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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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699TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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WEDNESDAY

OCTOBER 5, 2022

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The Advisory Committee met via hybrid In-Person and Video-Teleconference, at 8:30 a.m. EDT, Joy L. Rempe, Chairman, presiding.

COMMITTEE MEMBERS:

JOY L. REMPE, Chairman

WALTER L. KIRCHNER, Vice Chairman

DAVID A. PETTI, Member-at-Large

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

JOSE MARCH-LEUBA, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

DEREK WIDMAYER

ALSO PRESENT:

ELIJAH DICKSON, NRR

JEREMIAH DOYLE, NuScale

TYLER ELLIS, Public Participant

SID FOWLER, Public Participant

STEVE LYNCH, NRR

ANDREW PROFFITT, NRR

WILLIAM RECKLEY, NRR

DIEGO SAENZ, Department of Homeland Security

MOHAMED SHAMS, NRR

JOSEPH STAUDENMEIER, RES

DUNCAN WHITE, NMSS

CONTENTS

P R O C E E D I N G S

(8:30 a.m.)

CHAIR REMPE: Good morning. The meeting will now come to order. This is the first day of the 699th Meeting of the Advisory Committee on reactor safeguards. I'm Joy Rempe, Chairman of the ACRS.

Other members in attendance are Vicki Bier, Vesna Dimitrijevic, Greg Halnon, Walt Kirchner, Jose March-Leuba, Dave Petti and Matthew Sunseri. I note we do have a quorum.

Today the Committee is meeting in person and virtually. The ACRS was established by the Atomic Energy Act and is governed by the Federal Advisory Committee Act.

The ACRS section of the U.S. NRC public website provides information about the history of this committee and documents, such as our charter, bylaws, federal register notices for meetings, letter reports and transcripts of all full and subcommittee meetings, including all slides presented at the meeting.

The committee provides its advice on safety matters to the Commission through its publicly available letter reports. The federal register notice, announcing this meeting was published on September 19, 2022.

This announcement provided a meeting agenda as well as instructions for interested parties to submit written documents or request opportunities to address the Committee.

The designated Federal Officer of today's meeting is Mr. Derek Widmayer. A communications channel has been opened to allow members of the public to monitor the open portions of the meeting.

The ACRS is now inviting members of the public to use the MS Team's link to view slides and other discussion materials during these open sessions.

The MS Team's link information was placed in the Federal Register notice and agenda on the ACRS public website. We have received one request to make an oral statement from a member of the public regarding the topics that will be discussed during today's session.

And periodically, the meeting will be opened to accommodate this request and to accept comments from other participants listening to our meetings.

Written comments may still be forwarded to Mr. Derek Widmayer, today's Designated Federal Officer. During today's meeting, the Committee will consider the following topics: SECY Paper on Fusion

Energy System Regulatory Framework and the NuScale Topical Report, Methodology for Establishing the Technical Basis for Plume Exposure Emergency Planning Zones, Rev. 2.

A transcript of the open portions of the meeting is being kept, and it is requested that speakers identify themselves and speak with sufficient clarity and volume so they can be readily heard.

Additionally, participants should mute themselves when not speaking. At this time I'd like to ask other members if they have any opening remarks?

Hearing none, then I'd like to ask Dave Petti to lead us in our first topic for today's meeting.

SECY PAPER ON FUSION ENERGY SYSTEMS REGISTRY FRAMEWORK

MEMBER PETTI: Okay. So this is a follow-on to our subcommittee meeting of a couple of weeks ago on the draft SECY White Paper. And Steve is here, so I'm assuming he wants to lead us off. Go ahead, Steve.

MR. LYNCH: Thank you. Appreciate the members welcoming us back on a quick turnaround. We appreciate the incites that were shared on our initial presentation on September 23rd for the NRC staff's considerations of establishing a regulatory framework for fusion technologies.

In particular, the staff presented on the options that were contained within a draft white paper, titled Licensing and Regulating Fusion Energy Systems.

This white paper forms the basis of the staff's forthcoming SECY Options paper that will be presented to the Commission by the end of this month.

This paper will contain options for establishing a fusion regulatory framework, as well as include a recommendation from the staff to the Commission on how on what we believe to be the best path forward on this matter.

Establishing a fusion regulatory framework is important to meet the needs of developers that expect to have commercial fusion energy systems under development now and in the next decade.

Also establishing this fusion regulatory framework is consistent with the requirements of the Nuclear Energy, Innovation and Modernization Act, which requires the NRC to establish a regulatory framework for advanced reactors to include fusion technologies by the end of 2027.

We look forward to productive feedback today on our updated presentation material. Today's presentation seeks to address some of the open items from the subcommittee meeting a couple of weeks ago.

The staff will be providing additional details and considerations of its recommended approach, including the ability of Part 30 to scale with the material acknowledging potential hazards of proposed fusion systems.

We will also identify specific revisions of 10CFR Part 30 that would need to be augmented should that approach to be followed to efficiently regulate fusion energy systems.

We are also going to discuss our next steps in what implementation of a bi-product material framework may look like for fusion energy systems.

With me at the table today is Andrew Proffitt, Senior Project Manager in the office of Nuclear Reactor Regulation and Duncan White, Senior Health Physicist in the office of Nuclear Materials Safety and Safeguards.

So with this, I will turn the presentation over to Andrew to begin our remarks for today. Thank you.

MR. PROFFITT: All right, thank you Steve. And I'll also point out that we have, you know, other members of our fusion working group on the line.

A couple of members to note, Bill Reckley as you heard him contribute during the subcommittee.

Joe Staudenmeier, in our Office of Research, one of our fusion experts here at the agency.

And another one to note as we mentioned at the subcommittee our partnership with the agreement states who have been to date regulating and overseeing the fusion devises that are out there now.

He's joining us on the lines for his perspective, if need be, so. You know, as Steve said we really don't want to rehash what we talked about at the subcommittee meeting.

I think we have that direction to cover new ground and provide some more information related to some of the discussion and open items that we heard, so. We'll do a quick review of the options and then we'll spend the bulk of the time talking about our recommendation and what that could look like.

Some of the context into that recommendation, the scalability of the provisions and requirements that are there in Part 30. Some of the augmentation we see, we're going to get into specifics. Duncan will walk us through that.

And then what implementation could look like. And look like we're directed down that path by the commission. And then finally talk about some of the enhancements to the paper.

The paper is actually maybe close to double the size as it was to when we released it to you all as the white paper. So there is a lot more information in there and we'll cover that and how the discussion of the subcommittee helped us bolster that. And then a path forward.

So our options for commission consideration so quickly, we have three options with one with a sub-option.

The first option would be to treat fusion energy systems, all fusion energy systems as utilization facilities as defined in the Atomic Energy Act which we covered last meeting. And we, the staff's approach there would be to supplement Part 53.

So Part 53 right now is being developed for advanced fission reactors largely. It could address fusion. It's not specifically addressing fusion now, but that would be a potential path forward. Legally and technically it could be applied to fusion energy systems.

A couple other things there that draw concerns for the staff is there are some requirements in the Atomic Energy Act that we have discussed, you know, related to financial assurance, the licensing process in hearings, and a few other items that are

really geared toward fission reactors.

And given the differences with fusion and the hazards that are posed, the fundamental differences, you know. Sometimes in the subcommittee meeting we may have said lower risk or lower hazards. I think we're pivoting a little bit to separate the hazards. They're different hazards.

MEMBER PETTI: So I would challenge you. Yes, it doesn't have a clinical chain reaction. But there's lots of other hazards that fission systems have that are shared by fusion systems.

They have inventories of radioactive material, particularly tritium and activated dust. They have energy sources, decay heat chemical reactions, slow damaging sources.

So there's a, you know fundamentally different. It's the word fundamentally that I think is, yes, there are some differences, but they're not fundamental.

What's actually more fundamentally different is the distribution of the hazards. You know, fission by and large, take the spent fuel pool out, it's all about the core.

In fusion, it's a distributed hazard. Which makes the safety analysis even more complicated,

and the design more complicated. You've got inventories in places, important inventories, all over the place.

And so that's a difference. But again, these are in details. I just worry about words, adverbs that are very strong, when in almost all these things it's shades of grey.

MR. PROFFITT: Yes --

MR. LYNCH: Sure. Yeah, no. Appreciate that, Member Petti. You know, I think one of the signs we have specifically tailored, is acknowledging that there are a fundamental set of programs that regardless of the option that is chosen, that need to be addressed.

You're looking a physical security, emergency planning, radiation protection, and we're going to go into that as best addressed in our proposal program.

MEMBER PETTI: My just concern is, you know, as the commissioners read it, they're not as necessarily technically savvy as, you know, the working level engineer.

And words to them can have, imply meanings that maybe, you know, we would say yes, we take that away differently than they do. That's the concern.

MR. LYNCH: Understand. And we can be

sensitive to that language as we continue to revise and update our SECY paper.

MEMBER HALNON: Yeah, and this Greg. Further on that, when you use the term, you know, it's legally able to be covered under Part 53, or legally able to be covered under Part 30, or hybrid too, I mention this at subcommittee.

If the statements are considerations doesn't intend fusion or doesn't mention fusion, to shoehorn it in, it doesn't seem like legally it would be a good -- because when I was in the industry, if I tried to apply a regulation to something outside the statements of considerations, I was stumped.

So we've got to be careful there also. Now I understand technology inclusive could be pretty broad, so you could interpret that as well.

But I know that Dave, I guess I wouldn't, if you've gotten the preamble, is that part of Part 53 as fusion is part of, isn't --

MEMBER PETTI: I'm only halfway through the preamble so anything -- I didn't say anything about fusion.

MR. LYNCH: Yeah, I can provide some clarity there.

MEMBER HALNON: I don't think it's

explicit but that doesn't mean it doesn't -- I just want to be careful there also.

MR. LYNCH: So, yes, to provide some clarity on that, Part 53, as it is currently written, does not include fusion energy systems. What we're looking at here as we put these options on the table is that one potential approach is to treat fusion energy systems as a utilization facility.

We put Part 53 out there as a starting point where, similar to Part 30, in order to include fusion energy systems, we would need to make deliberate updates to accommodate the technologies, the structure systems and components, hazards and different types of analysis.

MEMBER HALNON: Okay. So, so this does not preclude rule making --

MR. LYNCH: Correct.

MEMBER HALNON: -- to put it in there.

MR. LYNCH: Correct.

UNKNOWN MALE: Requirement.

MEMBER HALNON: To make it that legally.

MR. LYNCH: Correct. Correct.

MEMBER HALNON: Okay. Good. Thank you.

MR. PROFFITT: Yes. So moving to the second option being regulating fusion energy systems

under our bi-product material framework that would be to enhance Part 30 and one of the, you know, we sort of use Part 30 almost in slang a little bit, but that entails Part 20, the rest of the chapters in the 30s, you know.

The framework is in Part 30, but it builds on several other regulations that it references and that help it perform its job, so.

That's what's currently used for research and development in limited commercial fusion activities that are going on in the states right now.

And we believe that Part 30 provides a solid foundation to scale with the, with the technologies in the industry as it grows.

So it's currently addressing those systems, and we can foresee, and we will get into a lot more detail with this about how we could grow as the industry grows to address larger hazards, larger risks, and just more complicated facilities in general.

CHAIR REMPE: I have a question, and I haven't looked at the slides.

MR. PROFFITT: Yes, sure.

CHAIR REMPE: I have a question and I'll look at your slides, so maybe it's covered later. But when I thought about this a bit more, and I kind of

refer this at this subcommittee meeting, I don't see a lot of difference between Option 2 and Option 3A.

If you would explain, very carefully, what are the decision criteria on when you need to do something else and scale the requirements.

And are you planning to have a, define some criteria in your Option 2 of when you need like above a certain power level, or tritium amount on site you need to do something more?

MR. PROFFITT: So a lot of that is in Duncan's, our Part 30 expert, and we will get into that into specifics about there are items in Part 30 where, you know, if you go over this amount of material, you then need to address, you know, things like emergency plan, or things like that.

So there is scalability in the current regulations in Part 30. I mean, they currently regulate things from like a portable gauge up to a panoramic irradiator with millions of theories of cobalt 60.

So there is some of that in Part 30. We would need to bolster that. We definitely see that we would need to do that and augment. We would have -- I mean it would be significant work, any of these.

CHAIR REMPE: Yes. Wait, what's the real

difference then if there's some cut off criteria in Part 30 between Option 2 and Option 3A, other than you're going to put it in 53. Because again, Option 2 seems very fuzzy. If I want regulatory certainty, I'd like to know where those cut offs are.

And then, I understand the staff isn't quite sure what you're going to do, because we've not had that happen yet, and in both cases I think something else is going to come down the pike.

So what's the real difference?

MR. PROFFITT: Sure. So, right now, so, we do not have firm decision criteria of what that would look like. But what the decision criteria would be based on is looking at the Atomic Energy Act and what are those definitions of what constitutes a utilization facility.

And while there are specific provisions for fission facilities, there's also a more general provision for facilities that would present a significant enough hazard to the common defense and security such that we would need to provide those additional provisions contained within the Atomic Energy Act for a utilization facility.

So this would mean we need to look at additional sighting considerations. For example, Part

100 would be more stringent than what would be under a materials framework.

You may also need to look at additional security requirements beyond what's in Part 37, emergency planning that could be more similar to what's at a nuclear power reactor than what may be looked at for a materials facility.

As of today, we've done extensive stakeholder outreach to understand the technologies that are proposed.

And the technologies that have been presented to the NRC staff by developers from a technical perspective do not seem to exceed material quantities or expected hazards to workers or members of the public that would necessitate treatment outside of the existing frameworks in Part 30.

So that's where we're at. Right now the bounding facility that we're aware of for treatment of hazards and material contents would be the ITER facility.

And even looking at ITER, we believe if a facility similar to that were licensed in the United States, that our existing materials framework could accommodate that with some specific enhancements that we'll get into, that would better define definitions

of facilities.

And this gets back to your point, Member, that yes, we have imperfect definitions in Part 30 as it is for particle accelerators, that while the framework for Part 30 may be generally acceptable, we need to have a clear entry pathway for that.

And that's what we need, we're proposing that we work on. So I will pause --

CHAIR REMPE: I guess I -- I'm not hearing again. What's the real difference between Option 2 and Option 3A? Why are you guys saying oh Option 2's better because you're saying, what I'm hearing is yes, we need some cut off criteria too to figure out when you need to start scaling and what changes to be made.

Why is it you're focusing on 2 versus 3A?

MR. PROFFITT: Sure. So I guess to clarify a little bit, what it comes down to is how we best focus our resources and efforts at this time.

We're not aware of any facilities that would necessitate a medium ad approach to go into a utilization facility approach at this time. Our approach is to meet developers where they're at and the plans for facilities to be developed in the next several decades.

Right now, we're not hearing of designs

that would necessitate that additional higher option of regularization of --

CHAIR REMPE: Okay. So if I said I'd like Option 3A, but let's defer it, have some cut off criteria, but let's defer what is needed next.

Whether it's Part 53 or doing something else under Option 2, are we saying they're the same thing?

MR. PROFFITT: That's certainly an approach we could take.

CHAIR REMPE: Okay. That's what I kind of thought and that's what I was kind of getting to. When Dave asked the question about why you had more flexibility with Option 3, and I kind of said, before you answer that if you put cut off limits on Option 2. You're in Part 1 of Option 3A in my opinion. And I think that I got the answer to my question.

MEMBER PETTI: You know, the other thing, as I said in subcommittee, nobody knows, truly, what their next steps are going to look like. Okay? There are uncertainties that are so different than anybody here who has spent their careers in fission reactor safety understand.

These are so fundamental. Okay? Having spent a decade running the Fusion Safety Program in

the United States, we ran into these issues all the time.

How do you craft a strategy when the uncertainties are in fact, you know, we don't think we can convince anybody, because the physicists themselves, you know.

You get five physicists together; you get about eight answers. And I don't say that, you know, facetiously. It's that complex to understand the response of the plasma, particularly when you get close to, at and above ignition. They're just not there.

And making sure that you've -- the problem is that you're making a decision that's going to affect things very long term. And I just, you know, you'll see in the draft letter, this is not the National and International consensus of the approach developed in the 1990s. Okay?

And the letter cautions you to look at that, all that evidence that was not in the white paper. Lots of very serious people looked at this stuff, including John Holdren. You all probably know the name, right? Former OSTP under President Obama.

This has been studied extensively. Okay? And I'm just cautioning that there's a lot of factual inaccuracies that were in the paper that we're trying

to set the right context for the commissioners.

That's the concern that I have. That if -- it makes it look like it's a slam dunk to go over here. It is nowhere near that. It's very, very fuzzy. And flexibility to me is really critical at this point.

CHAIR REMPE: I understand your reasoning, but I think I wanted to understand versus --

MEMBER PETTI: Yes, yes. Moe has a question.

CHAIR REMPE: Yes, Moe does, but just to make sure everyone understands. I see a hand up externally. Unless the staff needs that person, we're not calling on external people. There's time for public comment later.

MR. PROFFITT: Diego is part of our working group from the State of Wisconsin.

CHAIR REMPE: Oh, that's up to you guys to call on them. I will not be doing so. Go ahead, Moe.

MR. SHAMS: Thank you, I appreciate it. Moe Shams with the NRC, with the staff.

I just couldn't be more grateful for the comment that you all are providing us about how we strengthen the paper and, you know, we build it right to make sure that we have the right words for the

Commission.

But I also wanted to share with you where the staff is coming from. I think we're exactly where you want us to be, perhaps except we're just seeing things in a slightly different way.

We're seeing that the Part 30 approach gives the flexibility to the Commission and the staff to grow with this framework as the industry matures.

We're looking at the landscape currently. We're seeing what technology's being presented to us, the size of the technologies that are being presented to us. And we feel that Part 30 can give us the time to understand the hazards better, to build the tools that we need better.

We do have tools at our disposable -- to add to Part 30, licensing condition, orders, rules of particular, these are all instruments for us to add as we see the hazards moving perhaps beyond where we feel comfortable to just leave 30 as it is.

So we do have these tools and we think they're the right tools to use now as opposed to forcing perhaps a more defined box than an Option 3 would require.

Or one that say go, no go, here's a line that if you cross over -- we think that's a level

precision that perhaps is not, is not advisable for us to go after now.

Rather the Part 30 is the right foundation with the right augmentation in addition to the all the instruments that we have. So we're coming to the problem perhaps with just a slightly different thinking as, you know.

But I think we're trying to reach the same point. Make sure that the hazards are covered, make sure that we have the right instruments in place, and make sure that we have the right flexibility to allow the framework to mature with the industry and with the technology.

CHAIR REMPE: Is there someplace where you're going to get to such a large hazard that you think Part 30 would not be appropriate with your approach? I mean that's why Dave's --

MR. SHAMS: Potentially --

CHAIR REMPE: And how will you back track after you say Option 2 and we're going to stick with Part 30 no matter what. How will you get out of your decision?

MR. SHAMS: I wouldn't need to get out of the decision. I mean, we still have the ability and the tools to add requirements as appropriate as I shared

with you that the idea is we have instruments.

We can issue additional requirements. We do that in other areas that currently are not covered, you know, under Part 50 or 52 for utilization facilities.

We do know how to apply additional requirements.

CHAIR REMPE: A Part 30 facility will have emergency planning and all the stuff that you've got to deal with for the activated materials. It'll be like as cumbersome as with a rove reactor.

MR. SHAMS: We believe that it's not going to start out this way. But if a facility grows to a place where these hazards and these considerations needed to be considered, we have the instruments and the tools to address them.

Just the Part 30 option gives us that elasticity to be able to grow as opposed to draw a solid line that we have to go another way. That's our thinking. Thank you.

MEMBER HALNON: So these instruments and tools that you have that may supplement Part 30, would just inform future rule making for specific, that specific line that Joy is looking at.

MR. PROFFITT: Certainly. I mean I think

if we look 30 years in the future, 40 years in the future, and there's a viable fusion energy industry in this country, right, I mean I think we would have a part in the regulations, like Part 50, that addresses fusion energy systems.

MEMBER HALNON: Yeah, that's what I --

MR. PROFFITT: But to make a decision, I mean I think that's also one of the staff's concerns. A decision now to either go utilization facility route or have a bifurcated approach, there's a lot of work to be done under the utilization facility approach to tailor it to the systems we see now.

Certainly, there could be systems in the future or as we learn more about the systems that are being, you know, deployed in the country, that may necessitate that. But to build it now starting from a top, down approach and having to really tailor it to what we're seeing it today, would maybe not be the best use of resources.

Where if we could start with Part 30, what's currently regulated in the facilities, we've -- Duncan's done a lot of work looking at what specifically needs to be augmented, how we can make tailored changes to the regulations, and more significantly in guidance to fully address the systems that are out there and

grow as the industry grows.

You know, one of the things I think about a little bit, right, I mean, we didn't have Part 50 the way it is today when we licensed the current fleet.

You have a third of the current fleet operating that didn't have the GVCs when they were licensed, right? So, and we continue to have rule makings on Part 50 today.

We have Part 52 in the late '80s, we're working on Part 53 now. So, and that's what certainly would be great to have perfect framework that would deal with all these systems for 30 years to come and be certain that these were the appropriate requirements that we needed and the framework that was necessary.

But to try to do that now we may well develop something that isn't useful at all. I guess, I mean, I'm seeing a lot of great colleagues that could do a lot of great work, but we see that as probably not the best approach and stuff.

CHAIR REMPE: So I will call on our consultant, Dennis Bley. Go ahead Dennis.

MR. BLEY: Yes, thanks. Where you just got to is where I guess some of us have been a little uncomfortable.

We started with Part 50, and we patched

it together to cover new situations until we had a real patchwork regulation and that led us to wind some new ones.

It almost seems to me the way you're going is one ought to call this a regulation rule making for test and proof of concept facilities that will get patched up later, when things get more difficult.

I, having the alternative structure, even if you only developed one part of it at this time and leave the others as blanks to be filled in later, but making it clear that we really might need a different framework when we get to much larger machines, should we ever get there, is what makes some folks uncomfortable with starting out the way we're starting out.

It almost sounds as if we're convinced there are never going to be machines that have a substantial hazard associated with them. Anyway, that's enough from me.

Mr. Proffitt: Yes, I appreciate that. And I think we'll cover some of that hopefully as we go through the presentation. So let me just let's move us forward a little bit and we'll get a little bit more into the details here as we go, so.

Back to an overview of our recommendation

here. So we're recommending the bi-product material approach, strengthened by a targeted rule making and development of supporting guidance.

So what that would look like is as Steve mentioned, you know, definitions in Part 30 to explicitly include fusion energy systems, using devices, fusion facilities, something to that regard. And then also update the regulation in Part 30 to include a content application requirement for these types of designs.

So the current Part 30 is, you know, addresses radiation protection ways to fission security on materials and hazards possessed by these fusion technologies.

The byproduct material framework right now, as we mentioned, is used to cover R&D, and then the content application requirement, if it's a specific thing we feel it would do is it would help scale Part 30 the way it currently is to ensure technology inclusivity and for potentially larger hazards.

So we believe that this rule making and guidance developed would cover the foreseeable technologies that we've heard from industry planning to deploy.

And then the guidance along with the rule

would obviously be prepared in parallel and ahead of expected licensing submittals.

MEMBER PETTI: Andrew, one augmentation to clarify. As we talk about this concept of scaling Part 30, this looks at existing scaling that is within Part 30 for decisions currently are certain facilities may not need emergency planning considerations for example.

But we want to make sure that should hazards be presented to workers, members of the public, that we have that clear criteria for commercial fusion facilities that, indeed, emergency planning would be required.

Now that's on a very based supple of scaling for just an in or out. But we also have the ability, as part of this rule making, to the Member's comments, to continue to look forward of what our different options, for example, emergency cleaning that may be needed in the future.

And the staff is not precluded from borrowing concepts from Part 50, or Part 53, or even the new emergency planning rule making that has been developed to incorporate into something like this to provide full spectrum of scaling.

Even though we are suggesting that a

starting point based on the focus on byproduct material at these facilities as being Part 30. So I wanted to include that, that we are precluded from incorporating other concepts from throughout the regulations into our rule making, even starting on a foundation of Part 30.

MEMBER HALNON: So it, that's just taking emergency planning as an example. If you're going to pick maybe attributes of Part 50, you have to go back and look at ACRS comments relative to that emergency planning as it would still apply.

For instance, with --

MEMBER PETTI: Absolutely.

MR. PROFFITT: -- the off-site planning comments that we made.

MEMBER PETTI: Absolutely.

MR. PROFFITT: So a little context into, you know, what we had in our mind when we were selecting the recommendations. So again, I know Member Petti, you don't like this word, but different hazard profile of fusion technology.

So we see, the way we currently see fusion technologies is it's different than fission in that when you have an upset or potential accident, you don't continue to progress necessarily.

The fission, the fusion reactions are obviously very difficult to achieve at this time, right? I mean that's, we've talked about, you know, we currently haven't had a breakeven or above fusion reaction.

Now there have been significant advancements in recent years to enable that and the private developers foresee that in the next couple of years.

But it's obviously a very, at this time, it's very difficult to achieve those conditions that are required to have continued fusion reactions.

So we see the machine as having an upset or accident progression, it would stop that reaction. You wouldn't continue to have energy being produced other radionuclides produced.

You would have an upset and the state of the facility would be, the state of the facility in regard to radioactivity, and radionuclides, and radioactive material would be, that's what you have. You're not continuing to produce more or produce more energy than is physically --

MEMBER MARCH-LEUBA: I was going to say. How, how confident are you in that? Once is extremely difficult to achieve ignition. But once you have

ignition, what prevents you from blowing up?

MR. PROFFITT: At this time, the way we see it and the requirements for the reactions the developers have and the designs that they have --

MEMBER MARCH-LEUBA: You have negative activity perhaps, but let's hope they're right.

MR. PROFFITT: Well certainly, and that's part of why we acknowledge, we have other tools that, as Moe mentioned, we believe this brainwork could scale as appropriate. You know, different hazards, different --

MEMBER MARCH-LEUBA: Obviously, the machine we have now don't achieve ignition.

MR. PROFFITT: Yes.

MEMBER MARCH-LEUBA: So, they're going to be different than what we have now and once you reach criticality, I'm using fusion, you're there. I mean if you go with a positive feedback --

MEMBER PETTI: So a good designer, though, understands the physics as best they understand the day. You design the system for better confinement than the model tells you -- more heat generated because you don't know.

And so there's, you've got to have that margin in there because until you get there, you don't

know.

And so they don't even know exactly where the heat will go -- the blanket, the converter, these different paths. So you over design it because you don't know until you get there.

MEMBER MARCH-LEUBA: Yes. My point is the only fusion machines that work today are called H-bombs. Okay? So this is --

MEMBER HALNON: Yes, but that's, that's inertial fusion. That's a very, very different system.

MEMBER MARCH-LEUBA: But a blanket statement, that nothing can possibly go wrong, it's a little naive. This has to be considered.

MR. PROFFITT: Certainly, certainly. And I see Diego raised his hand again. Diego, go ahead, if you can come off mute.

MR. SAENZ: Yes. So I think one of the important things to contextualize and I think maybe going back even to the Part 30 decision point. I think one of the things to address head on, I know Steve and Moe touched on this, but we really just don't see a criteria where you would have to step outside of Part 30.

Specifically, commercial versus R&D does not seem appropriate. Right now, we're licensing a

tritium handling system for SHINE. I mean, you're familiar with the SHINE facility, but they're doing the R&D side under the state licensing and that includes their prototype of their tritium handling system.

When you look at that tritium handling system versus some of these other proposed full scale commercial R&D power facilities, those tritium handling systems can look pretty similar.

So you look at a Helion versus what we're licensing right now under SHINE, and those look very similar. So, I think that's another important context here is we don't want to end up in a framework where just because of the commercial that would drive it.

The other complicating factors, we currently do license commercial uses of fusion, and they have significant activation products and we -- significant enough to require financial assurance.

The other side of that is even the accelerator side, so non-fusion, we're seeing accelerators with much higher power levels, such that those activation products are requiring significant financial assurance.

So these could have much higher activation products than some of these fusion facilities and without any fusion. And to add to that, that's

currently a problem that this definition for byproduct material would fix.

So this same facility that is having such high amounts of activation products using accelerators not using fusion currently would not meet the definition for bi-product material under the NRC, because those activation products would not, you know, be for commercial research or whatever uses.

So right now, that would also benefit from an update to that definition. So that's some other context, it's not specific to fusion, but I think it's really important to understand the decision that we've chosen.

I think the other thing to note, like specifically when we're talking about having some kind of specific decision point from stepping outside of Part 30, would be the hazards do not scale with thermal power unlike fission.

It's very dependent on the specific reactions, the specific fusion reactions, so when we talk about aneutronic versus neutronic systems, that's really important.

So I think that that's some other important context that I wanted to highlight here. And the other part is, we're not saying the hazards are not

significant.

Right now the states have what I would consider very significant hazards under their jurisdiction. When you look at some of these panoramic irradiators, we have millions of curies of cobalt and other isotopes.

That's a very significant hazard that we have to consider and there are facilities that have emergency plans under the state's jurisdiction.

So I think that that's some important context. I know the ACRS isn't as familiar with that, so would be happy to provide more context. But I did want to provide that context as well here. So I hope that helps.

MR. SHAMS: Can I make a -- please don't use the chat to -- somebody send me a message in the chat about my comment. Don't use the chat to do technical comment, because that's not recorded. And with respect to my previous remark, very rapidly it moves into classified material. So don't use the chat.

MR. PROFFITT: Okay. Thank you, Diego. I think that provides some additional good context. Moving through some of the other considerations here.

So we believe we are proposing an approach that best accommodates the specific hazards and

security considerations associated with the use of the material at these sites.

Again, we're anticipating, consistent with DOE and the White House's bold decadel vision, potential commercial deployment in the early to mid-2030s, and we believe our framework aligns with that and can meet and support developers' schedules.

And Diego mentioned this too, but the current array is very broad and it isn't just one hazard, all these different designs. And I think if you look at the Fusion Industry Association's report, you know, there are over two dozen different philosophies of fusion that are being addressed.

And, you know, some of the considerations would be lower no neutron technologies versus very high neutron technologies that produce a lot of activation products versus some that produce very little, or none.

And then there are some that produce a lot of tritium or use a lot of tritium. And there are some that don't use tritium or produce very little tritium.

So there is a broad array and certainly technology and inclusivity is very important as we develop this framework.

CHAIR REMPE: How do you provide regulatory certainty when you have such a broad array

of designs being approved, by agreement, state regulators.

I mean, unless you have some firm cut offs in Part 30 to make sure that folks don't get away with something in Wisconsin versus Massachusetts.

MR. WHITE: I can take that question. The current agreement state's program there's a requirement there for the states to maintain what's called an adequate and compatible program.

That's words from the actual act. And compatible means compatible with NRC requirements. That includes rule making and guidance. And again, although the system does have some flexibility built into it, there is, states have to follow the general objectives of that guidance.

They have to have stuff, guidance that's in place that's deeply protective or in some, if it's allowed to be more protective. And that, again, that's done at, the compatibility's done during rule making for guidance. It goes, it's evaluated internally and to decide what that is.

But again, the comment about consistency relates, really relates back to that. If we, the agreement, current agreement states structure right now, with rule making or with guidance states have to

have, they have to be in line with what the NRC has to have in place.

So it kind of addresses your question. They can't, someone can't go off, you know, like in Wisconsin, go off, you know, go off and do something very extreme or anything like that. That's, that deal, we all have to be in the same ballpark to do that. Yes, go ahead.

CHAIR REMPE: So what if they have a new widget and they say yes, I have 20 million tons of tritium, but I have a new widget that keeps that tritium highly absorbed; it'll never get out.

Do they come back and say okay, they're exceeding your limit, but it's being held in by my new widget that has some sort of data. Does that come back to NRC to evaluate? Or do they get to make that decision?

MR. WHITE: They, the way the agreement program was set up was they, they're the ultimate, they get to license it, but often they will come back to us and talk to us about --

CHAIR REMPE: They don't have to, it's just if they feel like it?

MR. WHITE : Oh they will come back, they, they end up coming back to talk to us, because again,

there is the, you can see this in area -- medical area, you know, there's a lot of sharing of information that goes back and forth in the medical --

CHAIR REMPE: But it's their decision. It's not a requirement.

MR. WHITE: It's their decision because they sign the license. And we also review their -- we also periodically review their programs.

And part of that review we would look at specific licensing cases, just making sure that they are -- that they stay within the balance of where they -- with the program, a compatible program.

MR. LYNCH: Yes. And we do have another tool as well that which each agreement state we have a specific agreement in place with them that authorizes specific activities they can carry out, including, in some cases, quantities of material or certain facilities that they may or may not have jurisdiction over.

And some, a tool that we have at our disposal is, as we look forward, if we think there are certain checks that need to be in place, we can revisit those agreements.

Is that correct Duncan? It's another way we can look at it?

MR. WHITE: Yes, that, that's what the audit program is designed to do is to look at those particular, be sure that they maintain an adequate program and make sure that they, we -- that's a statutory requirement. That's in the Act that we require to do that.

CHAIR REMPE: All right.

MR. PROFFITT: Yes, and another thing, you know, we see with the, with the recommendation that we have is building off the framework that we're using for R&D, allowing that the scale as we've talked about.

But it also provides certainty for an industry that's moving forward. And a couple of items with the decisions criteria.

One, you know, as we've mentioned, there's not necessarily a clear delineation that we see today of a facility that would utilize that decision criteria, that would be above that criteria.

And a lot of the paper and, as Steve mentioned, we benchmarked the ITER a little bit more in the paper now and describe these facilities.

And everything we've heard from the industry today is that everything will be significantly smaller than the scale of ITER, whether it be a tritium inventory or some of the complex systems that we have,

so.

And I've gone to the organizations sometimes, is this a true statement? Your significantly lower tritium inventories and potential hazards than ITER? And they continue to tell us that that is true, so.

It, valid cruncher, and they, and other consideration with the criteria is, it would be tied to the Atomic Energy Act, as Steve mentioned, but many of the ways of developing the criteria would likely lead to an NRC review to determine whether or not you met that criterion.

So it would provide a lot of uncertainty when you're coming in for an application about what box you may end up in. And you may not know until significantly into a review to where that would happen.

And we're going to get a lot more into this with Duncan's presentation as I think Moe mentioned to you, there's no clear end point to Part 30, as we see it today.

Obviously, it needs augmentation through rule making, needs augmentation through significant guidance development to address these systems, and we feel like we can build as the industry matures and evolves.

And I think I touched on the last item here with the scale of ITER consideration. So I'll hand it over to Duncan.

MEMBER PETTI: And I don't want to belabor the point on tritium. But all of this uncertainty you talked about, all effects what you think the tritium is, your best estimate of how much tritium you think you're going to have on site is uncertain.

So fine, you're not, you're not at the scale of ITER. Your near kilograms scale for power of challenge any of them.

Just because the number on the record, you'll see it in the letter, it's a little less than 56 kilograms per gigawatt year is what needs to be burned per gigawatt year. You can then calculate from that.

That's how much is being burned. But you need more than that and, you know, to say that I'm only going to have a couple hundred grams is not credible.

Now, you know, near kilogram at a minimum.

MR. SHAMS: It's not that. You're just moving the proton to a storage facility.

MEMBER PETTI: Yes, well, I mean, that's, yes, that's where the inventory's at. Yes. And, you know, it has to do with things like holdup and just all this, all these other uncertainties that make that

very difficult.

MR. PROFFITT: Joe, I see you have your hand up here. He's a member of our working group.

MR. STAUDERMEIER: Yes, I mean, you're going to be, you need to produce that much tritium a year, but you're not going to have this whole stock of that much tritium to start out with.

You're going to be producing it as you're operating it and you, yes, the amount of inventory in your system does depend on things that we won't know until they develop full scale systems.

But the upper estimates that we've seen from the potential plant developers are more in the hundred-gram range and not in the kilogram range, and --

MEMBER PETTI: The challenge -- that's just a --

MR. STAUDERMEIER: -- they're attempting to get it much lower than that and it's, it all depends on the efficiency of their tritium processing system is what it comes down to.

And they're developing new systems for that, and we'll have to wait, it's a thing we'll have to wait and see on. It's something that's known like right now. As you said, there's uncertainties.

MR. PROFFITT: Thanks, Joe. We'll turn it over to Duncan now and I think we'll get into a lot more specifics here about Part 30, and I think this is really the meat, meat of the presentation here. So Duncan, take it over.

MR. WHITE: Thanks. On this slide, we talked a lot about what's in Part 30. Again the Part 30 has high, a lot of high-level licensing requirements that the applicant's required to address.

We talked a lot about emergency planning. Again, in Part 30, if you have more than 20,000 curies of tritium or about 2 grams, you'll have to evaluate if you need an emergency plan or not.

If you have an off-site dose of one REM, you have to have an emergency plan and submit that emergency plan and it has to be part of your license to be, you know, be approved.

VICE CHAIR KIRCHNER: Duncan, sorry to interrupt here. Would you just repeat what you said again for the record?

MR. WHITE: Current requirements in Part 30 right now do, you know, do cover emergency planning for tritium.

And in Part 30 right now it's about, it says 20,000 curies and assumes a release fraction of

about 50 percent, and that's the threshold, that's what's in the regulations.

But if you -- from a licensing standpoint, if you have more than 20,000 curies, or about two grams, you have to do an emergency planning evaluation.

You have to demonstrate why the facility is going to be less, have an off-site dose of less than one gram.

VICE CHAIR KIRCHNER: The point I, thank you, because you already said something that addresses one of Dave's points.

Two grams, two grams is the threshold effectively when rated to curies for tritium release. We're talking about a lot more than two grams to run any of these facilities. Beyond research, you know.

I guess one of the problems this connects -- I guess I'm having is that we're, like I said at the subcommittee meeting, thinking forward successfully that this is a viable future mechanism for producing energy and electricity, it's just, as Dave said, just work the numbers.

How much tritium, you know, I know there are non-tritium concepts, but they are more difficult to achieve. So, if we just stick with the tritium-based system, you're dealing with a lot more than two grams.

I just want that to be in the record.

MR. WHITE: Absolute agreement. There's a proposed, they're building a facility right now. It's a research facility. They're using five grams. I mean, and there are designs out there that go even much higher than that.

I absolutely agree. So that's, we talked about financial assurance and decommissioning I already mentioned. And anything over 120-day half-life, you have to evaluate what you have on site.

Yes, you have activation products. Over 120-day half-life and yes, you're going to have to take that into account from a licensing standpoint.

And again, these facilities will most likely have to submit what you call decommissioning funding plans under Part 30 and under -- it would have to fund those plans.

And yes, it could be, you know, decommission funding plans can get very expensive, but they have to, again, it has to be put into place before we would issue the license.

And again it would be, obviously, tritium would fall under that, any activation products would fall under that. And again, this is operational and, you know, and obviously what's stored in waste, waste

management.

A little bit about fissile security. Obviously, tritium's covered by that. Radiation safety is covered under Part 30. Again, my reference is to Part 20 there.

Facility design requirement, again, the very high-level facility design requirements, but again specific, again, we use, Part 30 we use the regulations in concert with guidance.

And again, that's, the applicant to submit specific information for their facility with specific information on, you know, on how they're going to be protected for health and safety.

And then, again, environmental protection's another area where, again, in the NRC space for Part 30, Part 51 again, there might be a requirement there to do an environmental assessment.

MEMBER PETTI: So, these are really broad areas. Things like conduct of operations, technical specifications, do they fit in one of those?

MR. WHITE: Yes.

MEMBER PETTI: Okay.

MR. WHITE: Yes, they would. Again, because this is just, again, we just want to use samples from starting points here, but again guidance would

provide, ask for very specific information about the design versus how they're going to do, operate their facility.

And I'll give you an example about emergency planning. One of the things, obviously, they're going to have to look at, you know, radiological hazards and non-radiological hazards that would drive off-site, potential off-site, you know, public scenarios are most likely.

And again, and that's the type of thing you would be looking for in the application. What, you know, what do they have on site, what would drive potential off-site, you know, credible or they may just decide to battle it if they, you know, they have very conservative case.

Depends on what they choose to do. But that's what you're looking for there. So they, so it's a lot, it says it's a lot of high-level, but again, add the guidance to it and, again, and there's additional, some of these have additional requirements listed under ITER and you have to look at a lot of different things here to, again, to issue a license and approve the license to do that.

And again, regulations will go, will work with, in concert with guidance to, again, specific

purpose fusion facilities which, again, would have to be put into place with the rule makings.

MEMBER HALNON: So on part of this, the numbers may show, you know, whatever grams or curies, but there's a couple of other aspects that just like emergency planning, it's not just what can get off-site, it's what can get in on site.

Because you may be relying on ambulance or law enforcement and other things that -- the other part of this is the public perception. Fusion nuclear plant.

Just the word nuclear fusion in itself could require beyond just when you say doesn't require emergency planning if it's below a certain point, there's always emergency planning.

And these are always dealing with hazards, and security as well. You're always going to rely on certain amount of off-site law enforcement. So a lot of these things you can go by the numbers, but you have to look at what you're doing, what you're talking about --

MR. WHITE: Yes. I absolutely agree with that.

MR. LYNCH: And to augment slightly, I do want to make sure it's clear that listing these topics

on the slide here are not implying that the current regulatory requirements or guidance associated with this are necessarily fully adequate for future fusion facilities.

We highlight these as a starting point where we would then scale, add additional requirements to the point that was made about tritium quantities and how that maybe play into emergency planning.

That could be an area as, and I think Duncan will give some examples on the following slides, where augmentations to the regulations would be necessary and updates to guidance to appropriately handle the commercial fusion facilities.

MR. WHITE: Yes. I was just going to say, we have a couple of slides, take some of these examples and, you know, dive in, and say this is why we need more development in these area as to best fusion facilities.

Last bullet, and we mentioned before, again, we have the ability to oppose whatever official safety security requirements as in stressors and specific hazards of the designs.

Again, we can do this, you know, through the licensing process and if necessary, you know, of other tools like orders. Next slide.

Yes, the, again, the, we talked about the recommended option would include limited rule making and augment Part 30. And this would be I think the most part, looking at adding one thing definitions, you know, to kind of fusion clearly, you know, squarely in the relative framework.

The other more important thing has a section to regulations talks about what's the contents of the application for a fusion facility. What type of things would it cover?

Again, it wouldn't be super specific, but it would be, cover the high-level things that we would expect to see. And again, this would be augmented by, augmented by guidance.

Currently, and we talked about this, fusion R&D is going to be licensed either by NRC or states, you know, with compatible programs, again, and whoever, what state this is located in.

Again the guidance would, the initial guidance that we would do would probably be geared towards early movers, but again, the advantage of doing guidance is that you can update and revise guidance as you learn and go along.

And, again, this gets back to the last point too is, again, is you see what applications, what

technologies, and moving forward you can, then you can fill your guidance and learn from that and update your guidance as you move forward to ensure that there is, that there's been NRC and for the agreement states that the guidance is covering the advancements of the technologies as it goes forward.

The hazards that may, again, we talked about what happens if you do go over ignition, you know, what does, what's that going to look like. Maybe we'll see that, and we can learn from that, and the guidance can be updated to reflect that.

And again, the other thing I'd like to point out too is with regard to the evolution of regulations and guidance, we use the example of NRC did with panoramic irradiators. We had, for years we licensed them on a case-by-case basis. We had minimal regulations, and we used mainly some of Part 20 and Part 30 to regulate them.

And as, once the industry matured and some standardizations of designs, we actually did, at that point, decide to implement a separate part for that.

So again, it was a conscious decision as we moved forward. We decided that we hadn't, that the industry, we put actually a new part in place that

specifically addressed, found what we believe, what we knew about panoramic irradiators.

Again, it was years down the road when we started doing that. But again, it's what, we've gone down this path. We've done this path before.

And regulating on these on a case-by-case, really on a case-by-case basis, this is how we've approached, you know, new technologies in the past. Next slide.

And here's, again, I'll talk a little bit about, a little bit more about what we need augmentation for Part 30, you know. As I said, Part 30 is not complete right now for fusions. It's not, it's just not.

So we're going to have to -- we do have requirements in place, but again, we may not have the current applicable guidance that we have sitting on the shelf today.

We may have to pull that in from other sources. We may have to develop it ourselves. And we need to prepare that for, again, looking in the, for the early movers, what we would need to do.

In this particular case, Diego mentioned tritium handling. Then there's nothing specific in Part 30 about tritium handling. We don't have, we

really don't have anything in place right now for, you know, large, larger scale fusion, you know, tritium handling systems.

So we would have to have appropriate guidance in place, use, you know, so we can reference other guidance we could use. To do that, we could pull from part, other parts of the regulations to do that.

Chilling and designs is another area that's going to be needed. Again, that's something that would be design specific and there are certain requirements already to handle the operational radiation to do that.

Some of the design features will be, you know, very site specific. We may have to, you know, from other sources to do that. And, again, if the Commission does choose this option to move forward, we would have to do guidance and rulemaking again, and we would have to weigh in together.

I think I talked about emergency planning quite a bit there. Again, I think there's not much more to say about that. Again, it's, the guidance was developed not specific to tritium or fusion facilities.

So -- and the new guidance would have to provide more specific information, how to look at this, and how to handle that, again, revise the framework to move forward.

Again, and as a general requirement to what you have to consider in the scenarios, but again, you would want in the current, in the new guidance exactly what you want to look at and how you want. Next slide.

Mr. Petti talked about the inventory and how inventory is spread over the facility. Absolutely right, how are you going to track that and account for that? Absolutely correct.

Active products. What type of materials are you going to use? What type of activation products are you going to do? It's going to be challenging to, it's going to be a challenge to, you know, what's the inventory for that?

And obviously, it doesn't, it goes without saying, you have to know where things are, how much you have, do some of these other analyses. No question about that.

Physical security, again, we do have physical security requirements under Part 30 and they're in Part 37. Tritium is not listed there. That will have to be addressed.

But, again, if we look at fusion facilities, I think it's up to about -- what we've seen proposed now for fusion facilities by industry which fall under what we call category. It would be IA

Category 2 quantities.

Again, these categories are based on the deterministic effects from certain quantities of those, stuff that was used on (audio interference) only. And, again, what we've seen for inventories -- that again, but we also may go into Category 1.

And, again, we have regulatory -- we regulate that under Part 30 now. We have about 130 facilities across the country that are classified as Category 1, the highest category in terms of physical security.

So I think, but we're going to have to augment Part 30 to look at tritium particularly and to have the facility and how you do that. And, again, you know, a tritium facility is very different. Where tritium is going to be at a fusion facility, it looks very different than it's going to be panoramic irradiator and how you deal with and how you address that. There's no question about that. So that's one of the reasons you have to update guidance, to make sure how you're going to address that and meet those requirements.

Non-radiological hazard, and I touched on that a little bit with the emergency planning. But, again, you have to, you know, those could be very

important in look at potential off-site scenarios and for operational considerations, once again, because of, again, those different designs have different -- you're talking about magnetic hazards, you're talking about biogenic hazards, you're talking about the hazards that could, you know, that could control -- it's just that there's a lot, it's just that these are complex machines, and a lot of things can go wrong.

Again, we need to, we need to be able look at those and evaluate those. Again, Part 30 does provide a -- provides the requirement that you need look at these things. Again, it would have to be design specific.

Andrew talked about aneutronic devises. They have very -- they look very differently than a Tokamak. So we're going to have to think about and look at those.

What are the hazards associated with that design versus, let's say, a Tokamak design? And, again, have that evaluation. It has to be part of that.

And Part 30 does provide, does require you to do that because, again, it recognizes the facilities are going to look different.

Is this your slide or my slide?

MR. PROFFITT: Yes. I think that was the

last slide on Part 30, but I think the message that we're trying to send is, you know, the foundation that's in the framework in Part 30, being augmented as we've mentioned with the guidance and specific regulatory requirements that we see that need to be updated right now, can help us.

Can address what we have today and be a bridge to the future, adequately addressing the systems as the come, the devises and concepts as they're deployed, and move us to a place where we fully expect to have, you know, a Part 38 or Part something like that in the future if there was a full fusion industry in this country.

So I think, I hope we did that and if there are any more questions that relate to Part 30, I'll call on Diego here. I see his hand up and he has a lot of good insight from a state perspective of implementing Part 30. So Diego, go ahead and then we'll entertain any more discussion on specifics of Part 30.

MR. SAENZ: Yes. Another context that I would add these slides is that a lot of this would also apply under a Part 50 framework as well, right. As you know, there is no specific guidance for tritium handling even under Part 50.

Inventory tracking for tritium would be

something that we would need to develop those techniques and guidance under a Part 50 framework as well.

So I do want to contextualize that as well, that this isn't a, only if we go under Part 50. A lot of these things would need to be done regardless of the approach, but we just wanted to illustrate some of those things that we recognize readily need to be enhanced in the framework.

MEMBER PETTI: I'm just, I'm sure you're aware of the safety documents, the hazard categorization the DOE uses. The DOE faces a really broad range of facilities.

So there's a whole document that was developed on guidance for fusion facilities that pulled all the tritium handling guidance that was available at the time, this is 1990, in one place.

And so, you know, they've done the categorization and they have three levels, and, you know, done the dose calculations. So there is a structure there that's worth, I think, looking at.

MR. WHITE: I just want to reemphasize --

MR. PROFFITT: We have -- Oh, I'm sorry.

MR. WHITE: I just want to re-emphasize Diego's point. I think we recognized early on that the requirements either be under Part 53 or Part 30.

You going to access the same information before you go in terms of regulating these.

MR. PROFFITT: I mean I would just say that technology inclusiveness for out fusion, this makes Part 53's technology inclusiveness a piece of cake.

I mean, this is so much broader, you know. And Moe's laughing. He gets it. I mean, this is a much, much broader than landscape to have to navigate. That's for sure.

MR. SAENZ: I did want to quickly respond to that point about the DOE's guidance. So, as we've been licensing fusion systems, that DOE guidance has been critical to us right now to license fusion facilities.

So I'm glad you're highlighting that because that has been of great use to us. So, we've been using that to date, and it's been extremely helpful.

MR. PROFFITT: Thanks, Diego. Any other specifics on Part 30 before we move on?

All right, so obviously great discussion at the subcommittee meeting. I mean, it really challenged us to look at our paper and think about what we had and make sure we were fully informing the commission to make their decision.

So a couple of the aspects that we have here, and again, the paper is probably nearly double the size that it was that was provided in the white paper format.

But I've got greater detail on the scope and magnitude of the designs under consideration, benchmarking some to ITER and sort of using that as a limiting box of what we expect.

Additional information related to potential hazards from fusion energy systems to bolstering that section. Member Petti, you brought up the dust explosion and that's, that consideration is in the paper now, along with others.

Specifics, as Duncan went through, some of the examples we've talked about today and the augmentations that would be needed to Part 30 and certainly not trying to give the impression that Part 30, as is, is appropriate, but would require significant work.

And then also, assessment of common defense and security considerations related to fusion energy systems. So we've talked about this line in decision criteria, and that is a line that would require that they be considered utilization facilities based on the Atomic Energy Act. If they were determined to be of

significance to common defense and security, that is a line to be drawn.

So, Chairman Rempe, I think you mentioned one, you know, a very large facility maybe million of tons or something. So I think something of that nature would likely trip a common defense and security finding and would be categorized at a utilization facility and would need to be treated that way.

But, again, the understanding that we have of the landscape that's out there and its sort of benchmarking that to ITER, don't feel it would necessitate following a utilization facility.

So we appreciate the discussion at the last meeting. We think the paper's in a lot better position now.

So moving forward, I mean I think this top bullet is the same from the last presentation but is really the key and we'll continue to fulfill our mission through licensing on the other side of fusion energies.

If we get down the road at some point and we realize the path we're on is inadequate, we have tools to address that and we do that today with the systems.

We expect that future designs and hazards as they evolve, will continue to inform the requirements

that are needed, the guidance that we have, the requirements that we set to receive a license, and lastly, we'll continue to involve that framework as the industry matures as consistent with how we've regulated new industries in the past.

So moving forward here, we'll finalize the SECY paper that the Commission will direct us to implement the framework as they see fit and we will produce, if there's any rulemaking required based on the framework, and certainly there be significant guidance development. We'll seek to have that in place by 2027 based on the NEMA deadline that Steve discussed.

So our final steps here are delivering the paper, hopefully on track for later this month. I'd say we still have significant work to do, but we believe we're on track to deliver that paper ahead of the Commission's set meeting in early November on the topic.

And that's our presentation for today. Welcome any more discussion.

VICE CHAIR KIRCHNER: One observation I would make is, again, and I don't want to repeat comments from the subcommittee meeting, but this being success oriented, that this may work, and it may contribute significantly to clean energy in the future.

If you -- and I understand the advocacy

those people who are advocating fusion want to make this distinction from fission and so on, but it is a form of atomic energy.

So I think sooner or later you have to cross that line. It's a utilization facility. I'm not saying therefore use Part 50, because I don't think that would very well.

So, the big thing in the fission business that I think will happen and also in fusion unless there's some direct conversion, is you're going to couple it through some kind of power conversion Carnot cycle.

And that's where things get complicated. That's where things get complicated for fission, and that's where I expect things will get complicated for fusion.

Because then you're building a more complex system. The nominal goal is 24/7 electricity, high capacity factor, and so on. And that's what will take fusion from R&D accelerators to something that's a lot more complicated.

And, you know, and first, thermodynamics, the first rule is to push up the temperature. And as soon as you push up the temperature of a system's light fission, you get a lot of complexity.

And the same thing, I believe, is going to happen with those fusion systems that, at least right now, that look credible as contenders for purposes of making electricity.

And that, I'm just planting a seed, that that changes the game. It changes the hazards. It changes -- it makes, as Dave was saying earlier, you've got a system with if it's a neutron driven power conversion system, neutrons all over the place.

You've got tritium, if you're breeding tritium for fueling your system, that's another complication because tritium at high temperatures is really hard to manage, and so on.

So, and just, I just put this observation of caution out there, that once you cross over to making useful power, the design and complexity of the systems goes up and it pushes you.

And it will, unless there are some techniques that I'm not aware of in the fusion area, it will, you want useful power, you're going to push up the temperatures and you're going to be dealing with a lot of neutrons and a lot of complexity.

And that's where things get a lot more complicated, and that's where things like hazard analysis and such gets more complicated, because you're

running at higher temperatures, and yes, there's not decay heat like you had with fission, but you've got a pretty hot machine, with a lot of a high energy.

And you've got radiation, you've got materials that have been activated, and you've got tritium. And so when that system then shuts itself down for whatever reason, in part for whatever, then the complexity goes up much more than you have to worry about when you're running a particle accelerator at a laboratory.

And so, I think Dave, it's not quite the same way you said it, but that's my concern that you, that when you build this framework that you're really building a framework that can realistically address hazards that are going to be there which are, are going to be, I won't make the fission/fusion comparison, but just, it'll have its own set of challenges and hazards when it's scaled up to something that's useful for making energy.

MR. PROFFITT: Yes, go ahead, Moe.

MR. SHAMS: All right. I couldn't agree more with the point being made, and I heard it a couple of times about that uncertainty in the physics yet and the uncertainty around the hazards that you have.

And we're totally mindful of that. Just

even the structure of us looking at things, you are looking at it as well, provides the assurances that this will be looked at.

We come from the reactor side of things where also, safety features, novel safety have to be addressed, have to be fully vetted, have to be looked at.

So we're definitely not abandoning that thinking. And if we look at the moment in time in fusion that we're in, it's in Research and Development. It's in proving of concepts.

So we're definitely on that journey looking and learning and understanding before we license anything that's quite different than what we're already seeing or being proved so far.

So I just don't want us to come across as we're not recognizing or dismissive of the concept, that there's a long journey for the technology to go and prove itself.

And we're on this side. We've got to be the ones that are ensuring the best outright. So at the end of we have to make sure it's done, you know, safely. So your reminder to us is incredibly important and thank you for that.

MEMBER PETTI: Other members? Comments?

Okay, let's turn to public comment then.

CHAIR REMPE: I believe there was a member of the public who is here in the room, and I believe the best thing to do is still, to come to the mic?

MEMBER PETTI: The mics don't work.

CHAIR REMPE: The mics don't work? Oh, so you're going to have to use the microphone there and turn it on and make your comments.

MR. ELLIS: Can you hear me?

MEMBER PETTI: Speak a little closer to the microphone.

MR. ELLIS: All right. Well thank you very much, Chairman Rempe and other members of the Advisory Committee on Reactor Safeguards. Thank you for the opportunity today to make public comment as you and your members are reviewing the NRC's staff's work on evaluating regulatory framework for fusion energy systems.

My name is Tyler Ellis and I'm with Commonwealth Fusion Systems or CFS, and by way of background, I completed my bachelors, masters, and doctrine degrees in nuclear science engineering at MIT, as well as an MBA at Harvard Business School.

I've built out TerraPower from its founding by both leading the engineering design effort as well

as looking at the licensing frameworks, in a variety of international markets.

With CFS I focus on several areas including regulatory affairs. And to start out, I'd like to say that I support the NRC's staff's proposal to regulate fusion energy system under Part 30 approach.

At the last ACRS meeting there were several questions raised as to both what was in Part 30, and I think the NRC staff covered a lot more detail of that as well in this meeting, as well as the current status of the private fusion industry, which I'd like to provide some perspective on.

So we've submitted a letter for the record, which covers a lot of the points that I'll kind of briefly mention here. And if you'd like even more detail, I'd encourage you to read the longer letter that we've submitted to Chairman Hanson, summarizing the two-plus years' worth of public meetings discussing all of this material as well as the Fusion Industry Association's white paper on Igniting the Fusion Revolution in America.

So over just the past five years, the private fusion industry has really rapidly progressed, raising over $5 billion of capital spread out over 30-plus companies around the world with the view to

put the first fusion megawatts on the grid by the early 2030s in order to address climate change.

This is in line with a decade old vision that was announced by the White House to construct a commercial fusion power plant within the next ten years. And most of the private fusion companies were not in existence ten years ago.

So a lot of the work that was performed then would probably focus more on ITER and DEMO scale type of facilities as opposed to the current concept that have been developed rapidly over the last couple of years.

So CFS specifically is currently building a fusion energy demonstration facility called SPARC in collaboration with MIT. We're both designing and conducting a global citing search for a first commercial fusion power plant called ARC which will put fusion electricity on the grid in the early 2030s.

We have kind of raised enough money through the fund raiser this past October, as well as the demonstration of the magnet breakthrough last September, where we demonstrated a 20 Tesla sized coil at fully representative size for fusion energy facility.

And that will fully fund the completion

of SPARC as well as the design activity for ARC.

Right now we are building SPARC in Devens with the goal of achieving net energy, so Q greater than 1 by 2025, and Q greater than 10 shortly thereafter. With a -- which is basically about a decade more before ITER.

The scientific basis for the plans have been peer reviewed in the special edition of the Journal of Plasma Physics, so if any of you are interested in that, I encourage you to read.

And if you actually would like to come out to see the Devens site and see the progress we are making, we extend the invitation for all of you to come out and we would be more than happy to host.

I'd just like to cover a couple of brief points that address some of the questions that were raised in the previous ACRS meeting in five major areas.

So first is risk profile, second is tritium volumes, third is the activated waste stream, fourth is regulatory flexibility, and then the final one is kind of the tide lines.

So some of the questions were raised on the anticipated risk profile for future fusion energy systems. We think that the future fusion energy systems present risks that are much more similar to

particle accelerators than fission systems.

There are no special nuclear material on site. There are no criticality concerns. They do not create high level waste.

A lot of the hypothetical accident scenarios that have been discussed and presented in previous NRC public meetings were showing that estimated off-site doses were well below the NRC Part 30 evaluation criteria of 1,000 millirem for the coordination of off-site emergency evacuation response.

Dust generation was also another topic that was raised at a previous meeting and several of the publications from the jet facility, which actually utilizes the new ITER like wall, which is more like a tungsten wall as opposed to a carbon wall that a lot of the previous research has been based upon, shows that it produces about 100 times less dust than a carbon wall, and then that dust actually holds on to tritium about 100 times less effectively than a carbon wall.

So, this is a significant difference from the research that was conducted many decades ago on a lot of the carbon-based walls. The tungsten-based walls will be, create much less dust and it will also retain much less tritium.

On the kind of a related point of metrics. So we just wanted to kind of reemphasize the point that I think the NRC staff mentioned before, that power level and electricity production are probably not good metrics to look at evaluating this just because it doesn't correlate to the off-site risk.

We think the post appropriate metric is expected dose to the off-site public, which is kind of contained within the, within Part 30.

And then one of the other comments today kind of discussed distributed sources, and in fusion facilities much of the tritium is immobilized on solid metal beds and thus not releasable in accident scenarios.

So I just wanted to kind of bring up that important distinction where, you know, we talk about total tritium inventories for the site, doesn't necessarily correlate to what is actually is released in an accident scenario.

And then kind of similar to some of the aneutronic approaches, you know, which also generate neutron fluxes from secondary reactions and preactivated materials, just like a tritium system does, but just at a lower level comparatively.

And we think that the metric of off-site

dose to the public is a pretty effective metric because that can ramp up or ramp down based upon the hazard that the actual facility presents.

On the tritium area, one of the questions was about the amount of tritium that is required. Private fusion energy facilities will have far smaller tritium inventories than ITER or DEMO. The magnet demonstration that CFS just demoed last September, shows that you can build a Tokamak that is 40 times smaller than ITER. Forty times smaller.

It's a significant size in volume reduction. Other private companies are looking at similarly sized facilities. Nobody is looking at ITER or DEMO sized facilities for deploying of these systems.

And I think that's just a practicality up here. Talking about a 30-to-50-billion-dollar sized facilities, private companies can't afford to do something like that.

You have to have most of the governments of the world come together in order to fund that, so. For a private endeavor to try to take that on is not necessarily realistic.

Now looking at SPARC's tritium inventory, SPARC's tritium inventory is estimated to be 10 grams.

This compares to ITER's 5,000 grams. They are both kind of accomplishing a similar mission to demonstrate Q greater than 1.

But that is the difference in scale between these 40 times smaller sized machines. Just try to put the tritium amount in context.

ARC itself is expected to be slightly larger than SPARC but will also have significant smaller tritium inventories than either ITER or DEMO, which is currently estimated up at about 15,000 grams.

When you're looking at tritium consumption to operate an ARC sized power plant, about 250 megawatts electric, you're looking at a consumption rate of about 81 grams per day.

So if you're actually kind of going back and doing the math in a lot of these different facilities, the reason that it's different is because unlike experimental machines like ITER and DEMO, which have large inventories of tritium on site in order to run repeated experiments and then change the parameters quickly and go up and down quickly, commercial fusion energy machines utilizing a DT reaction have a completely different operational philosophy.

It is focused on consistent operations that use, generate, and recirculate that tritium very

rapidly, as opposed to kind of storing a large amount on site in order to draw from to run experiments.

So there are a lot of significant differences between the tritium systems that are designed for an ITER and DEMO size system, and what is currently being developed for private systems.

Just a quick note on the activated waste stream. So, a lot of the preliminary calculations that we have for SPARC is that the total amount of low-level waste that's generated is going to be to orders of magnitude smaller than what they expect for ITER.

So again, significantly smaller amounts of low-level waste. Lion's share of that will be Class A. And likewise, ARC is expected to general a pretty small fraction of low-level waste associated with what they expect for either an ITER or DEMO sized system.

We expect that all the activated materials are going to comply with NRC standards under Part 61. And for SPARC, a majority of this is going to be Class A, low-level waste.

For ARC, we are designing this facility such that the waste will be Class C and below, not greater than Class C.

So on the regulatory flexibility point, we think actually that the Part 30 regulations are

flexible enough to be able to ramp up and ramp down based on the hazard that the specific facility presents.

And this has been the approach that the NRC has taken with well loggers and irradiators as has been mentioned earlier in this meeting, so.

We think that experience from multiple cycles of development, operations, and maintenance for several cycles is pretty critical before any additional guidance is necessary to be developed because that's been kind of the historical precedent that's been followed so far.

Finally, on the timeline, just wanted to clarify some points around the pace of the commercial fusion energy and kind of the need for regulatory certainty.

One of the areas where there was some questions was the need and the time for developing a regulatory pathway for fusion and is it needed for a while.

So most private companies are developing fusion energy systems and they are targeting the early 2030s for deployment in order to be able to deliver something on the timeline and for the decadal vision from the White House.

Assuming a five-year construction schedule

and a three-year design period, fusion companies would need regulatory certainty by like about 2023 in order to support this timeline and keep the United States as a viable location for the initial ARC and other types of private power plants.

So, just trying to give some time perspective of why it's actually important to be able to develop an appropriate framework in the near term.

So thanks very much for the opportunity to offer public comment.

CHAIR REMPE: Thank you. We do have the letter you submitted, and it will be part of the transcript. Most of what, we don't do question and answers, and most of what you said I could hear, but you mentioned I think 250 megawatts electric.

And was that correct? Because that number did not appear in what your paper was, and so I could not quite hear that. Could you repeat that number?

MR. ELLIS: Yes, article, you know, can be approximately around there. It's not set, because the design is still being formulated, but that's --

CHAIR REMPE: That's different than what I saw in an earlier paper, I guess. But it's 250 megawatts electric is what you're going to demonstrate.

Thank you. Are there any other --

MR. ELLIS: No, I'm sorry. For ARC, for SPARC?

CHAIR REMPE: Which one is it though?

MR. ELLIS: Well SPARC is what we are building now.

CHAIR REMPE: And it is?

MR. ELLIS: So the power level equivalent is not isolated because it's a pulse machine, so it doesn't necessarily, it doesn't produce electricity for the grid and --

CHAIR REMPE: And then the smaller one will be 250 megawatts?

MR. ELLIS: Yes. The commercial unit ARC would be 200-megawatt electric class machine.

CHAIR ELLIS: Electric, okay. Are there any other public comments?

Okay Dennis, did you have a closing remark you wanted? I'm sorry, what?

MR. BLEY: Yes, I do.

CHAIR REMPE: Oh hold on Dennis, there is another public comment. I thought we only had one person who wanted to make public comments. There's two in the room?

MR. FOWLER: Yes. Thank you very much.

So my name is Sid Fowler, here on behalf as counsel for the Fusion Industry Association.

I just want to make a couple of very quick comments to sort of add some clarity to what the staff said which I know you had asked about the Option --

CHAIR REMPE: If you could bring the mic real close to you.

MR. FOWLER: Oh, sorry. I know you'd asked about the Option 3, which is the cut-off criteria.

I just wanted to emphasize that in the Atomic Energy Act the commission always has the authority to declare anything, a utilization facility, by rule making at any time.

And so the staff, the proposal, the Part 30 proposal in no way locks the Commission in to never declaring any fusion technology in the future to be a utilization facility.

The Atomic Energy Act always gives the commission that discretion. Okay, so I just wanted to clarify that.

The other thing is that you know the discussion of tritium facilities and large amounts of tritium is that under Part 30, large tritium facilities, they would already be licensed under Part 30, and they've never been considered utilization facilities,

even when they have very large quantities of tritium on site.

And those are the two comments we wanted to clarify. And then I believe the Fusion Industry Association might like to submit a short letter addressing some of the technical issues for the record.

Thank you for the opportunity to -- and thank you very much.

CHAIR REMPE: Okay, and then I think we're back to Dennis.

MR. SAENZ: And Joy, I did want to make a comment, I don't know --

CHAIR REMPE: Are you a public, member of the public here now, at this point?

MR. SAENZ: I'm in a hybrid role so, but yes, maybe I'll make comment as a member of the public.

CHAIR REMPE: Go for it.

MR. SAENZ: Okay. I think one piece of context that I think would really be helpful here is the working group was mostly composed of NRR folks with a familiarity of Part 50, and 52, 53.

So I think there's few people, like me, which some of you may remember from the operate subcommittee presented on Mello Plus and EFW in the past, that I have kind of worked both sides.

So kind of the default of the group really was how do we fit this into a Part 50 framework? A Part 50 framework? A utilization facility framework?

That really was the starting point. And even if you look at the SECY paper that created the working group, it's made some comment along the lines of it didn't really see a role in this for the agreement states.

To the great credit of the working group, which I'm lucky to be a part of, those members kept an open mind and as we went through this process and learned more about the current technologies, got presentations from future facilities that are being proposed and companies are working on, we eventually started to work to the hybrid approach.

Okay, it looks like some of these facilities could fit under a Part 30 approach and then as we came to a close of this process, we've come to the conclusion where we are now, which is we haven't seen a line where something that is foreseeable would require that Part 50 approach.

Now, of course, as Dennis highlighted and as we've seen with the SHINE Part 50 license, we have that capability of putting something that doesn't right now fit under Part 50, in a, you know, needed timeline

to fit it into Part 50 as a utilization facility. That tool always exists.

I think it really was something that we needed to address from the last meeting of, hey why don't we -- why are we boxing ourselves now to one decision, why don't we have some, you know, go that hybrid approach, and leave that door open?

And that's because we really aren't seeing that line. So I guess I want to provide that context and I also know a lot of the folks here at the ACRS are more familiar with that Part 50 approach.

So I understand your concerns, you know, as somebody who lived in the Part 50 world prior to coming to the Part 30 world. I wasn't aware that a lot of these mechanisms existed.

So, you know, I think that that's all of your comments have resonated very well with, you know, my own experience going through this process. So I wanted to very much recognize that as well. So I hope that's helpful. Thanks.

CHAIR REMPE: Any more public comments before I allow Dennis to speak? Okay Dennis, you're up now.

MR. BLEY: Okay, thanks Joy. Two, two things. One I was beginning to feel kind of guilty

like I missed the boat when several members of the staff talked about a revised white paper that's twice as big as it was very much expanded.

I've nosed around, and apparently, I didn't miss the boat, they have a new draft that the Committee hasn't seen and if it's revised as extensively as they say, it seems, I wonder if it's wasted time for you folks on the Committee to be writing a letter on what we saw a few weeks ago.

Then I had a question for you and Dave. My copy that I read of the original white paper has an Option 2A and 2B, but it doesn't have an Option 3A and 3B. I'm guessing you mean the two different paths under Option 3.

One for the bi-product material model and one for the utilization facility. Is that right?

MR. PROFFITT: Yes. I think so. And actually, to make things more confusing, in the slides today it was Option 3, Option 1, 1 and 2, which are sub-options under that.

And I thought they were A and B at the subcommittee. So, I was a little confused as well.

MR. BLEY: Okay, so you were taking it from your memory of the subcommittee meeting. I just wondered because I didn't have an A and B, but I figured

I must know what you were talking about. And I did.

CHAIR REMPE: With respect to, is it wasting our time? And we can clearly say, the white paper and the slides and make sure everyone understands what we were talking about.

My concern is, and Dave and other members may have different opinions, is that the SECY, the revised paper that we weren't given an opportunity to see, is going on up to the commission in October and there's a public meeting.

So I think they haven't changed what they told us they were going to at the subcommittee meeting and so if ACRS wants to comment, I think the time is now. Other members may have a different opinion.

MR. PROFFITT: Well I just think when they see if everything survives in the draft letter, there may be some more useful information in the letter to incorporate into the white paper as well.

CHAIR REMPE: Yes, Moe has his hand up.

MR. SHAMS: Thank you. Yes, I just wanted to take on the point of the revision to the paper.

The SECY is built --

MR. BLEY: Moe, can you stay on the microphone. It's hard to hear you.

MR. SHAMS: Oh, I'm sorry Dennis. I'll

get closer. The SECY is built directly off the white paper and the technical discussions in the white paper.

We've expanded some of the legal areas a bit to get through some definition of utilization facilities versus material framework and what have you.

But that ultimately had no bearing ultimately on the recommendation we've made, which we presented to you today. And the technical positions that we've laid out in the paper with respect to risks and what's missing in Part 30.

So, in my view what you have is the thrust of the paper. The rest is really augmentation to support the commission decision.

MEMBER PETTI: Okay. Well with that, then I want to thank the staff. Good discussion, good presentations. And I turn it back over to you, Joy.

CHAIR REMPE: Sure. We're actually ahead of schedule which is amazing with all the discussion for less than 12 slot, because it's only really 11. But anyway, I would like to suggest we take a 15-minute break and come back and let you read through your letter at 10:25, which is five minutes sooner.

I'd also like to tell the court report that we're going to go off the record at this time and ask him to return at, or someone else, whoever's covering

this afternoon, at 1:00 p.m.

Okay, and that said, do you have a comment? No. Okay, we'll see you at 10:25. Okay.

MEMBER PETTI: Yes, thank you.

(Whereupon the above-entitled matter went off the record at 10:11 a.m. and resumed at 1:00 p.m.)

CHAIR REMPE: Good afternoon, everyone. It's 1:00 p.m. I thought my microphone -- oh that one.

Good afternoon, everyone, it's 1:00 p.m. and we are resuming the full committee meeting, but there has been an issue with admitting some members of the staff, and I'm waiting to get a go ahead from the staff.

Is it acceptable to go ahead and start?

MR. SNODDERLY: No, if I could please, this is Mike Snodderly, I'll be the DFO for this portion of the meeting, and there's some members of the staff that had the wrong invite and we believe we have the right invite for them now. So I just want to make sure they're here before we get started.

CHAIR REMPE: So we'll wait until we get a go ahead from you.

MR. SNODDERLY: Yes. Thank you.

(Whereupon the above-entitled matter went

off the record at 1:01 p.m. and resumed at 1:05 p.m.)

CHAIR REMPE: Okay, I've been told by our Designated Federal Officer for this session that we've resolved enough of the issue that we can begin.

So at this time, I'd like to ask Member Kirchner to lead us to the topic regarding the methodology for establishing the technical basis for the plume exposure emergency planning zones.

VICE CHAIR KIRCHNER: Thank you Chairman. I think to start, first I'll just observe that I believe all the members of the Committee were at our subcommittee meeting in September when this material was presented by the applicant and the staff.

So we did not ask for that to be repeated today, but I wanted to open the floor to any members who might have questions based on what was presented in September.

We have staff and new scale available. I'll start with the Chairman.

CHAIR KEMPE: Well if no one else has, this is a minor question. This is a minor question and I apologize for not asking earlier, but I was just curious when on Page 11 when you're talking about the codes that can be used for this methodology and the applicant mentioned MELCOR, RELAP, and MACCS, you brought up some

other codes, such as TRAC.

And I just was curious, usually in NCR, they ask for something and you say yes, you can do this, and what was the motivation for that?

MR. DICKSON: This is Elijah Dickson with the staff. TRAC is an updated version of RELAP, effectively at --

CHAIR REMPE: It actually has some additional capabilities like the couple draft --

MR. DICKSON: That's right additional capabilities. I myself am not an expert user in that. I would reach out to our office of research. They are developing all those codes. And they said in general the agency is moving away from that older software and moving on to these new ones.

CHAIR REMPE: And of course the applicant has a methodology that they're using and I frankly -- the agency's codes aren't really, well this is a different story, but.

They were going to do a different type of submittal, or something and they have their approved code and RELAP is approved for their applications.

I'm not sure that, although TRAC has some additional, wonderful capabilities, I'm not sure that the staff would accept it for some types of responses.

I mean, frankly, it would be nice to see the applicant do it for some things because of the coupled reactor physics from a hydraulic feedbag, but I just was surprised basically that you don't really have a stronger reason for it other than --

MR. DICKSON: No, other than researching and reaching out to the folks using the code and developing the code that said in general, they are moving on to these other codes, though internally.

CHAIR REMPE: Oh, absolutely. The staff has I agree with that, but they can use, the applicant can use.

MR. DICKSON: Yes. That's it.

CHAIR REMPE: You're basically giving this applicant to use an NRC code for corporate regulatory application, which is kind of interesting, but it's not the traditional.

MR. DICKSON: Yes. I understand.

CHAIR REMPE: Anyway, I dug that point out. Thank you.

VICE CHAIR KIRCHNER: Thank you. Other members? Also, I believe we have our consultants Dennis Bley and Steven Schultz on the line. Dennis or Steve, have you any questions of the staff or the applicant?

MR. BLEY: No, nothing from me beyond what we've talked at subcommittee.

MEMBER DIMITRIJEVIC: Walt, I have a general question.

VICE CHAIR KIRCHNER: Go ahead, Vesna.

MEMBER DIMITRIJEVIC: All right, so my very general question is we call this the risk inform application, right? And so my question is, what is the risk here we are considering? Which risk are we talking about?

VICE CHAIR KIRCHNER: Are you asking the question of me?

MEMBER DIMITRIJEVIC: No, no, no. I'm asking question of the NuScale when they said it is risk inform, what is their understanding? What risk we addressing here? I just want to know that because we often, they make up the numbers and sequences we call this risk inform application. But I always, you know, my, one of my specific things when it comes to that is can, we discuss what is the risk we are talking about.

Because like 1174 is very clear. We are talking coal frequency or lab release frequency. So what is the risk we are discussing here? You understand what you mean. What is the risk we are talking about

when we say this a risk inform application?

Are you talking about exposure? What is the risk, those, what are risk we are addressing here? In your opinion, how you see it when you say that's a risk inform application.

MR. DOYLE: This is Jeremiah with NuScale. Can you hear me?

VICE CHAIR KIRCHNER: Yes, Jeremiah.

MR. DOYLE: Okay. Yes, the risk that we are discussing here is the risk of release and the off-site dose risk to the public.

MEMBER DIMITRIJEVIC: So we are discussing off-site risk to the public is what is our risk measures here?

MR. DOYLE: That is correct. Those three dose criteria. We're looking at the off-site dose risk to the public.

MEMBER DIMITRIJEVIC: Okay, but we don't have an established expectations for that risk measure, right? I mean, we don't have a really, let me try to say that we don't have a really acceptable level of risk defined here, right?

MR. DOYLE: Well, we have a, we have three kinds of acceptable limits for, for protective action planning. You know, we do set those three, those three

dose criteria and I would say those are our risk limits here.

MEMBER DIMITRIJEVIC: Sorry, my microphone was off. So what you are saying meeting those criteria is what gives you risk inform thing.

I'm sorry to be like this, but this is something from my point that important that we often as soon as we see number, you know five minus five or 1.5, we say oh this is this inform application.

But I truly, this inform application is something which shows, represents low risk to something or we have a reduction in risk to something.

And so my question to you by meeting those criteria you are saying that this is that should be fine risk inform.

MR. DOYLE: Okay, thank you for that explanation. Yes. I would say there's two, there's really two pieces of the risk inform to this.

One is the, we're informing the spectrum of accident sequences to be evaluated. And that's based on risk incites from the PRA and deterministic inputs from, you know, Chapter 15.

So there's that balance of the quantitative, the quantified probabilistic risk and the deterministic risk. And that combination there

is part of the risk informed process.

And then the other piece of the risk informed process is for that defined spectrum of accident sequences. You know, what is the distance at which we meet the dose criteria.

And so we're really then ultimately risk informing that that location where we we're having the commensurate level of risk to the public at and beyond the EPZ boundary as the currently established 10-mile EPZ.

MEMBER DIMITRIJEVIC: Okay. All right. I just wanted to hear your opinion about such. Okay. Thanks.

VICE CHAIR KIRCHNER: Thank you, Vesna. If there are no other questions or comments, what I'm going to proceed to do is read that document and that is the version that the staff prepared --

MR. SNODDERLY: Excuse me Walt.

VICE CHAIR KIRCHNER: -- the evaluation against -- yes?

MR. SNODDERLY: Yes. I think that now that we're at the end of the question-and-answer period, I don't believe we need the court reporter any longer, so.

CHAIR REMPE: Furthermore, I'm wondering,

what do we do about public comments? Maybe we should ask if we should have public comments before.

VICE CHAIR KIRCHNER: We would take any public comments on this particular topic. I think if you're on-line you have to press *6 to unmute yourself. If you're on Teams, go ahead and activate your microphone.

MR. SNODDERLY: Ms. Sarah Fields is on --

CHAIR REMPE: Do you hear previously that she did want to make --

MR SNODDERLY: No, I just saw that she was one of the ones --

CHAIR REMPE: Oh, there were several that I recognized that -- and we'll give them another few minutes. Not hearing any comments then I think we are done with this public comment portion, and we will ask court report and ask him to return tomorrow at 8:30 a.m. Thanks. 8:30 tomorrow morning is good.

MR. NGUYEN: Excuse me, Chairman. I think it's P&P tomorrow so did you want him to --

CHAIR REMPE: That's true. And we've got a lot of people with echoes. But we will have a session tomorrow at 1:00. And I sent you and Larry a note and Quynh. Can someone -- everyone turn off their mics?

Quynh, Larry? Okay, so I ask us to -- okay, I asked before, with my opening remarks. I sent you and Larry a note, and Quynh. And you coming back and said, yeah, what you have is fine.

But I thought we do need to have an opening remark at 8:30 to make sure that we cover what's going to happen at one o'clock. And we definitely want a court reporter.

But I mentioned it several times. And we were just going to have this guy on the line for about ten minutes. Now is that true?

MR. NGUYEN: That's understood.

CHAIR REMPE: Is that true? Because I did sent you a note, you and Quynh, a note back. Okay, and Quynh, is that true?

I mean, this is a weird situation but because of what we are starting off and then starting at 1:00, in the middle of a session, if you don't have an opening remark, to me seems strange.

MEMBER MARCH-LEUBA: My agenda says 1:30.

CHAIR REMPE: Okay, 1:30, but is it 1:30 when we are to resume?

MEMBER MARCH-LEUBA: That's what it is.

CHAIR REMPE: Okay, so anyway, please come back at 8:30 tomorrow morning, court reporter, okay?

And then we'll get right to -- yes, until probably 1:30.

Jose's probably right because I was just doing it from memory. Okay, so at 1:30, then, we'll have a longer time. Thank you for correcting me.

MR. NGUYEN: Thank you, Chairman.

(Whereupon, the above-entitled matter went off the record at 1:18 p.m.)

Advisory Committee on Reactor Safeguards

Full Committee

Licensing and Regulating Fusion Energy Systems

October 5, 2022

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

Agenda

- Review of Options
  - Treatment as utilization facility
  - Adaptation of byproduct material framework
  - Hybrid approach
- Staff Recommendation of 10 CFR Part 30 Approach
  - Context for recommendation
  - Scalability of requirements
  - Potential augmentation of requirements
  - Expected implementation
- Enhancements to SECY Paper
- Path Forward

Options for Commission Consideration

- Option 1: Treatment as Utilization Facility – Supplement Part 53
  - Would impose requirements in Atomic Energy Act (AEA) currently applied to nuclear fission reactors
  - Would present challenges because hazards associated with fusion devices are fundamentally different than fission-based systems
- Option 2: Regulate under Byproduct Material Framework – Enhance Part 30
  - Part 30 framework addresses the most significant hazards associated with fusion energy systems
  - Currently used to safely license and regulate fusion research and development (R&D) facilities
  - Would scale requirements to address expected hazard levels
- Option 3: Hybrid Approach – Scale Between Options 1 and 2
  - Bifurcated approach with decision criteria to regulate as utilization facility or byproduct material

Staff Recommendation – Part 30

- Staff recommends a byproduct material framework approach to fusion regulation; strengthened by a targeted rulemaking and development of supporting guidance
  - Part 30 and associated regulations addressing areas such as radiation protection, waste, and physical security provide relevant foundation to address material and hazards posed by fusion technologies
  - Byproduct material framework is currently used to safely license and regulate fusion R&D facilities
  - Limited rulemaking would scale existing requirements to ensure technology inclusivity and provide content of application requirements
  - Guidance would be prepared in parallel with rulemaking to support expected licensing submittals

Context for Staff Recommendation

- Fusion technologies have fundamentally different hazard profile than fission reactors
- Staff proposing an approach that best accommodates specific hazards and security considerations associated with possession and use of byproduct material
- Anticipate first commercial systems, consistent with the Department of Energy's "Bold Decadal Vision" in the early-to-mid 2030s
  - Staff proposing a rulemaking approach that is timely and supports developers' schedules
- Fusion energy systems under development vary greatly in technological approach and potential hazards; necessitates a scalable, technology-inclusive approach
  - Different technologies: low/no neutron technologies vs. high neutron technologies
  - Different hazard considerations: large vs. low/no tritium inventory
  - Building upon the materials framework used for R&D facilities, would support a technically consistent and predictable regulatory infrastructure, while ensuring adequate protection of public health and safety
- No facility of the scale and tritium inventory of ITER is being considered in the U.S.
  - Additional safety and security considerations under a utilization facility framework unnecessary

Part 30 Framework and Scalability

- Part 30 includes high-level licensing requirements that address design, safety, and security considerations relevant to fusion facility materials and technologies, including:
  - Emergency planning
  - Financial assurance and decommissioning
  - Physical security
  - Operator training
  - Radiation safety
  - Facility design requirements
  - Environmental protection
- NRC will scale or impose additional safety or security requirements as needed to address specific hazards for the applicant's design

Expected Implementation of Byproduct Material Framework

- Staff would initiate a limited rulemaking to augment Part 30 with technology inclusive definitions as well as updated, scaled content of application requirements
- Fusion R&D, not within DOE jurisdiction, would continue to be licensed by the NRC or Agreement States with compatible programs
- As needed, guidance would be developed to support early movers
- As fusion energy systems are deployed and industry evolves, staff will evaluate the need for further rulemakings and/or guidance updates
  - Incorporate licensing and operating experience
  - Further tailor and scale requirements to designs and associated hazards
  - Consistent with evolutionary nature of regulation

Augmentation of Part 30 for Fusion Energy Systems

- Facility design requirements and radiation safety for tritium handling systems
  - Current requirement: 10 CFR 30.34(a)(2); no current applicable implementing guidance
  - Specific guidance to be developed on:
    - material properties and composition in very high neutron fields
    - tritium handling systems
    - shielding and design
- Emergency planning
  - Current requirements and guidance: 10 CFR 30.32(i) and Regulatory Guide (RG) 3.67, “Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities”
  - Current guidance is not specific to tritium or fusion facilities. New guidance will need to provide specific information on how to evaluate the release of tritium based on design specific accident scenarios such as loss of coolant, loss of vacuum, fires, or explosions to determine if the potential offsite doses exceed 1 rem effective dose equivalent.

Augmentation of Part 30 for Fusion Energy Systems

- Radioactive material inventory
  - Current requirements: 10 CFR 20.2006, 20.2201, 30.3, 30.33(a), and 30.35
  - Accurately tracking large quantities of tritium: Licensing guidance will address demonstration of process for accounting of the tritium inventory.
  - Accounting for activation products from neutron activated components: Licensing guidance will address means of tracking inventory for meeting waste management and financial assurance requirements.
- Physical security
  - Current requirements and guidance: 10 CFR Part 37 and NUREG-2155, “Implementation Guidance for 10 CFR Part 37, ‘Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material’”
  - Fusion facilities may use quantities of tritium in excess of IAEA Category 2 quantities. Part 37 and associated guidance do not currently include tritium as one the radioactive material requiring physical protection.
- Non-radiological hazards
  - Current requirements: 10 CFR 30.32(i) and 30.34(e)
  - Current guidance is not specific to fusion energy systems. Licensing guidance will need to provide specific information to integrate non-radiological hazards into evaluation of operational and incident scenarios. Some non-radiological hazards that could initiate scenarios that would release radioactive material include fire, loss of vacuum, or loss of plasma control.

Enhancements to SECY Paper

- Based on discussion at the September ACRS subcommittee meeting, staff have enhanced the draft SECY paper to better inform the Commission of its consideration of options to regulate fusion energy systems, including the following modifications:
  - Greater detail on the scope and magnitude of fusion energy system designs under consideration
  - Additional information related to potential hazards from fusion energy systems
  - Specifics on augmentations to Part 30 framework
  - Assessment of common defense and security considerations related to fusion energy system

Path Forward

- NRC will continue to fulfill its mission of protecting public health and safety through the licensing and oversight of fusion energy systems
  - Designs and hazards of anticipated fusion energy systems, inform the development of requirements
  - As appropriate, staff will continue to evolve regulatory framework for fusion energy systems as the industry matures, including consideration of new designs, hazards, and operating experience
- Commission will direct the staff to implement the appropriate regulatory framework
  - Staff will continue stakeholder engagement to inform its development of selected framework
  - Rulemaking and/or guidance will be completed by the end of 2027 (NEIMA deadline)
- Next steps
  - Staff to deliver options SECY to Commission later this month (October 2022)
  - Commission meeting on fusion energy systems scheduled for Tuesday, November 8, 2022

Discussion