Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards

Docket Number: (n/a)

Location: teleconference

Date: Wednesday, November 6, 2024

Work Order No.: NRC-0096 Pages 1-94

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1716 14th Street, N.W.
Washington, D.C. 20009
(202) 234-4433

DISCLAIMER

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

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

720TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

WEDNESDAY

NOVEMBER 6, 2024

+ + + + +

The Advisory Committee met via teleconference at 8:30 a.m., Walter L. Kirchner, Chair, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chair

GREGORY H. HALNON, Vice Chair

DAVID A. PETTI, Member-at-Large

RONALD G. BALLINGER, Member

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member

CRAIG A. HARRINGTON, Member

ROBERT P. MARTIN, Member

SCOTT P. PALMTAG, Member

THOMAS E. ROBERTS, Member

ACRS CONSULTANTS:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

HOSSEIN NOURBAKHSH

CONTENTS

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

(8:30 a.m.)

CHAIR KIRCHNER: Okay. The meeting will now come to order. This is the first day of the 720th meeting of the Advisory Committee on Reactor Safeguards, ACRS. I'm Walt Kirchner, Chair of the ACRS.

ACRS members in attendance in person are Ron Ballinger, Greg Halnon, Craig Harrington, Bob Martin, Scott Palmtag, Dave Petti and Tom Roberts.

ACRS members in attendance virtually via Teams are Vicki Bier and Vesna Dimitrijevic. And ACRS consultants also via Teams are Dennis Bley and I expect Steve Schultz to join us as well. If I missed anyone, either ACRS members or consultants, please speak up at this point.

Derek Widmayer, the ACRS staff, is the designated federal officer for this morning's full committee meeting.

No member conflicts of interest were identified for today's meeting and I note that we have a quorum.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, or FACA. The NRC implements FACA in accordance with its

regulations.

For these regulations and the Committee's bylaws, the ACRS speaks only from its published letter reports. Therefore, all member comments should be regarded as only the individual opinion of that member and not a committee position.

All relevant information related to ACRS activities, such as letters, rules for meeting participation and transcripts, are located on the NRC public website and can be easily found by typing "About Us ACRS" in the search field on the NRC's home page.

The ACRS, consistent with the Agency's value of public transparency in regulation of nuclear facilities, provides opportunity for public input and comment during our proceedings.

We have received no written statements or requests to make an oral statement from the public; however, and, in addition, written statements may be forwarded to today's designated federal officer. We have also set aside time at the end of this meeting for public comments.

A transcript of the meeting is being kept and will be posted on our website. When addressing the Committee, participants should first identify

themselves and speak with sufficient clarity and volume so that they may be readily heard.

If you are not speaking, please mute your computer on Teams. If you're participating by phone, press *6 to mute your phone and *5 to raise your hand on Teams.

Please do not use the Teams' chat feature to conduct sidebar discussions related to presentations. Rather, limit use of the meeting chat function to report IT problems.

For everyone in the room, please put all of your electronic devices in silent mode and mute your laptop microphone and speakers.

In addition, please keep sidebar discussions in the room to a minimum since the ceiling microphones are live.

For presenters, your table microphones are unidirectional and you'll need to speak into the front of the microphone to be heard online.

Finally, if you have any feedback for the ACRS about today's meeting, we encourage you to fill out the Public Meeting Feedback Form on the NRC's website.

During today's meeting, the Committee will consider two topics. In the morning session, we will

discuss the Draft White Paper "Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations."

And in our afternoon session that will begin at 1:00 p.m., we will discuss the Triennial Review and Evaluation of the NRC Safety Research Program.

Tomorrow morning, the Committee will discuss the TerraPower Natrium Topical Report on Plume Exposure Pathway Emergency Planning Zone. And tomorrow afternoon, the Committee will have its monthly planning and procedures meeting.

Before I turn over the Committee's deliberations to Vicki Bier, who chairs our Regulatory Rulemaking and Policies Subcommittee, I'll ask members if they have any opening statements or comments for the record.

(Pause.)

CHAIR KIRCHNER: Okay. Hearing none, we'll turn now to the Draft White Paper on Nth-of-a-kind micro-reactor licensing and deployment Considerations.

Vicki, the floor is yours.

MEMBER BIER: Thank you very much, Walt.

As Walt mentioned, the Subcommittee on Regulatory Policies and Practices heard a detailed

briefing on the staff's Draft White Paper on Nth-of-a-kind micro-reactor licensing at its subcommittee meeting a couple of weeks ago and this draft is planned to become a SECY paper and sent to Commission for consideration.

So, we are reviewing the paper, as part of our obligations, under Title 10 of CFR to report on matters concerning the safety of nuclear power reactors.

At the subcommittee meeting, all but one of the ACRS members were present. We had some detailed discussion at the time and it was recommended that most likely a letter would not be needed at this time.

We may have comments on Nth-of-a-kind reactor licensing and deployment later as the process develops and becomes more detailed, but that at this time we most likely will not write a letter.

So, therefore, the plans for today are to have a short briefing summarizing some of the status of this effort on the part of the staff.

After that, there may be some discussion among the Committee Members and time for public comment.

I anticipate that this meeting will most

likely end fairly early, you know, not go the full morning session.

Anyway, with that, I apologize for not being in the room in person today. So, I'm not sure who is the lead presenter this morning, but whoever is opening for the staff can go ahead and begin their remarks.

MR. LYNCH: Good morning. This is Steve Lynch, Chief of the Advanced Reactor Policy Branch. I just wanted to thank the members again for the opportunity to come and discuss the important work that we are doing to prepare our regulatory framework for the rapid advanced deployment of micro-reactors.

The staff here is going to share a summary of the work that we have done by addressing operational programs and reviewing of the standardization of those to facilitate more effective licensing Nth-of-a-kind micro-reactors.

We look forward to answering any questions that the Committee may have for us today to further inform the work that we're doing as our next milestone with this effort is to prepare a policy paper for the Commission.

We are still in the feedback stage of developing this paper. So, getting feedback from the

members today will be taken into account in our continued work, and the staff is further engaging with stakeholders at a public meeting later this afternoon to get additional perspectives on the paper.

So, thank you, again, for your time. I will now turn it over to our presenters Duke Kennedy and Jackie Harvey.

MR. KENNEDY: Okay. Thank you, Steve.

Good morning, members of the ACRS. Pleasure to be here today to talk to you about our paper on Nth-of-a-kind micro-reactor licensing and deployment considerations.

So, the contents of our presentation today will include the motivation for the paper, the background, we'll talk about the conceptual deployment model for transportable micro-reactors, the anticipated licensing strategy for Nth-of-a-kind reactors, and we'll cover the options for standardization of operational programs and their review concurrent with the design stage.

And then there are five other topics related to Nth-of-a-kind micro-reactor licensing and deployment that we'll discuss that relate to enhancing the efficiency of Nth-of-a-kind licensing. And then we'll wrap up with brief notes on stakeholder

engagement and next steps.

Our motivations for the paper. We've been working for several years to evaluate the regulatory framework for micro-reactors and prioritizing strategies for reliable and efficient licensing of micro-reactors.

We continue to engage those stakeholders and pre-applicants through periodic stakeholder meetings as well as dedicated pre-application engagement activities.

We are prioritizing these strategies for predictable and efficient licensing and regulation of micro-reactor designs and the new operational models that they present, and have been working to identify, prioritize, and take steps to address and resolve associated policy issues.

So, for licensing purposes, micro-reactors are commercial power reactors licensed under Section 103 of the Act.

Based on feedback and information from developers, they're typically planning to use non-light-water reactor technologies, power levels anywhere from a few megawatts to several tens of megawatts. They have anticipated small site footprints which could be just a single container that

the reactor is contained in or a small site with simple instruction activities and buildings to support operations.

It is anticipated they'll have lower potential consequences in terms of radiological releases and increased reliance on passive systems and inherent characteristics to control power and heat removal compared to the large light-water reactors that are in operation today.

So, factory-fabricated transportable micro-reactors are a subset of micro-reactors that would rely heavily on standardization and mass production to simplify licensing and deployment.

We covered other topics related to factory-fabricated transportable micro-reactors in the SECY paper provided to the Commission in January of this year that focused on licensing and -- options for licensing and regulation of fuel loading and operational testing in a factory as well as a concept of features to preclude criticality that would allow a reactor loaded with fuel to be considered not to be in operation, which would facilitate transportation and other activities under the current regulatory framework.

For the purposes of this presentation, the

term "Nth-of-a-kind micro-reactor" generally means a micro-reactor of a standard design that has been previously approved by the NRC. This could be through a design certification, a manufacturing license, as well as through a first-of-a-kind licensing effort. Any of these can then be referenced in a subsequent application for an Nth-of-a-kind reactor.

And so, Nth-of-a-kind micro-reactor licensing refers to the licensing of micro-reactors of the standard pre-approved design for operation as power reactors at fixed sites.

Here's our conceptual deployment model. This is the same deployment model that we developed for the SECY paper provided to the Commission in January.

It starts with a manufacturing facility or factory where the reactor is fabricated. And depending on Commission direction on the previous SECY, it could be loaded with fuel or potentially operated for functional testing, including nuclear testing.

Then the reactor would be transported to a deployment site where it would be either set up as a standalone, self-contained design or incorporated into buildings and structures and equipment that's

constructed onsite.

And so, the paper that we're discussing today really focuses on the process for licensing that operation at the deployment site, in the middle column there.

And then following operation, reactors may be transported offsite and decommissioned elsewhere. They may be decommissioned onsite or they may be refurbished and refueled and redeployed.

So, what's in the Draft White Paper? We have two vote topics. One is approval of standardized operational programs at the design stage concurrent with a manufacturing license or design certification.

Then we also have alternative approaches for environment reviews, which we are not going to discuss today, but we have released an enclosure last week that covers more information about environmental reviews.

There's another enclosure, Enclosure 1, that provides additional information about operational programs and how they might be standardized for micro-reactors.

And so, that enclosure includes a lot of information about the staff's thinking of what might be able to be standardized for micro-reactors and what

benefits could be achieved by approving standardized operational programs early in the licensing process concurrent with a design review.

And then Enclosure 3 includes six additional information topics related to efficient Nth-of-a-kind license.

So, next we'll talk about the anticipated licensing strategies. Phase 1 is a robust up-front approval of a standard design. Listed there are numerous pathways through which this could be accomplished.

Also, approval of standardized operational programs to the extent practicable, and completion of a generic environmental review, to the extent practicable, and also completion of hearings that are necessary to cover the standard design or the rulemaking process for design certification.

So, these up-front approval activities would resolve many technical and other issues generically and then would be able to be referenced in the Nth-of-a-kind review.

The last bullet here is the time frames for these different pathways for achieving the standardized design. It can be varied.

We have generic milestones published for

how long these processes take and these -- the route that's chosen for approval of a standard design can also affect the time frames for Nth-of-a-kind licensing. We'll touch on that a little bit more later.

So, Phase 2 of the process is the actual Nth-of-a-kind licensing which would leverage the up-front approvals.

Because these reactor -- the reactor design would be essentially approved up front, we think there's an opportunity to take advantage from streamlined administrative processes. I'll touch on that a little bit later.

There would also need to be safety and security reviews that focus on confirmation of site suitability.

So, the level of standardization achieved in Phase 1 will determine the effort that's necessary to do these reviews for confirming site suitability.

There will also be site-specific environmental reviews, confirmatory inspections at the place of fabrication and also at the deployment site.

And, again, this will depend on a developer's deployment model and whether they're taking advantage of manufacturing the reactor at a

manufacturing facility or how much onsite construction is necessary to -- for the reactor design.

Then for Part 52, licensing there would be a verification of completion of the inspections, tests and analyses and satisfying the acceptance criteria, ITAAC.

And then for Part 50, there will also be readiness inspections for operations and verification that the reactor has been -- construction has been substantially completed.

And then both Part 52 and Part 50 include site-specific hearings that are mandatory hearings as well as opportunities for contested hearings.

VICE CHAIR HALNON: Duke, this is Greg Halnon. One of the things that at least I'm struggling with, and I think a few of the members may be, I understand that security is not in the purview here; however, the effects of a security event could very much affect what we decide and talk about around this table relative to source terms and effect on the public and other things.

In addition, I get that the environmental review you say is not in our -- necessarily part of this meeting, but the effects on the environment are. So, when we try to exclude those from our discussion,

we're incomplete in some things.

So, bear with us if we talk about those things, maybe not how we protect, but what happens if something from a security event, if you will, occurs because that's a big piece of the discussion when you're transporting and fueling and operating these things all across our land.

So, I just wanted to make that comment at this point so that if we don't come back and put our hand on this thing, we can't talk about that, we may.

MEMBER PALMTAG: This is Scott Palmtag. I just want to follow. I agree with what Greg said. Environmental review is not part of this review.

Is it going to be? Are we going to see this in the future? Is there a plan to hear about the environmental review?

(Pause.)

MEMBER PALMTAG: I'm going to take that as a no, but I do agree. I'm very curious how that's going to work out. So, I'd like to hear something about the environmental review when it is ready.

MEMBER MARTIN: This is Bob. Environmental is kind of outside the scope of ACRS, typically, right?

VICE CHAIR HALNON: Yes.

MEMBER MARTIN: Yeah. So, we --

(Simultaneous speaking.)

MEMBER PALMTAG: It's part of the licensing, though.

MEMBER MARTIN: Yes, it's part of the licensing, but I don't think it's part of ACRS --

(Simultaneous speaking.)

VICE CHAIR HALNON: Maybe our staff can help us, nor does it exclude us from looking at environmental --

MR. WIDMAYER: So, hey, you guys. This is Derek Widmayer. What we're excluded from doing is the NEPA review, the mandated NEPA review.

So, that -- and that's basically what they are addressing in Enclosure 2 is how they want to do that.

You're not excluded from talking about appropriate environmental impacts as they relate to safety, but we're talking about the mandated legal review as something that you guys don't have to get involved in or are not supposed to get involved in.

CHAIR KIRCHNER: Right. So, we don't weigh in in the NEPA process directly, but certainly the safety review that the staff performs for any concept informs the environmental review in many different

ways. And so, it's part of our statutory responsibility in reviewing safety issues.

Indirectly, we will look at environmental impact, but we do not participate formally in the NEPA process.

MEMBER PALMTAG: Thank you. This is Scott Palmtag again. I understand that. The one area I have is in the schedule in that, my understanding, you still have to go through the environmental review.

And if the environmental review is still going to take something, I mean we're at a year or more, it seems like unrealistic expectations to try to get our licensing approval done in six months.

So, specifically I have questions about it. I don't want to do oversight of the environmental review, but I'm curious how they plan on getting the time frame for the environmental review down to six months like we're expected to.

MR. LYNCH: This is Steve Lynch, Chief of the Advanced Reactor Policy Branch, just to speak briefly on the environmental review piece of this.

So, the NRC does have parallel actions that it is taking right now looking at how we are conducting environmental reviews particularly in response to the Fiscal Responsibility Act that does

direct the NRC to look at streamlining activities that we could take to improve our efficiency in conducting environmental reviews.

So, we do expect that there will be continued efficiencies identified in some of our parallel actions that we will coordinate with our micro-reactor efforts.

MEMBER PALMTAG: Thank you.

MEMBER ROBERTS: Yes. Tom Roberts. Following up with what Greg and Derek said, part of the environmental assessment is the Severe Accident and Management Alternative -- the Severe Accident Mitigation Design Alternatives and that's an area that I would think we would want to look at that just generically is that that's where that type of assessment shows up.

Maybe everybody has a different view on that, but that's one area it seems that we should just, you know, inherently review.

MR. LYNCH: Steve Lynch again just to speak on severe accidents. In the guidance that the NRC has developed for advanced reactor environmental reviews to include micro-reactors, that is a topic that we have aggressed in looking in making sure that the staff is aware of differences and how we may look at

SAMDAs compared to previously licensed large light-water reactors. So, there are efforts looking at that.

For the current paper that we're working on, you know, looking at the operational programs and more on that administrative side, that is exciting to hear.

But as we continue to implement strategies moving forward consistent with legislative direction, whether that be NEIMA, the Fiscal Responsibility Act, or the ADVANCE Act, the NRC staff will continue to look at the hazards associated with the operation and siting of these micro-reactors.

And to the extent that we have issues that come up that we are looking to address that are unique to these facilities, we will bring them to the ACRS to discuss. So, thank you.

MR. KENNEDY: Okay. Thank you. I will just also mention that the regulations for manufacturing licenses and design certifications require the NRC to prepare an environmental assessment that directly address SAMDA.

That's one environmental issue that is reviewed as part of proceeding for a manufacturing license or a design certification.

I think I'll also offer with respect to the question on the timing of the entire process, we have laid that out in the White Paper, some illustrative time frames for what we think could be sort of minimal overall process time frames for parts of the licensing process that are directly under NRC control, as well as -- I don't want to say "maximum" time frames, but longer time frames.

And in developing those illustrative time frames, when you get to the lower ends, you're talking about situation where reactors are fully standardized. They're being produced without any departures from the approved design.

And then, also, the environmental review has been pared down to a streamlined environmental assessment or even a categorical exclusion.

So, those are the options that are discussed in the paper that would help to achieve the shortest time frames, but, if you read Enclosure 2, you'll see a fulsome discussion of the staff's overall strategy for conducting its NEPA reviews and how it might be phased over time to take advantage of gaining experience with licensing a particular design.

So, I'll just say that we have considered how the environmental review can be streamlined and

the overall time frame shortened would be aligned with the time frame that we think would be necessary to conduct the safety portion of the review. So, we've considered both in our illustrative time frames.

Okay. So, now I'm moving into approaches for review of standardized operational programs. So, this is the first vote topic that would be presented in the SECY paper and that's discussed in the White Paper.

There are two options the staff has considered and the first option -- let's go here to the next page -- the first option is the status quo that's currently applicants can submit operational programs as topical reports or they could also reference operational programs that have already been approved in a previous reactor licensing review. So, those are available at this time.

The second option the staff has been considering is the review and approval of operational programs in parallel or as part of a design certification or -- sorry, as part of the design certification or manufacturing license application.

So, this would allow applicants to propose standardized operational programs in the ML or DC application for the NRC staff to review and approve

those at the design stage, which would essentially allow applicants for Nth-of-a-kind reactors to reference those programs and not have them have to be part of the extensive review of a COL application.

So, the thinking here is that by having those programs pre-approved as part of the ML or DC, that the time frame for Nth-of-a-kind licensing can be reduced by saving the time needed to review those programs with a review of each combined license or construction permit and operating license application.

VICE CHAIR HALNON: So, did you envision change process for customization similar to the 5059-type process later down the road? The company buys one of these and then they make a small change to these standardized programs?

MR. KENNEDY: So, there are change control processes specified in the regulations and as part of the design certification rulemaking. One of the appendices usually includes a discussion of the processes needed for change control.

I don't know, Jackie. Did you want to add anything here?

MS. HARVEY: Yes. This is Jackie Harvey. So, that is something that we are going to explore, if directed by the Commission, to pursue Option 2.

VICE CHAIR HALNON: But we saw recently in a discussion we had on SMR that the degree of standardization during the approval process sometimes was left up to the COL applicant where it put into question what the definition of "standard" was, basically, and we struggled a little bit with how deep to go with that.

So, on this will you have a list of at least the minimum set of programs required to be standardized or is it going to be left up to -- is that just nebulous at this point?

MS. HARVEY: Yeah, this is Jackie Harvey again. So, there are a lot of different deployment models that are being discussed right now.

So, we're trying, at least at this point in time, to allow staff the flexibility to make that decision in the future to see what developers are going to do.

VICE CHAIR HALNON: So, it could be reactor-specific?

MS. HARVEY: Exactly.

VICE CHAIR HALNON: Okay. Thanks.

MR. KENNEDY: Thank you. So, one other thing to mention, and this goes to your question, is that there is some uncertainty about how fully an

applicant could describe its programs and how much reliance there would actually be on site-specific features.

And so, this approach would allow the staff to prove these programs up front if they're fully described.

MS. HARVEY: Um-hm.

MR. KENNEDY: And if a full program isn't described, there may be the ability to approve some aspects or requirements within that program on a generic basis and then focus the Nth-of-a-kind review of those programs on filling in the site-specific considerations.

The idea is that a future applicant, if Option 2 were available, could still choose to do Option 1. It really depends on what's appropriate for their deployment model.

And so, this -- the options that we're considering for the paper are really to provide additional flexibility for the staff and for applicants to be able to implement their desired deployment models and we think that there's going to be a wide variety of what applicants end up wanting to do.

Okay. So, now moving to the information

topics that are presented in the paper, the first is maximum design standardization.

And this isn't really anything new; however, micro-reactors having typically simpler designs and smaller site footprints, perhaps much less reliance on site-specific construction activities, really offer kind of a new opportunity to take advantage of design standardization in making Nth-of-a-kind licensing more efficient.

So, again, there are various pathways by which a standardized design could be approved. Could be a manufacturing license, which really provides the greatest level of standardization for a reactor that can be fully manufactured in a factory.

The regulations for design certifications cover the entire plant. And so, the whole-plant design could be standardized through a design certification which could include things that would be constructed at the site as opposed to just things manufactured in the manufacturing facility.

And then there is also standard design approval that can be used for entire portions of a plant; however, that doesn't really achieve the same level of standardization in terms of regulatory stability and finality of the proceeding on the design

approval.

And then, again, there's also the ability to standardize through first-of-a-kind reactor design that could be referenced in subsequent applications.

But when we're talking about maximal design standardization, we're really focusing on manufacturing licenses and design certifications that provide the greatest level of finality and regulatory stability of the design.

MEMBER PALMTAG: This is Scott Palmtag again. This is just a follow-on to Craig's comment from before, but there's -- as we discussed yesterday, there's different kinds -- there's standard designs and then there's as-built designs.

When you say the standard designs, are you saying the standard designs or something that fully is or another category that's fully built, all the piping diagram concerned, et cetera, et cetera?

MR. KENNEDY: Yeah. So, maximal design standardization, in this paper, is what would be needed in order to achieve the shortest time frames.

And we're talking about a design that's fully -- a final design that's fully approved and that each individual reactor deployment does not take any departures from that design.

So, it's not a -- when I hear "as-built," I think of when you get to the end of construction and you're ensuring that you've followed the design exactly.

If there are any departures that require additional analysis, that's not maximal design standardization.

MEMBER PALMTAG: This is Scott again. You could have a standard design, but people could still make changes. It's a category below that standard design, for example where the pipes go, et cetera, et cetera.

Is there any -- is there a separate category for that? I would think if you're going to do an Nth-of-a-kind, you'd sort of want the same reactor going out the door not changing the small things, is there?

MR. KENNEDY: So, there are some flexibilities depending on how the final design is described; however, what we're looking at here is a case where every reactor is essentially identical.

If an individual applicant wanted to make changes to that design for some reason to account for some specifics of the site, that would open up that portion to review again as part of the COL review or

the CBOL review which would necessarily extend the licensing process. So, somewhat compared to if the design fit the criteria of maximal design standardization.

MEMBER PALMTAG: My concern is that standard design does not mean identical designs. Just something to think about.

MR. KENNEDY: Thank you. And one thing that we've heard from developers, also, is that they may actually have more than one model of a standard design where -- depending on where the reactor -- the characteristics are the same where the reactor could be deployed.

They may have different, for example, seismic protection equipment, a model A reactor that goes in lower seismic hazard zones and a model B reactor that could go in higher seismic hazard zones.

And so, there are ways that a single reactor design, the basic design, could be -- could have variants approved ahead of time so that we get to the site-specific licensing and you, again, you don't have to go back and review that aspect if the correct model and reactor is chosen for the site that part is going to be deployed. So, that's one strategy that we've heard from stakeholders.

Okay. The next topic is grading the level of site characterization. So, the thought behind this, and it's being presented at a conceptual level in the paper, there would need to be -- or likely be guidance developed on how to implement this and that would be something coordinated with stakeholders, but the idea -- the conceptual idea presented is that for micro-reactors and considering their design characteristics, it may be possible based on a comparison of the bounding design parameters of the reactor and the actual site characteristics and the margin between those, the design parameters and the site characteristics, and also considering the margin between the actual consequences of potential accidents and the regulatory criteria for doses, that considering those margins it may be possible to do the site characterization in a way that's different from how we do it now and integrate it based on considering those margins.

So, for example, if the consequences of a potential accident are very low and the margin between the design limit and the site characteristics is very low, may be possible just to rely on existing data that's available in vetted public sources, USGS maps, instead of doing detailed onsite investigations.

That's one illustrative example.

This would have to be done on a characteristic-by-characteristic basis. So, each site characteristic would be evaluated with respect to the margin between that characteristic and the design value. Also, consider the consequences of accidents that could potentially result from site-specific hazards and then determine if there was a -- if there was enough reliable data that already existed or if there needed to be some site characterization activities to supplement that.

And you may find that, in the end, you need to do the same level of site characterization as we're currently doing.

MEMBER MARTIN: This is Member Martin. I appreciate of course the amount of high level of what you've written down, but I'd like to emphasize the point that’s been made a couple times about novel deployment.

I can't help but believe that kind of a business case for micro-reactors is all about the novel and we're still thinking kind of in the old way with site characterizations and operations and what have you, you know.

I, you know, events like, you know,

Hurricane Helene or, you know, any natural disaster, you know, brings up the thought that you might want a micro-reactor, transportable reactor, to respond to national emergencies, novel deployment situations where you wouldn't have time to do, you know, a thorough site characterization in the sense that we normally would do.

When do we address those novel situations, because I think they're going to be more common with these things particularly considering, you know, micro-reactors are a more expensive option.

So, when is that option the right option? And certainly we can think of, you know, emergency situations, quote situations, what have you, but transportation is a big part of it.

And, you know, there isn't, you know, a lot in the white paper on novel, but I know it has to be on your minds.

When does that come in? We've just been trying to tweak regulations that we have now with an eye towards the future and then expecting other incremental changes as we get more clarity or is there some activity to really focus on some of these novel deployment scenarios?

MR. KENNEDY: Thank you for your question.

So, this paper focuses on fixed site deployment and really where the reactor would be reviewed and licensed at a single fixed site, but that doesn't preclude a single reactor from actually being licensed at other sites as well, but that is not the focus of this paper.

There is legislation that was signed earlier this year of the accelerating deployment of advanced nuclear -- versatile advanced nuclear for clean energy or ADVANCE Act, and that has a section, Section 208, and that covers micro-reactor licensing and regulation.

Section 208 has eight topics. One of the topics is siting and the siting has three subtopics. Those are considering the population density criteria that was described in a staff paper to the Commission in 2020, and also to consider siting in relation to licensing mobile deployment of micro-reactors, and siting in relation to environmental reviews.

And so, the ADVANCE Act directs the NRC to develop risk-informed, performance-based strategies and guidance in these areas that are called out in Section 208. And so, mobile -- licensing mobile deployment is one of those areas.

And so, those strategies and guidance are

to be developed within 18 months of signature of the law, which was in July. So, that would be January 2026.

And then to have those strategies and guidance implemented by -- within three years, which would be July of 2027. So, that is coming.

MEMBER MARTIN: So, what will we expect in 18 months? I mean, a white paper or is there more there?

MR. KENNEDY: So, I think it's too early to say specifically on that topic.

MEMBER MARTIN: All right. Thank you.

MR. LYNCH: Real quick. This is Steve Lynch, Chief Advanced Reactor Policy Branch. When it comes to implementation of specific strategies under the ADVANCE Act method of transportation, the NRC staff has taken a coordinated approach as an agency in working methodically to develop reports and implementation strategies acquired.

At this time, the NRC staff is still assessing what the strategies are that we would like to implement.

We intend by early 2025, as directed by the legislation, to have identified the areas and strategies that we will be working towards to support

micro-reactor licensing and in line with the Act we have three years to work toward implementation.

So, as we have those implementation strategies identified, we do expect additional engagement of the ADVANCE Act.

CHAIR KIRCHNER: I would just interject at this point that I requested our staff to arrange with my teams leading that effort to respond to the ADVANCE Act, as Steve just outlined, and we'll have a presentation at the ACRS in February time frame.

And that will go into detail on -- well, as they formulate their strategies and timelines, they'll share what's available then in February.

MEMBER ROBERTS: Yes. This is Tom Roberts. I think the answer to Bob's question is the comment that Greg had made at the subcommittee, which is there are a lot of topics that need to be reviewed and some of them were described as future in the earlier this year SECY paper.

To get them all resolved in the next 18 -- well, 14 months, right? We've already got four months, you know, behind us.

There's been a lot of interaction, I think, with us to try to make sure we're up to speed on what it is you're doing in a way that doesn't

interfere with the schedule.

I'm sure you're working that out in terms of how you guys interact with us as part of the overall timeline.

It's a very aggressive timeline. There's a lot of topics in there. I don't envy you at all for, you know, great challenge, I guess, I was going to say for you to come through that, but just we want to be caught at the appropriate time so we're not limited at the end.

VICE CHAIR HALNON: Yeah, and there's a double reason for that. One, that Tom just said. The other reason is we need to establish, in parallel, what our process of review is going to be for Nth-of-a-kind reactors as well.

So, we want to complement what you're doing to make sure that our -- down the road our reviews are as efficient as your review is going to be.

So, it's -- there's a double reason there for our process as well, not just the topical aspects.

MR. KENNEDY: Okay. Thank you. The next topic is deployment site emergency preparedness. So, there's information in Enclosure 1 that talks about standardization in emergency preparedness programs for

micro-reactors.

But in Enclosure 3 in the information topic it provides some additional information related to what emergency preparedness looks like for Nth-of-a-kind micro-reactors at the deployment site.

And so, the regulations in -- the existing regulations in 10 CFR Part 50 and 10 CFR Part 52 apply to micro-reactors of a common design.

And the NRC staff is exploring approaches for streamlining the review of emergency preparedness for licensing Nth-of-a-kind micro-reactors based on several considerations. And these include the possibility that potential accidents would result in low doses at the site boundary and, under certain circumstances, might not require extensive offsite response.

So, the particular characteristics of micro-reactors come into play here as well as the level of reliance onsite or interfaces with the site and what site-specific factors might need to be considered under emergency preparedness depending on the specific design of the reactor and what can be approved ahead of time in the manufacturing license or design certification or result in a first-of-a-kind licensing proceeding.

VICE CHAIR HALNON: So, just one followup on this because I don't think there's any concern about the classic emergency preparedness.

We know it's going to be a lot less impactful than obviously what we used to with the light-water reactors and whatnot. So, that's not a problem.

But I would hope that in the conversation that you guys have about emergency preparedness, you talk about maybe the non-classic stuff. I mean, stuff like, you know, we've lost RT sources. People have put them in their pocket and had problems and things like that.

I'm not saying that you're going to get a micro -- even though it says "micro," you're not going to put a micro-reactor in your pocket, but there may be some things from an offsite preparedness perspective that may need to be done even though an offsite response is not required.

For example, at least some training and other things. You look at those things that are not just licensed-based events, I mean, that's very small, it's not going to be a problem from a dose perspective, but there may be some other things based on reactor-specific issues that could affect at least

the offsite locale.

So, it may be just a legal discussion from that vantage to make sure that there's nothing that we're introducing that could be harmful to the public, I mean, not deadly or could cause impairment or a response or something to that affect, but still something that may be there that we need to prepare for.

MR. KENNEDY: Thank you for your comment. The next topic is streamlined processing of license applications and licensing documents.

I won't go into this in depth, but the basic idea is that when you're getting to Nth-of-a-kind in licensing the same reactor over and over, you're generating very similar documentation both on the applicant side and the NRC side and there's an opportunity there using additional electronic tools to reduce the processing time frame for these documents.

So, unless there are questions, I'll just move on.

(Pause.)

MR. KENNEDY: Okay. Next is construction inspection. So, as I showed in the deployment model, there is a category or type of designs where the reactor is essentially self-contained and that it's

fully manufactured in a factory or manufacturing facility and then it's transported in one or several containers that are placed at the site and maybe interconnected and then connected to a load and started up.

And then there is the other model where the core and perhaps the vessel and some internals are fabricated in the factory and then essentially plugged into permanent structures and systems that are constructed onsite.

So, this creates a situation where there will be a need for some inspection activities at a manufacturing facility or where the reactor is manufactured as well as the site.

And so, the staff's goal in implementing such an inspection program is to ensure that these inspections can be conducted within the deployment time frames that developers are looking at and that these programs can be put into place in a way that they would take advantage of experience that's gained as the same reactor is manufactured and constructed repeatedly.

And so, there are requirements, of course, that I mentioned earlier in Part 52 that before a reactor is placed into operation, the NRC verifies

that the ITAAC have been completed or that the reactor is substantially -- sorry, construction of the reactor is substantially complete and ready for operation.

And so, these -- so, there's a site-specific component as well as a component that would take place at a manufacturing facility.

So, there was a SECY paper that was issued last year that was the vision for the Nuclear Regulatory Commission's Advanced Reactor Construction Oversight Program.

And so, that considers risk-informed and performance-based approaches. And so, that will be leveraged in developing appropriate inspections for these different types of deployment models.

Okay. Finally, consistent with what we did for the SECY paper provided to the Commission in January of this year, we had numerous meetings with stakeholders and the public to discuss the topics that we are considering putting in this paper and then to follow up with information about the potential strategies that we were looking at.

And through these meetings we received favorable feedback from stakeholders on the scope of the paper and the options that were being developed.

And, again, we anticipate there will be

additional engagement then as the staff implements Commission direction on the paper.

We also received a letter from the Nuclear Energy Institute on "Regulations of Rapid High-Volume Deployable Reactors in Remote Applications and Other Advanced Reactors" and there was a presentation by NEI at the subcommittee meeting on their paper.

As mentioned, this afternoon we'll be having a public meeting to -- dedicated to discussion of this paper with stakeholders.

Then finally, next steps. We're developing a Commission paper based on this draft white paper and we'll be requesting Commission direction on two policy issues.

One is the approval of standardized operational programs. The other is options for alternative environmental reviews.

And we will include the -- Enclosure 3 on the information topics that support efficient Nth-of-a-kind licensing. Several of which include strategies and information that would be useful for enhancing clarity for developers as they continue to work on their designs, licensing strategies and deployment models.

So, thank you very much for your time and

for your comments and that concludes the staff's presentation.

MEMBER BIER: Okay. Thank you very much. This is Vicki Bier again, subcommittee chair. I wanted to make a couple of quick comments mainly for members of the public who may not have tuned into the subcommittee meeting.

The reason that the subcommittee recommended not writing a letter is not because we don't appreciate the importance of Nth-of-a-kind reactors and not because we don't think there could be important safety implications in how that's done, but simply because in the current stage of development where the main choice is between Option 1 and Option 2 or whether to allow both options, we didn't see a safety implication at that level that our sense was that either Option 1 or Option 2 could be implemented in a way that protects public health and safety and that the situations where ACRS might have more detailed substantive comments would come later as those approaches are developed in more detail and finalized.

So, that's just kind of to lay the land that this is -- looks fine for now, I think, in my personal opinion, but ACRS may obviously have comments

later on as the process evolves.

We had quite a bit of lively discussion already. So, if there is further discussion now by members of the Committee or consultants, I am happy to take that.

CHAIR KIRCHNER: Vicki, this is Walt.

MEMBER BIER: Great.

CHAIR KIRCHNER: I'd like to just make some observations, not questions of the staff.

MEMBER BIER: Super.

CHAIR KIRCHNER: So, going back to, I think, earlier discussion, Greg and Scott, what I would just note here is that there's a nexus between safety, safeguard, security, and environment. And for the deployment considerations, that's a pretty tight coupling.

So, the first-of-a-kind licensing in this instance is the most important because you're going to look at the robustness of the technology that's proposed for deployment. And that's -- the deployment is actually a big challenge for this concept of using micro-reactors. So, let me provide some context and background.

40 years ago I led a design team that was tasked with designing a reactor to power radar sites

on the arctic circle called the North Warning System.

There was a proposal to power 13 sites that strung from Alaska to Greenland with small -- not called micro-reactors then, but small reactors for the radar stations.

The biggest challenge that we saw right off was the robustness of the technology for the deployment concept.

It included the transportation of the modules, the safe transportation. The presumption was they would be fueled and essentially intact.

They had to operate in a very harsh environment and they had to withstand the external hazards that we expect in any reactor deployed to accommodate.

So, at the time, just to -- without making a technology recommendation, I'll just say what we consider in the prototype that we built was a TRISO-fueled graphite-moderated reactor using heat pipes for the power conversion and thermoelectric. So, essentially a very passive design.

We partnered with the AECL. Most of the sites were on Canadian territory and the environmental impact was a major consideration.

So, we wanted the minim footprint in terms

of when you're done with the deployment, any residual contamination, and of course there was the concern about leakage of radionuclides during operation. So, effluents, et cetera.

Those were all drivers and considerations, but it turned out the deployment considerations were the biggest.

So, when we leave that behind, we did not deploy those reactors at 13 sites. The North Warning System Project was cancelled because technology advanced and we went to satellites instead of fixed radar installations.

But, I mean, forward to today, what I would point out is unlike large reactors, including SMRs that are being considered, fixed installations, to first order they're naturally hardened by design and the external hazards and other considerations, manmade hazards and sabotage, are much more of a challenge for a micro-reactor than for a large reactor with large fixed containment shielding and such.

So -- and let me give you some examples of considerations and why I feel the first-of-a-kind licensing activity is the most important in going forward with deployment.

Small reactors, for example -- I'll just

give you a few examples for consideration. Small reactors tend to be leaky because they're small. They are leaking neutronically.

So, if you immerse a small reactor, this is a big consideration with small reactors that face applications, they actually -- you add reactivity. If you flood the internals in one of these reactors, you add reactivity in most designs that are being considered.

So, flooding in a large LWR, yes, is a concern. You worry about loss of equipment, auxiliaries, and so on, but it doesn't add a reactivity component to the reactor. So, that's just one example.

Another example that I point to is that the external hazards like tornado-driven missiles, telephone poles, cars and such are a much bigger hazard for a small reactor that isn't encapsulated in a hard containment like an LWR, et cetera.

So, what I would point you to is that the technology selection up front is very critical. You need a very robust design and that robustness should also take into account safeguards and security considerations as well.

Fixed fuel, for example, is much

preferable through a liquid fuel system when it comes to safeguards and other related issues.

So, all those things, I think, are very important considerations up front. So, I think the first-of-a-kind licensing is the bigger challenge than the Nth-of-a-kind.

I think the Nth-of-a-kind becomes a challenge when you look at the individual sites that are considered.

So, if the developer, for example, to maximize the opportunity for deployment has to be thinking about things like environmental qualifications.

Most -- if you think about a large LWR, most of the equipment is protected within the containment.

It's in a hot environment, but it's shielded. So, the environmental qualifications aren't as demanding as they will be for deployment of these small reactors.

I'll give you a few examples. Temperature becomes a big issue especially in the Arctic. We had to worry about the reliability and functionality of things like control systems.

These systems have similar considerations

because they're not -- well, we'll see. We'll see what the developers propose in terms of building fixed installation versus something that's very -- be transported with a modest amount of protection. So, that -- I just want to highlight some of those issues that will be critical.

So, in my opinion, again, the first-of-a-kind activity, the robustness of the technology given all these considerations, external hazards, environmental qualification, diversion of materials, et cetera, are really critical for the success -- potential success and deployment at scale.

And then the other thing that the agency needs to be considering is the proliferation of risk if there's a large-scale deployment of these -- of this technology and how it's going to protect that.

With a large LWR you have -- again, you've got the containment. You've got a large exclusionary or boundary. You have a large guard pro force.

I think many of the proponents of these technologies are thinking minimal manning, if not unmanned. We were looking at unmanned operation of those Arctic sites. So, those are the considerations.

So, I see the deployment aspects are the harder challenge for the agency than the actual

technology itself.

Getting to Nth-of-a-kind is -- if the proponents stick to a standard design, as Scott was pointing out, I don't think the Nth-of-a-kind licensing is the issue. The issue is going to be the deployment, the site, and the environmental aspects that go with it presuming you really have a robust technology going forward. So, with that, I'll wind up my comments.

MEMBER BIER: Thanks for the comment, Walt. One followup, especially kind of in regards to Bob Martin's comment, is that I think one of the things we see in this whole process is the agency trying to adapt regulations that were developed for large fixed reactors to a totally different context.

And if we had started out with manufactured micro-reactors back, you know, several decades ago, the entire regulatory system might look very different.

And, you know, we're kind of playing catchup for not having designed this -- the regulatory system with this in mind. So, that's where I think some of the complexities are going to come from.

I see that Dennis has his hand raised.

DR. BLEY: He does. Hi. A couple things

have been eating at me and they don't really apply to the current white paper and whether the Committee decides to write a letter or not -- well, you're not writing one.

Walt and Greg kind of read my mind yesterday. Walt talked a little bit about the fact that the reviews of TMI -- well, if you haven't read the Rogovin report and the Kemeny report ever or in the last 20 or 30 years, it's worth going back and reading them.

I did a couple years ago and they hit a lot of interesting things, but both pointed to the creation of some problems because there wasn't standardization in the industry.

I understand under the law and the rules the staff has to look at any application that comes to them. So, there's no way for the staff to force standardization, but, you know, in a few other meetings it's really become clear that standardization is kind of hard to get to because everybody wants to make some changes and yet everybody, individual applicants, aren't really thinking about -- aren't being controlled by thoughts about how this affects the overall process of licensing.

Now, Greg pointed out there's a strong

connection between standardization and safety. And I think that's true and the link is, for me, unintended consequences.

In the individual members and the chairman's discussions with the commissioners, this might be something to discuss.

Somehow making it clear publicly that the lack of standardization involves additional review and complicates the review process, but needs to come across and be understood because there's lots of forces trying to push us to standardization and I suppose economic forces taking us away from that.

Maybe it will be different with micro-reactors, and Vicki made some really good points there, but I think this is something the Committee needs to think about and think about how they interact with the NRC.

They're a statutory committee, which means Congress made you very special compared to all the other committees around the government, and they're really creatures of the legislature, too.

So, somehow getting the word out about how this problem -- how this might create problems in the future is important.

I don't have an answer for you, but I

think it's worthy of thought in the future as you go forward. It doesn't have anything really to do with what you're doing today. That's all.

MEMBER BIER: Thank you, Dennis. And one other thing that I've been thinking kind of just in the last 24 hours since our discussion yesterday, if you look at the manufacturing industry across the board, we started off with, you know, you could get any color Ford you want as long as it's black, and you now have mass customization for cars or other consumer product, but it tends to be along very limited lines.

You don't get to redesign the chassis when you go buy a Ford. You get to choose the upholstery and the sound system and whatever and it took, I think, quite a long time for industry to develop the management capabilities to manage that mass customization cost effectively.

And, you know, it's well beyond our purview as a committee, but I think, you know, industry needs to think about how much customization do they want to allow and can it be kind of pre-standardized where you can customize certain things that don't affect the safety and regulation of the plant in a major way, et cetera.

So, anyway, that's kind of random comments

from my last 24 hours. But since I'm not in the room, I'm not aware if there are other people wanting to make comments or ask questions right now.

CHAIR KIRCHNER: Thank you, Vicki. I'm just looking across the table.

Any further comments from the members?

MEMBER PETTI: I'll just add to some of yours, Walt. The fact that it's leaky does other things.

There's Argon-41 activation that has to be considered, but there's also activation of the surrounding –

(Simultaneous speaking.)

MEMBER PETTI: -- and the dirt, you know, that you put it on.

I mean, that's not a problem with the current fleet, you know. There's plenty of shielding. So, there are these unique -- and that should come up in the environmental stuff, I would think, but, again, it's not something that we standardly think about. So, you have to think about they systems a little differently.

CHAIR KIRCHNER: Occupational exposure becomes a challenge --

MEMBER PETTI: Yes.

CHAIR KIRCHNER: -- because you get a fair amount of shine from the designs that are being considered vis-a-vis a large LWR system.

Obviously, a much larger LWR system has a significant shielding challenge and they deal with that, but it's a fixed installation, so to speak.

But from what we've seen to date of the concepts being considered, that will be something that you'll have to look at, occupational exposure and, as Dave pointed out, the activation of the environment as well.

These are all manageable things, by the way, so -- but the -- it goes back to the point I was making about having a robust design and looking at all these considerations and it goes beyond just having a mass manufactured module.

The deployment is going to be, I think, more of a challenge for the agency than once you get by the first-of-a-kind if the -- if the vendor or the proponent sticks to the standard design, then the attention will quickly shift to the siting issues.

MEMBER BIER: Okay. Walt, are there additional questions or comments in the room?

CHAIR KIRCHNER: I do not see any at this point. So, Vicki, maybe we should turn to public

comment.

MEMBER BIER: Yes. I would be happy to take public comments. And, again, I guess if you're online, you should be able to raise your hand. If not, on the phone press *6 and just unmute yourself. Also, please identify yourself before any comment.

Yes, Spencer. Go ahead.

MS. TOOHILL: Hi, there. Good morning. Can you all hear me?

MEMBER BIER: Yes.

MS. TOOHILL: Hi. My name is Spencer Toohill. Thank you so much for such a thoughtful discussion so far today.

I am an analyst with the Breakthrough Institute and my comment is for efficiency and regulatory stability. We -- I and the Breakthrough Institute are urging consideration of how this effort meshes in context and in timing to the ADVANCE Act requirements related to micro-reactors, as well as the Part 53 development, to avoid creating a situation in the near term that creates new impediments for Nth-of-a-kind licensing efficiency in the medium and long-term.

And just -- well, that was my first comment and then just a brief addition to that

comment.

We believe that a generally standardized design, more appropriately referred to as a core design that's not identical, but that still meets the threshold for a note design, is definitely preferable to us and we'd definitely like to see that in the future.

We would love to hear any thoughts and any -- share any thinking on these topics would be great. Thank you so much.

MEMBER BIER: Thank you for the comment. Any additional public comments?

(Pause.)

MEMBER BIER: If not, then I think we can be ready to close this session. So, I will hand it back to you, Walt.

CHAIR KIRCHNER: Thank you, Vicki. One thing that occurs to me while the staff is still here is, Steve, when does the -- you sent that paper up in January to the Commission.

What's the status currently of that?

MR. LYNCH: So, at this time the Commission is still reviewing that paper. That is all the status that we have from them.

CHAIR KIRCHNER: And do you expect an SRM

out of that?

MR. LYNCH: Yes, we are expecting -- we provided options to the Commission. We are expecting direction from the Commission when they have completed their review, on how to proceed with factory fabrication considerations and factory testing of micro-reactors.

CHAIR KIRCHNER: Thank you.

VICE CHAIR HALNON: So, will that be a SECY paper after that? I mean, it seems like they're doing a lot of things in sequence that isn't normal in sequence.

I mean, normally they don't give an SRM on a white paper, do they?

MR. LYNCH: So, the current paper that is with the Commission is a SECY paper and the strategies that were proposed and recommended to the Commission the staff can implement under its existing regulatory frameworks without needing to go through rulemaking at this time.

The white paper that was discussed today, the staff is in the process of converting this into a SECY paper to deliver to the Commission with the recommendations on how to address these items.

VICE CHAIR HALNON: And the other items

that you have in your last bullet was we're thinking about other steps, too. I assume that it's all in play.

When do you anticipate that we might be able to get reengaged to having a further discussion on this?

MR. LYNCH: So, I think, and I'll also give my staff an opportunity to weigh in, I think at this point our next stage is looking at how we move forward taking into consideration the direction that's been provided in the ADVANCE Act, because that has introduced some direction on specific topics that the staff had not been focused on such as mobile reactors as they have primarily been in the military space.

So, we are currently in the process of assessing how we want to prioritize the next set of topics that we'll be moving forward with. And once we've got that prioritization identified, we can engage with the ACRS and provide some timelines on when we may be engaging on those next topics.

VICE CHAIR HALNON: Okay. I'm fairly interested in how the public meeting comes out this afternoon on the NEI white paper, which was quite extensive, known as a real white paper. It's 300 pages or so.

So, our next engagement I'd like to see where we're -- maybe a summary of where we're at with that white paper where we deviate from the industry, you know, if we're at any kind of disagreement or maybe strong agreements, so that we stay in line with the manufacturers so that we understand, you know, both the direction of the construction part of the deployment, development and regulatory process because we're beginning 53 -- Part 53 discussions coming up, too, and all these are significant changes to regulations. And we want to make sure that we don't -- we don't collide down the road with something that is doable, but now unconventional.

In other words, someone may be on the verge of maybe it's not a micro, maybe it's a small modular, but it's transportable.

The more options we give, the less regulatory certainty we're going to have, especially from the timeline of six months or less trying to get these things licensed.

So, what I'm concerned about is that we're going to have so many different options that every first-of-a-kind is going to come in with a different pathway.

And much like, you know, we put 52 into

the new reactors, but many are going back to Part 50 because it's more familiar to the customer.

With Part 53 coming up, maybe someone will want to go under Part 50. So, we're going to continue to give them regulatory paths to licensing and it's going to get confusing, which is what we're in, because right now I think we have Part 52, Part 50, we've got research, test reactors, we have NUREG 1537, all different types of valid pathways.

And then we're talking about manufacturing licenses for the micro, we're talking a lot of different things that we're streamlining into existing regulations or writing new ones and just want to make sure that we're not providing this landscape of confusion about where we need to go for this.

So, that's why I wanted to stay in tune with where the industry is going. What is their preferred path? Why is it preferred? How is the agency dealing with that and make sure that we don't get into sort of a logjam because we have so many different options.

MR. MOORE: Chair Bier, this is Scott Moore, the Executive Director of the ACRS. Just so all the members understand and, Steve, correct me if I'm wrong, I think the staff -- the NRC staff's plan

is to send up discrete white papers on specific issues regarding the kind of micro-reactors as they come up.

The January paper was the first of those. This would turn into another paper and they're being presented to the Committee's white papers, but they will be turned into SECY papers when they go to the Commission.

MR. LYNCH: That is correct.

VICE CHAIR HALNON: That makes more sense.

CHAIR KIRCHNER: Go ahead.

MR. KENNEDY: This is Duke Kennedy. I think maybe in my haste to try to get through this presentation I overlooked one important point, and that is the staff has been working on micro-reactor issues for a number of years.

And just over the past two years we've developed and provided the Commission this SECY paper in January that had three policy topics and ten information topics.

And now we have this paper under development that has two policy issues and six information topics, but we have another group of topics that we've identified and prioritized.

And so, our strategy has always been to look at the -- holistically what are all the micro-

reactor topics that we know about and work on as industry continues to develop their deployment models and designs.

We've been looking holistically what are all the micro-reactor topics that we know about and where do we see the most benefit in getting policy direction at this time with the information that we know?

And because there are so many topics, we've had to, as Scott mentioned, bundle them in a way that makes sense so that we're not getting ahead of the state of our knowledge and we're not presenting too many different issues at once to confuse, you know, create additional confusion.

So, we're really trying to take a deliberate approach in how we're going about addressing these topics to try to provide clarity to the developers, enhance the reliability of our regulatory processes in a way that meets the immediate needs and the emerging needs and also takes a longer look at, you know, where are we going to be down the road as the landscape continues to change.

And so, there are a lot of topics on the table. We've been engaging with the industry and stakeholders frequently on this matter.

In a subcommittee meeting, one point that came up is that although the list of topics that was identified by the industry in its letter is fairly consistent with the list of all topics the NRC staff has also developed and that the NRC staff priorities have aligned well with what the industry priorities are.

There's more engagement to be had, of course, and we will continue to do that, but I just want to state clearly that we have a very broad landscape of topics that are taking a deliberate approach to addressing them in a way that doesn't cause more internal conflicts.

For example, the SECY that went up in January, those topics and how the Commission decides to vote on them doesn't directly affect the policy topics we're presenting here because we don't -- we want to avoid those conflicts, right?

And we also have Part 53 going on and we're making sure we stay consistent with what's happening there as well. So, I just want to be --

VICE CHAIR HALNON: Yeah, I appreciate that. That makes me more confident we're not in silos. That was the real point, to make sure we're not in silos.

CHAIR KIRCHNER: Okay. Any further comments?

MEMBER HARRINGTON: One quick question. This is Craig Harrington. Do you get the sense from the -- your prior public engagements and maybe from the one this afternoon, that this concept of six months has become -- that industry will become fixated around that and expect that kind of turnaround regardless of how standardized they actually go with the plethora of different paths and is it exactly fixed so that everyone is the same, very cookie cutter, or somebody wants it blue, somebody else wants it green?

Do they understand that standardization might get them to six months, but any deviation is going to realistically extend that window? Have you gotten any sense for that? Probably an impossible question to answer.

MR. KENNEDY: Obviously, I can't speak for the industry, but in our paper we've tried to be clear that in order to achieve the shortest time frames, that it's going to need to be standardized. There won't be room for departures.

I think we've been clear that departures are going to extend time frames and require additional

resources for individual reviews, but, again, we're trying to lay out in this paper what are the assumptions, what are the expectations to provide clarity to the industry and what is really needed to achieve these aggressive time frames.

And we're not committing to the time frames in the papers -- in the paper. We're laying out thoughts about what types of time frames might be achievable under different circumstances.

And so, the goal is to be clear in that communication to industry on what are the assumptions so that they can use that as they develop their licensing strategies and deployment models.

MEMBER HARRINGTON: Thanks.

CHAIR KIRCHNER: Okay. We've just come to ten o'clock where we would normally take a break, but at this point we will recess until this afternoon and at one o'clock Eastern Time we'll take up our Triennial Review and Evaluation of the NRC Safety Research Program.

So, with that, we're in recess until one o'clock and I thank you, NRC staff, for your presentation today, Steve, and your team. Thank you very much.

And with that, we are recessed.

(Whereupon, the above-entitled matter went off the record at 10:01 a.m. and resumed at 1:01 p.m.)

CHAIR KIRCHNER: Okay. We are back in session. This is the afternoon session of the 720th meeting of the Advisory Committee on Reactor Safeguards.

I'm Walt Kirchner, Chair of the ACRS. ACRS members in attendance in person are Ron Ballinger, Greg Halnon, Craig Harrington, Bob Martin, Scott Palmtag, Dave Petti and Tom Roberts.

ACRS members in attendance virtually via Teams are Vesna Dimitrijevic and Vicki Bier. And I believe our consultants, Dennis Bley and Steve Schultz, are all with us this afternoon.

If I missed anyone, please speak up at this time.

(Pause.)

CHAIR KIRCHNER: Hearing none, the hearing may proceed. Hossein Nourbakhsh of the ACRS staff is the designated federal officer for this afternoon's opening meeting.

Again, a reminder that all member comments should be regarded as only the individual opinion of that member, not a Committee decision.

All relevant information related to ACRS

activities such as letters, rules for meeting participation and transcripts are located on the NRC public website and can be easily found by typing "About Us ACRS" in the search field on that NRC home page.

I'd like to turn to Member-at-Large Dave Petti who has been leading our review of the safety research program at NRC. And with that, Dave, I'll turn the floor over to you.

MEMBER PETTI: Thank you, Walt. So, I do have a letter. But before that, I thought I wanted to thank the members that provided the appendices that will be attached to the letter which is really where all the meat is.

It's a good, at least, 25 pages, I think, when all is said and done. As we say, it was 11 R&D topics, six different research meetings over the last couple of years.

Before I go to the letter, I just wanted to; A, thank Hossein. He was the person that kind of made sure that the appendices have common format, have a common theme and structure. That was a big effort and I wanted to thank Hossein for all of that.

Do any of the members who wrote anything on their appendices want to say something about what

they've done?

(Pause.)

MEMBER PETTI: Okay. If not, let's get into the letter.

Dear Chair Hanson, During the 720th meeting of the Advisory Committee on Reactor Safeguards, November 6th through 8th, 2024, we completed our triennial review and evaluation of the NRC safety research program, which is primarily conducted by the NRC Office of Nuclear Reactor Research, RES. Our review also considered deep dives on 11 R&D topics across RES in 16 separate meetings. A summary of each of these deep dives is provided in Appendices to the letter. Our high-level observations are provided in this letter.

Executive Summary. The depth, breadth, and scope of the ongoing safety research program continues to meet the Agency's current needs for anticipated regulatory decisions. The research program enables staff to maintain core competencies and prepare for reviews of anticipated submittals. We note that RES has evolved from what was a static reactive organization over a decade ago to a more dynamic forward-looking one. RES uses a systematic approach to prioritize research emphasizing

"enterprise risk" in project selection, evaluation, and termination. The use of the future focused research program, the establishment and implementation of integrated action plans, and the recent RES leadership of agency-wide initiatives, are enabling the Agency to become agile and more proactive in preparing for emerging technologies associated with future licensing submittals. The result is an organization that is having greater impact on agency priorities. These activities are all signs of a healthy research organization and should support the Agency's broader efforts to transform itself into a modern, efficient risk-informed regulator.

Background. Our research reviews consider the 1997 Commission direction to examine the need, scope, and balance of the safety research program. We also considered how well RES anticipates research needs and how it positions the Agency to understand the regulatory implications of new technologies being developed by industry. In this letter report, we focused our efforts on (a) determining if the RES research portfolio is meeting current and can meet future agency needs and (b) on evaluating the impact that the portfolio is having on the NRC mission.

NRC research activities include conducting

confirmatory analyses, developing technical bases to support safety decisions, and preparing the agency to evaluate the safety aspects for new technologies. Through this process, staff competencies are improved, and agency transformation is facilitated.

Discussion. The research report -- of the report highlights selected high-level findings from our deep dives of the following research projects: Source term-related activities; digital twins; materials harvesting; Level 3 PRA; risk assessment and human factors for non-LWRs; artificial intelligence; fuel fragmentation, relocation, and dispersal; advanced manufacturing technologies; artificial intelligence and machine learning in NDE and ISE; computer code development and validation for non-light-water reactors and high energy arc faults.

These deep dives span the three RES divisions: Division of Risk Analysis; the Division of Safety Analysis; and the Division of Engineering. Summaries of our detailed findings, conclusion, and recommendations are provided in the Appendices.

Overall, the portfolio looks well-balanced and appropriate in light of the major regulatory challenges facing the Agency over the next three to five years: Subsequent license renewal; higher-burnup

higher-enrichment fuels for the current fleet; and advanced non-LWR reactor licensing applications. We note the work on HEAF has been completed resulting in not only improved modeling approaches, but also plant maintenance and design recommendations to enable reducing risk from HEAF events. Beyond these general observations, we provide comments on the following five themes that arose repeatedly during our meetings: focus and communication; engagement; education; impact; and future activities.

Focus and Communication. We observed excellent linkage between the NRR staff, focusing on their needs, and the RES staff managing the projects. This linkage enhances communication and allows for focused mission-driven research that will provide the greatest probability of success in terms of actionable/impactful results for regulatory decision making and NRC safety review activities.

Engagement. We observed that the research personnel are well-engaged with parallel activities underway in industry (e.g., EPRI, ASME, IEEE). This engagement helps the research team have a more complete understanding of industry plans and allows industry to appreciate the corresponding regulatory needs for any anticipated upcoming licensing actions.

The engagement also helps the research team not duplicate industry activities, but instead perform the confirmatory research necessary from a regulatory perspective.

Education. The research portfolio is helping the NRC staff become better informed about new technologies that industry is considering using, through example, artificial intelligence/machine learning for inspection; digital twins; additive/advanced manufacturing; and new reactor technologies in future applications by industry in a deeper way, building useful experience and expertise for the staff. Other projects such as the Level 3 PRA and the work being done on nonreactor risk applications are providing unique insights and a plethora of risk data that will serve the agency well as it becomes a modern risk-informed regulator and begins to use risk in decision making beyond the realm of power reactors. The development of reference plant models for each of the advanced reactor technologies has been extremely valuable for the staff to understand these systems in advance of licensing applications. Today, the staff is ready to perform confirmatory analysis for anticipated near-term advanced reactor applications. This will require an

agreement of continued financial commitment from NRC for the codes and DOE for the underlying computational framework to meet current anticipated licensing timelines. Because experience informs judgment, developing this experience is critical in light of the large turnover in the staff, and it supports the agency's overall knowledge transfer. The quality of research staff that we heard from in our deep dives is excellent.

Impact. The RES research portfolio is having real impact on regulatory decision making and reducing unnecessary uncertainty in technical areas including: Providing the technical basis for source terms from MELCOR severe accident calculations to support an upcoming revision of Reg Guide 1.183; supporting regulatory decisions by performing scoping calculations using RES developed non-LWR system analysis tools for advanced reactor applications like Hermes; highlighting potential safety issues via synthesis of the existing database associated with FFRD in a timely manner as the industry plans for higher burnups and higher enrichments and as the staff is working on rulemaking language associated with higher enrichment fuels for the current LWR fleet; informing Part 53 operator training requirements

through human factors research; leveraging unique irradiated materials samples (a/k/a harvesting) to support vessel embrittlement database and associated regulatory evaluations; developing the technical bases for informing NDE and inspection activities using machine learning and artificial intelligence; and resolving an important safety issue associated with high energy arc faults, a real success story illustrating how research can impact safety decisions.

Future Activities. Some projects that are just starting, for example, digital twins, AI, additive manufacturing, appear reasonable and should provide impact in out years. Other projects like the non-LWR code development require additional efforts related to verification and validation and transformation into useful evaluation models to support confirmatory analyses in support of efficient and timely NRC reviews of anticipated non-LWR license applications. Updates to LWR source terms and the impact of FFRD at higher LWR burnups on licensing options are also anticipated as part of the increased enrichment rulemaking. We look forward to additional briefings on these topics as the results become available. Sincerely, Walt.

I can see some words need help. When you

read it out loud, it's never like reading it -- just reading it.

CHAIR KIRCHNER: Thank you, Dave.

Members, this is a little bit unusual because typically, in the past, we've had presentations from Research and we intentionally chose to forego that and just cut to the bottom line.

So, the discussion that was going on in the background is we're going to release the court reporter. So, is there any high-level comments that you want to make before we go to line-by-line review?

I think this would be an appropriate time to make those comments, and then I would turn and afford the public an opportunity to make any observations or comments as well.

So, members?

VICE CHAIR HALNON: The only thing I would -- Dave, is there any of the -- and I didn't go through the appendices in detail. So, I apologize for that, but is there any high-level findings or conclusions that we buried into the -- in the appendices that may warrant raising it up because it's a very glowing, nothing is wrong, everything is cool. And if you start with the letter, it seems like there's -- it's just all rainbows and unicorns.

MEMBER PETTI: Not of things we haven't written a letter on. So, we don't -- I'd say, what, maybe half of these resulted in a letter and that's in the appendix.

VICE CHAIR HALNON: Should we mention that letters have already been written on these then and --

MEMBER PETTI: On some of them.

VICE CHAIR HALNON: On some of them that highlight our major --

MEMBER PETTI: Maybe that would be --

CHAIR KIRCHNER: Are there references that -- for example, Bob wrote a letter on the code development work. Is that referenced here in the references and should we highlight that one? That's one that comes to mind, Greg, in terms of --

MEMBER MARTIN: Conclusions, recommendations and stuff that may look like a normal format of our letters.

CHAIR KIRCHNER: Microphone.

MEMBER MARTIN: Sorry. I think just that the letter had a traditional form of conclusions, recommendations, to kind of address Greg's point there.

VICE CHAIR HALNON: Maybe not anything specific, but we can say throughout this process we

wrote letters on our more significant interactions or something to that effect.

MEMBER PETTI: Yeah, yeah, yeah.

VICE CHAIR HALNON: Okay.

CHAIR KIRCHNER: I know that Dave highlighted that HEAF and -- I would just observe that when I joined the Committee now eight years ago, we were -- we had presentations from Research. They were more -- they were informative about the problem.

It looked like a topic that, from a research standpoint, was almost intractable. And what was done by Research, I think, is just -- just first-rate piece of work to address that.

There was a lot of concern, I think, from the industry and other stakeholders that the Agency would go off on some tangent and I think Research actually did an excellent job in coming up with methods to address this in a practical way.

So, that's one that Dave already cited in the letter and you did put in a note about the continued support for the code development.

And as they go through V&V, are there any others, in light of Greg's comment, that we should highlight further? Anything that comes to mind from your perspective?

MEMBER BALLINGER: I was -- the FFRD thing I thought worked out pretty well. I actually made a few changes today because of my initial thoughts on what they were going to do with the increased enrichment.

Now, they're going to choose Option 2. So, I went and changed it so that it wasn't -- I'm saying I think you made --

(Simultaneous speaking.)

MEMBER BALLINGER: I wasn't that enthusiastic about the NDE and the AI stuff and I said so in the letter in my response because I think that nowadays -- and I actually confirmed this last week.

I was at the EPRI NDE center. I talked to Greg Selby, but we're down to the point now where everything is controlled by the microstructure.

We have enough resolution so that the microstructure pretty much defines it and we're basically in the soup over CAS materials. We can't really do much with CAS materials.

And so, I was kind of hoping that they would say something about if you make false-positive calls, that costs you money. If you make false-negative calls, that costs you downtime because you can get a failure of that.

And so, they didn't say too much about that in there, but I don't know that they were supposed to. So, I kind of went off on a bit of a tangent when I wrote --

MEMBER PETTI: You know, I didn't take it as a negative. You highlighted, you know, some concerns that --

MEMBER BALLINGER: Yeah. Okay.

MEMBER PETTI: -- they'll have to be aware of.

MEMBER BALLINGER: Yeah.

MEMBER PETTI: Because, again, this was still pretty early in their research. It's --

MEMBER BALLINGER: The AI and the NDE stuff was just a survey. They hired PNNL, I guess, to just go out and survey what's been done and what commercial packages are available.

And then they did some evaluations and there was no real research part of it, I don't think, other than doing the survey.

VICE CHAIR HALNON: The other comment that I had, just a question, do you think that we gave enough press to maintaining the funding as necessary?

That was -- seemed to be a theme of the supervisors and branch chiefs, whatnot, that the

amount of funding needs to continue flowing to us to keep --

MEMBER PETTI: It's said twice now.

VICE CHAIR HALNON: Is it?

MEMBER PETTI: It says, in the future activities, acquire additional efforts, but then the funding I mentioned earlier that it required a continued commitment or something.

VICE CHAIR HALNON: Okay. I was looking and I couldn't find it.

CHAIR KIRCHNER: Do we have --

MEMBER PETTI: I added that right before we started lunch. So, depending on --

(Simultaneous speaking.)

MEMBER BALLINGER: By the way, I'm not sure what kind of research they could do in the area of NDE. That's being done by industry.

MEMBER PETTI: Right. Well, I mean --

MEMBER BALLINGER: So, other than doing another survey and evaluating things, I'm not sure what they can do.

MEMBER PETTI: I think it was just to get smarter about what's out there --

MEMBER BALLINGER: Yeah, okay.

MEMBER PETTI: -- to know what industry is

doing. I mean, you know, we didn't see anybody duplicating what industry was doing.

MEMBER BALLINGER: Yeah.

MEMBER PETTI: I mean, they're very well-aligned, you know.

MEMBER BALLINGER: Yeah.

MEMBER PETTI: These items that I highlighted was just at one of the meetings. I kept jotting the same sort of comments down. Boy, these guys, they're well-linked. They, you know, they -- remember we had people -- they had brought in -- they had industry colleagues in sometimes, you know.

From a pure research perspective, someone who's read a lot at the R&D organization, I mean, these are the things you want to look at, you know. You're not duplicating it, you know what the issue is, that you're focused, and it's not just research for research's sake, you know. It supports the mission.

I mean, all those things, I just kept seeing them over and over again and that's what made me think that this is sort of a letter. And then if people are interested, they can go onto each of the appendices for the specifics.

We have changed how we've done this letter substantially, you know.

CHAIR KIRCHNER: Yeah. For the newer members, we previously would do, candidly, just like a repeat and it was voluminous.

MEMBER PETTI: 80 pages was not uncommon.

CHAIR KIRCHNER: Yeah. Repeat of a summary of all the research that is being conducted without any really critical assessment of -- we did identify, in the past, things that we thought should be terminated, that -- where a continued investment wasn't going to be a payoff for the Agency, but what Dave has done here, I think, is a marked improvement in focusing into the future and addressing relevance and need for the Agency to be prepared.

I mean, one of the large words that we had from the research presentations was, you know, "readiness" particularly in the areas like code development so that they would have the tools on hand to be able to do the kind of confirmatory analysis necessary. And to that extent, they've done quite well, I think.

MEMBER PETTI: I mean, to me, that, the HEAF work and the FFRD and source term, I mean, you know, they've done quite a bit of work and those are major initiatives.

MEMBER BALLINGER: You know, we didn't say

it, but that FFRD stuff is resulting and will result in a sea-change in the way industry approaches accident analysis because of the new burst and all that kind of stuff.

It really has made a huge impact on the way people have -- especially with increased enrichment. So, that's a -- that may have been an unintended consequence of pointing out FFRD, but it sure is making a difference.

MEMBER MARTIN: I think the unintended consequences apply to HEAF also. That EPRI wanted to develop maintenance improvements make HEAF less likely because the problems were shown to be a big deal.

MEMBER BALLINGER: Yeah.

MEMBER MARTIN: Not necessarily because of the research, but it's tied to the research.

MEMBER PETTI: Vicki?

VICE CHAIR HALNON: Dennis was up first.

MEMBER BIER: You can let Dennis go first if he wants. That's fine.

MEMBER PETTI: Okay.

DR. BLEY: I don't particularly want, but I will. You've touched on something that, you know, the Commission often addressed us about where can we -- where is the research finished, in your opinion,

and where should we stop spending money and it seems we just touched on that lightly.

I don't know if you found anything else, but that would have been something to elevate up into the main report if, in fact --

MEMBER PETTI: So, I did have something in there in Matt's area, the material harvesting. Not that it's not adding value, but a cost benefit.

It's expensive to do and given all the data we have on vessel embrittlement, you know, in that broad effect, is it worth spending money there?

MEMBER BALLINGER: I'm glad I didn't -- you didn't ask me to write something -- you didn't ask me to write something on that because it would not have been complementary, especially with the new correlations that are --

MEMBER PETTI: Yeah.

(Simultaneous speaking.)

MEMBER BALLINGER: The old correlations, that 1.99 stuff, that correlation was going to go south on us and have influence, but the new one doesn't and it's way past eight years. So, we're -- I don't know why we need to take more samples.

MEMBER PETTI: So, I mean, if you think about, I mean, if people feel that way, I can put the

sentence back in. I had it in an earlier version.

MEMBER BALLINGER: Yeah, these are extremely expensive.

MEMBER PETTI: Yeah, for sure.

MEMBER HARRINGTON: I wasn't here to participate in that discussion, but was the harvesting presentation from Research directly focused on vessel integrity or was it much broader than vessel integrity because the industry regulatory collaborative activities worldwide on harvesting are much broader than just vessel integrity.

A continuing effort very broadly to look at the full range of materials issued and any time a plant is being decommissioned it's looked at. Is there something here of value?

And so, those are highly-leveraged projects across a number of organizations.

MEMBER PETTI: I'm just looking at the writeup. I don't know that Matt's on it. There was some cable, electrical cable, which is a big deal. And we had a comment about availability of splices.

Staff reported that in some cases documentation for the harvested materials is nonexistent, difficult to retrieve or has no longer been retained by the owner. Loss of the pedigree

diminishes its value, you know.

And it says research conducted using harvested materials continues to be a relatively expensive, opportunistic endeavor, not necessarily systematic regarding strategic needs or priorities; however, RES has been able to participate in a few projects.

Research on harvested unique rated materials can be leveraged to improve industry initiatives such as vessel embrittlement and other life limited components.

So, maybe I don't want to say anything because materials harvesting is too broad and this is a subset of that. But if questioned, we could bring up the embrittlement example, but another area that's still very valuable. Depends on what the problem is, I guess.

DR. BLEY: This is Dennis. I have one other comment. I like Dave's letter and I like the emphasis on high-energy arc faults, but I just wanted to mention that some years ago after we had then enthusiastically supported the staff's work on HEAF, NRC cut it out of the budget for a number of years before it came back in -- NRC -- the Commission cut it out of the budget for a few years.

CHAIR KIRCHNER: Vicki?

MEMBER BIER: Thanks. I wanted to get back to Greg's question about is this really like unicorns and candy and if -- looking at the first sentence on line 148, I don't have any expertise on additive manufacturing.

With regard to both digital twins and AI, I don't disagree with the sentence that we have, but I would describe it as polite. And that if you look at the actual situation especially in the AI area, the staff is very limited by personnel and budget.

And, yes, they are doing reasonable things that may have impact, but they are very incremental and very dependent on work done by other agencies or the national labs or whatever that have bigger budgets to address it.

And so, I don't know if it's worth revising to make that sentence more critical because I don't know that I would necessarily argue for huge budgets in those areas, that there's a reason the staff is constrained by budget, but it's just something to think about that, you know, given the limitations of budget and personnel, there may not be huge impact and the agency is going to kind of continue being dependent on other actors with greater

resources.

CHAIR KIRCHNER: Vicki, this is Walt. I would concur with you. I mean, let's pick one. Digital twins. I mean, this is something that the private sector actually has made large investments in, but was even as far back as 10 or 15 years ago called "big data" and ties into AI and machine learning.

So, maybe some of the words you just used are appropriate there to, you know, Research often can do a number of things and Dave, in earlier sections of the letter, touches on this.

Sometimes it's maybe a modest investment in these areas, is just necessary for educational purposes and keeping the staff informed and, you know, up to speed with what's going on in the private sector or in the labs and universities.

So, maybe we can temper that sentence with some of the words that you just used.

MEMBER BALLINGER: I took notes.

MEMBER BIER: Yeah.

MEMBER BALLINGER: In all of those areas, they're only going to be able to keep up with what's going on, what's educational, so that they understand the lingo when somebody comes in and says, here's what we're doing.

CHAIR KIRCHNER: Right, and the state of the art and so on, but not necessarily doing --

MEMBER PETTI: A watch and review, but they should -- gosh. They should have enough knowledge to be able to ask questions that are probing enough to get an answer that's meaningful.

They should, you know, not super -- they shouldn't be just superficial, but they should be a little bit better than that so that they can understand what's going on and ask probing questions.

MEMBER BIER: Yeah. And I think, from that perspective, what the staff is doing is reasonable for that purpose.

They are getting their feet wet. They're playing around. They're learning about what's going on elsewhere. They're trying things out and, you know, getting to a position where they can evaluate those kinds of issues, but it's not going to be impactful compared to what the labs are doing or industry or other groups. So --

MEMBER PETTI: We can deal with that line by line.

CHAIR KIRCHNER: Thank you, Vicki. Other comments? Dennis, I think your hand is still up or it's back up.

DR. BLEY: It's back up and I had trouble getting my mic open. There's one area and, Dave, I might have missed it.

Back just before Obama left office, he issued an executive order requiring all the agencies to look at geomagnetic storms and figure out the impact on the things they regulate.

The last we heard on that there was some kind of interagency research work looking at geomagnetic storms that -- did you talk about that at all or should that be something that the Committee might prod the staff on where they stand now on what kind of things could be significant to the industry?

MEMBER PETTI: Yeah. We didn't hear anything about that. So, it's worth putting on the list, I guess.

MEMBER BALLINGER: If you get aviation fleet like I do, you'll discover that there was a lot of work going on in that and all of a sudden it got classified --

MR. MOORE: This is Scott Moore.

(Simultaneous speaking.)

MEMBER BALLINGER: Gone.

MR. MOORE: So, yeah, you make a good point. My understanding is that the Office of

Research wasn't doing that kind of work. I think Office of Nuclear Security Incident Response has followed up on that topic.

CHAIR KIRCHNER: Okay. At this point, let's turn to see if there is any members of the public who wish to make a comment.

If so, please unmute your mic and state your name and affiliation as appropriate and make your comment.

(Pause.)

CHAIR KIRCHNER: Hearing none, then, James, our court reporter, I think we are finished with you for this afternoon and we'll look forward to you joining tomorrow morning at 8:30 Eastern Time. Thank you.

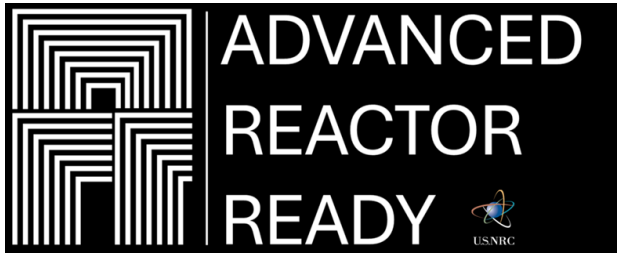
(Whereupon, the above-entitled matter went off the record at 1:37 p.m.)

Licensing and Deployment Considerations for Nth-of-a-Kind Micro-Reactors

Advisory Committee on Reactor Safeguards

November 6, 2024

Steve Lynch, Chief, Advanced Reactor Policy Branch
William Kennedy, Sr. Project Manager, Advanced Reactor Policy Branch
Jackie Harvey, Sr. Project Manager, Advanced Reactor Policy Branch



https://www.nrc.gov/reactors/new-reactors/advanced.html

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Opening Remarks
and
Introduction

Contents

- Motivation for the paper
- Background
- Conceptual deployment model for transportable micro-reactors
- Licensing strategy for Nth-of-a-Kind (NOAK) micro-reactors
- Options for standardization of operational programs
- Other topics related to NOAK micro-reactor licensing and deployment
  - Maximal design standardization
  - Graded approach to site characterization
  - Deployment site emergency preparedness
  - Streamlined licensing process
  - Construction inspection
- Stakeholder engagement
- Next steps

Motivation for this Paper

- Stakeholders have expressed interest in rapid, widespread deployment of micro-reactors of a standard design on timeframes that are significantly shorter than current licensing timeframes.
- The NRC staff is currently in pre-application engagements with micro-reactor developers that are considering a wide range of deployment models with novel aspects such as standardization of operational programs and alternative site characterization.
- 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.

Background

- For licensing purposes, micro-reactors are commercial power reactors licensed under Section 103 of the Atomic Energy Act of 1954, as amended (AEA).
- Micro-reactors typically use non-light-water reactor technologies, are anticipated to have power levels on the order of several tens of megawatts thermal, small site footprints, low potential consequences in terms of radiological releases, and may have increased reliance on passive systems and inherent characteristics to control power and heat removal.
- Factory-fabricated transportable micro-reactors are a subset of micro-reactors that would rely heavily on standardization and mass production to simplify licensing and deployment.*

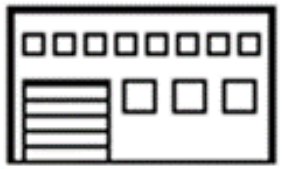
* See SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory," dated January 24, 2024 (ML23207A252).

Background

- For the purposes of this presentation, the term “NOAK micro-reactor” generally means a micro-reactor of a standard design that has been previously approved by the NRC through a design certification (DC), manufacturing license (ML), or final safety analysis report for a first-of-a-kind (FOAK) combined license (COL) or construction permit and operating license (CP/OL).
- NOAK micro-reactor licensing refers to licensing micro-reactors of a standard design for operation as power reactors at fixed sites.

Conceptual Deployment Model for Transportable Micro-Reactors

Factory or Manufacturing Facility



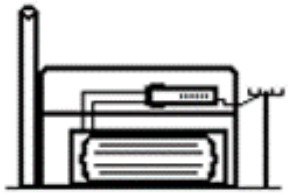
Fabricate the reactor, load fuel, and potentially operate the reactor for functional testing

Transportation to the Deployment Site

Reactors may contain fresh or irradiated fuel

Deployment Site – Power Operation

Stand-alone, self-contained micro-reactor design

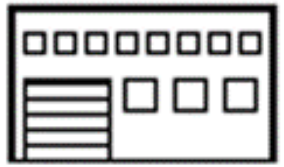


Core module with onsite reactor building and power conversion equipment

Transportation from the Deployment Site

Reactors may contain spent or irradiated fuel

Decommissioning or Refurbishing Facility



Remove fuel and decommission the reactor, recycle components and systems, or refurbish and refuel the reactor for redeployment

Deployment Lifecycle

NRC Staff Draft White Paper

- Describes regulatory approaches the NRC staff is developing for consideration by the Commission related to two topics:
  1. Approval of standardized operational programs
  2. Alternative approaches for environmental reviews*
- Includes Enclosure 3 with information on other topics related to licensing and deployment of NOAK micro-reactors
- The draft white paper and enclosures are available at:
  - Draft White Paper on Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations (ML24268A310)
  - Draft White Paper on Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations - Enclosure 1 (ML24268A314)
    "Standardization of Operational Programs for Nth-of-a-Kind Micro-Reactors"
  - Draft White Paper on Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations - Enclosure 2 (ML24302A292)
    "Environmental Reviews for Nth-of-a-Kind Micro-Reactors"
  - Draft White Paper on Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations - Enclosure 3 (ML24268A317)
    "Technical, Licensing, and Policy Considerations for Nth-of-a-Kind Micro-Reactors"

*Environmental reviews are not within the scope of this meeting but are mentioned here for completeness. Enclosure 2 will discuss in detail approaches for environmental reviews.

Anticipated Licensing Strategy

- Phase 1: Robust upfront approval of a standard design
  - Approval of a maximally standardized design in a DC, ML, COL, or CP/OL
  - Approval of standardized operational programs, to the extent practicable
  - Completion of a generic environmental review, to the extent practicable*
  - Completion of hearings covering the standard design
- Timeframes will vary based on the licensing pathway and reactor design and are bounded by the generic milestone schedules established by the NRC in response to the Nuclear Energy Innovation and Modernization Act of 2019 (NEIMA).

*Environmental reviews are not within the scope of this meeting but are mentioned here for completeness.

Anticipated Licensing Strategy

- Phase 2: NOAK licensing leveraging the upfront approvals
  - Streamlined administrative processes
  - NRC staff safety and security* reviews focusing on confirmation of site suitability
  - NRC staff site-specific environmental review that applies the upfront generic environmental review, as appropriate*
  - Confirmatory inspections at the place of fabrication and deployment site, as appropriate
  - Verification of completion of inspections, tests, analyses and acceptance criteria (ITAAC) for a COL or confirmation of compliance with license conditions for a CP/OL and conduct of readiness for operation inspections
  - Completion of site-specific hearings

*Security and environmental reviews are not within the scope of this meeting but are mentioned here for completeness.

Regulatory Approaches for Review of Standardized Operational Programs

- Current Commission policy does not support review and approval of the operational requirements (i.e., parts or aspects of operational programs) in the context of DC or ML application review beyond those that are material to the finding on the safety of the design.
  - Advanced Boiling Water Reactor (Volume 62 of the FR, page 25806 (62 FR 25806)) discusses that the operational requirements were not accorded finality because the operational matters were not comprehensively reviewed and finalized for the DC.
- The NRC staff anticipates that most operational programs for a specific micro-reactor design could be standardized by an applicant for a DC or ML to support NRC review and approval.
- This would support a streamlined review of a COL or CP/OL application that referenced the approved operational programs.

Regulatory Approaches for Review of Standardized Operational Programs

- The NRC staff is exploring approaches to review operational matters at the design approval stage (ML or DC) for a standard micro-reactor design
  - Option 1 (O1): Status quo
    - Currently staff can review and approve operational programs through topical reports or the design-centered review approach
  - Option 2 (O2): Review and approval of operational programs proposed in a DC or ML application
    - An applicant would have the option to provide proposed measures to satisfy operational programs as part of a DC or ML application
    - Assuming the proposed measures are fully described and constitute an essentially complete program such that staff could make a safety finding, and that the staff comprehensively reviewed the proposed measures, this would provide additional regulatory stability for those programs when referenced by COL or CP/OL applicants

Maximal Design Standardization

- The regulations in 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” provide several regulatory pathways for design standardization, including manufacturing licenses, design certifications, and standard design approvals, under which most safety issues would be resolved.
- Maximal standardization would involve approval of a standardized micro-reactor design and subsequent deployment under a COL or CP/OL without any significant departures from the standardized design.
- Maximal design standardization could allow micro-reactors of a standard design to be deployed to most sites in the U.S. with minimal need for site-specific features or the associated additional NRC reviews and approvals.

Grading the Level of Site Characterization

- A standardized design for a micro-reactor could establish bounding parameters for site characteristics that are important to the safety review so that micro-reactors of the standard design could be deployed at suitable sites throughout most of the U.S.
- The NRC staff is considering approaches for grading the level of site characterization for micro-reactors of a standard design (and potentially other reactors) based on the applicable hazards for the specific micro-reactor design, the amount of margin included in the design for each bounding site parameter, and the amount of margin to appropriate dose reference values.
- A graded approach could focus on how a construction permit or combined license applicant can provide the required site characterization information and demonstrate that the bounding parameters are met for the candidate site.

Deployment Site Emergency Preparedness

- The existing regulations for emergency preparedness in 10 CFR Part 50, “Domestic licensing of production and utilization facilities,” and 10 CFR Part 52 apply to licensing micro-reactors of a common design.
- The NRC staff is exploring approaches for streamlining the review of emergency preparedness for licensing NOAK micro-reactors based on considerations such as the possibility that potential accidents would result in low doses at the site boundary and, under certain circumstances, might not require extensive off-site response.

Streamlined Processing of License Applications and Licensing Documents

- Licensing applications referencing an approved micro-reactor design that leverages maximal design standardization will likely be nearly identical, with some possible minor variations related to licensee-specific or site-specific information.
- NRC-generated licensing documents, such as the NRC staff safety evaluation, license, and required Federal Register notices, will likely be very similar for licensing each individual micro-reactor of a standard design.
- The NRC staff is considering approaches for using electronic licensing forms, licensing document templates, and automation to streamline processing and review of micro-reactor applications to reduce the timeframes for acceptance review, docketing, safety review, concurrence, license issuance, and other steps.

Construction Inspection

- Micro-reactors of a common design might be “self-contained” in that they would be almost entirely fabricated at a factory and require minimal site preparation or construction activities at the deployment site, or they might consist of a “core module” that is fabricated in a factory and then incorporated into or connected to permanent structures and systems constructed at the deployment site, such as a reactor building and power conversion equipment.
- In either case, it will be necessary for the NRC staff to verify completion of ITAAC in support of a finding for authorization to operate under 10 CFR 52.103(g) or to verify substantial completion of construction for issuance of an operating license under 10 CFR 50.56 and 50.57(a)(1).
- As discussed in SECY-23-0048*, the NRC staff is considering approaches for risk-informed and performance-based inspections at both the fabrication facility and deployment site that can be completed within the expected timeframes for licensing and deployment of NOAK micro-reactors.

*SECY-23-0048, "Vision for the Nuclear Regulatory Commission's Advanced Reactor Construction Oversight Program" (ML23061A086)

Stakeholder Engagement

- Public advanced reactor stakeholder meetings in December 2023 and March and July 2024
  - Favorable feedback from stakeholders on the scope of the paper and the options developed by staff
  - Anticipated engagement on guidance for implementation of Commission direction
- Public meetings with various micro-reactor developers and stakeholders
- Nuclear Energy Institute (NEI) proposal paper, “Regulations of Rapid High-Volume Deployable Reactors in Remote Applications (RHDRA) and Other Advanced Reactors” (ML24213A337) dated July 31, 2024
- Planned public meeting November 6, 2024, on the NRC staff’s draft white paper

Next Steps

- Develop a Commission paper on NOAK micro-reactor licensing and deployment considerations:
  - Request Commission direction on regulatory approaches for standardizing operational programs
  - Request Commission direction on options for alternative environmental reviews*
  - Provide information on other topics related to NOAK micro-reactor licensing

*Environmental reviews are not within the scope of this meeting but are mentioned here for completeness.