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

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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REGULATORY POLICIES AND PRACTICES SUBCOMMITTEE

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THURSDAY

OCTOBER 17, 2024

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The Subcommittee met via Videoconference, at 10:00 a.m. EDT, Vicki Bier, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

VICKI M. BIER, Chairman

DAVID A. PETTI, Member-at-Large

RONALD G. BALLINGER, Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

CRAIG HARRINGTON, Member

ROBERT MARTIN, Member

SCOTT PALMTAG, Member

THOMAS ROBERTS, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

ALSO PRESENT:

JACKIE HARVEY, NRR

JOY JIANG, The Breakthrough Institute

WILLIAM "BUCK" KENNEDY, NRR

STEVEN LYNCH, NRR

MARCUS NICHOL, Nuclear Energy Institute

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P R O C E E D I N G S

10:00 a.m.

CHAIR BIER: Today's meeting will now come to order. This is a meeting of the Regulatory Policies and Practices Subcommittee of the Advisory Committee on Reactor Safeguards. I am Vicki Bier, chair of today's subcommittee meeting.

ACRS members in attendance virtually are Ron Ballinger, Gregory Halnon, Craig Harrington, Robert Martin, Scott Palmtag, Dave Petti, Tom Roberts, Matthew Sunseri, and myself. So that is almost perfect attendance. Vesna Dimitrijevic may be joining later or --

MEMBER DIMITRIJEVIC: I just joined.

CHAIR BIER: Oh, you just joined, perfect. Thank you very much. And two of our consultants are also participating virtually via Teams, Dennis Bley and Stephen Schultz. So I don't think I've missed anybody.

Derek Widmayer of the ACRS staff is the Designated Federal Officer for today's meeting. No member conflict of interests were identified for this topic and we have a quorum for the meeting.

During today's meeting, the subcommittee will receive a briefing on the staff's draft white

paper on nth-of-a-kind, NOAK, Micro-Reactor Licensing and Deployment Considerations. In case there are any members of the public who are unfamiliar with the terminology, first-of-a-kind would be a brand-new design that may require heightened scrutiny in the approval process. And nth-of-a-kind is what we're talking about if we're producing large numbers of essentially identical reactors, so the initial approval has already taken place.

Following this meeting and after additional work, the staff's draft white paper will become a SECY paper and sent to the Commission for consideration. We are reviewing this paper as part of the ACRS statutory obligation under Title 10 of the Code of Federal Regulations Part 52, Subpart E, Section 141, referral to the Advisory Committee on Reactor Safeguards to report on matters that concern the safety of nuclear power reactors.

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. Per these regulations and bylaws, the ACRS speaks only through its published letter reports. Therefore, all member comments during this meeting should be regarded only as the individual opinion of

one member, not as a committee position.

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

The ACRS, consistent with the Agency's value of public transparency and regulation of nuclear facilities, provides opportunity for public input and comment during our proceedings. We received a request to make a presentation from the Nuclear Energy Institute and have made time in the agenda for them to present. We have also set aside time at the end of this meeting for public comments.

The ACRS will gather information, analyze relevant issues and facts, and formulate proposed conclusions and recommendations as appropriate for deliberation by the full committee.

A transcript of the meeting is being kept and will be posted on our website. When addressing the subcommittee, 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 or by

pressing *6 if you're on your phone. Please do not use the Teams chat feature to conduct sidebar discussions related to the presentations. Rather, please limit use of the meeting chat function to report any IT problems.

Since this meeting is being held entirely virtually over Teams, I ask that ACRS members and all other attendees use the raised hand feature of Teams if you have a question or a comment, so that the meeting can proceed an orderly fashion.

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.

We will now proceed with the meeting. I call on Steve Lynch, Branch Chief of the Advanced Reactor Policy Branch in NRR's Division of Advanced Reactors and Non-Power Production and Utilization Facilities, for opening remarks.

Steve, the floor is yours.

MR. LYNCH: Thank you and good morning. As Member Bier stated, I'm Steve Lynch, Chief of the Advanced Reactor Policy Branch at the NRC. Today, the members will be hearing from Duke Kennedy and Jackie Harvey, two of our senior project managers in the

Policy Branch.

We thank the members for inviting the NRC staff to discuss our continued efforts to prepare the NRC's regulatory framework for the future licensing and anticipated rapid deployment of micro-reactors. The staff recently released its draft white paper on strategies for streamlining the licensing of nth-of-a-kind micro-reactors manufactured at a facility.

Today, the staff is prepared to discuss several aspects of this paper with the ACRS, including its proposed strategies for improving standardized, operational programs. As this subject will become a vote topic for the Commission in a forthcoming SECY paper, the staff is looking forward to insights the members have to share with us today.

There are also some information topics that the staff will not be seeking Commission direction on in this paper that we will also cover in today's meeting, including maximal design standardization, graded site characterization, emergency preparedness, streamlined application processing, and construction inspection.

Also include in the white paper and forthcoming SECY is a discussion of alternative approaches to environmental reviews, which is beyond

the scope of today's meeting. Accompanying the environmental discussion in the main paper that the members have seen will be an enclosure referred to as Enclosure 2. This enclosure will provide additional details on the NRC staff's proposals to streamline the environmental review process for repetitive licensing and permitting actions. The considerations associated with environmental activities to be discussed and evaluation in this paper and associated enclosure are independent and distinct from the staff's discussion today related to operational programs.

The NRC staff is continuing to work on Enclosure 2 and for completeness will share the draft version of this environmental enclosure with the members when it becomes available later this month.

Again, thank you for your time today. We look forward to a productive discussion and I will now turn it over to our staff for the main presentation.

MS. HARVEY: All right, thanks, Steve, and hi, everyone. Again, I'm Jackie Harvey, a senior project member in the Advanced Reactor Policy Branch. I think we are ready to share the slides if we can have those presented. And while the slides are coming up, I just want to reiterate what Steve said about, I thank you very much for having us here today to have

a discussion regarding licensing and deployment considerations for nth-of-a-kind micro-reactors. We're looking forward to this.

Next slide, please. We can actually go another slide forward.

So today we're going to be discussing the motivation for the paper, some background, the conceptual model for transportable micro-reactors, licensing strategies for nth-of-a-kind, or NOAK, micro-reactors, options for standardization of operational programs, other topics, as Steve mentioned, and then finishing up with stakeholder engagement, and next steps.

Next slide.

So looking into the motivation for this paper, for several years staff has been evaluating the regulatory framework for micro-reactors and has been prioritizing strategies for reliable and efficient licensing. For example, staff recently provided to the Commission SECY-24-0008 with options related to fuel loading and operational testing at a factory. So staff continues to engage with stakeholders, pre-applicants, and through this continued engagement, stakeholders have expressed interest in an enhanced clarity regarding rapid and widespread deployment of

micro-reactors of a standard design to include having operating license review time frames that are significantly shorter than our current licensing time frames. So staff is continuing to review the regulatory framework here to identify efficiencies within the licensing process, while ensuring safe and thorough reviews.

Additionally, I'll mention the accelerating deployment of versatile advanced nuclear for Clean Energy Act, also know as the ADVANCE Act, was signed several months ago and has provisions in Section 208 to address for licensing and regulation of micro-reactors. The Act directs the NRC to consider unique characteristics of micro-reactors and look for opportunities to enhance efficiencies. So additionally, in addition to what we were already pursuing through the NOAK paper, we are also ensuring that our review of the framework is taking into account the direction in this Act.

Next slide.

The micro-reactors considered in this paper are commercial power reactors licensed under Section 103, commercial licenses of the Atomic Energy Act of 1954, as amended, and are anticipated to have power levels on the order of up to a few tens of

megawatts thermal, small site footprints, expected to have lower potential radiological consequences than current large light water reactors, and may rely more heavily on passive systems.

And then factory-fabricated transportable micro-reactors are a subset. And those would rely heavily on standardization of mass production.

So one note to mention here, I did previously mention SECY-24-008 is currently under consideration by the Commission, so the options presented in the white paper do not assume any particular Commission direction from the previous paper, 24-008.

Next slide, please.

So for this paper, and for purposes of this presentation, the term nth-of-a-kind micro-reactor means the micro-reactor of a standard design that has been previously approved by the NRC through a design certification, a manufacturing license, or through the full first-of-a-kind review for a combined license or a construction permit and operating license. So NOAK licensing refers to licensing micro-reactors really of a standard, common design for operation at power reactors in a fixed site.

At this time, it seems like external

stakeholders are focused more on a design certification, or DC, or manufacturing license, or ML, deployment model, but later on in the presentation we will also discuss some potential considerations for a first-of-a-kind review and a standard design approval.

Next slide.

This slide is depicting a generic deployment model considered by staff in its paper where a reactor is fabricated at a factory or a manufacturing facility, transported to the deployment site, operated at the site, transported from the deployment site, and then decommissioned.

I do want to point out the middle column here for the deployment site power operation. This column shows two models of factory fabricated micro-reactor deployments at the site. So the first on the top is a stand-alone, self-contained, micro-reactor design which incorporates essentially the entire plant in one or several transportable containers and that would require a minimal site preparation for construction activities.

And then the other model that -- or other designs that staff anticipates may consist of a core model which -- a core module which is comprised of the core and potentially other significant reactor vessel

components which are then incorporated into or connected to permanent structures or systems at the design deployment site. For instance, that may mean significant power conversion equipment.

I see a hand up.

MEMBER BALLINGER: Yes, this is Ron Ballinger. Can you give us an example of one of -- each one of those classes that we're now thinking about? I think eVinci would be of the first, right?

MR. KENNEDY: So I can answer that. This is Dick Kennedy. So the top one there, self-contained, I think there's a number of designs. One is proposed by Radiant Nuclear Industries and there are others where the idea is that the reactor can be incorporated or put into a single container that can be transported by truck.

And regarding the bottom figure there, I think the eVinci design is an example of a reactor, micro-reactor design where there would be on-site buildings constructed and then the reactor would be transported there and housed in that building.

MEMBER BALLINGER: Where would Pele fit in here?

MR. KENNEDY: So I'm not familiar with all of the design specifics of Pele. My understanding is

that it was to be housed in containers that would be transported to a site and so I think it would probably fit more on the top column or the top illustration there, but again, I'm not familiar with the exact design.

MEMBER BALLINGER: Thank you.

MEMBER HALNON: Before we get off this slide, this is Greg Halnon. I know we focused a lot on the deployment site and we've had some discussions about transportation. I'm actually interested how, or where your head is, relative to the factory or manufacturing facility if we're actually saying that we could operate a reactor there. Are we talking a different type of license for that facility, maybe having a potential containment building in that facility as well? Would we be licensing that similar to the deployment site?

MR. KENNEDY: So that was covered in the last SECY paper that went up to the Commission in January and it really depends on what the developer or the manufacturing facility operator wants to do and what's needed for testing of their reactor. We didn't get into any of the real technical details of how that would be done. It was more about the licensing processes that could be used to license operational

testing at a factory or at a nearby location.

So I would say at least we had an option where the reactor operation and licensing review would be conducted more like that for a non-power reactor and we had a status quo option where the reactor would be reviewed against the full power reactor regulations for the operations testing.

MEMBER HALNON: Okay. I think that we're probably going to have more discussion on this because I noticed that in the paper it talked about maybe upwards of ten modules a year which could mean that there's overlapping operations of multiple modules. It could be temporary systems and other things that may be maintaining cooling of a licensing-basis event, but are specific to the manufacturing facility. So I'll go back and look at the SECY and review it again, but I think we're probably going to have to have more discussion on that piece if we are actually talking about operating a reactor in the manufacturing facility. But thanks. I know it's premature. A lot of this is conceptual at this point, but I'll be interested in that front end of the cycle as well.

MR. KENNEDY: Is another hand up?

MR. BLEY: Yes, Dennis Bley. This is also premature, but I wonder if you've had any hints and I

haven't thought about this until just now of whether the vendors, when they sell to an organization that's going to operate it, will that organization provide the operations report or are the vendors thinking of including that in the sale? Have you heard anything about that?

MR. KENNEDY: I think right now there are many different deployment models under consideration and really any of those ideas are on the table. I don't want to go into the specifics of any particular vendor, but there are a very wide variety of deployment models and operational models under consideration.

MR. BLEY: Okay, thanks. And I'm glad you're at least hearing some of that at this point.

MS. HARVEY: Another hand?

CHAIR BIER: I don't see any, but --

MEMBER PETTI: Hold on. No, I was still muted, sorry. This is Dave. I have a different question. I know this is all about nth-of-a-kind, but does the idea of streamlining licensing, given the characteristics of these systems, impose any additional requirements on the first-of-a-kind? It would seem to me that it would be that you would want some demonstration of these quote, I'll call them

characteristics or attributes, that are not really delineated in the paper, but just kind of pointed to at fairly high levels so that you had confidence that the design actually meets the high levels of safety and environmental characteristics that were talked about in the paper, but delineated in a more concrete and detailed way so that you have a technical basis for saying, yes, this micro-reactor can go through this nth-of-a-kind approach, but this one over here, there's something in the design that we think would cause a problem from being able to access this avenue.

MR. KENNEDY: So that's a great point. I will talk a little bit later about the role of first-of-a-kind in achieving an nth-of-a-kind design. But at a higher level, there isn't a requirement in the regulations to, quote, build a first-of-a-kind before you get to nth-of-a-kind, but there are requirements that the NRC staff as all the necessary information to make its findings of reasonable assurance of protection of public health and safety. And so there are also requirements related to prototyping and testing new safety features.

And so again, while there isn't a requirement for, quote, first-of-a-kind, we will need to have all the necessary information to have

confidence in the safety of the reactor before they're mass produced.

MEMBER PETTI: But is it worthwhile? I'm thinking down the road in some guidance document somewhere where one would kind of put together in one place. What are all the attributes of the characteristics that weigh in on such a decision? Because I've seen numerous micro-reactor designs in the last few years and some have the characteristics that I think we'd all like to see as discussed in the white paper, but some may not because of the constraints that are relative to the mission for the micro-reactor. So one has to be, I think, a little bit careful at the front end. And I think having sort of the rules of the road and criteria would help both sides, the licensee and the NRC, going like these are the things we're going to be looking for in order to say that you can have this expedited process.

MR. LYNCH: Thank you for that. One thing that I will highlight is, within the NRC regulatory framework, we do have provisions that for new designs that may be licensed for the first time, we do have provisions under 10 CFR 50.43(e) for prototype plants where we can impose additional safety criteria on such facilities until they have demonstrated that they can

be operated safely and within the bounds that we would expect. And we do have guidance that exists for some of that in the regulatory review road map and Appendix B that we put out and this lays out what is expected for doing the necessary testing to make those regulatory requirements. But agree that, as we are looking at how this interplays with mass-produced reactors, we'll need to take another look at updating that guidance to make sure it is appropriate going forward.

MEMBER PETTI: Yes, I mean a lot of this stuff in the safety space and even in the -- mostly in the safety space, I think we know what we're looking for there. Even in mostly environmental space, but there is some uniqueness with micro-reactors. They leak a heck of a lot of neutrons and so the quote, insult to the environment of -- would the neutrons activate the dirt? Would it activate the air? And what does that mean from the EIS perspective is one aspect to think about. But also the operational side, this is kind of new that you'd like to really change some of the operational licensing programs that we've had. And in my mind that just means we should know by operation of the first-of-a-kind that, in fact, this is actually doable and is in the interest of good and

safe operation.

These are really different and new ideas. So I'm just trying to think of ways that can help everyone kind of see the rules of the road the same way, if you will. Thanks.

MS. HARVEY: Thank you. I appreciate the comments. Okay, before we move on, any additional questions on this slide?

Seeing None, next slide, please.

So the white paper explores the efficiencies in the operating licensing program and this slide gives a high-level overview of the contents of the white paper and provides the links to the different -- the main paper and the enclosures.

So just to reiterate, staff is developing two topics for Commission consideration related to -- the first related to the approval of standardized operational programs with a design certification and manufacturing license and the second being alternative approaches for environmental reviews. And then these topics are further discussed in Enclosure 1 for operational programs and then it's restated in upcoming Enclosure 2.

And then Enclosure 3 of the white paper provides additional information on other topics that

we will also go into more detail later.

Okay, and now I will turn the presentation over to Duke Kennedy.

MR. KENNEDY: Yes, next slide, please. So this slide and the next describe the anticipated licensing strategy for efficient licensing of nth-of-a-kind micro-reactors. Later, I'll cover information topics that were included in Enclosure 3 of the white paper and those will provide a lot more information and detail about how the licensing strategy would work. But please stop me at any time if you want to discuss those ideas here.

So the licensing strategy that we're anticipating for widespread deployment of micro-reactors is separated into two phases. The first phase is a robust, up-front approval of a standard micro-reactor plant design. The second phase leverages that up-front approval of the standard design to streamline and accelerate the reviews of applications for individual reactors. So this isn't a new concept, but the design and operational characteristics of micro-reactors presents a potential opportunity here to dramatically reduce licensing time frames while benefitting from safety enhancements that standardization can provide.

So Phase 1 is focused on reviewing as much of the design and environmental information as practicable for the complete plant and its operation. This includes the maximal standardized design which the NRC staff anticipates will be described in a design certification or a manufacturing license application, and I'll discuss what's meant by maximal design standardization in more detail and information topics in Enclosure 3, but just briefly what it means is that the standard design is as defined in the regulations in 10 CFR Part 52 The complete design would be approved in a design certification or a manufacturing license, or a combination of the two. The design uses bounding parameters that would envelope the actual site characteristics and the design minimizes site-specific features and the licensing application for an individual micro-reactor would not include departures from the approved standard design.

So in a couple of minutes here, Jackie will cover standardized operational programs in detail, but I'll just say here that an assumption in this licensing strategy and the consideration of how much of a reduction in the time frame for licensing can be achieved, is that most operational aspects can

be approved ahead of time in this up-front approval before the submission of an actual application for combined license or construction permit and operating license.

Another thing to mention here is that depending on the pathway that's taken for licensing the standard design, there may be mandatory hearings or contested -- opportunities for contested hearings or other opportunities for public engagement such as the public comments on a proposed design certification.

Is there a hand up?

MR. BLEY: Yes, it's Dennis Bley again. Two comments or questions here. Our history hasn't been so good in being able to stick to standardized designs. My interpretation is, back in the original round of licenses, each of the utilities had really strong leaders in the nuclear area who knew what they wanted in their plants and got the vendors to design them specifically to their goals. When we got to Part 52 which was supposed to deliver standardization, the process didn't work the way it was originally envisioned so the original designs had to be modified once you had buyers deeply involved in the process.

I'm kind of guessing here, one expects the

kind of buyer to be very different such that you don't expect to see a lot of pressure to change design. And the second part of this is, and I'm glad we'll hear more about the standardized operational programs, to the extent that there are procedures and emergency operating procedures, the onus for that has been on the operators once they buy the design. For these kinds of operators, it seems to me you're going to be looking for the procedures to be part of the package because that's already put together.

Do you want to comment on that or will that come out later in the talk?

MR. KENNEDY: Yes, I can comment briefly on that, but it will come out later in the talk. And, actually, this is feedback that we received from stakeholders during I think our last advanced reactor stakeholder meeting about the history of the reference COLA and subsequent COLAs and how that worked. I think for what we've heard from developers, they -- they're looking to be able to sell or deploy many of the same design and really benefit from being able to manufacture these reactors in a factory without subsequent design changes and instead of customizing each reactor to the needs of the buyer or the deployment site, they will incorporate additional

margin in the design so that it's better suited to different locations. They will seek to minimize the dependence on site-specific features that would require tailoring to the particular conditions of the site. So I think this is something that I'll discuss later and it's something that's on the mind of the developers, as well as the NRC staff, as how do we learn from the past and how do we effectively develop this licensing strategy and make it clear how applicants and developers would engage in it.

CHAIR BIER: Also, if I can comment. This is Vicki Bier. It seems like part of the issue is a different business model. The architect and engineers made some of their money off of design modifications and if your business model is as a manufacturer, then that's not really helpful to the company in the same way. So that may be part of the issue. I see there's one other hand up.

Ed, you want to go forward?

MS. HARVEY: Ed Robinson, is your hand up?

MR. ROBINSON: I totally apologize for that. I'm over here listening, but I have my arm -- I'm having some computer issues. Sorry about that. No questions.

CHAIR BIER: All right.

MR. KENNEDY: Thanks for the comments and the feedback. So depending on the pathway for licensing a standard design, again there may be sharing or opportunity for other public engagement. Also, each pathway will have its own time frame and so in this paper we're really focused on time-frame reductions and efficiency gains once you achieve the nth-of-a-kind state. So we're not so focused on the time frame for the Phase 1 review, but typically, the processes for design certification or manufacturing licenses are around 30 -- 46 months as described in NRC's generic milestone schedules.

And finally, as has been demonstrated in recent licensing reviews of advanced reactor applications, pre-application engagement can really go a long way to enhancing the efficiency and timeliness of licensing reviews, and so the same type of pre-application engagement would be beneficial related to the licensing activities that result in the approval of a standard design.

Next slide, please.

So now we'll go on to Phase 2 which is actually licensing nth-of-a-kind micro-reactors for operation as power reactors of fixed deployment sites. And this has leveraged the up-front approvals in Phase

1 to enhance efficiency, reliability, and clarity of licensing many reactors of the same design.

So I want to point out that the licensing of nth-of-a-kind reactors can be carried out under either 10 CFR Part 50 or 10 CFR Part 52. Either of the combined license under Part 52 or the construction permit as an operating license under Part 50 can reference a design certification rule or design that's approved in a manufacturing license. So this is another area where, when we developed this paper, we tried to be very flexible on how we're describing all the different potential options. We can't describe every single iteration, but we try to describe the main processes that could be used by developers and it would really be up to them to decide which of these licensing processes for the up-front approval, as well as the licensing of individual reactors, really fits best with their deployment model.

Part 53 that's under development can also be -- will also be applicable to licensing micro-reactors, but that's not discussed in this case as those regulations are still under development.

So looking at the sub-bullets here, I'll cover streamlined administrative processes in more detail when I get into the topics in the enclosures.

I'll just skip that for now.

And I'll say that leveraging front review should allow the reviews of individual nth-of-a-kind micro-reactor license applications to be focused almost entirely on licensee-specific and site-specific matters. For example, the regulations in Part 50 require and Part 52, require information about the organization, the operating organization, as well as financial qualifications, so those are going to be different for every application. And the other thing that we're anticipating is that much of the review will be the application of site-suitability, so this could, for example, through the review of the applicant's site characterization activities and comparison of the actual site characteristics with the bounding design parameters.

As was mentioned in the last remarks from the members, there will need to be similar verifications related to site-specific aspects of operational programs such as emergency preparedness.

Moving to the next couple of sub-bullets here, I'll cover inspections again later in the discussion of the topics in Enclosure 3. And then I'll just say finally, this last bullet that the licensing processes under 10 CFR Part 50 and Part 52,

include mandatory hearings and opportunities for contested hearings, the Commission recently directed the staff to modify the procedures for mandatory hearings, but they will be the same procedures used for both first-of-a-kind and nth-of-a-kind licensing. And then finally, the enclosure to SECY 24-0008, or the one that was provided in January, describes the processes of timing related to opportunities for contested hearings for both the Part 50 and Part 52 licensing processes.

And before I turn it back over to Jackie, I just want to mention as a final point that we need to be clear that the efficiency gains that we're talking about here, the reduced time frames, are not going to be at the expense of safety.

So much of the efficiency gains and timing depends on the NRC staff being timely and implementing its processes and making sure those processes are optimized for micro-reactors, but a lot of the responsibility also relies on the developers and their ability to design and reliably produce standardized reactors that are actually suitable for widespread deployment and similarly, applicants for the member micro-reactor licenses will need to provide high-quality applications and also follow through on their

obligations under the licensing processes in a timely manner.

So with that, I'll turn it over to Jackie to discuss operational programs.

MS. HARVEY: Thanks, Duke. Next slide. So the first topic to discuss here, which is one for Commission consideration, is related to standardization of operational programs, so being able to review and approve operational programs or a subset of operational programs with the design certification or manufacturing license. So this is really getting to what Duke was saying about the Phase 1 licensing strategy of what can be reviewed up front.

I do just want to make a note, so the presentation in the white paper referred to both the term operational requirements and operational program, so the requirement aspect is a part of a whole program and more specific to those parts that were required to verify the adequacy of the design for design certification.

So under the current framework, operational programs are generally reviewed and approved during the review for combined operating license or a construction permit and operating license. There are several design certifications in

manufacturing license regulations that do require portions of operational programs or operational programs that support the design, but, generally, full programs are not required at that stage.

Additionally, current Commission policy does not support the review and approval of operational programs in the design cert or manufacturing or the application beyond those are immaterial to the adequacy of the design, and I'll talk about that a little bit more now with the history.

So we're looking at the design certification rules. The NRC decided to report regulatory stability only to those requirements or programs, operational requirements or programs material to the design. Additionally, they had to have been completely reviewed and approved for the rulemaking. So this regulatory stability was given through and stated in the design certification rule that those requirements, that met those requirements, those requirements that -- material to the design and completely reviewed and approved are governed by 10 CFR Section 50.109 which describes the back-fitting requirements.

And then the design certification rules

also state in part that the Commission does not consider operational requirements for an applicant who references the design certification appendices to be matters resolved within the meaning of 10 CFR 52.63(a)(5) which discusses finality and resolution of matters within -- and resolution matters.

So this approach to only review and approve operational programs material to the design was initially approved in the Advanced Boiling Water Reactor and System 80+ parts design certification rule, codified as appendices in Part 52. And then further, the preamble to the ABWR rule also addresses stakeholder comments that was seeking finality for operational programs and the NRC's response stated that, in part, finality was not given because these standards were not comprehensively reviewed and finalized for the design certification.

I will also add that the Commission excluded from finality information voluntarily provided in the economic simplified boiling water reactor design certification, so in this case, the applicant included several programs that were not required to provide for the adequacy of the design and then the Commission excluded those operational programs even though they had been voluntarily

provided.

So that's just to give some of the history of where the current policy is, but staff in exploring potential efficiencies for the COL and the CP/OL licensing process is looking at that policy again for nth-of-a-kind micro-reactors which, as stated, are expected to have different characteristics from traditional large light water reactors such as a small footprint and significantly lower power levels.

So because of this, we anticipate that these reactors may not have the site-specific systems and interfaces or attributes that we traditionally have seen or require operational programs of this same scope that we've traditionally seen. So in that case, staff anticipates that, in some cases, operational programs could be reviewed, approved, and standardized through a DC or an ML application review to support a more efficient COL review.

And I know we've talked a lot about there are a lot of potential deployment models, potential technologies that developers are pursuing, so a lot of this, a lot of the staff's assumptions that go into this is the information and quality of information provided by the developer because it would need to be sufficient for us to -- for the staff to make a safety

finding to approve the program.

And I see a hand up.

CHAIR BIER: Yes, thanks. This is Vicki Bier again. This is kind of a hypothetical or counterfactual, so maybe you guys feel like you can't answer this, but it seems like if we had started out early in the U.S. history with these types of relatively mass produced small reactors, that the whole regulatory system might have been different and it might have been set up to review operational requirements in an ML application. Is that correct? And we're now having to backfit because we came up through a different approach?

MS. HARVEY: So I'm not sure if I can say that's correct or not. We definitely came up with a different approach and as we discussed previously, reactors once you go -- traditionally, once you go through the building, you learn and you may need to make changes, I don't know, Duke or Steve, if you wanted to --

MR. LYNCH: Jackie and Duke, would it be fair to say that the existing regulatory framework is really focused on the licensing of individual reactors and is not necessarily looking at the connection or merging of steps in licensing between reactors relying

on the same information outside of a certification?

So with that, what we're looking to do is push the boundaries of how can we bring in some of these decisions that may be made at later licensing steps and pull them up in ways that allow us to give a greater certainty to applicants as they're preparing their information so that they can get licensed more effectively. So I would not characterize this as a backfit on the work that we're doing as we're really just looking to find ways that we can approve of information at earlier stages.

We do have some provisions in different types of licensing that let us look at certain areas and then see in construction permits and OLs, but we're trying to be responsive to the proposals to have design certifications in manufacturing licenses for micro-reactors manufactured out of the facility.

Jackie, is that accurate?

MS. HARVEY: Yes, that's a fair characterization.

CHAIR BIER: That's helpful. Greg, I see your hand is up.

MEMBER HALNON: Yes, just a couple of things. This is Greg Halnon.

And again, I realize that we're dealing

with very early in the process. However, again, back to the manufacturing facility, if somebody is actually operating or testing a reactor, it seems like there would have to be a certain subset of operational programs approved for that purpose in itself, including, potentially, a subset of the EOPs, should something go wrong.

I think we've talked about this in previous meetings, about the potential for needing a standardized approach to emergency operations procedures, the generic technical guidelines, and whatnot, recognizing there's going to be a spectrum of operator roles that we'll be dealing with in all this.

But the second question is, I guess, more of a question rather than a comment. Do you envision at some point seeing maybe a small, maybe a short list of operational programs that would be absolutely required early on, as opposed to leaving it up to the designers to say this or that is required for the design?

MS. HARVEY: So, I think that will come out more so in guidance. Because some of these designs are so unique, at least for me right now, it's hard to say definitively what operational programs may be generally applicable to every design.

Right now, we also have guidance out there, the Advanced Reactor Content of Application guidance that was recently published earlier this year that actually walks through regulations that are applicable or not applicable to light water reactors versus advanced reactors or non light water reactors. So, there is some guidance out there right now.

But I guess going back to your question, it might be very possible that, if we see in the future a number of, you know, one technology that has a -- expect to have a broad or significant number of applicants pursuing that technology for a COL or CPOL, you know, we could further expand our guidance to be more specific.

MEMBER HALNON: Yes, I think you're right. I think you're going to come up and learn as we go a little bit. But, certainly -- and I'm going to probably beat the drum quite a bit about EOPs -- it seems like you would want a standardized response to emergency operations if the role of the operator is such that it's an active role, rather than just a passive, which, again, is going to be technology-specific.

However, if the operator does have to respond to an emergency situation, you don't want one

part of the country doing it one way and another part of the country doing it another way, if there's a specific purpose through the design that's required. So, I think that, as we see the designs, it's going to become evident --

MS. HARVEY: Uh-hum.

MEMBER HALNON: -- as we go forward.

The other part of this was that I know we look backwards at existing regulations and existing guidance, but we're dealing with a whole different technology and a different approach to these things. I would hope that we would do what's right, and if it takes rulemaking or new policy guidance, or whatever, or new policies, then we would go after it and do it rather than trying to force fit into old large light water or even RTR-type regulations. So, I'll be watching for that as well.

But thanks for your thoughts.

MS. HARVEY: Yes, thank you.

Any additional questions before we move on?

All right. Next slide, please.

So, for review of standardized operational programs up-front for the paper, and then, the upcoming SECY, staff is considering two options.

So, option one is status quo. So, really, to review and approve only those programs material to the design with regard to the ML and DC.

And then, option two is review and approve of any operational programs that were proposed in conjunction with a design certification or manufacturing license application.

And I'll just state here that in this case the design certification applicant or manufacturing license applicant would provide those at their own option. So, what we're looking at right now is they wouldn't necessarily be required by regulation, at least at this point in time. Going back to the previous comments, that could be a future change if we see that.

So now, looking at status quo, an applicant could submit today at its option a Topical Report for NRC review and approval, and then, a combined operating license or construction permit operating license applicant could incorporate that by reference in its application.

Alternatively, today, staff could review and approve operational programs through a design-centered review approach, where staff would review the first-of-a-kind, the entire first-of-a-kind process

through the combined license or CP and OL application of a particular design. And then, that review could apply to multiple other subsequent operating license applications of that same design.

So, these regulatory tools would still allow for the standardization of operational programs up-front, going back to more in the phase one for licensing, with the intent for the NRC staff to not revisit its evaluation for the COL or CPOL applicant unless there is new information/material to the conclusions on the adequacy of the program or another good cause.

But looking at this, staff had determined that these reviews might not give maximum finality, nor maximal efficiency benefits, as staff would be reviewing, for instance, each Topical Report on its own individually for applicability and appropriateness specific to the design, when we would get to the review for the combined license or operating license stage.

Now, under option two, staff is exploring strategies to allow really the maximum flexibility to review operational programs in connection with the design certification or manufacturing license. So, in this case, an applicant would have the option to

provide measures to satisfy an operational program not required to support the design as part of the design certification or manufacturing license application.

The NRC staff would then review these programs and could approve them, as appropriate. So, assuming that staff was able to make a safety finding, and that the program was, essentially, complete, and then, incorporate that into the design certification rulemaking or the manufacturing license.

But again, the onus is on the applicants that they would select which programs to choose to provide additional information and complete information on, and that they would be responsible for providing the sufficient information.

These programs, then, would be able to be referenced in the COL or CPOL application and should be in an even more streamlined review at that point in time, because these programs have already been reviewed in the context of a design with a manufacturing license or a design certification.

As to another -- oh?

CHAIR BIER: Yes, go ahead.

MS. HARVEY: Just the final thought is, with this option, a combined operating license or a construction permit operating license applicant

wouldn't necessarily be bound to an approved operational program. So, if you think of a well-established fleet, they may want to use an operational program that they have as opposed to one that a developer has proposed or standardized.

CHAIR BIER: Okay. I do have several comments or questions on this slide. This is Vicki Bier.

First, do you envision that the agency will choose one of the two options? Or is it possible that both will be available pathways and that the applicant will choose which process to use?

MS. HARVEY: So, for the purposes of the Commission, the Commission consideration is that we would need the Commission to tell us that option two, or direct us to pursue option two. But, right now, the staff fully intends, whether or not option one is specified or option two, to use the regulatory tools that we can currently use today, that we could discuss under option one.

So, even if option two is directed, we still expect applicants then can, additionally, choose to provide Topical Reports for early review.

CHAIR BIER: Okay. Second, you mentioned that pursuing option two would require some Commission

direction.

MS. HARVEY: Uh-hum.

CHAIR BIER: Do you think, following up on Greg's earlier question, do you think it may require rulemaking or that Commission approval of the strategy would be adequate?

MS. HARVEY: So, that is something that I think we're going to need to take a deeper dive on, once the Commission provides us direction. We are considering rulemaking. For instance, the manufacturing license regulations, you know, maybe there is a more generic way to scope-in additional operational programs to be reviewed, say, in the manufacturing license regulations, as opposed to doing it using another regulatory vehicle on an application-by-application basis. So, in short, yes, we are also considering if rulemaking would be the best option.

CHAIR BIER: Okay. Yeah, I think, you know, again, this is just one member's opinion, but, similar to what Greg said, I don't know enough about the regulatory process to know whether rulemaking will be a more efficient strategy in the long run. But, certainly, I would encourage doing whatever kind of makes the most sense, if that means going through rulemaking.

The last question I have, which may be more something for the Committee to ponder, but we're happy to hear you guys' opinion, if you have one. It seems to me that the choice between options one and two, if we're only going to allow one of them, or whatever, is really not a safety issue of the sort that ACRS would need to opine on; that both could be implemented in a way that maintains safety and that the crucial ACRS safety evaluations might come at a later stage, as you flesh out, for instance, what kinds of operational information would and would not need to be included under option two. At that point, we might have strong opinions about, no, it's important to include this or that aspect.

But I'm not sure that the choice between one and two really is safety-critical at this point before we know more about the operational details of how they would be implemented. So again, you know, right now, I think that's just something for Committee members to keep in mind for a later discussion. But if you want to comment on that question, I'd be happy to hear your thoughts.

MS. HARVEY: Well, I'll just, first off, say, you know, we'll absolutely defer to ACRS and what you determine and decide is best.

But I just wanted to reiterate the thank you from earlier. I mean, the feedback is appreciated.

MR. LYNCH: Well, I mean, I'll chime in here. I think you're absolutely correct that, looking at these programs as part of the early part of a review, just determining the timing of when you do that, it's not itself a safety issue. As you correctly identified, where the safety considerations come into play, so that it is detailed in the operational programs themselves and how they will be executed once the reactor is up and running. And, yes, I think we do agree that just the timing of when we perform that review is itself not a safety consideration.

MS. HARVEY: I see another hand.

MR. SCHULTZ: Jackie, this is Steve Schultz, consultant to the Committee.

You had mentioned, under option two, just as you closed that discussion, that perhaps an operator that had more experience or different experience associated with operating a next-of-a-kind design could, I'll call it, deviate from the standardized operational program in some fashion.

Based on our previous experiences, both

with large light water reactors and, also, in the SMR environment, anytime you open the door to deviations from a standardized program, be it design or operation, it opens the door in a regulatory environment, that it becomes very complex, or has the opportunity to do so.

So, I would suggest that we concentrate on developing a standard operational program that is fairly solid and that the operators of a next-of-a-kind design would not deviate from the standardized program.

MS. HARVEY: So, I appreciate the comments. The thought with that right now is or was, I guess, to not lock COL or CPOL applicants to have to use that program, but they would be able to use that standardized program if they wanted, but with the caveat, if they didn't use that standardized program that was already reviewed, it's still going to be going through the required NRC review. And you may not get the nth-of-a-kind benefits that we've been talking about. But I understand your comment, yes.

MR. SCHULTZ: That's what I would expect. It can become very complex, both for the applicant as well as for the staff.

MS. HARVEY: Right.

MR. SCHULTZ: There will be a lot of applicants out there for these.

MS. HARVEY: Uh-hum.

MR. SCHULTZ: And once you open the door, it gets very complex rapidly.

MS. HARVEY: Uh-hum, right. Yes. And so, the time lines that we've estimated -- and as Duke has mentioned about the streamline of reviews -- you would necessarily get those benefits --

MR. SCHULTZ: Yes.

MS. HARVEY: -- as we work through those complications.

MR. SCHULTZ: Perhaps NEI will comment on that later, thank you.

MS. HARVEY: Uh-hum.

And another hand?

MEMBER HARRINGTON: This is Craig Harrington.

Yes, just a comment. It does seem very much like a regulatory carrot-and-stick thing; that the opportunity is there; that the manufacturers and the prospective purchasers and operators can take advantage of all the benefits and not change a thing, or they can take the slower path and do as we've done in our nuclear fleet in this country for so many years

and decide you wanted a different color or a different this or a different that. And so, it seems like a carrot-and-stick kind of an opportunity.

MS. HARVEY: Okay. All right.

So, the last comment that I make, that I'll make here -- and I had said this previously, and this is before I turn it over to Duke for the information slides -- is, again, just we have regulatory tools right now that were discussed under the status quo option. And staff fully intends to use those, you know, whether we go status quo or are directed to review and approve operational programs, whether a DC or ML application.

But an important aspect of this is also pre-application engagement. And so, staff just really want to highlight the importance that developers or COL or CPOL applicants utilize pre-application engagements as much as they can.

All right. So, next slide.

Duke?

MR. KENNEDY: Okay. Thank you.

So, the next several slides cover the information topics that are included in enclosure 3 to the draft white paper.

Just as a bit of background, when we began

formulating the ideas for this paper, we had a very long list of microreactor licensing and deployment topics that we had developed. We went through and looked at, okay, which topics can we combine that make sense as a coherent paper? And those ended up being the topics that led to treating nth-of-a-kind licensing.

It was fortuitous because it very soon thereafter became a focus of developers. And so, then, we looked and said, well, which of these topics actually require some Commission direction to achieve additional efficiencies? And we pulled out the topics of standardized operational programs and alternative environmental reviews. And then, the topics that were left that were, essentially, needed to complete the roadmap for nth-of-a-kind licensing were included in this enclosure. And so, I'll go through those now, but the purpose of these information topics is to fill out the picture of nth-of-a-kind licensing and to provide additional clarity and reliability for those regulatory processes.

So, as I mentioned before, the design standardization and the benefits for streamlining licensing and regulation of nth-of-a-kind microreactors aren't new concepts. So, the purpose of

describing maximum design standardization is more setting the expectations for how design standardization can work under the various licensing processes and what the benefits will be for the nth-of-a-kind reviews. So, it's not just to create some entirely new paradigm for licensing, but it's more to reiterate what exists and how it can be used most effectively to achieve efficiency and reduce time frames for licensing nth-of-a-kind reactors.

So again, based on stakeholder feedback, we anticipate that most licensing strategies will involve up-front approval of the standard design and the manufacturing license or design certification. There are other regulatory pathways, such as a standard design approval, or as was mentioned, the licensing proceeding for a first-of-a-kind reactor. But those don't provide the same level of finality and standardization as the design certification or the manufacturing license. And so, the focus in this topic is on the design certifications and manufacturing licenses.

And just as a quick refresher -- and maybe this is coming a little bit late -- the design certification is a rulemaking that codifies the standard plant design. They're included in

10 CFR Part 52 as appendices. A manufacturing license is a licensing action whereby the complete final reactor design is approved in the manufacturing license, as well as some other provisions related to the organization of the manufacturing license holder and aspects of transportation of a manufactured reactor from the manufacturing facility to the site where it's authorized to be deployed.

So, both manufacturing licenses and design certifications can be referenced in combined licenses or in construction permits and operating licenses. And so, there's a variety of different ways these licenses can be used in combination or connection to achieve maximal design standardization and to reduce the time frames for reviews at the deployment sites.

So, I'll go a little bit more into detail now on the main tenets of maximal design standardization that the NRC staff considers are necessary to achieve the greatest benefits for nth-of-a-kind licensing.

So, first, the design should be usable for a multiple number of units or at multiple numbers of sites without reopening or repeating the review of the reactor design.

Second, the complete plant design should

be sufficiently detailed to be approved and provide finality in the design certification or manufacturing license, or again, a combination of the two.

Third, the design should use bounding site parameters that would make it suitable for licensing at deployment sites with a wide variety of site characteristics.

Fourth, to minimize the use of site-specific design features.

And then, again, fifth, applicants should avoid or not take the departures from the standard design in their applications for individual microreactors.

So, on this last point, and as was already mentioned, and also, in relation to standard operational programs, departures from what's been approved in the phase one up-front approval are going to need to be addressed in the application for a specific microreactor and reviewed by the NRC staff on a case-by-case basis, which, of course, introduces additional time into the review. It requires more NRC staff resources.

And so, if a particular departure becomes commonplace for a standard design, it may be worthwhile for that standard design to be updated

through an amendment to the design certification rule or the manufacturing license.

And so, this gets into an issue that we've already discussed a little bit here, but that we've also heard a lot about it from stakeholder through our periodic meetings. It is the idea that, as microreactors, our experience with microreactor licensing and design grows, there are going to be safety enhancements or enhancements that support operational efficiency that developers want to incorporate into their designs. And so, they may want to iterate on a certain design over time to achieve those enhancements.

And developers are looking to have flexibility in that regard. However, the regulations would require that, depending on the actual design change, there would likely be a change to the design certification rule or to the manufacturing license to incorporate that.

So again, some developers have had ideas that, instead of a one-size-fits-all reactor design, they may have a standard basic design, and then, have various models with some different features and have all those models approved up-front by the NRC. So that, when it comes time for deployment, they can pick

the model that best fits the actual site where it will be deployed. So, the simple example is that there may be two models with different resistance to seismic hazards and they just pick the model that best fits the actual characteristics of the deployment site.

So, I'll touch again on the idea that it may be possible to proceed nearly directly from a design certification or a manufacturing license to, more or less, the nth-of-a-kind licensing process, but, again, that hasn't been the experience in the past. And so, it very well may take a first-of-a-kind reactor to go through the complete licensing process, be approved, and begin operating before it's understood well enough to actually achieve the state of maximal design standardization.

Hand up?

MEMBER HARRINGTON: Yes. This is Craig Harrington again.

Just could you clarify for me, are the DC and ML essentially interchangeable? Or is there possibly a case where someone might obtain a DC and an ML for a design? Could you just comment on how they relate to each other?

MR. KENNEDY: Yes, yes. That's a great question.

So, the design certification regulations and the manufacturing license regulations have a list of what needs to be included in an application. And they are very, very similar in terms of the technical information related to the design that needs to be included.

There are some differences when it comes to the part of the nuclear plant that isn't the utilization facility itself, but the part that's designed to sustain the nuclear chain reaction. And so, the manufacturing license is really geared towards the manufacture of the utilization facility, which may then require additional plant features to be at a specific site in order for that utilization facility to actually continue operating and produce usable power. Whereas, the design certification kind of can cover everything.

So, it is possible that there's a design certification for a standard plant; there's a manufacturing license that references the utilization facility portion of that design certification. The utilization facility is manufactured in the manufacturing facility, and then, the combined license holder, for example, references the design certification in their license. And then, that

manufactured reactor is able to be brought to the site covered in the combined license that authorizes operation of that manufactured reactor.

So, there's an interplay here between the different types of licenses that can be used and how they can be referenced and which different licenses cover different aspects of the entire plant design.

Does that answer your question?

MEMBER HARRINGTON: I think so. It sounds like it's a bit of a complex interaction, and as with all the rest we've talked about, ultimately, it comes down to some choices and decisions by the designers, the manufacturers, the users, how they want to proceed through the various licensing tools.

MR. KENNEDY: Okay.

MEMBER HARRINGTON: So, thanks.

MR. KENNEDY: And you just stated my last point on this slide. So, thank you for that.

And, okay, move to the next slide, please.

The next topic is grading the level of site characterization, which is really described at a conceptual level in the white paper. And the concept described in the white paper is, essentially, to use margins between the actual site characteristics and the bounding design parameters and the margins to

appropriate those reference values to assess whether it would be appropriate to use alternative methods for site characterization.

This will be done on a parameter-by-parameter basis. So, while some parameters, site characteristics or parameters, would need to be looked at in a more traditional way, other parameters might be able to benefit from grading the level of characterization.

So, just as a couple of examples for a microreactor that's designed to withstand high seismic hazards, site characterization through a literature review or based on regional hazard maps might be adequate if the literature shows that the seismic hazards for that proposed site are very low. So, there you have a large margin between the bounding design values for the reactor and the actual site characteristics.

Another example is that, if there is an event that would be caused by exceeding some site parameter, but that event has no or very low radiological consequences compared to the reference values, it may be adequate to grade the level of site characterization for that specific parameter that could potentially induce an event.

There's another idea that's discussed in the paper and that is that the design could be insensitive to certain site characteristics. And so, for example, a reactor that's located deep underground might not be sensitive to meteorological conditions at the site.

And so, for instance, in that case where a reactor is not sensitive to meteorological conditions or it's found that there are large margins, it might not have to go through the process of collecting site-specific meteorological data over a long period of time. It might be adequate to, again, rely on available information.

So, one thing I want to point out, also, about this concept of grading the level of site characterization is that we're here today talking about nth-of-a-kind microreactors, but this is one topic where the staff is considering whether these approaches could be applied to other types of reactors, including first-of-a-kind reviews for specific reactor designs.

So, that's actually a larger theme in this paper and in the Commission paper that went up in January on factory fabrication of microreactors. But we are focused right now on microreactors, but we

understand that some of these ideas and concepts have broader interest to other developers. And so, we're considering that now and that's something that will be considered in the development of guidance as well.

Go to the next slide, please.

Okay. This slide covers deployment site emergency preparedness. And so, enclosure 3 of the white paper includes information about emergency preparedness for microreactors. That's in addition to the discussion that's in enclosure 1 about standardization of emergency preparedness programs.

So, enclosure 1 discusses considerations related to standardization such as site-specific considerations, efficiently addressing emergency planning zone sizing, and deployment of multiple microreactors at the same site.

So, existing regulations for emergency preparedness that are in 10 CFR Part 50 and Part 52 apply to microreactors. And an applicant for a license or in considering the development of a standardized operational program could choose to use the regulations that are in 10 CFR 50.47(b) and appendix E, which is emergency planning and preparedness for production and utilization facilities, or the requirements in 10 CFR 51.60, which

are emergency preparedness for small modular reactors, non-light water reactors, and non-power production and utilization facilities.

So again, there are choices for developers to make. We are trying to stay flexible and allow for developers to decide what's best for their deployment models.

In either case, the NRC has a graded approach to emergency preparedness in which requirements are set commensurate to the radiological risks and hazards of the facility. And so, microreactor applicants can use this risk-informed approach to emergency preparedness to establish appropriate emergency plans and response capabilities.

So, finally, on emergency preparedness, let's say that the staff is exploring approaches for streamlining the review of emergency preparedness for licensing and for the kind of microreactors 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 offsite response.

Yes, hand up?

MEMBER ROBERTS: Yes, this is Tom Roberts.

I noticed that your previous slide didn't

address site population. This slide has that such as caveat in the second bullet that talked about the possibility that the dose at the site boundary might be so low that you don't need to have extensive offsite response.

Doesn't that same thought apply to the siting? And if not, what is your thought in terms of a generic site population density or how would you bound that in the site characterization?

MR. KENNEDY: Sure. Thank you for the question.

There was a SECY paper that was presented to the Commission, I want to say it was SECY 20-0045 on site and on population density considerations for siting, in which the staff presented a few different alternatives for how to determine the appropriate location for siting a reactor, depending on proximity to population density centers, as well as the population density outside of that center.

And so, those alternatives included consideration of microreactors. And the Commission provided an SRM on that SECY paper, and then, the staff proceeded to update; I believe it was Regulatory Guide 4.7, I hope. That's right, isn't it? Okay. So, that has been looked at.

Later, I'll mention again the ADVANCE Act, and the ADVANCE Act also has direction in it for the NRC staff to reconsider the population density siting criteria to ensure that it has taken a risk-informed and performance-based approach to considering population density siting criteria specifically for microreactors.

MEMBER ROBERTS: Right. Yeah, thank you for that.

There's two approaches one could take. One is the such as caveat on this slide, which is the site population density, per Reg Guide 4.7, will not be a concern if the doses at the site boundary met the criteria in Reg Guide 4.7. So, that's a relatively elegant solution.

The second approach is the one I'm asking about, which is, if you can't meet that, then I'm wondering how you would do a generic site characterization, given that the site population density would be a factor in determining whether or not or how you might meet the criteria in Reg Guide 4.7.

So, it may be that your intent is to make that an equivalent of an ITAAC condition for the site, or it may be that you would put that in the generic

site as a boundary condition. That's what I'm trying to understand, how that plays out.

MR. KENNEDY: Yeah, I understand the question. I think all the options are on the table. At this point, we're not trying to hone-in on any particular one here, but in the process of developing standardized programs and in any related guidance, those are great considerations.

MS. HARVEY: And, too, with the guidance that is being developed for the siting considerations, that's great site care characterization.

MEMBER ROBERTS: Yes. Okay. Thank you.

MR. KENNEDY: Okay. I guess we'll move to the next slide, then, please.

Yes, the next slide covers streamlined processing of license applications and licensing documents. So, the idea here is that, when you get to nth-of-a-kind licensing and you're processing many applications for reactors of the same design, and there are a limited number of site-specific factors that need to be considered, the applications will generally be required to contain the same small set of information and they will look similar.

In the same vein, the licensing documents that are generated by the NRC during the licensing

process will also look very similar for microreactors of a common standard design, but perhaps, also, more broadly across microreactors of a certain type of design. For example, the self-contained reactor designs may all have very similar aspects in their applications and in the documentation generated by the NRC.

And so, the idea in this topic is really to look for those new opportunities to rely heavily on electronic processing of submitting applications, as well as processing the applications to the latest review steps, to really reduce the resource burden on the NRC staff in the administrative aspects.

So, I just want to be clear that we're not talking about artificial intelligence here or replacing NRC technical staff with AI algorithms. This is simply about well-established data manipulation software where data can be put into a database, and then, populated in templates or various documents automatically to avoid manual manipulation by the NRC staff.

Also, it can be used to compare, for example, a value in a license application with the bounding values that are considered in the actual design approval as a first check to make sure that an

application is actually providing information that's consistent with that standard design. And if it's not, that may be okay. It may be indicating a departure, but at least that can provide a flag for the NRC staff to see that there's a discrepancy there.

And so, this feature can also, I think, help in streamlining our process for acceptance reviews as well, especially considering the smaller volume of information in an application for an nth-of-a-kind reactor where the design has already been reviewed and approved.

So, just like under the current process where all of the NRC documentation is subject to quality checks and technical verification by qualified staff, this is no different. It's just using electronic tools to perform a lot of the steps that are now administrative and performed by hand.

And going back to kind of documents looking similar, this is also an opportunity to rely more heavily on templates than we have in the past, where we're looking at individual first-of-a-kind reactor designs with very large and complicated reviews and needing to tailor each of the various licensing documents to really fit that particular design. Here we have an opportunity to do a lot more

things generically using templates and automated tools.

Okay. Next slide, please.

Okay. So, the final information topic that's covered in this presentation is construction inspection. So, in 2023, the NRC staff provided SECY-23-0048 to the Commission, which covered the staff's vision for the Advanced Reactor Construction Oversight Program, or ARCOP.

So, the NRC staff's ARCOP vision looks to build on its construction oversight experience while remaining adaptable to future advancements in reactor technologies, such as those that we're seeing potentially being proposed for microreactors.

So, going back to what Jackie mentioned earlier in the presentation about there's, generally, two types of microreactors, one that's a self-contained design and one that relies more heavily on actual site construction activities. There's an important distinction there when it comes to developing and performing construction inspection.

For designs that would be manufactured almost entirely in a manufacturing facility, and there may be very few site disturbances, more inspection activities or the inspection program would focus on

what's being done at the manufacturing facility, in addition to verification that the reactor has been installed appropriately at the deployment site location.

On the other hand, of course, for microreactors of the core module design, where part of the reactor is manufactured and there's still substantial construction activities onsite, again, the balance between the two locations in the inspection program, but it may rely more on inspections that are performed at the actual deployment site.

So, the NRC staff is considering approaches for risk-informed and performance-based inspections at both of these locations, the manufacturing facility and the deployment site, and is looking for ways to ensure that these inspection activities can be carried out within the time frames for construction and manufacture that will be considered by the developers, so that the construction inspection process doesn't become a holdup on the critical path for the entire licensing process.

And so, through gaining experience and refining the program, it's anticipated that the program can be scaled over time to really hone-in on the amount of inspection that's really necessary to

meet the program objectives, and in this way, ensure that the overall construction inspection time frames and the required findings can be made within the construction time lines being considered by developers.

And so, the staff expects to communicate the details of the ARCOP program in a separate paper to the Commission in the future.

Next slide, please.

All right. So, just to give a little bit of background on stakeholder engagement, as I mentioned, we first engaged with stakeholders on the concepts for this paper in December of last year, and then, we engaged again in March and July on more details regarding the topics that are included in the paper; the ideas that the staff was considering for approaches to standardized operational programs and alternative environmental reviews.

Also in this time frame, there was a session at the Regulatory Information Conference that focused on factory-fabricated microreactors. And so, these ideas were discussed as part of the staff presentation during that session, and some of the developers and other panelists also provided their insights related to some of the concepts that became

part of this paper.

I think the feedback that we heard was generally supportive of the approaches that the staff were developing and about the scope of the paper. And there's interest in stakeholders staying engaged in the development of any guidance that would be necessary to implement Commission direction on the SECY paper that we're planning to prepare.

There were also public meetings with various developers that provided additional information to the NRC staff about developers' plans and, also, what their anticipated licensing and deployment strategies might look like.

We also received a paper from the Nuclear Energy Institute that covers regulations of rapid, high-volume, deployable reactors in remote applications and other advanced reactors. And this provided industry perspectives on most of the topics covered in this paper, as well as other topics that have been addressed or considered in previous NRC papers or that are still available for future consideration.

And then, finally, we are planning to hold a public meeting dedicated to discussing this white paper in early November. This is, essentially, the

same thing that we did before we provided the SECY paper on factory-fabricated microreactors to the Commission. We had a dedicated public meeting to explain what was in the paper to the public, to hear any public feedback. And so, we're planning a similar meeting in early November, with the exact date to be determined, but the announcement for this meeting should be forthcoming in the very near future.

Next slide, please.

Okay. So, next steps. So again, we're planning to develop a Commission paper on nth-of-a-kind microreactor licensing and deployment considerations that is based on this draft white paper. It will request Commission direction on regulatory approaches for standardizing operational programs, as well as direction on options for alternative environmental reviews. And it will provide the information on these other topics to round out the picture of nth-of-a-kind microreactor licensing.

Finally, I wanted to provide a little more detail about the ADVANCE Act and how it relates to microreactors, and what the NRC staff is doing in response to the congressional direction in ADVANCE Act.

So, Section 208, which is titled Regulatory Requirements for Microreactors, directs the NRC staff to develop and implement risk-informed and performance-based strategies and guidance to license and regulate microreactors.

And it includes eight topical areas. The topical areas are staffing and operations; oversight and inspections; safeguards and security; emergency preparedness; risk analysis methods; decommissioning funding insurance; transportation of fueled microreactors, and siting. And siting includes three subtopics which are considerations related to population density; licensing mobile reactor deployments, and environmental reviews.

So, the staff plans to address the ADVANCE Act through the existing regulatory framework -- for example, just guidance documents -- through the Risk-informed and Technology-inclusive Regulatory Framework for Advanced Reactors that's being developed in 10 CFR Part 53, and other rulemakings, as appropriate, whether there are other ongoing rulemakings or we need to initiate new rulemakings to fully implement the direction in the ADVANCE Act.

So, in this respect, the staff is working proactively to enhance clarity, reliability, and

efficiency of its Regulatory Framework for Microreactors, while maintaining a focus on safety, security, and the environment. This includes addressing policy topics related to microreactors, such as the topics that are covered in the white paper and planned Commission paper that we're discussing today. Also, the topics that were covered in the SECY paper in January on factory-fabricated microreactors and developing new regulations and guidance for advanced reactors.

And so, the NRC staff will continue to engage with stakeholders as it identifies, develops, and establishes new or revised strategies that may be needed to optimize the Regulatory Framework for Microreactors and fully implement the ADVANCE Act.

So that, I hope, gives you a little more perspective on what's in the ADVANCE Act related to microreactors and how the NRC staff's activities are working to address the ADVANCE Act.

So, that concludes the presentation, and thank you very much for all of your questions so far and your feedback. And we will do our best to answer additional questions and we'll welcome all the additional insights from the ACRS. So, thank you very much.

So, there's a hand up.

MEMBER HALNON: Hi. Yes, this is Greg Halnon.

I'm sure at the upcoming RIC we're going to have sessions, if not more than one, on the ADVANCED Act. Have you proposed a specific session on the microreactor licensing?

MR. KENNEDY: I do not believe that we have proposed a session on microreactor licensing as of this date, but I would need to check with the actual people who are responsible for developing the RIC program this year.

MEMBER HALNON: Okay. Well, just it might be good to take advantage of the momentum that we have, and there's a lot of good ideas out there. At some point, they all have got to come together, so you guys can put together some framework. But, hopefully, it won't be just embedded into a larger session because I think it warrants a lot of discussion.

But thanks. A lot of good work going on and I appreciate the presentation. I think that your thought processes are very good. Thank you.

MR. KENNEDY: Okay. Thank you very much for the feedback.

CHAIR BIER: Are there any further

questions for staff at this time?

Yes, Joy, are you -- I don't see your information -- are you a member of the public or are you staff, or what's your role?

MS. JIANG: Hello. Can you hear me?

CHAIR BIER: Barely. Can you speak up a little bit?

MS. JIANG: Can you hear me now?

CHAIR BIER: That's better, yes.

MS. JIANG: Oh, good.

This is Joy with The Breakthrough Institute nuclear team.

CHAIR BIER: So, we are not quite at public comments yet.

MS. JIANG: Okay.

CHAIR BIER: Are you able to stay on and provide your comment later?

MS. JIANG: Yes. Sure.

CHAIR BIER: Okay. That's great. Thank you very much.

What I would propose is that we take a short break now, then hear from NEI, and then, go to public comments. Is that agreeable with everyone?

MR. KENNEDY: Yes.

CHAIR BIER: Okay. It sounds like

everybody is ready for a break. Can we get back at 12:00 Eastern or do people need an additional five minutes?

MR. LYNCH: That's fine, Vicki.

MS. HARVEY: It's good with us.

CHAIR BIER: Okay. So, let's plan to get together again at 12:00, and then, we'll start with NEI and go to public comments after that.

MS. HARVEY: Okay. Thank you.

CHAIR BIER: All right. So, we're now on break and we'll see everybody soon.

(Whereupon, the above-entitled matter went off the record at 11:49 a.m. and resumed at 12:00 p.m.)

CHAIR BIER: Okay. It looks like we are at 12 o'clock Eastern. So, at this point, I think we can go ahead with the NEI presentation, and then, we will take public comments and Subcommittee discussion after that.

You can go ahead. Thank you.

MR. NICHOL: All right. Thank you, Vicki. Thank you, other members of the ACRS, for letting NEI present today on what we call rapid high-volume deployable reactors for remote applications. I'll explain that, but, largely, it's the same topic that

you just heard from the NRC in that area.

And most of my presentation -- well, almost everything I'm going to say -- is going to focus on the concepts and proposals NEI developed. I will note that there is a lot of alignment with what the NRC just proposed or presented to you. Certainly, at the big-picture, conceptual level I think there's direct alignment and agreement there.

There are differences at the detail level. I'm actually going to try not to go into those. We'll save that for the public meeting that the NRC is planning in November. But I will note sometimes the details matter. And so, we will cover that with them.

The other thing I wanted to mention just at a big-picture standpoint, we certainly agree with the NRC that, while these efforts have started out focusing on microreactors, we also agree that many of these concepts could be extrapolated to other advanced reactors. In fact, that's one of the things we tried to do in our approach, is to make it a little bit more graded.

So, most of what I'll talk about is on the far end of the range, in which we would expect it's microreactors that would be able to achieve these things, but in our proposal we did establish graded

approaches, so that if other advanced reactors could meet them in part, but maybe not in whole, or they could meet them in whole, then they would have a graded approach to that. And it's all based around establishing the right performance-based acceptance criteria.

And so, what we found is that considering the potential applicability to other advanced reactor types really helps to get to the right performance-based acceptance criteria, which are what you will use, what would be used to determine who would be able to utilize this approach. So, I wanted to mention that.

So, that's why we called it the rapid high-volume deployable reactors rather than microreactor end-of-a-kind. We wanted to focus more on the performance-based aspect of it, more about the applications than a specific -- what we worried about mostly and why we avoided using microreactor as much as possible -- we didn't want this to be tied to a specific power level, because power level is not a very good proxy for levels of safety and safety and security performance. So, that's why we called it that.

Just a quick status in what's new. So,

you're well familiar with all of the microreactors work that the NRC has done. I've got a slide that just summarizes it real quickly.

Really, what was new -- and we're building on that -- but what was new is there's interest in oil and gas beyond that. And, in particular, Shepherd Power had sent a letter to the NRC articulating that, in order for nuclear energy to be viable for meeting their business needs and decarbonizing their operations, they're looking for the NRC to support a 180-day or less deployment. That's from site identification to operations, and then, also, to try to achieve regulatory costs that are on the range of 1 percent of total cost on the capital and O&M.

And then, of course, we have the ADVANCE Act, Section 208. We think that our proposal could be, if the NRC agreed with it, could be a good starting point for the blueprint for that regulatory framework.

And we asked, in the letter that we sent to the NRC, we asked a couple of questions.

One, does the NRC think that this is the right scope of issues that need to be addressed to enable the business model?

Two, did the proposals that we had in

there and the broad outcomes, did they look potentially achievable from where we stand today?

And then, three, is the NRC interested in trying to address all of those.

So, we've asked for a response by the end of the year on that.

I am going to go into the topics. I will note that our paper tried to be comprehensive. We didn't want to identify a few topics today, and then, a year from now identify a few more topics. We wanted to identify the entire suite of topics. So, we have about 31 in our paper.

David Petti, I see your hand is up.

MEMBER PETTI: Yes. Marc, before you get into that, I looked ahead and I wasn't sure. Help me with the mental model of these rapid deployable. Are we talking about something like a Tesla factory or something more like Boeing's airplane factory? Or is it even yet different again? How do you mentally envision -- you know, what does it look like to you? Because that, I think, helps think about you, you know --

MR. NICHOL: Yes. It would be, yes, I don't know, between Tesla and Boeing, I don't know exactly which one it fits into. But the concept,

maybe to describe it in words, would be that the manufacturer of these microreactors are able to manufacture them when they want to, and then, as a customer comes in and places an order, they would be able to ship them to the customer very quickly.

I'm avoiding off-the-shelf, as some companies may want to have these stocked on shelves and they just pull them off the shelf when they get the order and ship them out. Some companies may want to have a little bit more build-to-order. It will all depend on the manufacturing timescale; how much advance notice they get from the customer before they need delivery.

So, within this model, some of the things we heard is that, even though the specific identification of the site would happen about six months before they would want to initiate operations of the gas well, that before that site identification, they would know they need power. They just wouldn't know which site they need it. Maybe they would know they would need power a year before that.

So, there would be enough time to enable the manufacturing of it, but when it gets to identifying the site, there's not as much time to be able to work through all the site specifics. So,

similar to the NRC, we're trying to move those earlier in the process, so the NRC is not part of the bottleneck.

MEMBER PETTI: Okay. Well, thanks. That helps.

CHAIR BIER: Another question. This is Vicki Bier.

Again, it's probably looking ahead, and maybe you were planning to get to this. But do you have a definition of remote, either in terms of distance or population density, or whatever? Because it sounds like some of these might be truly remote, you know, with no resident civilian population nearby, or whatever. And other of the examples, like, you know, a village in Alaska that has poor energy access would be a small population, but with a local civilian population that might be quite nearby.

So, do you have a definition in mind for that?

MR. NICHOL: So, we don't have a specific definition. The reason we picked the concept remote is that we wanted to not have to include population siting as one of the issues that was critical to this. So, our concept for saying remote is that these would be located far enough from population centers that

they would be well outside the population distance requirements that the NRC has.

Now, there's nothing precluding these from someday in the future being located closer to populations, but, then, they would have to address the population siting requirements. And we just wanted to remove those population siting requirements from these considerations, so that we could focus more specifically on the technical aspects.

CHAIR BIER: Okay. Thank you.

And Greg?

MEMBER HALNON: Yes, Marc, this is Greg.

Back to Dave's question, just to put a period at the end, that 180 days on your slide, what is your assumption going into that? Is that an off-the-shelf or is it independent of the manufacturing piece of it?

MR. NICHOL: It would be, it would effectively be off-the-shelf. There may be, as I mentioned, if there's a long tail to the order, then there could be some build-to-suit. But the idea would be that site identification, that date, the reactor would be manufactured, licensed or approved under a manufacturing license or DC. It would be manufactured and it would be ready to ship on the day when the site

was identified.

MEMBER HALNON: Okay. So, there's some parallel work going in there, but also some work prior to that 180?

MR. NICHOL: That's right, yes.

MEMBER HALNON: Okay. Thanks.

MR. NICHOL: Yes.

All right. So, moving on to the next slide, just the historical work. We included the NRC SECYs and all the topics they've worked on for microreactors before. NEI has also submitted papers on these topics in similar time frames. And so, this shows which papers addressed different topics previous to this.

Now, of those, there were 22 topics. Sixteen of those topics are part of the 31 topics in our RHDRA proposal. Most of those 16, as we looked at the RHDRA, the business model needs, needed additional work and extension on them. So, it's not to say 16 of those issues were closed because of this prior work. Sixteen of those issues will benefit from the prior work, but will need to be extended to fully consider the new business models.

So, this slide comes from our paper and letter to the NRC. We recognize that 31 topics were

a lot to take on all at once and resources are always a consideration. We also knew that we didn't have to address all of them immediately; that we had time for some issues to address later on.

So, we put together this prioritization matrix, high priority versus medium or low priority, and then, near-term resolution is needed versus longer-term resolution is needed. And we laid out our issues on that.

The yellow highlighting is to show where the NRC's current NOAK paper maps to our issues. Sometimes we use different terminology. Largely, it's the same scope, but sometimes we divide scope a little bit differently than the NRC.

But you can see that the NRC's paper, for the most part, addresses all of our upper left, near-term urgent, high priority, with the exception of operations staffing, and then, they address some others in the other boxes as well.

Dennis, I see your hand.

MR. BLEY: Yes. This isn't a safety issue, but I'm kind of stewing over your last slide.

Even now, if you need to order large equipment, like a new transformer, and then, other big things, you've got a long wait for it to be built.

The idea that these could be even close to off-the-shelf implies a massive investment in inventory to me. I just wonder if you guys have thought much about how practical this is. I can understand why the buyer would like it, but it isn't at all clear how a manufacturer could do it.

MR. NICHOL: Yes. So, part of it rests on the volume of deployments that would be expected. We've heard, based on demand, that we could expect hundreds and thousands of microreactors to be ordered and deployed. And so, there likely would be the volume of orders to be able to support something that would be more like reactors on the shelf. And it may not be exactly that. But the throughput at the factories would be such that it could support a business model where manufacturing begins before the specific customer is identified.

MR. BLEY: Okay. Thanks.

MR. NICHOL: Uh-hum, yes.

All right. As we looked at this, just a top-level conceptual, we recognized, one, that the design features certainly for microreactors, but also for similar type of advanced reactors that can be rapidly deployed in high volumes were a lot different from large light water reactors, are somewhat

different from other advanced reactors.

The application and use cases are different. So, as you consider -- and partly, the application and use cases are enabled by design features -- and then, as you consider both of those, it really lends itself to alternative regulatory approaches that the NRC would be able to ensure public health, protection of the public health and safety in different ways, because the designs are different, because the applications are different.

This showed linearly, just because I wanted to have some detail on it, but if you look at the lower left, really, it's sort of an iterative process. So, the design features inform the applications and use cases. They inform alternative regulatory approaches. Those alternative regulatory approaches, in turn, have a feedback loop to enable, oh, the industry to think about we could do different things in design space because it makes more sense.

Somebody earlier said it's a carrot-and-stick type of approach. The NRC's regulations can be crafted in a way that incentivizes industry to achieve safety in different ways, but even at higher levels. And so, that's really important.

So, I see Steve Schultz's hand is up.

MR. SCHULTZ: Yes, Marc. A question.

Both you and the NRC, where you've got on this slide in the second box that there's limited time of used fuel onsite, referring to the fact that the reactors will be brought to the site, and then, taken away. On the previous slide, you had transportation to the site, but not from the site. Is that going to be a high hurdle or a low hurdle in terms of regulatory review and approval, the movement of the used reactors away from the site --

MR. NICHOL: Yes.

MR. SCHULTZ: -- to the decommissioning facility?

MR. NICHOL: Yes, it certainly needs to be considered. I believe we do touch on it in our paper "Transportation of Used Fuel."

It will be similar to the fresh fuel transport in terms of if it's loaded in a reactor, but, as you point out, there will be many other considerations because it now is radioactive. It now does produce heat. And so, all of those will have to be considered within how they're meeting the transportation requirements and doing it safely. So, yes, that does need to be included.

MR. SCHULTZ: Yes, for both you and for

the NRC staff as well. I mean, this could be a very nice feature associated with the overall utilization, but it ought to be something that's included for sure really up-front to make sure everything is in place for the whole operation of the microreactors.

MR. NICHOL: Yes.

MR. SCHULTZ: Thank you.

MR. NICHOL: Yes, thank you.

Dennis?

MR. BLEY: Yes, staff didn't talk about this, but I'd go back to them later after you're done.

If your sources are correct, then there might really be hundreds of thousands of purchases. To me, it implies a different kind of NRC than we have now for reactors, something you will likely do for materials, where some of the states take over some of the regulatory activities. And the staff wasn't talking about these kinds of large numbers. Have you guys thought about that aspect as well?

MR. NICHOL: It came up briefly. Certainly, you make a good point. That could be considered as one option.

We didn't pursue that as an option. We wanted to stick more closely into the NRC itself would regulate these because they're power reactors. And

because, as we looked at it and we identified, well, the NRC could do this, it takes some rule changes. In fact, I didn't mention this, but we identified 37 regulations that would need to be modified to be able to fully enable this. And so, there is quite a bit of rulemaking that would be needed. Exemptions could be used in the interim.

But, yes, so it was briefly considered, and then, we sort of put it to the side and wanted to focus on the traditional NRC licensing.

MR. BLEY: Thanks. Go ahead.

MR. NICHOL: Yes. Okay.

So, one of the things we did is looked -- and this is a notional chart; it's relative comparisons. So, these aren't strictly perfect numerically. But it identified that, as you look at microreactors, which is the starting point we had for a lot of these ideas, they're much more similar to research and test reactors, based on the relative potential consequences. And we know that the NRC regulates in proportionality to the potential consequences.

And so, we looked at that and said, well, if microreactors are really much more similar to research and test reactors from a potential

consequence standpoint, what could we learn from that? And then, this next slide is that we looked. We actually have an appendix in our paper that talks about RTR regulatory framework and how the RHDRA could be based on that. It might require some adaptation, but certainly could be a good starting point.

And there's a lot of similarities, especially at the rule-level language. A lot of the differences are more at the guidance level. And so, that was really insightful to know.

And when we thought through it, there's really a benefit to starting with the research/test reactor framework. And then, as we have traditionally been looking at advanced reactors, starting from the large light water reactors approach, we're naturally, by human nature, we're anchored to those requirements. So, it's very hard to get very far away from those requirements.

But if we start with the research/test reactors, which we know provide reasonable assurance backed with protection for that class of designs, and if our RHDRA designs are very similar from a consequence standpoint, then we could get to a much more efficient and effective regulatory framework. So, that was our starting point for a lot of the

concepts and proposals that we made.

Dennis?

MR. BLEY: Yes. The argument here makes sense to me and, in fact, the Committee has argued something similar in the past. But the key is that the consequences are much smaller than you would get from the large reactors.

Your avoidance of microreactor discussions and saying safety and power are pretty much decoupled, well, potential source term and power are not so decoupled. And it seems to me trying to stretch this to cover factors that are in many senses further away from research and test reactors kind of strains the credulity a bit on the other arguments.

MR. NICHOL: Yes, and you make a good point. And in my opinion, it really heavily depends on the performance-based acceptance criteria that are established. And what we have proposed in our paper is those performance-based acceptance criteria are really consequence-based, based on doses at distances. Sometimes we can look specifically at, you know, if a design can achieve a site boundary emergency planning zone, we think that would enable a certain approach. Or sometimes we might look at it and say, well, that is good, but it's not enough; we actually need that

site boundary to be less than a certain distance, and then, that enables something.

We do have some comparisons in our paper on dose at distances for some research/test reactors and some microreactors. So, in that respect, anywhere we have proposed criteria that are very heavily dependent on a dose-at-distance acceptance criteria, those lend themselves toward mostly being applicable to microreactors. A lot less is available as you get down that graded approach. But, then, there are some that are more decoupled from that acceptance criteria, and you can apply more at that graded approach for large reactors.

So, it is very topic-dependent. There's not a one-size-fits-all on all these topics.

Greg?

MEMBER HALNON: Yes, thanks, Marc.

I agree, when you draw a circle around the actual reactor plant, that your consequence and radiological issues are similar to RTRs. The only thing I would ask you to do is continue to keep in your thought process the different commercial processes that these things are being used for and the pressures of requiring a profit versus RTRs don't necessarily use their heat to try to make profit.

And I know that's addressed in the percentage of operating costs versus what you get out of it. However, it's not insignificant from the standpoint of commercial pressures that these might be under for making a profit.

So, just keep that safety culture aspect in mind as you go through all this. That is one, at least in my mind, that is the key difference between an RTR and potential use of this in the commercial world.

MR. NICHOL: All right. Great. Thanks, Greg.

Scott, you have your hand up.

MEMBER PALMTAG: Sorry, I was unmuting.

You mentioned that these reactors can be like research reactors. And I understand the source term consequences, but what about security and operators? I mean, even research reactors have a large staff and they have security and, actually, inspections, too. Can you give me an idea? Are these supposed to be, are you thinking autonomous reactors that are going to be sitting out there by themselves or are these going to be fully staffed 24 hours a day? Or can you give me a comment?

MR. NICHOL: Yes. We do have a slide

later on about the staffing, but there are different models. So, there are models with a minimal amount of onsite staff, and then, there are models where you have nobody permanently on staff at all times.

Those incorporate additional technologies beyond even what research/test reactors do in terms of automation, remote operations, and things like that. So, I've got a slide later on that will have a little bit more detail.

MEMBER PALMTAG: All right. Thank you.

MR. NICHOL: Yes.

All right. So, I want to talk a little bit about this concept the NRC presented, which is maximizing the standardization, and we're aligned with that.

We developed what we're terming "the ReLic process," or Rapid Efficient Repeatable Licensing. And so, we started with, what does an application today look like for a particular site? And now, this is Part 50 or Part 52, and this is the combination. If it's Part 50, both the construction permit and operating license because that's the entirety of the information; Part 53, COL and 103.g findings.

So, those are on the order of 6 to 10 thousand pages today. And we said, well, 5 to 10

thousand pages, that's eight- to 10-year deployments for most reactors today. We're not going to be able to get to the business model needs if we keep that current paradigm. So, what could we do?

And we had a couple of constraints in here. We wanted to make sure that we're not cutting corners, or I should say, we're not encouraging the NRC to cut corners. We want the NRC to fully review these designs just as they would today or have in the past, with all the rigor and all the scrutiny.

But what we want to do is recognize that, if there is high standardization, then if the NRC were doing that for every single site design, they're going to be doing a lot of repetitive review of the exact same information, and that's not efficient or really necessary from a safety standpoint. So, how can we move all that information that would be repetitive and never changing, move it into that one-time review, so that the NRC could reference it and not have to repeat that review over and over again?

And there are a couple of different methods. One is approving something based on range of technologies. And the advanced nuclear reactor, I guess it's the new Nuclear Generic Environmental Impact Statement is an example of it. This could be

done through rulemaking. So, there's a large portion of this that, by rules or general approvals, could be addressed one time and not have to be repeated every single time.

There is the approval with the design. This would be the maximum ML or DC that the NRC talked about.

There would be licensee pre-approval. So, this could be the operational programs, the financial qualifications, all the things that a licensee owner/operator would need and they would do for site after site after site. That could just be, you know, done once and accepted over and over again.

And then, what that would leave is that the site itself would have a very small portion. We actually envision that this would be more of a confirmation that the site parameters comply with all of the requirements or licensee conditions established from all those earlier. And so, the NRC review would be more of a confirmation that the site conforms to what they've already reviewed. The idea would be to try to address all of the safety and environmental in those first three blocks, so that the site doesn't have new safety and environmental considerations, because that helps to reduce the amount of time that's

needed for that.

And we think that it's possible to get down to applications of less than 100 pages. That's not a requirement; that's just anticipation. So, it may not be exactly like that, and we think that that can get to six months.

Shown in a different, maybe a little bit more illustrative way -- and I won't spend time on this because I have some other slides -- but it just shows how these different pieces would be put together to create what's called the site parameter envelope. And that site parameter envelope would be the basis for the NRC to confirm, yes, this site is within the bounds of everything we've already approved. Or if the NRC comes back and says, "Well, this site is outside of what we've already approved," well, then, that site is going to have to do additional things and they're likely not going to be able to get this accelerated schedule that we're looking at here. So, that's the concept.

And how you put those together? So, all of that early work would be that purple box up there. The NRC ML review happens years or many months ahead of the first actual site deployments, and then, when you get to the first or the later site deployments --

that's the green; that's the green arrow coming down -- that's when you get into, you know, more efficient, expedited reviews.

I wanted to show two slides. So, this slide is the schedule of what we would expect the NRC review to look like today if they were to receive a microreactor, based on the review schedule that they did for the Kairos Hermes and some of their other statements in terms of how long it might take things, including the recent decision on mandatory hearing schedules.

And so, you can see that's about 49 months from when the site is selected, and this would be to the NRC's 103.g finding. We actually think that, after that finding, the applicant needs about a month to fully deploy the reactor at that site. So, this would be a lot longer than the six months.

You'll notice there's a lot of things. If you split it down the middle, on the right side, these are a lot of the NRC review process. And the NRC has proposed making those more streamlined in their nth-of-a-kind paper, just as we had proposals on how those could be streamlined.

But if you look at the left side, site characteristics, 24 months, these are meteorological

towers. These are core borings and the SSHAC process. And so, we need to recognize that that is a limitation. Even though it is outside the NRC's review scope, it does impact the schedule of deployment. So, it does need to be considered as part of this effort.

So, the schedule, this slide shows the schedule that we think is possible if our proposal was accepted and implemented. And again, a lot of our ideas are similar to the NRC's. Just in the details is where there's some differences, but sometimes the differences matter.

And this could get to about five months, and it would allow sufficient time for the NRC to review the scope that would be part of that site license. Because, again, most of the information has already been reviewed and approved.

It would allow for public interactions. Here, in our paper we actually propose an Atomic Energy Act change to eliminate mandatory hearing, but if the mandatory hearing was still there, as well as the contested hearing opportunities.

And then, we put in here, you know, our proposal envisioned that it would be possible for some designs to fully address all of the environmental

issues before they get to the site license. This would be, like, we might call it a microreactor supplement to the new nuclear GEIS.

But if there were some remaining environmental issues left, there would be just minor impacts to the schedule.

Yes, Greg?

MEMBER HALNON: Yes, Marc, do you think there's enough time for the local government to get ready? I mean, I understand there's not a lot of emergency response requirements from an evacuation perspective, but there's the radiological preparation of the annex for the all hazards plans. If this is a brand-new site and a brand-new locale, I know you talk about remote, but you're still going to have to have some offsite preparation. Do you think this is enough time?

MR. NICHOL: Well, I think, if I'm understanding right on emergency preparedness -- I'm not an expert -- but if they have site boundary EPZ, they wouldn't have offsite preplanned activities. They may have interactions with the state environmental management agencies to talk about potential coordination and that sort of thing.

You know, we would have to have those

discussions directly with each state. They're all going to have their own opinions. But based on my understanding of the technology and the consequences, I think it is possible --

MEMBER HALNON: Okay.

MR. NICHOL: -- to be able to reach those agreements.

MEMBER HALNON: Yes. I mean, you start to have emergency response from the hospitals, EMS, fire protection possibly, certainly law enforcement. So, there's going to be some training required --

MR. NICHOL: Uh-hum.

MEMBER HALNON: -- some planning done. And if the local town, or wherever this is going to be supported, doesn't have that already in place, that could be a challenge. But, yes, we would probably need to talk through that and make sure we had enough time to do the all hazards preparations.

MR. NICHOL: Uh-hum. Okay. Thanks.

Dennis?

MR. BLEY: Yes, I know in your document you've considered the things we call external events -- winds, high winds, and fires and floods and earthquakes. What I don't know, especially since we're talking about transportation vehicles becoming

-- you know, not everything going into a building sometimes, but just being a package that you have anchored to the ground somehow. Have there been any real analyses of how that sort of system can withstand those external events?

MR. NICHOL: So, nothing generic that I'm aware of. I would imagine that each developer that is designing a reactor of that type would be going through their analyses now. And, of course, the NRC is going to have requirements with performance metrics associated that they're going to have to meet. So, yes.

MR. BLEY: Okay. So, I think I heard you say, no, it hasn't been, but people are starting to analyze it now?

MR. NICHOL: That's my understanding, yes.

MR. BLEY: Okay.

MR. NICHOL: Ron?

MEMBER BALLINGER: Yes, this is Ron Ballinger.

Apropos what Greg was saying and what's been mentioned at least in passing a little while ago, is there a possibility that this whole process can be effectuated, if you will, by -- if you've got a thousand of these things, a thousand divided by 48 or

50 gets to be a large number in each state. Can there be, in effect, Agreement States up-front with respect to the police and fire, and all that kind of thing, that would happen prior to any deployment, where the so-called Agreement State, for lack of a better word, would already have all of that thought process and all of that stuff in place?

MR. NICHOL: It's a good question. I don't know the answer. We can go and take a look at it. Or maybe at the end of the presentation, the NRC might have a response for you.

MEMBER BALLINGER: I mean, there's some reality that has to come in here. If there's a thousand of these things, they're going to be popping up on street corners.

MR. NICHOL: Yes. Well, yes, there will be a lot. There will be a different way to consider these. I wouldn't necessarily say, "street corners," but, yes, I get the point of your comment.

All right. This is the slide that, Scott, I think you asked about staffing. I did want to include this. In this presentation, I didn't get into a lot of details on a lot of the topics. You can imagine that that would take a long time. But I did want to include this one because it was the one topic

that the NRC didn't address in their current paper that we identified as a high need.

And it's really the onsite staffing. And we know that the technologies and the business models lend themselves toward fewer onsite operators. And in our proposal, we identify or propose a systematic way of going about identifying what would be the right staffing.

So, while potential outcomes could be one operator onsite or no operator onsite with a remote operations center, it's not a guarantee. You would have to follow the process.

That process would start by identifying the required operator functions through an HFE or other task analysis of the reactor and all the operational controls that you have. Once you identify the operator functions, then the developer could go through and identify where automatic operations -- note that I'm not saying, "autonomous operations"; just automatic operations -- which the NRC has approved in the past and are well-established and utilized today.

So, automatic features of the plant, including, you know, emergency shutdown and things like that. So, which of those functions are addressed

through automatic operations, and then, the next layer would be remote operates. What functions can be adequately addressed by remote operations? And then, anything that's left would be required to have local human actions.

And so, some designs may be able to get down to one onsite operator. That means that they could have other duties onsite, obviously, if they're an operator, but they wouldn't have to be at the controls all the time. But they would have to be near enough to be able to check on it periodically or respond if there was an alert. But they could be doing other functions. And then, you know, there's no onsite. There would be remote operations and things like that.

Much longer term -- it's not really a proposal in our paper; we just identify it as a potential future consideration -- is that you may have no operators at all with autonomous operations. I would say it's so far into the future, it's really aspirational, but we included it, so that autonomous features, the NRC is starting to think about them and how they could be applied in the future, was why we included it.

Dennis?

MR. BLEY: Just an opinion for you. Concept No. 1, I can see.

Concept No. 3, with more thought, for some designs where the physics and chemistry help you out, I can almost see how that happens.

Concept No. 2 with remote operations is one I just don't see how we ever buy into, because I don't know of any communications link that hasn't failed in memory.

MR. NICHOL: Oh, okay.

MR. BLEY: That one just seems like it's a way to end up in real trouble with overconfidence.

MR. NICHOL: Yes, thanks. That's a good point, and we did think a lot about that. We proposed some concepts on what performance criteria would be there. Certainly, a lot of work will be needed to develop the performance criteria. But some of them could be that, if you had the link broken with a remote operations center, the plant would be able to shut itself down safely.

The concept of operations included having field operators that would visit sites periodically and not be too far away from a site. So, you might have a requirement for a response time. So, the plant would shut itself down immediately. Somebody would be

able to respond within a certain amount of time that the NRC determined safe.

An additional layer of defense, if it were needed, is that we also framed as being located next to industrial facilities. So, if you were able to take credit for somebody at the industrial facility to be able to go to the plant immediately, so there was a faster response time, even though they're not a licensed operator, but, you know, those sorts of things.

And then, of course, I should have mentioned at the beginning, this would really be primarily for reactors that have such low consequences that offsite doses would really be really negligible. So, yes, a lot of work is going to be needed on that, is the point. So, I appreciate that, that comment.

Scott?

Scott, if you're speaking, you're on mute.

MEMBER PALMTAG: Oh, sorry.

So, this is a good slide on staffing, but I don't see anything about security here. That's one of my concerns, is you're going to have these reactors sitting there with no security, terrorism, that sort of thing. Have you put any thought into how you would handle that?

MR. NICHOL: Yes, we did. And so, security is, obviously, is part of staffing, but it also has its own separate considerations. And we have a proposal in there for security.

For, I would say, the far extreme of the spectrum where you would have the most benefits, we actually leaned into some ideas that the NRC had proposed in Part 53 where these microreactors, if they meet certain conditions, they would not have to protect against the design basis threat because, essentially, it would be determined that the design basis threat couldn't cause any consequences of concern to the public. And that would be similar to how research and test reactors are treated.

MEMBER PALMTAG: All right. I just had a followup question. This is really more of a comment about the six-month time line that you're proposing, and this kind of follows up on what Ron Ballinger was saying.

I understand why you're asking for six months. I just really question how realistic that is. If I was a large state and someone wanted to come in with -- a large state with, say, oil operations -- if someone wanted to come in and put 100 reactors scattered around, I would think the states would have

some pushback on that.

I just find it hard to believe you're going to be able to identify a site and put a reactor there in six months. And why this is a concern is you're actually putting quite a bit of burden on the NRC to come up with some way of licensing in six months. This really isn't a realistic time frame. It just seems like an unneeded burden on the NRC.

That's more of a comment, just something to think about. Maybe come up with a more realistic time line -- maybe a year, nine months, something like that.

MR. NICHOL: All right. Yes, I appreciate it.

I know that we can certainly work on the state role and how long it would takes the states. I do think that there could be areas where there would be such large volume of deployments -- let's just take the Permian Basin as an example, because we know that that area wants a lot of microreactors. The states could act to do, I would just say, generic approvals for a large number of microreactors that would, then, be supportive of a six-month schedule. So, we can develop that, so that it's more clear on how it would work.

The other comment I'd make is that our proposals in terms of the six-month schedule is not too far off from what the NRC had in their NOAK paper. I know they had, roughly, a 200- to 500-day schedule. And so, if we just look at 200, that's longer than 120 days that we are proposing.

But if you also look at the NRC's schedule, they have the construction permit and operating license in series, and we have put them in parallel, which we think the NRC could do. So, if you take the NRC's NOAK paper, put them in parallel, I think you get very close to what we're doing.

So, I do note and agree we don't want to ask the NRC to expend resources unnecessarily for anything unrealistic, but I think those two points would be why I think it would still be appropriate for the NRC to consider.

CHAIR BIER: Yes.

Greg, I see you have your hand up, but can we make this quick, so we make sure to save a few minutes for public comment, and hopefully, Committee discussion?

MEMBER HALNON: Yes, it's just two comments -- one on the security aspect of it. Just because it's not on this slide doesn't mean that they

won't have asset preservation security or industrial security at these places, which goes to that there will be some level of security by these industrial folks.

The other thing is, remote operations is not uncommon in the industry for complex plants. So, there's a lot of lessons learned from the gas-bottling plants and other things that are four or five plants operated by one operator, and then, they quickly shut down and dispatch on any problem. So, it's not a new concept in industry, maybe for nuclear. So, there's a lot of lessons out there.

So, that's my only comments.

CHAIR BIER: Okay. If I can bring this presentation to a close, I appreciate the information.

MR. NICHOL: Thank you.

CHAIR BIER: We're always interested in learning about that. But I think now I'm going to turn to public comments. Thank you.

So I know Joy had a comment earlier. I don't know if she's still on the call.

Are there any other public comments?

And anybody who wishes to provide a comment after the fact can, of course, get in touch with Derek Widmayer, the Designated Official, after

the fact, just to provide comments in writing.

Okay. If there are no public comments at this time, then I guess we can turn to Subcommittee discussion. And I think the main question for the Subcommittee is just, is there any perception that we really should be writing a letter on this topic at this time?

MEMBER HALNON: Vicki, this is Greg.

I think, in my opinion, it's a little bit premature to write a letter on the draft documents. I think the alignment between industry and the NRC is fairly strong, but it needs to be worked out, a little bit more time on some of these issues. I didn't hear anything today that caused me to sit back and say, you know, any red flags from the standpoint that we need to make a point of.

But I do think that we're going to need more frequent discussions at a Subcommittee level for this coming year. So, I would suggest that we have several meetings as milestones are reached and before new SECY papers are written, and whatnot.

So, I think at this point it would be premature to write a letter.

CHAIR BIER: That fits my opinion and my earlier observation, that I'm not sure the choice of

options at this stage has any safety implications.

Other Subcommittee comments?

MEMBER BALLINGER: Yes, this is Ron Ballinger.

I was pondering the last slide and what Dennis was saying about no operators remote, that kind of thing. And I wonder if the NEI folks should talk with the people doing this space-reactor-related stuff. Because they're developing techniques to interrogate in real time safety-related issues to reactors that are definitely remote -- they're 200 million miles away -- and based on that interrogation, be able to put the system in a safe condition.

So, there's a lot of work that has been going on, I think, in that area that might bear on the truly remote microreactors.

CHAIR BIER: That's a good suggestion.

Following up on Greg's comment, it seems to me that the issues where ACRS review would be the most crucial -- not necessarily the only ones -- but the most important ones are anything that would involve a waiver or relaxation of current requirements. So, places looking at, again, reduced staffing or reduced emergency response requirements, et cetera, at that level, we would certainly want to

be weighing-in. But I think at the procedural level of how these things are handled, most likely, no letter is needed at this time.

Any further Subcommittee comments or discussion?

Hearing None, since we were all represented here today, I don't think we need to repeat this briefing in full Committee week. So, staff can maybe get a little bit of time off that week.

MEMBER PETTI: Oh, Vicki? Vicki?

CHAIR BIER: Yes?

MEMBER PETTI: This is Dave. Walt was not here.

CHAIR BIER: Oh, good point. Thank you.

MEMBER PETTI: Well, I think at an abbreviated --

CHAIR BIER: Yes.

MEMBER PETTI: -- high level, because Walt has some strong feelings on microreactors, I think. And so, I think it would be worth the staff and NEI to hear, you know, to give him a chance to ask some questions.

CHAIR BIER: That's a good point. It's an excellent observation.

And, Derek, I guess you can deal with the scheduling. It sounds like maybe two hours total, counting discussion, is probably adequate or more than adequate for that.

Any other thoughts?

MR. BURKHART: Yes. So, Vicki?

CHAIR BIER: Yes?

MR. BURKHART: Vicki, this is Larry.

CHAIR BIER: Yes?

MR. BURKHART: Just to let you know that the FRN -- this is Larry Burkhart from the ACRS staff --

CHAIR BIER: Yes.

MR. BURKHART: -- the FRN has been published for the full Committee meeting in November --

CHAIR BIER: Got it.

MR. BURKHART: -- and this is the first topic on that Wednesday. And we do have two hours for presentation.

CHAIR BIER: Perfect.

MR. BURKHART: We don't have to use two hours.

CHAIR BIER: Yes.

MR. BURKHART: And we have an hour for

deliberations.

CHAIR BIER: Excellent.

MR. BURKHART: So, there is some time set aside for that, yes.

CHAIR BIER: Great. I appreciate that information.

And as people have said, I mean, the lack of writing a letter does not reflect any lack of importance or interest in the topic. It's, obviously, a crucial topic for the industry and the agency going forward.

And we appreciate all the information today and look forward to staying informed in the future.

So, if there are no further comments at this time, then, I will go ahead and adjourn this Subcommittee meeting. Thank you all.

(Whereupon, the above-entitled matter went off the record at 12:55 p.m.)

C E R T I F I C A T E

This is to certify that the foregoing transcript

In the matter of: ACRS Regulatory Policies and Practices Subcommittee

Before: U.S. NRC

Date: 10-17-24

Place: teleconference

was duly recorded and accurately transcribed under my direction; further, that said transcript is a true and accurate complete record of the proceedings.

Neal R. Gross

Court Reporter

Rapid High-Volume Deployable Reactors for Remote Applications

ACRS Subcommittee Meeting

October 17, 2024

Marc Nichol, Executive Director
New Nuclear

NUCLEAR ENERGY INSTITUTE

Status and What's New

- Status of previously identified Micro-reactor regulatory issues
  - Some are resolved (e.g., Emergency Preparedness)
  - Some are partially resolved (e.g., Annual Fees)
  - Some are in the process of being resolved (e.g., Remote Operations)

- What's New
  - Interest in Oil & Gas Upstream and business needs for regulatory schedule and cost
    1. Less than 180 days from specific site identification to operations
    2. Regulatory costs are less than 1% of capital and O&M
  - ADVANCE Act Section 208– Regulatory Framework for Micro-Reactors

- Scope of effort
  - Clarify regulatory needs for rapid and cost effective large-scale deployments
  - Resolve expanded scope of regulatory issues and propose solutions

Micro-Reactor Topics Previously Identified

- 22 Topics; 16 are part of the 31 Topics in the NEI RHDRA Proposal

	NEI 2019 Paper	NRC SECY 20-0093
Review Scope and Effort	X	
Regulatory Oversight	X	X
Emergency Preparedness	X	X
Physical Security	X	X
Aircraft Impact Assessment	X	X
Staffing and Training		X
Annual Fee		X
Manufacturing License Scope		X

	NEI 2021 Paper	NRC SECY 24-0008
Factory Fabricated	X	X
Factory Fuel Load (Preclude criticality)	X	X
Factory Operational Testing	X	X
Timing Authorize to Operate (Hearing & ITAAC)		Enclosure
Replacement at Site	X	Enclosure
General License	X	
Fueled Transport		Enclosure
Storage of Used Fuel		Enclosure
Decommissioning		Enclosure
Maritime Applications		Enclosure
Space Applications		Enclosure
Commercial Mobile		Enclosure

	NEI 2019 Paper	NRC SECY 20-0093	NEI 2022 Paper	NRC SECY 24-0008
Autonomous & Remote Ops	X	X		Enclosure
Dense Populations Sites		X		Enclosure

RHDRA Regulatory Topics and Priorities

NEI Paper July 31, 2024 (ML24213A337)

	Near-Term Urgent Resolution	Longer-Term Resolution
High Priority	1 – Environmental Reviews 2 – Standardized Design Approvals 5 – Site License 10 – Meteorology and Weather Data 11 – Geologic and Geotechnical 14 – Operations Staffing 19 – Physical Security	3 – Construction Authorization Upon Docketing 6 – Contested Hearing 7 – Mandatory Hearing 17 – Remote Operations 21 – AA/FFD
Medium to Low Priority	9 – AIA 13 – Fire Brigade 16 – Remote Monitoring 18 – Cyber Security 22 – Radiation Protection 23 – Oversight 25 – Use of Contractors by ML 28 – Features to Preclude Criticality 31 – Used Fuel	4 – ITAAC 8 – Licensing fees 12 – Other External Hazards 15 – Autonomous Operations 20 – Emergency Preparedness 24 – Annual Fees 26 – Loading Fuel at Factory 27 – Testing at the Factory 29 – Transport Modules to Site 30 – Replace Modules at Site

Topics addressed in NRC's October 2024 NOAK White Paper

Adapting the Regulatory Framework to Address New Technologies and Applications

Design Features

- Physically small and simple
- Low risks and consequences
- Small footprint – land and environmental
- Safety relatively insensitive to site conditions
- Factory construction
- Site assembly
- May load fuel at factory and ship fueled
- Fully replaceable modules

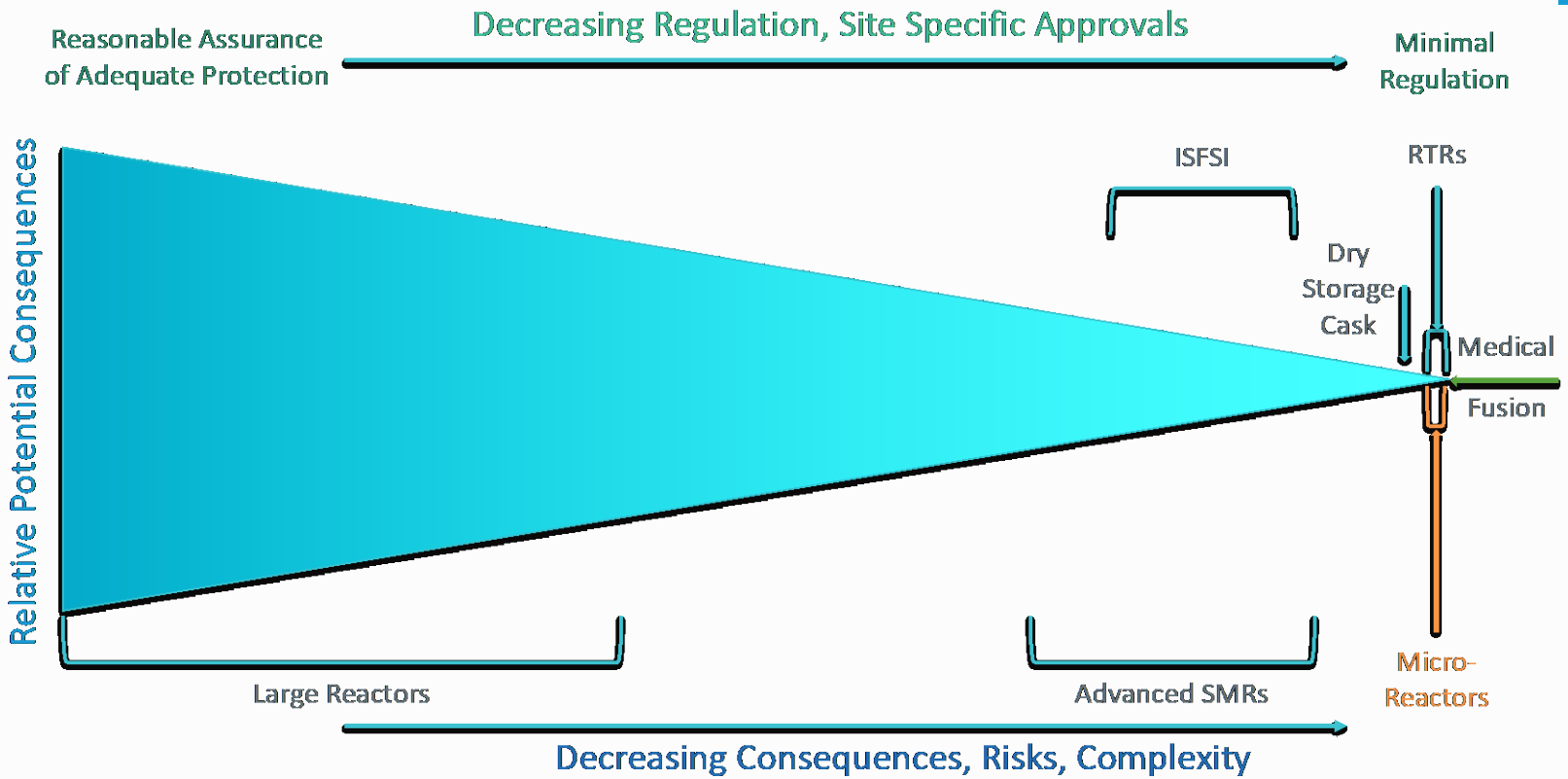
Applications and Use Cases

- Remote locations and micro-grids
- Industrial applications (heat and power)
- Not near population centers
- Large volume of deployments
- Deployment in months not years
- No disproportionate regulatory costs
- Limited or no on-site fuel movements
- Limited time of used fuel on-site

Alternative Regulatory Approaches

- Incentivize safety enhancements
- Avoid undue regulatory burden
- Leverage use of manufacturing license or design certification
- Technology-inclusive, performance-based and risk-informed
- Oversight scaled to the safety profile
- More similar to research and test reactors

Relative Comparison of Potential Consequences from Selected Nuclear Technologies



A Different Imperative Yields Different Results

Current Efforts

LLWR vs RTR vs RHDRA

- Same Dose Limits
- Same Normal/Accident Requirements
- RTR = Low potential consequences
- EPZ = 10 miles vs small site boundary
- Different Implementation Guidance
- Different Security (RTR = No DBT)
- RTR = No AIA
- RTR = Combined CP/OL is OK
- RTR = USGS/NOAA data is OK
- RTR = No min ops staff

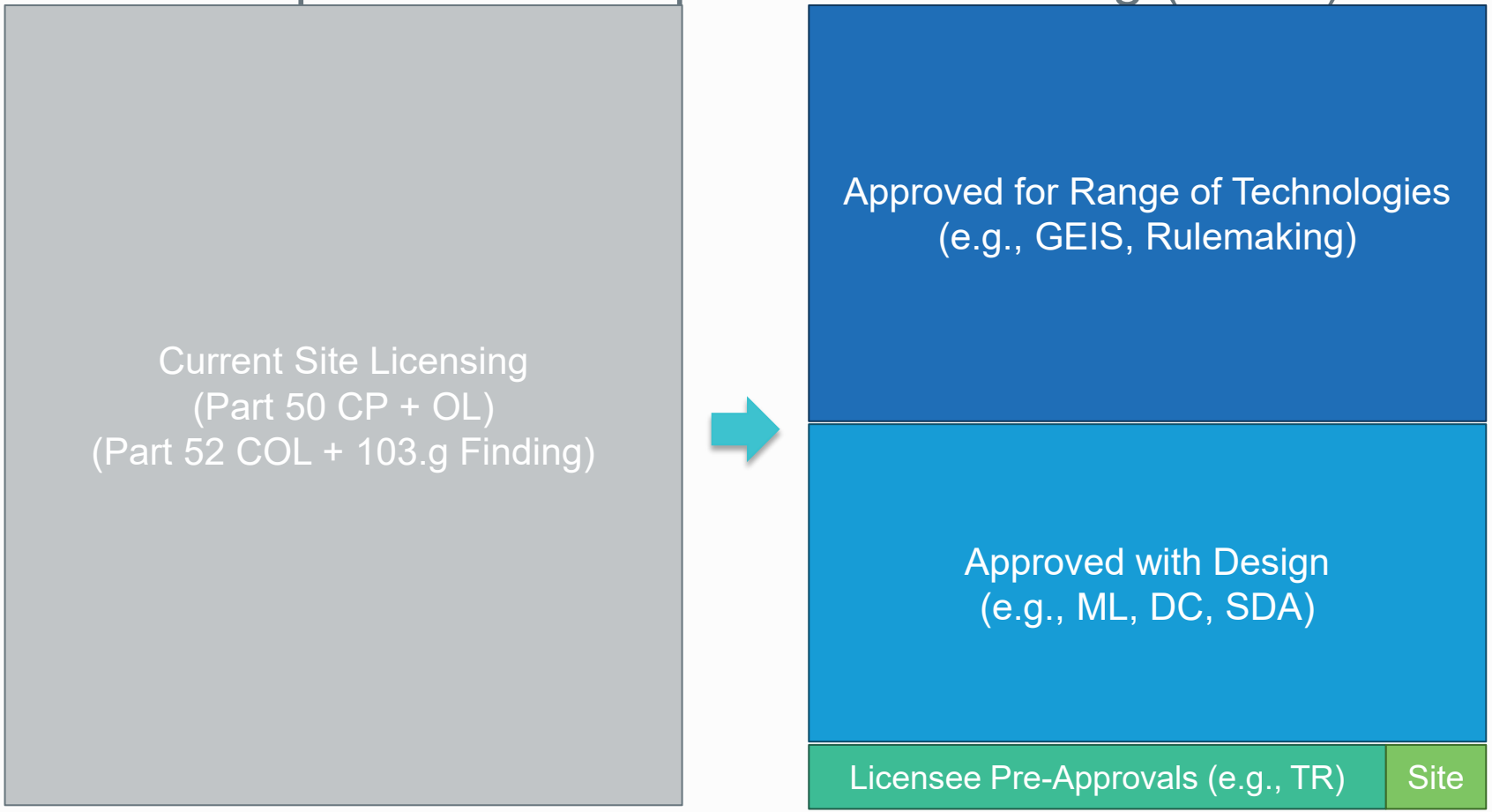
Apply and Adapt Non-Power Approaches

RHDRA Proposal

Innovation -> Revolutionary Change

- New technologies
- Question past/current practices
  - Avoid “we’ve always done it that way”
  - Understand bases for current approaches (characteristics of technologies and assumptions)
  - Question whether bases are still valid, if not form new bases and new approaches

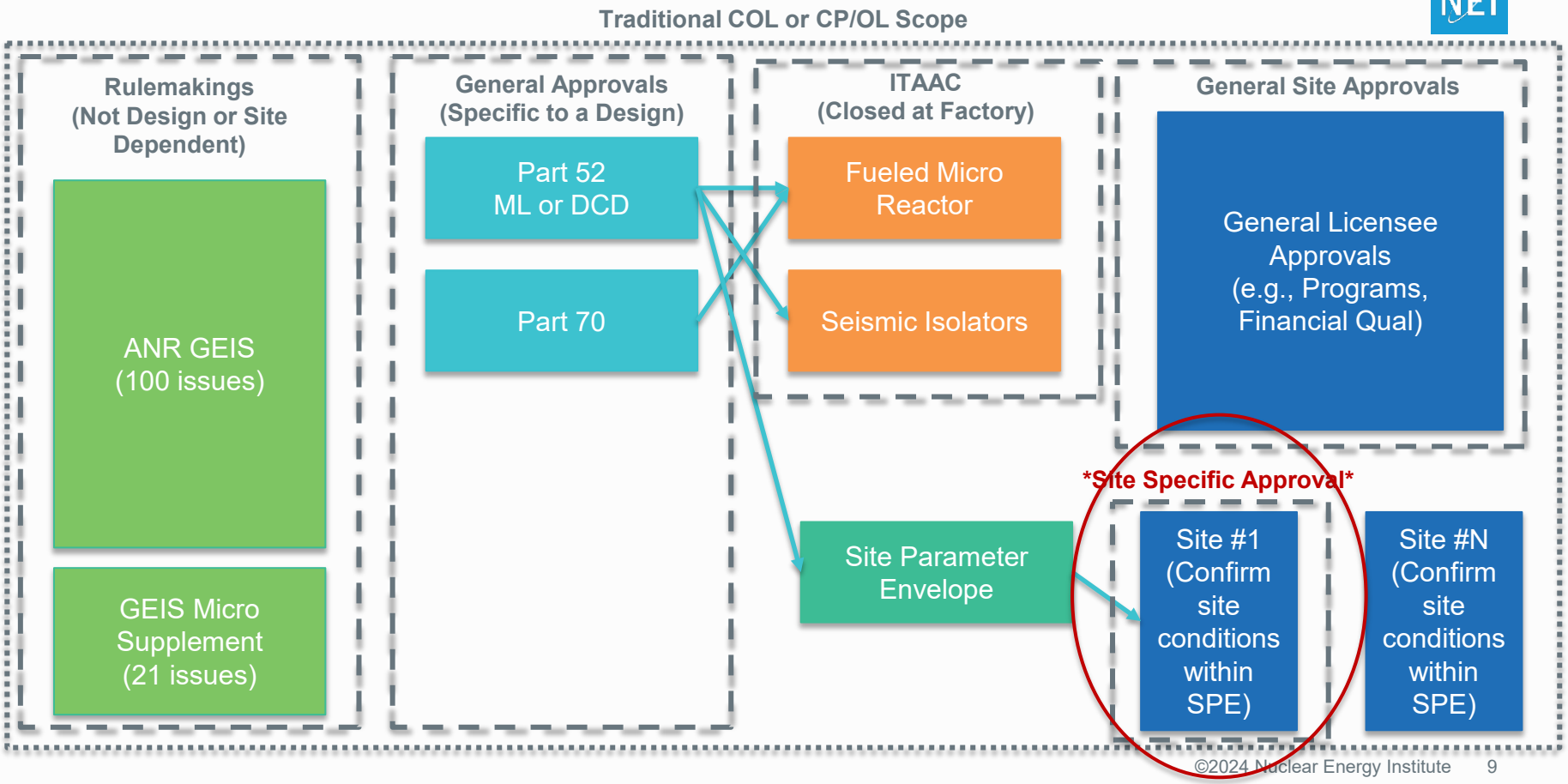
Rapid Efficient Repeatable Licensing (ReLic)



Site Applications of 6,000 to 10,000 pages
Enable Deployments 8 to 10 years

Site Applications of <100 pages
Enable Deployments of <6 months

Potential to Minimize Scope of Site-Specific Review



NRC Approval of the Design and Site

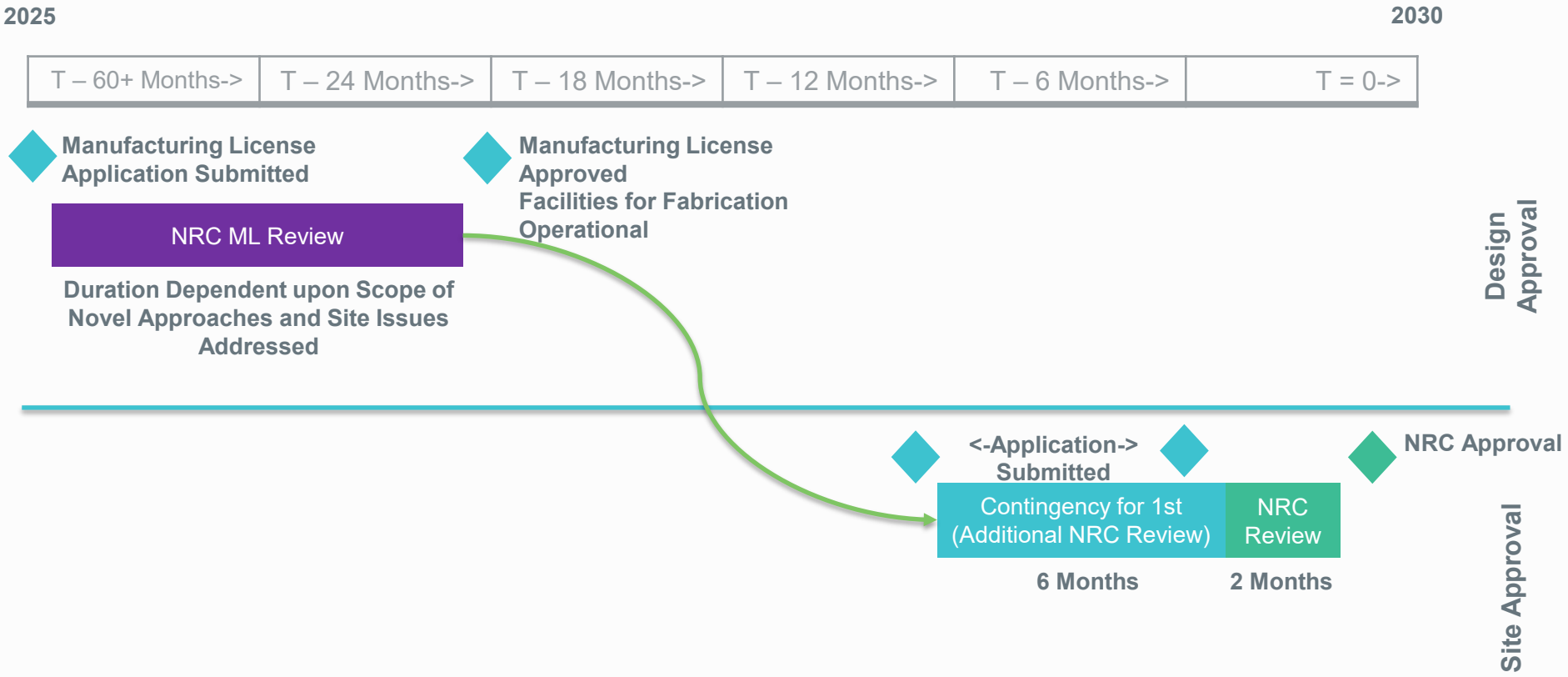


Figure 4-1: NRC Current Licensing Timeline (Expectations for NOAK RHDRA)

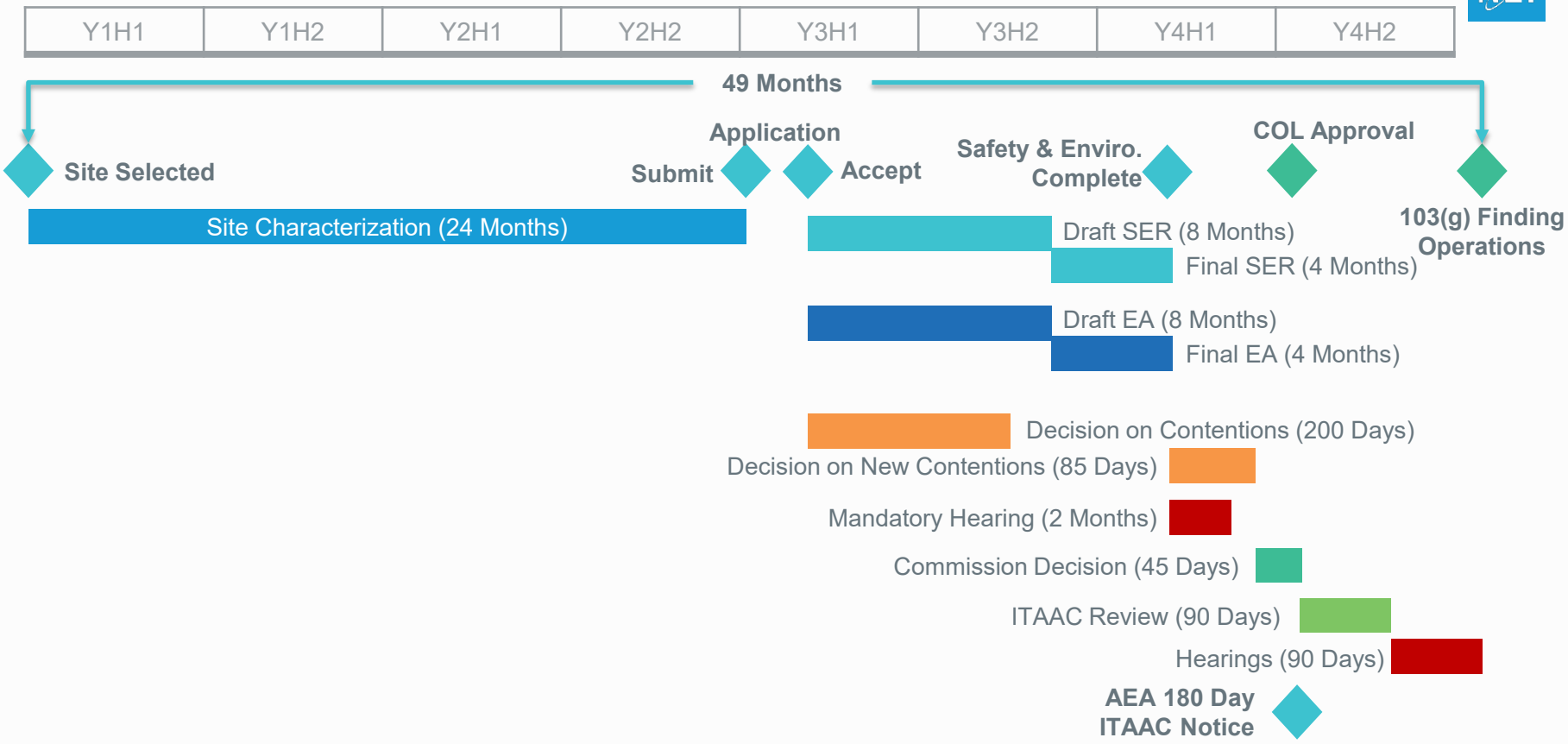
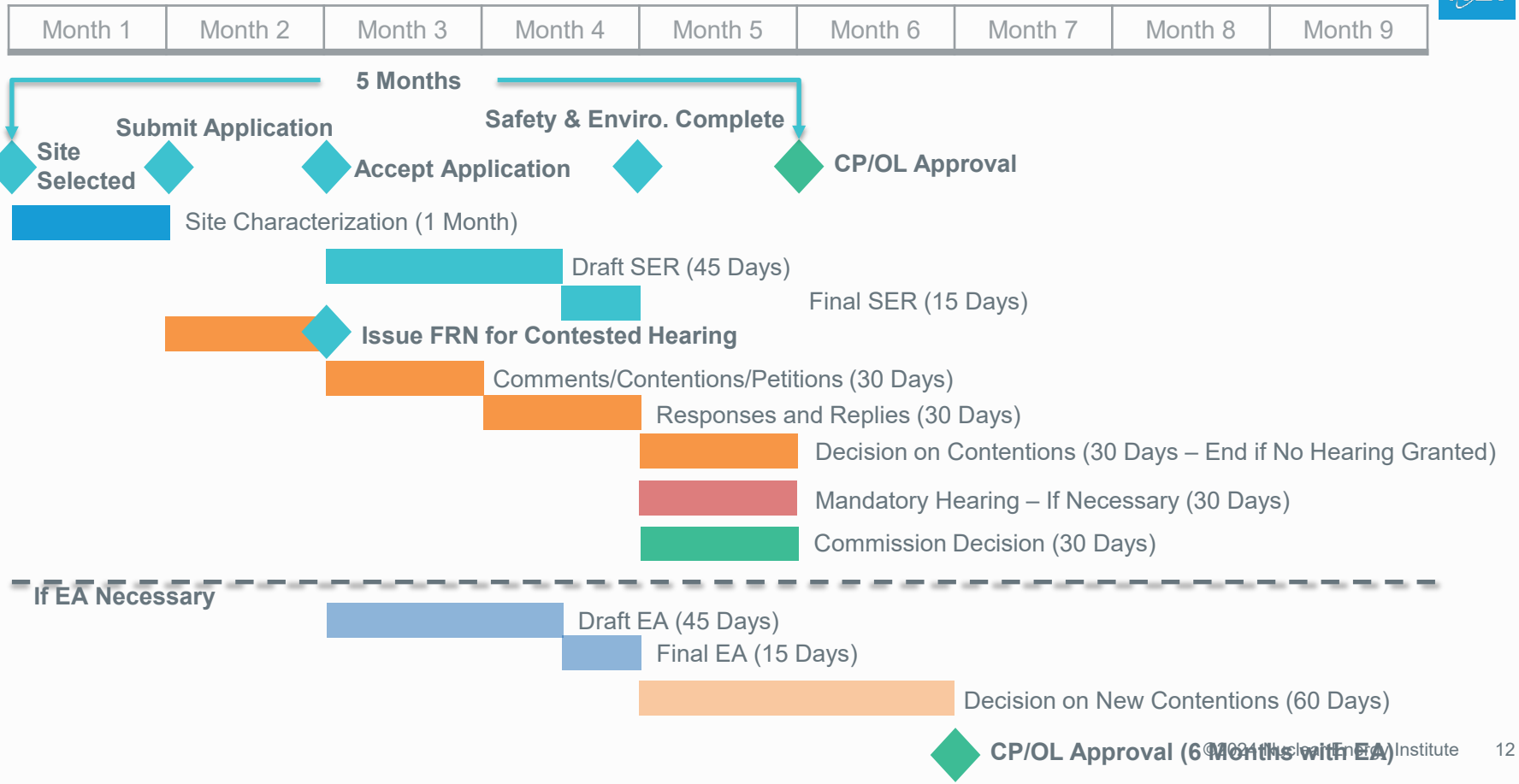


Figure 4-2: NRC Licensing Timeline (Expectations for ReLic Process)



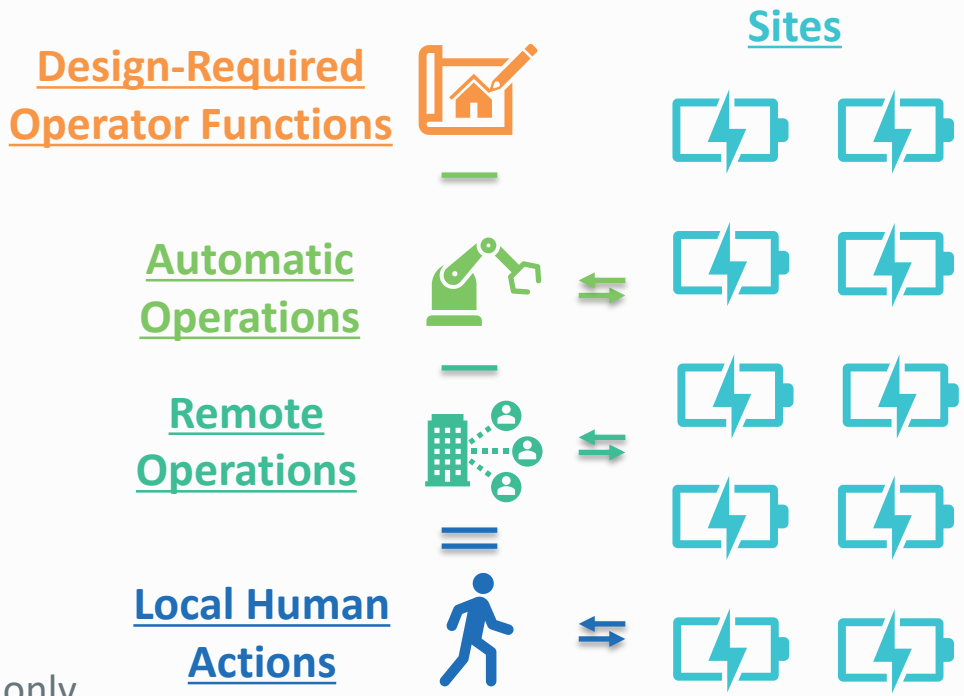
On-Site Staffing

Design (inherent safety features, active safety components, and technology) with functional analysis

- Determines if/what role is need for human action.

Concept of Operations:

1. One (1) on-site operator
   - Automatic operations
   - Away from controls/other duties
   - Remote Monitoring Optional
2. No (0) on-site staff, Remote Operator
   - Automatic and Remote Operations
3. No Operators - Longer-term
   - Autonomous operations
   - No human action, high-level oversight only
   - (Not needed but included)



QUESTIONS?

By Third Way, GENSLER

Backup Slides

Table 2-2: Summary and Functional Grouping of Specific Issue Topics

Topic Area	Priority	AR	RTR	GL	AEA	Reg/Pol
Group 1 (Licensing Process)						
1) Generically Resolved Environmental Considerations	High	Applicable	Non-App	Benefit	Option	Need
2) Design Approval Scope and Authorizations	High	Applicable	Non-App	Benefit	Option	Need
3) Construction Authorization Upon Docketing	High	Applicable	Non-App	Benefit	Option	Need
4) Inspections, Tests, Analyses and Acceptance Criteria	Medium	Applicable	Non-App	Benefit	Option	Need
5) Site License Scope and Purpose	High	Applicable	Applicable	Benefit	Option	Need
6) Streamlined Contested Hearing	High	Applicable	Non-App	Benefit	Option	Need
7) Elimination of Mandatory Hearing	High	Applicable	Non-App	Benefit	Solution	Need
8) Licensing Review Resources and Costs	Medium	Non-App	Non-App	Benefit	Option	No-Need
Group 2 (Concept of Deployment)						
9) Aircraft Impact Considerations	Medium	Non-App	Applicable	No-Benefit	Option	Need
10) Meteorology and Weather Data	High	Applicable	Applicable	No-Benefit	Option	No-Need
11) Geologic and Geotechnical	High	Applicable	Applicable	Benefit	Option	Need
12) Other External Hazards	Low	Non-App	Non-App	No-Benefit	No-Need	No-Need
Group 3 (Concept of Operations)						
13) Fire Brigade	Medium	Applicable	Non-App	No-Benefit	No-Need	No-Need
14) Operations Staffing	High	Applicable	Applicable	No-Benefit	Option	Need
15) Autonomous Operations	Medium	Applicable	Non-App	No-Benefit	Option	Need
16) Remote monitoring	Low	Applicable	Non-App	No-Benefit	Option	No-Need

Table 2-2: Summary and Functional Grouping of Specific Issue Topics (cont'd)

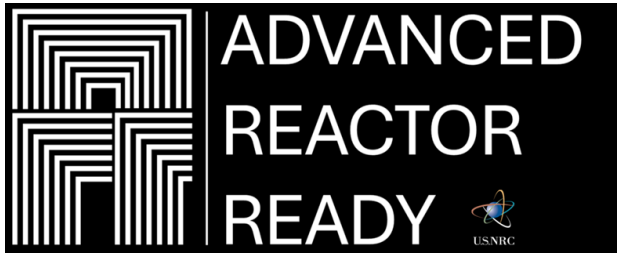
Topic Area	Priority	AR	RTR	GL	AEA	Reg/Pol
Group 3 (Concept of Operations) - Continued						
17) Remote operations	Medium	Applicable	Non-App	No-Benefit	Option	Need
18) Cyber security	Low	Applicable	Non-App	No-Benefit	Option	Need
19) Physical Security	High	Applicable	Applicable	No-Benefit	Option	Need
20) Emergency preparedness	Low	Applicable	Applicable	No-Benefit	Option	No-Need
21) FFD/Access Authorization	Medium	Applicable	Applicable	No-Benefit	Option	Need
22) Radiation Protection	Medium	Applicable	Applicable	No-Benefit	Option	No-Need
23) NRC Oversight	Medium	Applicable	Applicable	Benefit	No-Need	Need
24) Annual Fees	Medium	Non-App	Applicable	No-Benefit	Option	Need
Group 4 (Total Lifecycle)						
25) Use of Contractors By Manufacturing Licensees	Medium	Applicable	Non-App	Benefit	No-Need	Need
26) Loading Fuel at Factory	Medium	Non-App	Non-App	Benefit	No-Need	No-Need
27) Testing at the Factory	Medium	Non-App	Applicable	Benefit	No-Need	Need
28) Features to Preclude Criticality	Medium	Non-App	Non-App	Benefit	No-Need	No-Need
29) Transport of Fueled Reactor	Medium	Non-App	Non-App	Benefit	No-Need	Need
30) Replace Modules at Site	Medium	Non-App	Non-App	Benefit	No-Need	No-Need
31) Storing Used Fuel at Site	Medium	Applicable	Non-App	No-Benefit	Option	Need

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

Advisory Committee on Reactor Safeguards

October 17, 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.*

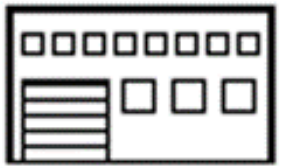
* See SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory," dated January 24, 2024 (ML23207A252).

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



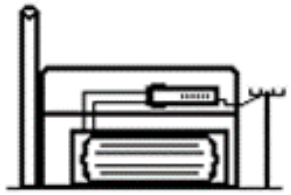
Fabricate the reactor, load fuel, and potentially operate the reactor for functional testing

Transportation to the Deployment Site

Reactors may contain fresh or irradiated fuel

Deployment Site – Power Operation

Stand-alone, self-contained micro-reactor design

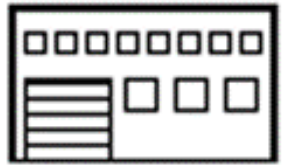


Core module with onsite reactor building and power conversion equipment

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 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 in early November 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.