonomous and remote operational characteristics to reduce the number of operators and other categories of personnel at the facility site
- As previously noted in SECY-20-0093, “Policy and Licensing Considerations Related to Micro-Reactors,” dated October 6, 2020 (ADAMS Accession No. ML20129J985), both autonomous and remote operations raise potential policy-related matters
- The NRC staff plans to further develop its understanding of the industry deployment models for factory-fabricated micro-reactors with respect to industry plans for remote and autonomous operations, identify any gaps in the existing human factors engineering review needed to address the deployment models, and develop the technical bases for any new guidance that may be needed

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Transportation of fueled reactors

- Factory-fabricated micro-reactor developers (and potentially developers of floating nuclear power plants that use reactors with higher power levels) envision transporting fueled reactors from a fabrication site or a refurbishment and refueling facility to the deployment site for operation and later removing fueled reactors from the deployment site at the end of their useful lives or fuel cycles
- Transportation packages for factory-fabricated micro-reactors may consist of the reactor itself or the reactor plus additional overpack, as needed. Packages for transporting a micro-reactor from the factory to the deployment site could be either a Type A fissile (Type AF) or Type B fissile (Type BF) package, as defined in 10 CFR Part 71

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Transportation of fueled reactors

- The NRC staff intends to use the existing regulatory framework (primarily 10 CFR Part 71) to review transportation of fueled commercial micro-reactors in the near term, which may include the use of the alternate test criteria in 10 CFR 71.41(c), the special package authorization option in 10 CFR 71.41(d), or exemptions, as appropriate

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Storage of fuel after irradiation in a power reactor

- Depending on the duration between the last use of the fuel as an energy source and placement of the fuel into a dry storage facility, different regulations may apply to the storage of fuel withdrawn from the reactor
- The definition of spent fuel in 10 CFR 72.3 includes criteria that the fuel has been withdrawn from a nuclear reactor following irradiation and has undergone at least one year's decay since being used as a source of energy in a power reactor

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Storage of fuel after irradiation in a power reactor

- In order to use an independent spent fuel storage installation to store irradiated power reactor fuel withdrawn from a reactor that had undergone decay for less than a year, the licensee would be required to apply for a specific license under 10 CFR Part 72 and request and justify exemptions addressing the one-year decay time requirement in the regulations
- The NRC staff intends to engage with stakeholders as they further develop their strategies for handling and storage of irradiated and spent fuel generated in factory-fabricated micro-reactors

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Decommissioning process and decommissioning funding assurance

- Factory-fabricated micro-reactor deployment models might involve transporting a reactor away from the deployment site to a facility at a different location for decommissioning at the end of its life or for refurbishment and refueling before re-deployment
- Depending on the activities to be conducted at a decommissioning facility or a refurbishment and refueling facility, the facility may need to be licensed under a combination of the regulations in 10 CFR Part 30 for byproduct material, Part 50 or 52 for a facility operating license or combined license, Part 70 for special nuclear material, and Part 72 for spent fuel storage

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Decommissioning process and decommissioning funding assurance

- The draft white paper addresses a scenario in which the reactor module is decommissioned away from the deployment site. In this scenario, the deployment site licensee would need to establish decommissioning funding assurance that considers the cost of removing the reactor from the site and decommissioning it elsewhere in addition to the cost of decommissioning activities at the deployment site.
- The NRC staff may consider site-specific decommissioning cost estimates that appropriately account for all activities at both locations and all waste disposal costs

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Siting in densely populated areas

- Some micro-reactor license applicants might seek to site reactors at locations that are inconsistent with the current Commission policy and the regulations in 10 CFR 100.21(b), i.e., a location within a population center of 25,000 residents or more
- The NRC staff is currently revising the population-related siting guidance in Regulatory Guide (RG) 4.7, “General Site Suitability Criteria for Nuclear Power Stations,” Revision 3, issued March 2014 (ADAMS Accession No. ML12188A053) to provide technology-inclusive, risk-informed, and performance-based criteria to assess certain population-related issues in siting advanced reactors
- In the near term, the staff will continue its effort to revise RG 4.7 and will review license applications in accordance with current Commission policy that allows alternative population-related criteria but precludes siting a commercial power reactor, no matter the size or type of reactor, within a population center of 25,000 residents or more

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Commercial maritime applications

- The NRC staff is aware of growing interest in commercial maritime applications of factory-fabricated micro-reactors and other reactor technologies for stationary power production, marine vessel propulsion, production of decarbonized fuels, and other uses
- Depending on the particular application, deployment of commercial maritime reactors could introduce a host of policy issues and legal matters, especially for nuclear propulsion in the international shipping industry
- The NRC staff will continue to engage with stakeholders and monitor developments related to commercial maritime applications and assess the need for future Commission direction

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Commercial space applications

- The NRC staff is aware that developers are considering space applications of factory-fabricated micro-reactors. However, the NRC staff is not aware of any plans for fully commercial space applications
- In the case of a fully commercial space application of a factory-fabricated micro-reactor, the NRC's established regulatory jurisdiction and licensing authority would cover the related terrestrial activities prior to launch activities, which would be under the authority of the Federal Aviation Administration's Office of Commercial Space Transportation (a part of the Department of Transportation)
- If developers engage the NRC staff on terrestrial activities related to commercial space applications of factory-fabricated micro-reactors, the NRC staff intends to apply the established regulatory framework, as informed by the potential licensing approaches and strategies outlined in this presentation

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Commercial mobile applications

- Factory-fabricated micro-reactor deployment models might include scenarios where the reactor would be operated on an as-needed, where-needed basis, such as for disaster relief or to meet temporary increases in demand
- The current regulatory framework for reactor licensing is not conducive to this deployment strategy because the regulations in 10 CFR Part 100 apply to every site at which a reactor may be operated, and NRC's implementation of the National Environmental Policy Act relies on performing an environmental review that contemplates a particular site

Other Licensing and Deployment Topics and Potential Near-Term Strategies and Next Steps

Commercial mobile applications

- Also, the NRC must complete its licensing process (safety and environmental reviews, hearings, etc.) before the Commission can issue a facility operating license or authorize operation under a combined license. The licensing process may take a minimum of several months to complete, limiting the ability to rapidly deploy a reactor to meet immediate, short-term needs
- The NRC staff will monitor developments in the commercial sector related to deployment models and the demand for commercial mobile micro-reactor licensing. The staff will assess the need for future Commission direction and rulemaking in this area

Stakeholder Engagement

- Public meetings March, July, and September 2023
  - Favorable feedback from stakeholders on scope of the paper and the options developed by staff
  - Request for continued engagement on guidance for implementation of Commission direction
- The Nuclear Energy Institute and Westinghouse Electric Company provided written feedback on the draft white paper

Next Steps

- Send a SECY paper to the Commission on licensing and deployment considerations for factory-fabricated micro-reactors in October 2023:
  - Request Commission direction on “features to preclude criticality”
  - Request Commission direction on regulatory approaches for loading fuel and operational testing at the factory
  - Provide information on other topics, including the NRC staff’s related near-term strategies and next steps

Questions?