UNITED STATES

NUCLEAR REGULATORY COMMISSION

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MEETING WITH ADVISORY COMMITTEE ON

REACTOR SAFEGUARDS

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FRIDAY,

JUNE 9, 2023

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The Commission met in the Commissioners' Hearing Room, at 10:00 a.m., Christopher T. Hanson, Chair, presiding.

COMMISSION MEMBERS:

CHRISTOPHER T. HANSON, Chair

JEFF BARAN, Commissioner

DAVID A. WRIGHT, Commissioner

ANNIE CAPUTO, Commissioner

BRADLEY R. CROWELL, Commissioner

ALSO PRESENT:

BROOKE P. CLARK, Secretary of the Commission

MARIAN ZOBLER, General Counsel

ACRS MEMBERS PRESENT:

JOY REMPE, Chairman, Advisory Committee on Reactor Safeguards (ACRS)

RON BALLINGER, Member, ACRS

VICKI BIER, Member, ACRS

WALT KIRCHNER, Vice Chair, ACRS

DAVID PETTI, Member-at-Large, ACRS

P R O C E E D I N G S

10:00 a.m.

CHAIR HANSON: Good morning, everyone, and happy Friday. I convene the Nuclear Regulatory Commission's public meeting for the purposes of hearing from members of the NRC's independent Advisory Committee on Reactor Safeguards, or ACRS, on issues recently reviewed by the Committee.

Welcome, everyone. And welcome to Commissioner Caputo, too. She's online with us, and will be joining us via Teams this morning, and look forward to her questions.

The ACRS plays an important role in the statutory structure of the NRC. It's intended to be a built-in review body with significant discretion and independence. This independence is even more important for new reactor reviews that will include significant novel considerations and issues associated with new technologies. Feedback from the ACRS is going to be critical.

That's why I'm glad to see the addition of Dr. Martin. Welcome, Dr. Martin. He brings significant experience over 30 years in nuclear reactor safety, and most recently as a technical consultant, I believe, for BWX Technologies. You have significant experience in accident analysis methodologies and code development support, and we look forward to your contributions. Thank you.

I also want to acknowledge up-front the Committee's good work recently, and value-add in the recent review of fusion regulatory options, and also identifying issues such as the density wave oscillation and the boron

redistribution issues with the NuScale design. So, thank you for that. We're going to be hearing from our ACRS panelists on a number of interesting topics to include both NuScale and Kairos and others, and Part 53's.

But before we get rolling with those presentations, I'll ask my colleagues if they have any remarks they'd like to make.

(Pause.)

CHAIR HANSON: Okay, with that, Dr. Rempe, I'll hand it over to you.

DR. REMPE: Thank you, Chair Hanson, and good morning, Chair Hanson and the Commissioners. The ACRS does appreciate the opportunity to meet with you. Slide two shows the agenda for this briefing. There'll be five presentations, after my overview we'll hear from Member Ballinger about the SHINE medical isotopes operating license application, followed by Member Kirchner on the NuScale topical report for the emergency planning zone site boundary associated with the plume exposure pathway. And finally, Member Petti will provide an overview of our reports on the Part 53 rulemaking, and the Kairos Hermes construction permit application.

Since our last briefing with you, which was in June, 2022, we've issued 17 letter reports. Four of these reports pertaining to fusion energy system regulation in the Part 53 rulemaking package. Slide four lists the letter reports we've issued pertaining to submittals for design centered application.

Our review of the SHINE, and the Kairos applications applied an approach that we first applied in the phase four NuScale ECA application, as you may recall. The staff of the ACRS along with NRR staff worked together to

implement this evolving report. The lead member will assign members with relevant expertise a particular topic, or chapters to review, and they report back to the Committee, and as needed risk important topics are scheduled for briefing.

Although this does reduce the number of meetings required, as well as the number of briefings from the applicant, and the staff, we believe it does not adversely affect our safety mission. As you may recall, during the phase four review, we identified issues such as the boron dilution issue that led to changes in the design, as well as instrumentation set point settings.

The approach does offer the ability for reductions in the schedule for the review. For example, our review of the Kairos Hermes application was completed last month, four months ahead of our scheduled due date with NRR, and yet, as you'll hear today from Member Petti, we still were able to identify several significant safety considerations that were not present in the initial application, or in the draft SC that we reviewed from the staff.

Slide five lists reports that pertain to the LWR operating fleet. These reports address topics related to digital I&C, new fuel types for PWRs, water sources for recirculation cooling, and a subsequent license renewal application. In the case of the Oconee SLR application, there were no findings in the staff review, or open items, or confirmatory items in the staff review.

So, we applied a streamlined approach that only required briefings from the staff, and the applicant in a single meeting. The last letter report was actually a one paragraph transmittal letter for a white paper that our senior technical advisor prepared, regarding Dr. Hossein Nourbakhsh, to be

prepared regarding historical, as well as recent contributions from ACRS during our reviews.

I asked Dr. Nourbakhsh to provide this white paper as a knowledge transfer effort to new members, and other interested stakeholders, and I think that it has some very significant findings. In the next slide I wanted to highlight some other ongoing review activities. As indicated in the first bullet, we have initiated interactions regarding several design center applications.

As you may recall, during our June 2022 briefing, I mentioned that the ACRS reorganized in January 2022, and we assigned a lead ACRS staff member to be associated with each of these applications, as well as other applications we anticipate for the first year. That lead member, along with an ACRS staff member hold informal meetings periodically with the NRR staff so they remain cognizant of the progress of that application.

And they report back to the ACRS, and we schedule meetings as appropriate on what topics we believe will be important with respect to risk, and safety significance. Ultimately as more of these applications as well as others transition from the pre-application stage to the application stage, we envision that we will again divide ACRS up into two teams as we did back during the nuclear renaissance era around 2010, or 2011 so that we can still accomplish our mission without adversely affecting schedule.

And the last two slides, I'd like to discuss some other ongoing ACRS activities. And as in prior briefings, I'll start with our continuing efforts to transform, or initiate process improvements. In addition to knowledge transfer, we are starting to develop, or continuing to develop guidance that promote best

practices for ACRS on conduct of subcommittee meetings on letter writings.

And most recently, we're starting to develop best practices for conducting design centered reviews. And we believe that this facilitates communicating not only us scheduling, and emphasizing what's risk important, but also in communicating to NRR staff on what our plans are for the reviews. We are continuing -- it'd be good to see the slide for a minute -- other activities, such as -- I'm sorry, the prior slide, please.

We are continuing other activities to streamline, and focus our reviews on risk significant items. For example, in recent times, you may have noticed that instead of letter reports, we're emphasizing our findings in paragraphs that are provided in our meeting summary reports, because we find it's more important to focus on those letters that are risk significant.

And then in the last slide, we are continuing other beneficial activities. We continue to hear from the staff on their transformation efforts, and provide comments as appropriate. We are resuming our visits to plant sites, as well as fuel fabrication facilities. Last summer we visited region three, the Byron plant, as well as the SHINE construction plant.

We find that these visits are extremely important, because they help us better understand the health of the facility, as well as interacting with the staff, so that we can better understand their concerns, and priorities. And at last. Oh, I also wanted to mention too that in addition to our knowledge transfer, our reorganization, and revising our approaches for conducting our reviews, we're also looking at to make sure that we have adequate expertise in our membership.

So, we do appreciate your efforts to help us bring Dr. Martin on board. And then last, I did want to mention briefly that we did complete our international activity with representatives from advisory committees that support regulatory agencies in Finland, France, Japan, and the United Kingdom. At this time we are in the process of compiling a report that includes the presentation materials.

As well as summarizing some of the discussion topics, and key findings from that interaction. And that completes my planned remarks, and I'd like to ask Member Ballinger to begin his presentation.

DR. BALLINGER: Thank you, Chairman Rempe, and good morning, folks. First slide, please. I'm going to give a discussion of the SHINE application review. The SHINE submitted an application in 2019, middle of July, and they asked for 30 year license, and we completed the review in December 2022 using roughly the same format that Chairman Rempe has described. Next slide. please.

With regard to the facility characteristics, the facility is designed to produce moly-99, which I'm sure many people in here know that if you're over 65, or have had heart surgery, present company included, technetium-99 is very important for the national medical infrastructure. So, it's produced, again, from fission produced moly-99, which in this case is actually fusion fission produced moly-99 from accelerators.

Which is probably the first instance of actually generating fusion power, hopefully not the last. And the production facility consists of this irradiation facility, plus an extraction facility, it's a two component system where

the moly-99 is separated from the fission products. Next slide. The SHINE's unit, the SHINE facility has a lot of safety features which make it both safe, and unique, if you will.

Low power density irradiation units accelerators, automatic shutdown of the irradiation process, they're accelerators that can just be turned off. And criticality is avoided, or not only avoided, but excluded during dissolving filling on the radiation side, and criticality safe vessels are used for the entire facility, as well as engineering design features.

Next slide. So, as part of this process, we had a number of subcommittee meetings, six to be exact. We had several 19 chapter topic memos as Chairman Rempe has described, and we had a site visit in Janesville. Chairman Rempe has emphasized the importance of these visits. This visit was for me, very important, because first off, this is kind of a one off facility, it's unique.

It's the first time we've been to visit one of these things, and we get to talk to people that were both actually the president of the company, plus the lead design engineer, and the lead technical person, that's the way I would describe them. And you get a really good feeling about these guys having a good handle on their topic, and on their design.

So, I can't more emphasize the fact that these site visits are very important. Next slide. By way of the safety analysis approach, the SHINE people used what's called a maximum hypothetical accident. What they basically did was to do a failure modes and effect analysis to identify every scenario that could cause an accident, then use that analysis to define a design

basis accident, and then deal with that.

So, that was their process, and it worked quite well. Next slide. As part of our review, again, visiting the site was very important. We realize the importance of human factors in the facility. This is going to be a facility where there's a lot of repetitive things going on, and so there's often times a problem with repetitive action where you get kind of complacent.

So, we needed to understand that process. The coordination with the community was also very important, because there's an airport that's within walking distance of the site, and the site is going to make use of fire departments, local organizations, and they really need to have a very good understanding of what they're dealing with if there's a need for their service.

And last, but not least, there's an increasing importance of cybersecurity, and so we got a chance to talk to them about that. But that is considered to be important. Next slide. Based on our analysis, and our visits, and the like, we concluded that the operating license should be issued. Next slide. Okay, some lessons learned.

Again, as I keep reciting this, but it's true, as Chairman Rempe has emphasized, the grouping of these chapters requires close coordination between us, the staff, and the applicant to make sure that we don't have a situation where there's kind of bleed off into other areas that we haven't discussed beforehand. So, it's important to coordinate things very well that way.

And that, also the importance of sequencing the review with no open items. We haven't emphasized that in the past, but this is a case where we've had no open items, and that puts the burden both on us, and on

the staff to make sure there's no open items. In the old approach, there were open items, and that kind of allowed for a little bit of slack in the system, but not so in this case.

That required, again, committee flexibility. We had to sort of adjust things on the fly, which we succeeded at, and this idea of having individual members conduct a detailed review, and then have a discussion with the overall Committee, that is not new, we started that with NuScale, but we advanced that with this thing, with this analysis, and that's proven to be very important.

Next. I think that's about it. That sure is about it. So, I will turn over the presentation to Walt Kirchner.

DR. KIRCHNER: Thank you, Ron. Good morning, I'm going to talk to you about our review of the NuScale methodology for establishing EPZs, emergency planning zones, for NuScale SMR plants.

Next slide, please. So, I think this is common knowledge background. Generally, EPZ sizes for nuclear power plants are defined by a plume exposure pathway, and that's roughly ten miles in radius, and an ingestion pathway area of about 50 miles in radius.

The basis for this was developed back in the 70s in a NUREG report 0396, and its primary objective was to provide guidance for citing, and development of emergency plans at then existing plants, and future plants, such as to produce dose savings for a spectrum of accidents that might result in exposure in excess of the protective action guidelines.

Next slide, please. So, there's an appendix to NUREG-0396

that outlines basically the rationale that was used to come up with this generic ten-mile radius, and that was a -- I'll choose my words carefully here. Again, we're talking about a generic ten-mile radius, and basically they recognized the need for establishing defense-in-depth, because that's when emergency planning is your last line of defense.

And in doing this they looked at a spectrum of accidents for the operating fleet at the time, and then they made use of the analysis in WASH-1400, which was just completed a couple of years earlier to look at severe accident sequences as well.

Next slide, please. So, we have existing provisions in the regulations for the plants, and we also have an exception, so to speak that allows for a case by case basis for setting the EPZ for gas cooled reactors.

As well as reactors less than 250 megawatts thermal, what we're calling SMRs in current parlance. Since that time, '78, when this was done, there have been really significant advances both in the knowledge base, the code methods that we use, and of course, unfortunately post Fukushima, the actions that came out of that, as well as the SOARCA study, that's the State of New York Reactor Consequences Analysis.

And so this concept, the concept that I'm going to talk about now in more detail of looking at sizing an EPZ based on consequences of dose, and then correlating a distance with the dose, such as to meet the protective action guidelines, was explored by your staff, and that was documented in SECY-11-0152. The industry picked up on that, and NEI developed a white paper in the following year that also examined this.

And some of the things that were recommended in the industry white paper are interesting here. That you would use the plant specific PRA to inform the analysis, and that you would also supplement this with an operationally functioned mitigation capability, which most of the plants post-9/11 have installed.

Next slide, please. I'll go more now to the NuScale methodology. Again, it follows the same basic approach that was used in 0396. It requires a full-scope PRA that meets the current standards, and looks at both internal and external events, and all modes of operation. So, all modes, in my parlance, is a euphemism for spent fuel pools and other aspects of plant safety.

They take advantage of RELAP and MELCOR tools to develop their source term, and then they use the MELCOR MACCS code for the actual consequence analysis. So, the MACCS code basically does the atmospheric dispersion, estimates the doses, and you can go through a number of sequences with that, and develop a family of dose exposure curves. The approach is very similar to what we reviewed for the Clinch River Early Site Permit. And it meets the intent of SECY-20-0045, and the draft rule for SMRs.

Next slide, please. Okay, so the criteria that are used, you do these analyses, and the criteria that is used to actually set that distance for the plume exposure pathway is based on three checks, if you will, and these are all conservatively implemented by NuScale. You first look at your design basis source term, and do your analysis, do that release.

And then look at what that distance is to an exposure of essentially one rem total equivalent dose exposure. Then you subsequently

look at less severe accidents. So, usually what we're talking about is for LWR system, the containment is intact, and you look at a sequence of accidents there. Again, using this PAG criterion of one rem, and you'll come up with a set of distance versus dose results as well.

And then for the more severe accidents, now, at least for LWR technologies, we're looking at containment bypass or failure, you then look at an acute body dose of 200 rem. And when you complete these analyses, effectively, it's that last criterion that sets the plume exposure pathway, and hence the EPZ size analysis.

So, in the case of NuScale, they also looked at multi-module effects, where you're concerned about common cause initiating events for the modules, as well as where the systems are connected.

So, that analysis was also done to take into account the multi-module aspects of the NuScale design. The staff did an excellent job in reviewing this, a very thorough job, and there were several conditions put on the application of the NuScale TR methodology. NuScale used a proprietary screening threshold for seismic events. Now, for this design, it's likely that a seismic initiator is going to be the dominant contributor to the risk profile.

So, the staff, when they completed their review, they put several conditions, limitations on the use of the TR. The first was they limit the screening threshold to sites where ground motion response spectrum is bounded by NuScale certified seismic design response spectrum, this just makes good sense by the way. And then secondly, they limit the seismic event screening threshold to the NuScale's high confidence of the low probability of

failure for plant level fragilities, so called HCLPF.

And when this TR is used at an actual site, then they will require that the COL applicant do a confirmation that the ground motion response spectrum, and HCLPF plant level fragility limits for that site are confirmed for the as built plant.

Next slide, please. So, in summary, this NuScale methodology is certainly technically sound, and I would add, conservative in its approach, and its application.

The staff's evaluation as I mentioned previously, was quite good, and they explored things like cliff edge effects, which is something one is concerned about when you're looking at seismic analysis of power plants. And we felt that the staff should preserve the insights gained from this exercise, and use that in other applications, where again, the seismic aspect of the accident spectrum may be the dominant contributor to risk.

We look forward, and plan to review an initial application of the TR for an actual site, and I'll just summarize by saying that prudent emergency planning, and preparedness will still require the staff looking at each applicant on a case by case basis. And especially when we get to advanced reactors, we're going to have different technologies, you're going to have different hazards.

So, it's not like this is just turn the crank, here's a number, you've got an EPZ. There are a lot of considerations that go into that kind of analysis, and what comes with that too is that you're looking for on site, and off site emergency plans that can deal with the hazards that the technology

presents.

And I will note, just one footnote to this summary is that going back to the NEI white paper from 2013, they recommended to address uncertainties, and the potential lack of completeness in the PRA, especially for a new design, where we don't have the operating experience that we have with the current fleet, that the emergency planning provide for expansion of the existing emergency response plans beyond the EPZ boundary.

And that's just, in my mind, I think a prudent extension of this methodology. And with that, I'll turn to my colleague Dave Petti.

DR. PETTI: Thank you, Walt. So, I'll first start by talking about Part 53. In terms of background, as you well know, there are two frameworks. Framework A builds on the industry DOE sponsored licensing modernization project. Framework B resulted from industry comments for the need for a more traditional deterministic approach to align with other international approach like the IAEA's approach.

An important consideration that I'm sure we'll get to when we get to Q&A, at least in my mind, is that any approach needed to demonstrate an equivalent level of safety with what we have today, Part 50 and 52. I will go through, there's two letters we wrote on this since we last met. The scope is, of course as you know, incredibly vast. I'm going to focus largely on the last letter, and the staff responses.

And how they responded, it's in blue text to help. I will not talk about the reg guides that we reviewed with the final package in December, just given the limited time that we have today.

Next slide, please. So, in terms of findings, and recommendations, we thought that the rule package, and the associated guidance were adequate to solicit public comments.

We found framework A to be a valuable, logical framework. It's a flexible, technology inclusive, performance based regulatory pathway for both LWS, and non-LWS. It is risk informed, it's consistent with LMP, and in the vernacular, you'll hear PRA in a leading role. Next slide. Framework B we felt was newer, and still evolving, and significant changes could still occur, and they did from our letter last July, I think, and in December.

There were substantive improvements over previous drafts. They took a risk informed performance based approach for siting, and for seismic design criteria, and seismic design, and that's a big cost driver, and doing that in a risk informed way is going to be really helpful for folks that have to design the plants. There are technology inclusive requirements for fire protection in the additional licensing basis events, sometimes called the beyond design basis events.

There is now a lot more common language with framework A on human factors engineering, staffing, operator licensing, and training, so all good improvements we thought. Next slide. With the package that we reviewed, it starts with the December letter, there was the preamble, formally known as the statements consideration. We felt important to talk about it, because it really gives you the rationale behind the frameworks.

Without it, you just can't understand the depth, what's really going on, and why things are the way they are. It provided at least to me, a

much clearer understanding of the depths, and the differences of the two frameworks. There were people talking about how to combine, A, and B are two different philosophies essentially, they're like oil, and water, they really don't mix.

We had that same argument when we first started, well why can't you combine them? It's when you read that preamble that it just jumps out at you about how different they really are fundamentally. It gave valuable context relative to assuring that a technology inclusive, performance based framework that is framework A yields the comparable level of safety to the existing regulatory requirements.

Next slide. So, the preamble spent some time talking about this evaluation of equivalent level of safety for framework A. Framework B is just what we have in a technology neutral mode, but it was different enough that they felt they needed to do this. They noted that it's very similar to the integrated assessment of plant risk using principles of integrated risk informed decision making found in Reg Guide 1.174.

All the requirements in framework A were cross walked against the existing set of requirements to make sure there were no gaps, or holes, and then industry performed tabletop studies on a variety of advanced reactor designs. They did gas, they did sodium, they did heat pipe, and a molten salt one was done, it may not have been part of the official study, but I remember reading a report, they looked at it.

I think the results indicated the approach is flexible, and workable, it didn't set a higher regulatory bar for safety, and it showed a way to

incorporate risk insights into the design, and the regulatory review.

Next slide. In terms of AERI, the alternative evaluation for risk insights, we really liked it. We had made an earlier comment about a graded PRA/risk approach should be considered, typically in light of microreactors, and I think that's really what AERI is about. So, we liked it so much, we said, gee, it would be nice if it could be made available under 50 and 52, like the LMP is available today under 50 and 52, that was sort of the thinking.

We also recommended a tabletop exercise should be performed, that was sort of a recommendation for industry, obviously, and us in tabletops. The language was a little unclear on this term self-reliant mitigation facility, which is really important for how involved the reactor operator is to execute a safety function, or not, and it needed to be somewhat more consistent with the interrelationship with AERI, there was just some wording.

And the staff did improve the definition, and clarified that the entry conditions, and the need for operator action were separate concepts, so that was good. The next slide we made a comment that the rules should explicitly mention that there will always be a human being maintaining oversight of the reactor, providing a last line of defense independent of the design features.

And the staff stated in the reconciliation letter that performance based demonstrations, and prescriptive minimum requirements would serve to ensure that there's always operating staff overseeing facilities. Next slide. We made a comment on the discussion of defense-in-depth. It

should be amplified to address more explicitly what's the role of inherent, and passive characteristics in accident prevention, and mitigation.

There is a difference in the balance between accident prevention, and mitigation with the existing fleet versus non-light water reactors. There's much more in the accident prevention camp. So, how does that evolve in your thinking, and how defense-in-depth is thought about in the entire approaches, because it's a lot, it's through all of our regulatory fabric.

And again, these safety characteristics, these inherent, and passive characteristics may have to be relied upon in combination with engineering, judgement, and data from the robust startup program to really compensate for the lack of operating experience. Staff agreed with this recommendation, and they anticipate some guidance. So, that's good, I think that will really help here.

Next, there was improved discussion of safety functions, they're very explicit in the top down approach of framework A. But in framework B they're implicit through the safety design criteria, and the staff told us they anticipate changing Reg Guide 1.232 to align the design criteria to the relevant safety functions for framework B. So, that logical flow that you see in A will also be available in B, and I think that'll help clarify things.

We commented, I think more than once on trying to streamline the rule. Although it is shorter that Part 50, or 52 individually, it may still be too long relative to expectations of stakeholders, and there is this trade-off between clarity and overall rule length that we've heard about from many. And the staff continues to look for areas to streamline, and they did in

framework B, streamline some things in the last draft that we had seen.

Next slide, additional recommendations here. Manufacturing licenses, there's large changes in the rule language here, a new licensing pathway obviously for some of the microreactor designs, but we felt at this point to make sure to exercise some prudence while more experience is gained. This is something we just don't do on a routine basis.

In terms of the facility safety program, we liked that it was going to improve the efficiency of NRC's licensing, and reactor oversight programs at the individual facility level, and should consider its use in B, as well as A. The integrity assessment program, this is words about looking for degradation of SSCs, building, and life, especially in view of the experience in the light water fleet.

Where water seemed like it was not going to be very difficult, and it's turned out to be a pretty difficult coolant to make sure you don't get stress corrosion cracking, and the like. And now you've got these new coolants, and so we thought that that was a valuable program to add to Part 53, recognizing that there are things like section 11 of the ASME code, I'm sure there'll be good guidance to make sure there's no overlaps, and duplications.

Next, safety classification. We reiterated in our letter, because it was in a previous letter, we're concerned the historical process of classification resulted really in too many systems being classified as important to safety, but later found when you had the PRA, to not have major risk significance. So, our goal was really to try to optimize the safety footprint in the design.

And this would have major benefits for both the licensee, and the regulator, keeping the focus on the risk significant components, particularly with the new technology, where you don't know is that important, is that important, or is this more important than that? You just don't know with the little operating experience, and the staff agreed with the concept, and felt that the classification systems were adequate.

Next is the concept of generally licensed reactor operators. Lots of engagement on this, went through a lot of iterations, but we generally now support the concept where there's a certain adequate level of qualification for different types of facilities, depending on what the role is of the operator. The staff improved the clarity of the definitions, and the tie between that self mitigation facility definition, and the GLRO.

But looking ahead, we felt it's important for both the licensee, and the GLRO to realize the weight of the certification decision. In the current fleet, it is a big deal. There's a little ceremony, and NRC is heavily involved, and it rests on their shoulders because of the role of operators in operating the current fleet.

But the licensees now would own that responsibility, and they have to diligently ensure certification requirements are met. And then the NRC inspections must be thorough, and frequent enough to ensure effective operator qualification programs to let the GLRO know look, they're still here, we're still looking, come two years after you got your certification, this kind of doesn't have the same impact.

So, let me talk a little bit in closing. Industry has provided

comments in our meetings about their concerns in Part 53. Some industries support Part 53, some do not. Achieving full consensus may not be possible. In my opinion, there's a lot about balance here. There's a lot of flexibility that's given in framework A for instance, which is really good, but with flexibility comes responsibility.

And I think you have to balance that, and that's really what the staff has been trying to do, I think. There are valuable pieces of Part 53 being used by non-LWR applicants today. The reg guides that basically endorse LMP, huge step forward, I think every single advanced reactor applicant that Chair Rempe showed in that slide this morning, we asked them explicitly, they are using LMP.

Which in a sense means they're using the heart of framework A. In addition, we think the two new draft reg guides, which I didn't talk about here, the one on how you identify accidents, which is in response to use talking about the need for having some good guidance, and the AERI approach could also be extremely valuable, and to make sure that we don't forget about those reg guides, that's important.

Now let me turn to Kairos, and the construction application permit for Hermes. Next slide. Before we get into it, Chair Rempe mentioned it, but this letter, the structure of it reflects our evolving approach for advanced reactor reviews. It builds on NuScale, and SHINE, but it's got a more top down focus. It starts with a little bit of what the reactor is, does, looks like, but then what are the novel features?

What are the key safety functions? What are they, how are

they implemented, how do they work, how do you know they work? What are the principle design criteria, the classification of the components that have to meet those criteria, and how is defense-in-depth implemented in the design? Then into sort of the heart of the safety analysis, the postulated event selection.

Safety analysis, and particularly the safety margin, that's something we're looking for, given these new concepts shouldn't be designed right to the edge, there should be some margin. And then are there any issues in the operational reliability realm, worker safety, and at least at a construction permit stage, is there any technology that has to be developed before you get to the operating license?

So, that's the way the letter was structured, and that is the way we hope to structure all of our letters. They might not have all of these, but it's kind of a punch list for us how to think about the problem going forward.

Next slide is a schematic of the Hermes test reactor. It is a pebble bed reactor using molten salt FLiBe as a coolant. That inner orange-red area is where the pebbles are. They come in through a chute in the top of the reactor, down through the graphite, and enter at the bottom of the core by the fueling chute. There's graphite, there's a reactor vessel. The blue is the decay heat removal system that sits on the outside of the vessel, so in the event of loss of circulation, heat is radially transferred through the pebbles, through the FLiBe, which undergoes natural circulation to the vessel.

And then to the system with water is in at sort of an ultimate heat sink. Next slide. So, what are the novel aspects? This is the first reactor application of functional containment. We've seen it in many DOE fuel cycle

facilities, SHINE actually kind of uses functional containment, but this is the first nuclear reactor application. It's also the first application of what's called Div 5, ASME Section 3 Div 5 developed for high temperature materials.

DOE spent a lot of money on getting these materials approved, and in the code, and it's good to see people actually using it. You couldn't design this reactor without it. The pebbles, and the graphite are buoyant in the FLiBe, so they float, and that provides some really interesting design challenges in the design. The pebble here is different.

It's not a classic German, and now Chinese high temperature gas reactor pebble. It is small, it's about the size of a marble, and the fuel pump TRISO particles are in an annulus in the middle of the pebble. Because in the German pebble, they're everywhere, except there's an outer line that has no particles, sot here's those differences.

There's anti siphon features to limit the loss of coolant inventory in the event of a pipe break. So, basically you can only lose so much FLiBe, and then it just sits in the vessel, so it's always there, if you will. There are what are called fluidic diodes to enable natural circulation when the forced circulation is lost. And then you've got to handle these pebbles.

They come out, they get scanned to see if they're fully burned, and if not, they go back in. So, all of that is new, relative to say light water reactors. Okay, next, in terms of our conclusions, and recommendations, we said that the key attributes of the design are the low thermal power, the use of TRISO fuel, and FLiBe coolant as an effective functional containment, and the passive heat removal capability.

I changed color there, because that means there's another slide coming on that in a little bit more detail. The overall design results, and projected dose consequences with large margins to regulatory citing criteria. And this allows us a unique approach to safety classification components that we'll talk about in a couple slides. Next slide, so what are the safety functions?

Limiting release of radionuclides, they use functional containment. Controlling heat removal, as I mentioned earlier, it's transferred by conduction through the fuel pebbles, natural circulation of the FLiBe, and conduction through the vessel. Fluidic diodes to help natural circulation, and the passive heat removal has four independent trains, three of which can remove heat, and testing is planned to verify that it will work as advertised.

Controlling reactivity, there are two sets of control elements, four elements in the reflector to control the reactivity, and three shutdown elements that go into the pebble bed to shut down the reactor. Only two of three shutdown elements are needed to accomplish reactor shutdown. Testing is planned to confirm their operation, and behind that is a very strong inherent negative temperature coefficient of the fuel coolant, and moderator.

So, some defense-in-depth there. And finally, for any of these safety functions, no AC power, or operator actions are needed to mitigate any design basis event.

Let's turn to functional containment. Two inherent robust barriers: TRISO fuel and FLiBe. This unique combination results in very small source terms. Even with Kairos assuming fuel failure 100 times greater than measured in the DOE TRISO fuel program, projected doses are still 100 times

below the citing criteria. And the doses are not dominated by fission products; they're dominated by tritium generated from the FLiBe and argon-41, which is from activation of the air trapped in the graphite porosity and in the cover gas.

Next slide. So, now let me talk a little bit about this functional containment, and what it can get you, and how it helps you with safety classification. So, the reactor vessel is a safety related item, but the piping in the design is not. Historical practice would say, and defense-in-depth would say you should make that piping safety related. Safety analysis takes no credit for the piping.

The FLiBe does not chemically react with the air, so the piping doesn't prevent a chemical reaction like in sodium reactors. And then there are these large margins, so which way do you go? Do you go with the historical precedent, or do you do something different? And in this case, we felt the safety margin outweighed the historical practice, but this would be done on a design specific basis.

We highlight this here, and put this little box at the bottom of the slide. We think we're going to see other types of departures like this, and the staff SCs sometimes don't really get into some of this rationale, it's just not what they do in the NSCs, but we think it's important for the public to understand that we've gone through, we understand the rationale. Nobody is cutting corners here, and explain that.

And this is one of these things with advanced reactors that you're going to see, we're going to see more of in different cases. Next slide. We said because of the first of a kind nature of the FHR technology, there are

performance uncertainties that can really be best addressed during operation of the reactor itself. The scaled demonstration plant like Hermes will be very valuable to test the technical elements, design features, the safety functions, and the equipment performance of the technology.

The key concern that we raised is how is the beryllium, airborne beryllium, and tritium in the facility going to be managed to stay below the relevant regulatory limits, and protect the safety of the workers. This is not an issue at the CP stage, it's more the OL stage, but we felt it had to be in the letter, because it's the key thing in this technology that we have to keep an eye on.

So, what are some of the performance uncertainties? To control what's called the chemical potential in the salt, this is to make sure you keep corrosion well under control. In presence of neutrons, and in a temperature gradient where you've got the hot outlet coolant, and the cold inlet coolant, this theoretically looks doable, but has not been demonstrated in a system such as this.

FLiBe, if you move off the eutectic composition, the viscosity can change, it can turn from water to molasses, so you've got to control it in a window. Can you control it in an engineering sense? This is something that we'll learn from the operation of Hermes. What are the level of impurities that you're going to see in the salt, and how do they affect fuel performance?

TRISO fuel is particularly susceptible to silicon carbide attack by metallic impurities. The chip industry is worried about this, TRISO people are worried about it, and again, you won't know until you actually operate it. In

addition, one of the issues that we raised was there is uranium that comes in the beryllium fluoride that's part of FLiBe, it comes out of the earth when you mine it.

And so, you're going to fission that uranium, and you'll get a mixed waste. And in the old molten salt reactor experiment, disposition of that salt was extremely difficult, but it had a lot more uranium. And so, we asked the question, well, have you looked at this? And they assured us that they had, and that they have disposition path, which was good, because that would be really important for the technology.

Next slide. As noted in the staff SC, there is confidence that this facility can be constructed in accordance with the relevant regulations, and the design basis that's outlined in the SAR. There are still detailed design analysis, and technology qualifications that will need to be completed prior to the operating license review, and we'll have a list of those in the next slide.

One thing that was not talked about by the staff was combustible gas generation associated with graphite oxidation. This is not hydrogen, this is carbon monoxide, and so we felt that should be included in evaluations going forward. And that we felt that the construction permit should be approved. In terms of what's the punch list of things left to confirm the adequacy of the design of these SSCs.

Fuel pebble behavior, the experiment's planned on the wear of the pebble, graphite dust. FLiBe infiltration into the porosity, of that happens, that could be a bad day. There's a number of tests relative to the high temperature materials, and the graphite qualification surveillance that they plan,

oxidation of graphite. We know a lot about oxidation of different grades, this specific grade hasn't been studied as much.

Validating the computer codes, developing this fluidic diode to make sure that it'll work. Justifying the thermodynamic, and vapor pressure correlations that are used to calculate the source terms, and developing the sensor technology for the chemistry is also very challenging here. Something that will work for as long as the reactor plans to operate.

Kairos is committed to finishing these before completion of construction, and the staff has noted these items in their review. They have something called Appendix A of the SC, it's kind of like their punch list. So, everybody is sort of aligned, and it's good to see that we've got that list. And with that, I will turn it back over to Chair Rempe.

DR. REMPE: Thank you, Dave. This completes our prepared remarks, and we'd now like to welcome questions from the Commission.

CHAIR HANSON: Thank you, Chair Rempe. We're going to begin this morning with Commissioner Crowell.

COMMISSIONER CROWELL: Thank you, Mr. Chair, thank you Dr. Rempe, thank you to all the ACRS members who are presenting today, and are here as well. In my short time at the Commission I've enjoyed our interactions, and getting to know all of you, and the important role that ACRS plays. Actually going forward would like to see you guys more regularly at some more routine meetings we do, rather than just once a year, so maybe we can work on that.

A lot of questions, I'm going to try to pepper all of you with

some of them with my time I have here. But Dr. Rempe, I wanted to start with you, and just I see the ACRS mission, and the value they play is critically important for the NRC, and commercial nuclear as a whole, because it's the belt, and suspenders approach that the NRC, and ACRS play is part of the heart of maintaining, and building public trust.

So, we've just got to make sure we're doing our jobs well, and we're doing them fully coordinated, but independent as well, and efficiently. So, could you talk a little bit more about the process improvements that you guys have self-identified at ACRS that you're hoping to implement going forward, and particularly if there's any of those that maybe apply to NRC staff, that they could adopt as well?

DR. REMPE: Thank you for your comments about ACRS, and your question. I tried to highlight some of the process improvements in my presentation today. The fact that we are working with this new evolving approach, and conducting these design centered reviews, so that we have reduced the number of meetings, and presentations by the staff, and the applicant.

It does require that members are very proactive, and working together with -- again, we have our ACRS staff member with us to preserve the independence, but as well as the NRR staff. And I think it's working well. Today I think I mentioned, I hope I did, that we did complete the Kairos review four months ahead of the agreed upon schedule, and that takes close coordination, as Member Ballinger indicated in the SHINE review, as well as Dave indicated in the Kairos review.

We are trying to look for other process improvements such as the way we conduct the SLR reviews, and then I think this guidance that we've been working on is actually very beneficial, and I think as we move forward, that that's where we're going to get the most bang from our bucks for trying to improve things. Because if you look at the workload coming down the pipe, there's a lot of these design centered applications coming through.

And the more that we can do to agree on the process for what should be done, and get agreement from NRR staff with our, again, ACRS staff present on how we'll conduct this, I think it'll be a more process oriented approach where we hit, as Dave mentioned, the key points of what we expect, and what we're going to be looking for, and everyone understands the ground rules.

And I had mentioned that our guidance development effort includes a Committee engagement plan, and we actually had a meeting with NRR staff present, and discussed where we believe the status is, and the four, or five projects that were discussed during that meeting this week, I think there was agreement on -- we didn't hear any disagreement from NRR staff.

Maybe we'll hear something later, but yeah, this is where we think things are coming in, and what we would expect for the upcoming review. So, I think that's where we should focus in the near term to get the most process improvements. Does that answer your question?

COMMISSIONER CROWELL: It does, and I appreciate that. I will add, if you don't mind, on your behalf, that you're also looking to round out the membership of ACRS, and with the goal of specific expertise so you can

handle an increased work load, and it's something that the NRC needs to be focused on as well, the increasing work load, and having the right matching expertise, so thank you for all of that that you do.

Dr. Kirchner, I think I want to talk about EPZs for a little bit. When you are going to move to review of the NuScale combined operating license, I believe you said that you're going to review that, are you going to consider in the applicant both an ingestion pathway, and a plume exposure pathway?

DR. KIRCHNER: The answer is yes. The focus of the methodology of course was on plume exposure pathway, and that was what we reviewed, and I presented today, but yes, that comes back with the actual COL application, and of course the ingestion pathway is a much more site specific set of considerations depending on obvious things, location, location, location, and such.

But that same -- the existing rules that are in place, I think will cover the proper review of the ingestion pathway considerations.

COMMISSIONER CROWELL: I know in your presentation you mentioned the focus on seismic is a key safety parameter, something we need to account for. Is that based on the technology's susceptibility to seismic activity, or based on the presumed site selection?

DR. KIRCHNER: Well, it will be both. I think the technology is pretty robust at this point, and also with this evolutionary LWR design, I think what we're seeing is that the frequency of events is much lower compared to the existing fleet when you start going through potential event sequences. The

dose, the source term is lower because the units are smaller, and that's almost the linear kind of reduction, and the potential source term.

And the design characteristics, for example, the NuScale design are such that the time to release also is a much slower process, so there are a lot of things that are lining up in favor of doing that kind of analysis, and allowing one to, with conservative assumptions, to pull back that EPZ boundary definition.

COMMISSIONER CROWELL: Thank you, appreciate it. Dr. Petti, talk about Part 53 for a quick second, I appreciated both of your presentations, but I wanted to focus on Part 53. I appreciate the point ACRS made last year about the balance of rule versus guidance, or formal regulation versus guidance in the new Part 53 rule. I mean, I think you guys flagged that in your early letter last year.

And since the Commission's had a chance to receive Part 53, and have a meeting on it, I think all of us are now thinking about what is that right balance between rulemaking, regulation, and associated guidance. ACRS says that it probably should be done for a variety of reasons, including just for general optics, and stakeholder support.

But is there a way ACRS could provide more insight on what areas may be ripe for guidance, or work with staff on that as appropriate? Because I think it'd be helpful if we're going to move in that direction, to have an informed, and substantiated reason for why we're putting some things in guidance, and others not putting them in guidance.

DR. PETTI: Sure, I think there's a way that we could do that.

We have seen an initial list of all the regulatory guides, and they're quite extensive. What we haven't done is gone through them with the staff, and from a risk perspective, say these look important, these don't. That's something that we could definitely think about going forward.

COMMISSIONER CROWELL: I think it'd have a lot of validation, particularly for the public, and stakeholders that we're thoughtfully thinking about what should be in guidance, versus what maybe is not appropriate. And not streamlining the rule for the sake of streamlining, but doing it in an informed way.

DR. PETTI: To me the issue that I struggle with is sure, it's easy to say put it in guidance. But if it's in Part 50 and 52, in the rule, you've created now a difference, and that's a boundary condition, the staff said no, we can't do that. So, many of the issues I think fall in that sort of category, where changing it would open up that difference, and that has all sorts of ramifications, I think.

COMMISSIONER CROWELL: It does, and I'll return my 30 seconds, and let that just hang out there for a while.

CHAIR HANSON: Do we need to take a moment of pause, of reflection on that? I don't know. Thank you, Commissioner Crowell.

Member Ballinger, I wanted to start with you this morning. Both SHINE and Kairos applications rely on NUREG-1537, which is the guidelines for preparing, and reviewing applications for the licensing of non-power reactors, right? Which uses deterministic approaches, such as single failure criterion and maximum hypothetical accident, I think, which you've noted

in your slides, to evaluate SSCs and components. And NUREG-1537 doesn't require use of risk assessments like PRA.

But do you see, potentially, I guess, a potential for broader application of 1537 being applicable to power reactors that employ simpler designs and passive inherent safety features?

DR. BALLINGER: Wow, that's a good question for which I don't have -- I'd have to think about the answer to that. With respect to the SHINE application kind of fell into the sort of grey area between risk-informed, completely PRA-related, and deterministic. But the SHINE -- gosh, I hate to say I'd get back to you on that, but I won't.

CHAIR HANSON: I thank you for your candor.

DR. BALLINGER: I think, yes, in some respects. I think so, especially with the newer advanced reactors, where there's a clear, as Member Petti has outlined, huge margins. I think that's my story, and I'm sticking to it.

DR. REMPE: If I could supplement?

CHAIR HANSON: Yeah, anyone.

DR. REMPE: One of the things that I think members were very pleased with with the SHINE application is they did a qualitative risk assessment, and they had a risk matrix. And when I hear some of the discussion about you don't want to do a PRA, I think people too often focus on a full scale PRA, and this simpler risk matrix is -- again, I can remember Member Bley when he was still on the Committee, people need to think about a simpler design could have a simpler PRA.

And this risk matrix was a great thing to see in the SHINE

application, and I personally was very pleased with it. And I think Member Petti would like to jump in.

DR. PETTI: To me, the big difference in 1537 is the lack of a requirement in the risk area. But I think you could do something, this risk matrix comes from DOE, because they deal with so many different oddball facilities, they've had to do a lot of thinking here that I think you could think about doing that here. I also agree, I even think full PRAs on advanced reactors will be much simpler than on the existing fleet.

This idea that it's a burden, we specifically asked the lead person who developed the non-PRA standard that question to confirm what my gut said. He said absolutely, there's fewer systems, there's fewer interactions between systems. Water reactors are fairly complicated, water, water everywhere sort of thing. Go ahead.

DR. BALLINGER: Recall, remember that in the rest of the world, they use, they call it failure modes and effect analysis. To this metallurgist, that sounds a lot like the initial part of a PRA, which is what they did.

CHAIR HANSON: We have this concept of incorporating risk insights, which is PRA, certainly related, but isn't necessarily the full-blown thing, but is important for reviews. So, thank you, I appreciate that discussion.

DR. PETTI: I sometimes think the risk insights are the most important. Calculating the number is not as important as getting those insights, because they influence design, they influence how the regulator thinks about things, those insights are really important.

DR. BALLINGER: Remember, 1537 was actually, there was a modification to it for this application.

CHAIR HANSON: Okay, yeah, thank you. I had forgotten that, appreciate that, thank you.

Member Kirchner, I wanted to touch on this EPZ, and you said something that really caught my attention. I think it was there are a lot of factors that go into the EPZ sizing, you don't just push a button and the number pops out. And that's really, in my book, kind of the difference between being kind of risk informed, and risk based.

And I wondered if you could just kind of say a little bit more about not solely relying on quantitative results from some kind of PRA, or risk based approach.

DR. KIRCHNER: Well, the advantage that, for example, NuScale has, or any evolutionary LWR would have, would be to draw on the huge operating experience that's out there with the fleet, with the equipment, the components. We talked about failure modes and effect analysis. So, you've got a much stronger base to deal with. But more to your question, as we expect the advance reactors in general consistent with your policy, to -- Dave mentioned this, be more reliant on inherent passive safety features.

So, we expect more margin, we expect that they'll be more -- I used the word for NuScale, robust in terms of their design. I think the challenge comes in in areas like for NuScale, if the seismic initiator is dominating their risk profile, and now we're getting into a space that becomes -- has a lot more uncertainty. The debate between the staff, and the applicant was pretty much

about how do you define the edge.

Where do you define the cut off, and in the end it's really qualified engineering judgment that applies. So, that's an example where you have numbers, and you basically have a fairly high level of confidence that this is conservative, the result. But it takes that added engineering judgement, and that's what I was trying to allude to when I said it will be on a case by case basis. And then the other thing that we have to look at is are there additional hazards.

And the proposed rule also requires you, and I didn't talk about that at all today, but the proposed rule requires you to look at other hazards off site that might impact the execution of your own emergency plan. So, that's an example of additional consideration. So, it's just not enough to turn the numbers, and come up with the -- the other challenge that I didn't mention is that what we're likely to see, and we'll probably see this with NuScale.

Is that the calculated result will be within the exclusionary boundary of the plant. Now, when you come in close, now I'll get a little technical, wake effects, and things like that become important in how you do the dose analysis. So, 0396 was based on classic dispersion, weather patterns, and so on. That works very well when you're looking at ten miles, and you have all the history of the site, and you can factor that in.

Now when you're very close in, you have to look harder at other things. For example, there are advanced methods for looking at close in dispersal, and dose effects that are used to currently analyze the control room

dose. There's a code called ARCON that is often used for this purpose. So, that doesn't directly answer your question, but there are a lot of factors that will go in that go beyond just that calculation of the EPZ radius.

CHAIR HANSON: Thank you, I appreciate that. One last question from me. Member Petti, I wanted to ask, the construction permit application for Kairos doesn't include a request for authorization to possess special nuclear material, and that's going to get addressed in the operating license, obviously. But based on your review of Hermes so far, can you offer any perspectives on the design from a material control, and accountability standpoint?

DR. PETTI: The biggest issue is the storage of the pebbles, I think. But if they're fully burned, they're not going to produce much of a risk from proliferation. There have been many studies looking at TRISO particles. When you go to these high burn ups, they're really not very attractive compared to others. There's an argument over whether they're more proliferant because it's a different fuel form.

I describe it as different compared to a fuel rod. I think if they had anybody that could read things in the literature, if you really want to do it, you could do it, I mean it's not that difficult.

CHAIR HANSON: Thank you very much. Commissioner Baran.

COMMISSIONER BARAN: Thanks. ACRS plays an incredibly important role in our licensing reviews, so thank you for your hard work, and your valuable insights, I appreciate it. With an increasing number of

new reactor applications anticipated in the near term, there's understandably, a lot of stakeholder focus on NRC's ability to review all the applications that come our way, and to do so with efficient, effective, and timely process.

The agency has received a good number of suggestions for how we can improve our processes, and some of those relate to ACRS. For example, the Nuclear Innovation Alliance recently issued a report on ACRS with some recommendations. Joy, I'd be interested in hearing your thoughts on the recommendations.

DR. REMPE: Thank you, Commissioner Baran, for that question. I am aware of the recommendations in that report, as well as several other reports, or letters that have been provided by stakeholders recently that do mention ACRS, and I do appreciate the opportunity to comment on them today. I first want to say that I think I speak for all of the members in saying that we are very receptive to suggestions for improving our processes.

All of us want to be as effective, and efficient as possible. In the case of the NIA, the report that was solely on ACRS, I think that members would agree generally with many of the suggestions, and recommendations in that report. But I'd also note that we have identified many of those recommendations, as well as received input from NRR staff, from applicants, the Commission actually in the last several years.

And we, as I hope I communicated during my presentation today, have taken actions, and made significant progress in reducing the number of duplicative meetings, streamlining our review process, reducing the number of reports, so that we can focus on risk important topics that we provide

the Commission. And again, we are continuing to try, and improve these processes.

I'd briefly like to note that there's some misconceptions in that report, perhaps due to a lack of understanding of our processes, our impact on schedule, and our costs. So, I'd like to put a flag out there to say wait, don't believe everything, because maybe there's some miscommunication there, or some omissions there on the full aspects of what we've done.

And then finally I'd note that I personally have some concerns about three of the recommendations in that report, because I believe that they would adversely affect the schedule for the Commission to complete their milestones, they might not be a wise use of agency resources, and then I have a lot of questions about one recommendation that I believe might adversely affect our ability to support the agency's safety mission.

I'm talking about recommendations to narrow the scope of the ACRS review to novel aspects of applications that affect safety significance. Today I think you've heard several examples where ACRS identified items that were not in the initial application, or the staff SC affecting boron dilution, or combustible gas generation for example. I'd note that these are not novel issues, or new phenomena.

And I would question how, if that scope is narrowed, if we would still be able to identify such issues. But again, I want to emphasize that we do appreciate comments, and suggestions, and we are trying to improve our processes. Does that answer the question sufficiently?

COMMISSIONER BARAN: Yeah, very much so, thank you.

DR. REMPE: Maybe more than you wanted to hear.

COMMISSIONER BARAN: No, that's great, I wanted to get your sense of it. The Part 53 new reactor regulatory framework is obviously a major focus for the Commission right now. We had a great discussion with the NRC staff, and a panel of external stakeholders a few weeks ago. We've also received five letters from the Committee, which I found very helpful.

I'd like to get your perspectives, either as a committee, or as individual experts on some of the tough issues we're all grappling with. There's been quite a bit of discussion about whether QHOs should be a cumulative risk performance standard in the rule. The safety goal policy statement includes qualitative health objectives, and quantitative health objectives.

What do you think about including the qualitative health objectives in the rule, and the quantitative health objectives in guidance, or are there other approaches we should be thinking about in this area?

DR. PETTI: The concern that I have is, I mean quantitative QHOs have been around for a while, I could cite industry documents, the non-PRA standard, I could cite Commission policy statements, other internal documents. You need a cumulative risk metric as a requirement to close the loop to say do you have the same level of safety as Part 50 and 52. Without that, the staff may be required to have to implement some new requirements to assure themselves that they have the same level of safety.

That said, I think there are many risk surrogates that could be developed, because we outline one of ours, that we're concerned that the LWR risk surrogates may not work for some of the advanced technologies. For

instance, the protective action guidelines. If you can meet the protective action guidelines, you should implicitly have met the safety goals.

And the staff, I'm sure, could do the math, and prove that in a way. So, I think there's some ways to prove it numerically. But without it in the rule, and in a quantitative way, I think it is a hole.

COMMISSIONER BARAN: Okay. Any other thoughts on that?

DR. REMPE: I just would note, that we have one member, Member Bier, who has a passion about the safety goals, and again, it's not -- I know the agency spent a lot of resources to come up with the safety goals. But she's convinced the membership that it's worth us having some exploratory activities where we periodically hear from outside experts about the history of the safety goals.

And I believe that her underlying objective to see if there's some insights that we might be able to gain. And I guess if it's acceptable to you, I'd offer her the opportunity if she'd like to add any thoughts on that.

COMMISSIONER BARAN: Please, yeah.

DR. BIER: Yeah, I do think it's worth, as Joy said, relooking at the safety goals now in light of new reactor designs, so we do have a small, kind of informal working group going forward. Former Commissioner Apostolakis is going to speak to us about this in August, August 24th, I believe. And I think it's too soon to say whether we are going to have any concrete recommendations out of that process.

But I think when you look at both smaller reactor sizes,

inherently safe designs, and the fact that the rest of the world has gotten safer also, we're not necessarily competing against coal plants anymore as the alternative energy source. I do think it's worth just taking another look at it, and maybe a year, or two from now I'll have more to say about that concretely. Thank you.

DR. REMPE: And just for clarity I note that the briefing interaction with Former Commissioner Apostolakis will be held as an open subcommittee meeting under the Policy and Procedures Subcommittee. So, the working group discusses it, but we have these presentations, they are posted, and meet all the FACA guidelines.

DR. BIER: Yes, thank you.

COMMISSIONER BARAN: Thanks, very interesting. Let me -- there are so many different questions I could ask, so many different topics to cover. Maybe I'll ask one of the big questions is this idea whether we need two frameworks in the rule, or could have just one that would cover everything. Dave, I got the sense from you, you were pretty skeptical given the philosophical differences between the two frameworks, that it was practical really to pull them together.

I'm interested in any thoughts you, or others have about, I guess both the desirability of having one framework, rather than two, and then the practicality of combining them, or I guess desirability, or practicality of a more guidance approach, someone suggested that, don't try to combine them, put those two frameworks in guidance, and have just higher level performance criteria in the rule. Any thoughts about that?

DR. PETTI: In terms of one, or two, I think of it as you come to the fork in the road, and you have to decide to go left, or right. They both get you to the destination, but they're two separate highways. So, practically I don't know there's a big difference. If you combine them, it's like being on a road, and you've got to get off of this -- if you want to do more risk based, you've got to get off at this exit.

But you stay on, and you get off, and there's like 15 different exits that you're going to have to get on, and off of. So, it's difficult. I think there's a greater chance to mess up, because you'll have to say well, if you're going to do this, if it's this approach, this is what you're doing, if it's not, then it's that approach, so I think practically it's a concern.

This idea of moving the framework stuff into guidance, my view is it's kind of like what the Brits do, because the Brits have a very high level sort of thing. They have a handful of reactors. Our existing regulatory fabric, to put framework A, and B, what are the safety functions, what are the design criteria down in guidance, you've created a huge difference from 50 and 52 in my opinion.

Never mind just the enforceability, it's a different level of safety, because then they can say no, we don't want to do that, we're going to do this. And that will just extend, because that will just open up questions in my mind. I'm not as worried about the two separate rules. Initially, we had many discussions in the Committee about, why don't you combine them?

But if you go back and read the preamble, and understand the foundations beneath it, you really see that they're really different. And although

at first brush they look similar, the rationale for them is different enough that combining them is, as I said, it's like oil, and water. In a sense, it's just you decide which highway you're on to get to the answer.

COMMISSIONER BARAN: Thanks, very helpful.

CHAIR HANSON: Thank you, Commissioner Baran. Commissioner Wright.

COMMISSIONER WRIGHT: Thank you, Chair. And thank you very much for your presentations, there's a lot that's floating around out here, and I don't know that we can assuredly cover it in the two hours that we have, but I want to appreciate what you do, your willingness to serve, and to do this. It's a very difficult job at times, and I thank you for what you do.

Joy, I'm going to start with you, you're the leader, so we're coming to you. You spoke a little bit about the NIA report a second ago, we also had the INL report that was out there too, that was one of the ones you kind of referenced without naming it. And I heard your comments when Commissioner Baran was talking to you.

Can you give me your thoughts, and I understand your position where you're coming from, but if we understand what the industry is saying, and what these trade groups are saying as well, these NGOs, the first of a kinds are coming, right? And the intent is for them to be standardized, the intent, because they're trying to meet national security goals, global security goals, carbon goals, you pick one.

But when you get down to it, they're looking at potentially streamlining this, okay? So it's your first of a kind, maybe up to two, or three, or

four before you get to your Nth of a kind cost, and stuff like that, and if they are truly cookie cutter designs, to simplify it. What are your thoughts on the benefits of reviewing every application in that case, if we're on an Nth of a kind review? Which is I think that's what the intent of what the comments are.

DR. REMPE: Again, I think ACRS doesn't want to waste time on looking at issues we've already looked at. But on the other hand, if it's put in, for example, if the Atomic Energy Act were to change, one might say well, do we really need to do a standard design approval if you've already done a reactor, or you've got a certified design? Well, is it really the same, or did you -- we've had changes where they're significant power upgrades.

Is that really the same? So, I guess that was one thing, you need to be careful how that language is changed.

COMMISSIONER WRIGHT: So, I understand, because we're all stuck, the agency is still stuck in that one off big plant design, they're all different, and I understand that. But in this situation, what we're hearing, and I have no reason to dispute it, because you keep hearing every CEO, every CNO, every designer talking about it, that this is going to be our design.

If you want to do something different, we're not selling it to you. This is how it's going to be. Once we get a design certified by the NRC, that's what we're going to sell, that's what we're going to go to market with. Now, maybe down the road they may change it, and again, I'm all for it, but if we're really talking that way --

DR. REMPE: If we're really talking that way, then you start looking at site hazards, and co-located hazards, and things like that. But I think

that ACRS --

COMMISSIONER WRIGHT: Exactly, which is not really novel, right?

DR. REMPE: The staff would be able to deal with it. But again, I'm thinking of what's coming down, and if changes were made, what if you have a certified design, but you say I haven't built it yet, and I'd like to tweak it, well how big is that tweak?

COMMISSIONER WRIGHT: Well, that's a change --

DR. REMPE: Yeah, again, that's how you change it.

COMMISSIONER WRIGHT: But that's not what we're hearing, okay? And that's what we have to pay attention to, I understand that, right?

DR. REMPE: Yeah, but then again, I'm from Missouri, and I guess I look at what I see written down in front of me in the near term, and so I would be careful, and make sure that the -- how one focuses that scope is done very carefully so that one doesn't miss some things.

COMMISSIONER WRIGHT: I mean I understand, we've heard -- not to pick on him at all, but we've heard Jeff Lash over at TVA talking about hey, I'm coming not with one, but my intent is to come with 12, or 20, and we're going to do them all the same to start with, and once we get some of it done, the fast followers are coming, right? And they're going to be the same way.

So, I understand, so I think we as an agency have to be open to get into more of a production kind of mind set, rather than a one off review on

everything.

DR. KIRCHNER: I think, Commissioner Wright, I think it would be a very expedited review. If indeed they achieve the Nth of a kind, and there weren't substantial, or significant changes in the design, such as a major power upgrade, or something. We are seeing that, I think we mentioned in your presentation, we touched on SLA, subsequent license renewal applications.

The first two, or three that we looked at, we took a lot more time, but our colleague Matt Sunseri, who was former chair, took a much more expeditious, or expedited approach to how we would do those reviews. So, we learn from the application of the GALL reports for SLR, and we know what to look for on the subsequent applications. Because it's not a one to one match for your example.

But it's an example of how I think both the agency has expedited their reviews, and focused on the key aging issues, and we've done the same. So that typically it's one meeting for that particular review. Theoretically, if we get to the Nth of a kind, that would be great for the industry, and for the agency. I think our review would be just perfunctory almost.

COMMISSIONER WRIGHT: Well, quite honestly for the world.

DR. KIRCHNER: But as Joy pointed out, the other big issue would be the siting.

COMMISSIONER WRIGHT: Right, and I understand that.

DR. PETTI: I mean we touched on it earlier, if the engineers are doing their job right, they're engineering out all the internal initiator risk, and

your risk sits with the external, and that's kind of a different setup, right? So, when you go to site selection, that's why the seismic stuff is so important. If you can get a seismic isolator, then you decouple yourself from the site a little bit. Then you don't have significant site adaptations, and things like that.

That's where the answer is going to be, and I don't think we've ever kind of been in that situation, where we've got to worry about -- the external stuff is what's really important. But I agree with Walt, if it's truly Nth of a kind, yeah.

DR. REMPE: I'd also note that when we had this international exchange, we have seen other examples, in France for example, where that type of situation, and there's a class. So, there's international experience for this too.

COMMISSIONER WRIGHT: Yeah, but I do think that the way things are being presented today, it is a paradigm shift because of the global security nature of this. And if we don't get it right here in the U.S., they're not going to be able to sell anything across the pond, because it takes that here. I've heard that more, and more recently, and I believe it's true. So, I'm going to go a little bit further with you in the couple minutes I got.

So, you mentioned earlier that you're continuing to streamline your reviews, right? And I like that, I think it's awesome. Okay. Anything we can do to make things more efficient, I'm all for it, as long as we're hitting that safety strike zone. So, let's talk a little bit about the meetings too. So, I mean you can speak, and I appreciate you speaking on how you're really looking at streamlining your processes.

But how are you addressing outside concerns as well, that technical questions during the meetings can veer past the point of addressing safety significance, and more into the area of technical curiosity. Can you? Are y'all getting a handle on that too?

DR. REMPE: I believe in recent years you'll see that sometimes other members will tell a member hey, we already discussed that. So, we are cognizant of that. I would also though, in fairness to those kind of comments, would note that our process sometimes is a probe to understand if something has been addressed. I think the issue about the combustible gas generation might have surprised some of the applicants when we first brought it up a bit.

And although they said they were starting to develop models for it, there was no indicator that that had been considered in the application. And so, again, it may come as a bit of a surprise, and sometimes we bring it back, and explain why we're interested in that issue, but I think sometimes our questions may be perceived as off target. And if the member can't justify it, then we will move on, and it's not just intellectual curiosity we hope.

COMMISSIONER WRIGHT: Okay, thank you. And I'm going to come back to you real quick with the 30 seconds I've got. So, you mentioned your visit to SHINE last year, and I recognize the value of seeing the facility in person, it always makes an impression, it helps, right? But I'm really interested in hearing a little bit more about how those interactions at the site helped you better inform your decisions, and gave you better insights, can you get a little bit more specific about what you --

DR. BALLINGER: Yeah, that's a very simple answer, yes.

COMMISSIONER WRIGHT: How, in what way?

DR. BALLINGER: When you talk to the people at the site, you get -- you're standing around, and you're getting to ask questions which you would not see, you wouldn't even think of if you're reading a chapter.

COMMISSIONER WRIGHT: Like what? Give me an example.

DR. BALLINGER: Like characteristics of the site, shielding, interaction with the public, the airport that's within walking distance of the thing. And also the design itself, and the safety issues related to design, the hot cell setup, all this kind of stuff. And you get to ask questions, especially they provided what I would call the overall construction manager, as well as the technical person.

And those folks answered every question that you could ask. And so, as a result of that, when it came back to assembling the chapter letters, and putting the overall letter together, that had a big effect on how we constructed the letter. We may say well, going in we should discuss this. We went out there, and we talked to them about this topic, and we now understand it a lot better, and we don't need to put that in the letter. So, I can't emphasize that more.

COMMISSIONER WRIGHT: That's what I was trying to drill down to to get some specifics, so thank you for that, I appreciate it. Thank you, Chair.

CHAIR HANSON: Thank you, Commissioner Wright. And

we'll finish up here today with Commissioner Caputo.

COMMISSIONER CAPUTO: Good morning. I'm glad to be part of this meeting today, but I'd like to start by welcoming Dr. Vicki Bier. Dr. Bier, I'm sorry I'm not there to say hello to you in person, go Badgers. I didn't actually have a class from Dr. Bier, but I remember her well from my time at UW, and I'm thrilled to see you participating on the ACRS. Dr. Petti, thank you for briefing us on the Kairos Hermes test reactor review, and how it built on the lessons from NuScale, and SHINE reviews.

I understand that the committee held ten meetings over the course of three years for a review of seven topical reports for both the non-power, and power reactor applications of Kairos' technology. For the non-power test reactor construction permit, the Committee held four multiple day meetings at the subcommittee level, and one meeting at the full Committee over this three year time span.

Was the Committee able to gain any efficiencies from the extensive pre-application interactions on the topical reports?

DR. PETTI: Yes, thank you, very good question. Absolutely. When everything came together for the full Committee, we had the answers already from the topical report. So, we really like the pre-engagement, and the early topicals. It kind of just aligns everything in your mind, so that when you see the application, you understand yeah, okay, now I remember that there.

So, it's the same thing as the chapters, you can't just review one chapter in absentia of another chapter, they're so interactive. So, that's this whole sequencing thing that really has a lot of efficiency gains, but you've got to

think it all through, and that's a huge lesson learned, and we're going to use it going forward.

COMMISSIONER CAPUTO: Okay. In the future, when the Committee is reviewing a Kairos power reactor application, do you expect the Committee's level of effort to increase, and include additional meetings?

DR. PETTI: Hard to say at this point. Certainly the documentation itself will be larger in volume, and there will be more detail. If it's only at the CP stage, maybe not. That may be more sort of an OL question, because at the CP, you've got a lot more flexibility. So, at the power reactor stage, it may be, particularly if they take all the lessons they learned from Hermes, and apply it, I think the CP could be faster, assuming they're going to go Part 50.

COMMISSIONER CAPUTO: All right, and going forward, do you anticipate the Committee's level of effort to be similar for other advanced reactor technologies we varying degrees of pre-application engagement?

DR. PETTI: Yes, but again, depending on the technology, and what they bring, and the level of detail that they bring. Almost all of them that we've talked to are doing a Part 50 two step. A lot of them are well along on their technology development. From what we can tell, we know what the key topical reports are that are in the system, Joy talked about, that we reviewed with NRR staff.

Looks like the top five that she had on her slide, they have the right topical reports, everyone is kind of following everybody else, and that's good, I think that's going to help streamline things. And I honestly think the way

we think about the letter, and how we probe, and think about it is also going to help that.

COMMISSIONER CAPUTO: So, given the level of effort that you've had on Kairos, and anticipate going on the future, and I understand what Chairman Rempe discussed in terms of cautioning against new, and novel reviews, but isn't it going to be awfully difficult for the ACRS to not only review initial designs, or initial licensing on these technologies, but also to review a consistent work load, hopefully, of these designs going forward?

Which gets back to Commissioner Wright's discussion about shouldn't get this to be fairly routine, and wouldn't it be the wisest use of the Committee's time to be doing new, and novel, or initial reviews of technologies, rather than each, and every subsequent license?

DR. PETTI: Again, depending on if they're truly talking about a standardized design, and they have an SDA, and nothing has varied, then you're left with just evaluating the site differences. That should be possible at Nth of a kind.

COMMISSIONER CAPUTO: Okay. I appreciated the discussion so far on the Part 53 review, and Commissioner Baran's question on quantitative health objectives. I'd also like to make a few observations on it, since the proposed rule is certainly at the forefront of the Commission's focus right now. As Dr. Petti pointed out, the staff's proposed framework A builds on the licensing modernization project that the Commission approved for use as guidance in 2020.

And that guidance, Reg Guide 1.232, is one of the valuable

pieces of Part 53 that's currently being used by applicants under the present Part 50 and 52. There's a lot to like in Part 53 with regard to proposing a framework that the licensing modernization framework project fits more neatly into than it does within a more deterministic framework like 50, or 52.

There's a lot in Part 53 that builds on prior work of the Commission and the staff that is currently found in policy statements and regulatory guidance. But I believe the Committee and the Commission should think long and hard whenever it's considering whether methods that have historically been acceptable in guidance should be codified in regulations.

Codifying those methods may sounds simple, but may create significant complications, not the least of which is how to manage needed modifications that may arise in the future. There will also be lost flexibility, and lost opportunity for developing innovative methods that may differ from that approach. Similarly, codifying policy statements should not be taken lightly.

We can assume that there were very good reasons why prior commissions chose to address these issues as policy statements at the time. Codification of safety goals is a prime example of this. In February, the ACRS Subcommittee on Regulatory Policies and Practices was briefed on the quantitative safety goals. The briefing noted that they were not considered to be absolute or viewed in isolation, and that there may be excellent reasons to allow operation above a goal.

That thought has been a consistent Commission policy since adoption of the safety goals. The practical ramification of codifying the safety goals would be to set a more stringent standard for advanced reactors than we

have for the currently operating fleet, contrary to the repeated Commission direction in both SRM-10-0121, and again more recently in SRM-19-0117.

As I understand it, the ACRS reviewed, and made recommendations to the Commission at the time that were consistent with what was issued, particularly with regard to the QHOs not being intended to be absolute requirements enshrined in regulation. Our reliability principle of good regulation states once established, regulations should be perceived to be reliable, and not unjustifiably in a state of transition.

So, reflecting on the response to Commissioner Baran's question, what is a compelling justification for the Committee to depart from this longstanding agency opposition as opposed to using, or directing effort toward other surrogates? Dr. Petti?

DR. PETTI: So, as I understood it, surrogates were allowed in the guidance that's there, that they can be innovative, and come up with different ones. We had raised, in one of our letters, concern about the applicability of the existing surrogates because they don't fit well. But this may be a case where there's differing guidance in the agency.

Because there's numerous reg guides and SECYs that talk about the qualitative health objectives being used; it's in NEI 18-04, it's in the non-PRA standard, and the like. And that may be reflected, there may be a time component here, right? When it was initially developed, now you look back on it and reflect on where you are today, and how helpful it's been with the current fleet, and then try to project to the future.

COMMISSIONER CAPUTO: But the examples that you

mentioned, aren't those enshrined in guidance, not rulemaking text?

DR. PETTI: Yes, they're in guidance, in the SECY, which is policy, I'm not --

COMMISSIONER CAPUTO: Right. So, the justification for putting them into rule text is a lack of identifying something else.

DR. PETTI: No, I think one of the other issues, which we haven't touched about is, I think a public perception issue. That it could be seen as the NRC moving away from those goals which are important.

COMMISSIONER CAPUTO: Well, if they are currently in guidance, and would stay in guidance, that doesn't sound like much of a justification for shifting them into rule text, they're not going away.

DR. PETTI: Well, but you wouldn't have to, if they're in guidance, you wouldn't have to meet them. And I would -- I don't know why we'd want an advanced reactor that was less safe than the existing fleet in terms of where they sit relative to the QHOs.

COMMISSIONER CAPUTO: But the implementation of the QHOs in rule text for advanced reactors sets a far more stringent safety level, and that's --

DR. PETTI: I disagree. I think these advanced reactors, if they're designed well, will have ample margin to the goals. None of them that we have seen I think will be so close. There should be significant margin when the numbers are done.

DR. REMPE: And the tabletops reflect that.

DR. PETTI: And the tabletops I think reflect that.

COMMISSIONER CAPUTO: So, is that really a justification for shifting away from a longstanding agency position, though?

DR. PETTI: The argument for putting it in the rule has more to do with having a metric to assure an equivalent level of safety to what's there in 50 and 52. That, without it, there's a hole, and the staff might feel compelled to put in additional requirements that could be -- well, that, A, could be more difficult to make a technology neutral as such.

COMMISSIONER CAPUTO: But, part of the discussion earlier, wouldn't it be simpler to use something like the PAGs rather than the QHOs? Because as I mentioned in my remarks, there are ample justifications for operating beyond the QHOs.

DR. PETTI: I think the staff wanted to give flexibility to developers. Because the PAGs are a more restrictive set of requirements, it's basically one to five REM at your site EPZ, which is usually the site boundary, that's much more restrictive than the QHOs, but if they meet them, then it gives you some assurance you can meet the QHOs.

COMMISSIONER CAPUTO: Well, I definitely don't think I agree with you on whether the QHOs are less restrictive, or more restrictive. I believe them to be far more restrictive. I also believe them to be incredibly complicated when it comes to compliance space, and having to meet those on a day by day basis, and the nature of how to prove that.

DR. PETTI: I would say that the current fleet meets the QHOs with good margin, but cannot meet the EPA PAGs at their site boundary, which is why they have emergency planning. So, the advanced reactors should

be able to meet the PAGs, then implicitly meet the QHOs.

COMMISSIONER CAPUTO: So, then what purpose do the QHOs serve if they need to meet the PAGs? If they can meet the PAGs, and don't need anything more restrictive?

DR. PETTI: It's flexibility. Somebody may decide they don't want to meet the PAGs at their site boundary for some reason.

COMMISSIONER CAPUTO: All right, well I think you, and I certainly will have to agree to disagree on whether meeting the QHOs is actually possible, and attractive. One last question, Dr. Ballinger, you discussed the Committee's visit to the SHINE facility under construction in Wisconsin, and the Committee's consideration of the staff, training, caliber, and commitment.

That sounds more appropriate to an oversight role fulfilled by NRC staff in licensing, and operation space. Isn't that kind of pushing the boundaries of the Committee's role?

DR. BALLINGER: No. I think that we were in the process of reviewing the application, and so anything that we can do to advance, and help that review, I think is perfectly appropriate. Now, it turned out that that visit was very instructive, and very useful in our review. I think it actually made it easier to do the review.

And so, I think that that visit, and such visits that achieve that goal are the right thing to do. There may be cases where a visit to a plant, or some site just simply doesn't add value to the review process, but in this case, I personally believe, and I think that our other members would agree that the visit

did add very significant value, and probably shortened the review process.

COMMISSIONER CAPUTO: Well, I don't doubt that the visit was very helpful. It's just the observation about evaluating staff during the visit gave me pause.

DR. REMPE: If I could help? I would like to --

DR. BALLINGER: Are you talking about the staff that was with us?

COMMISSIONER CAPUTO: No, you had a bullet that there were -- that during the visit the Committee evaluated the licensee's staff, and made observations about their training, caliber, and commitment.

DR. BALLINGER: I'm not sure we were doing evaluations of the facility staff. I would say that getting to know them, and their demonstrated degree of knowledge of their plant, and their construction was very helpful. But we weren't evaluating the staff. We were just -- I'm just acknowledging the fact that they were very competent, and we observed that.

DR. REMPE: If I could supplement Member Ballinger's response, one of the items I started to bring up when Commissioner Wright queried him about the visit was we actually saw a mock up where the staff was -- the SHINE staff would be training on how they would conduct some of their actions, and as you may recall in the letter, we did mention how the human actions, we had some questions about the repetitiveness, and that was very helpful at least for me to see during that visit.

COMMISSIONER CAPUTO: Okay, thank you, I don't have any other questions. Thank you, Chairman.

CHAIR HANSON: Thank you, Commissioner Caputo. We have reached the end of our time together, thank you all very, very much. Thanks to my colleagues for your insightful comments, and questions, and thanks to the members of the ACRS, and thank you for your service to the agency, and to the country, we really appreciate it very much, and thank you for the good discussion today. With that, we're adjourned.

(Whereupon, the above-entitled matter went off the record at 11:53 a.m.)