UNITED STATES

NUCLEAR REGULATORY COMMISSION

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MEETING WITH THE ADVISORY COMMITTEE ON

REACTOR SAFEGUARDS

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FRIDAY,

OCTOBER 8, 2021

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The Commission met via Videoconference, at 10:00 a.m. EDT, Christopher Hanson, Chairman, presiding.

COMMISSION MEMBERS:

CHRISTOPHER T. HANSON, Chairman

JEFF BARAN, Commissioner

DAVID A. WRIGHT, Commissioner

ALSO PRESENT:

ANNETTE VIETTI-COOK, Secretary of the Commission

MARIAN ZOBLER, General Counsel

ACRS MEMBERS PRESENT:

VICKI BIER, Member, Advisory Committee on Reactor Safeguards (ACRS)

DENNIS C. BLEY, Member, ACRS

CHARLES H. BROWN, Jr., Member, ACRS

GREGORY H. HALNON, Member, ACRS

DAVID A. PETTI, Member, ACRS

JOY L. REMPE, Vice Chairman, ACRS

MATTHEW W. SUNSERI, Chairman, ACRS

PROCEEDINGS

10:02 a.m.

CHAIRMAN HANSON: Okay, great. All right, good morning everyone. I convene the commission's public meeting with our Advisory Committee on Reactor Safeguards, or ACRS. This is a periodic meeting to hear from ACRS on several important topics recently reviewed by the committee. Before we begin today, I'd like to welcome two members of the ACRS, Dr. Vicki Bier, and Mr. Gregory Halnon, who were appointed as new members effective April 2021.

Dr. Bier joins us after a distinguished career in academia, and as a professor emerita at the University of Wisconsin-Madison. Her areas of specialization include risk analysis, decision analysis, and operations research. She has more than 40 years experience in risk analysis for nuclear power, chemical, petrochemical, and the aerospace industries, as well as Homeland Security, and critical infrastructure protection.

She's served on various advisory committees for the EPA, and the National Research Council. Mr. Gregory Halnon comes to us with more than 40 years experience in the nuclear, and utilities industries, most recently as the Chief Nuclear Officer of Three Mile Island Unit 2. Mr. Halnon has experience in all aspects of nuclear plant operations, as well as quality standards, security, maintenance, and engineering processes.

Welcome to both of you, and I look forward to working with you on the committee. Mr. Halnon, it's nice to see you again, I think we met several years ago when I had the opportunity to tour Three Mile Island. So, welcome aboard to both you, and to Dr. Bier. I'd also like to take a few

minutes just to recognize one member who has recently left the committee, and one member who will soon depart. Dr. Peter Riccardella retired in August of 2021 after serving two terms, including one year as chairman of the ACRS.

Since joining the agency in 2013, Dr. Riccardella made significant contributions to the committee in areas of structural, and seismic analysis. Among other important work, Dr. Riccardella led the ACRS's review of the agency's first design certification renewal, the ABWR. Dr. Dennis Bley, who is with us virtually today, will depart the committee in December 2021. He's served as a member since 2007, and has chaired the ACRS.

Dr. Bley has been a significant contributor to the work of the ACRS for many years and has led the committee on important issues involved in probabilistic risk assessment, Fukushima lessons learned, external hazards, and recently, the work on preparing for licensing advanced reactors such as 10 CFR part 53. Dr. Riccardella, and Dr. Bley, thank you for your service. The independent role of the ACRS is critical to fulfilling the mission of our agency, and you've helped lead us through many novel and challenging reviews. I am grateful for your unwavering commitment to the protection of public health and safety over the years, and I wish you both well in the future.

With that, we'll get started. I'd like to notice we're hybrid, Commissioner Baran, and I are here in our headquarters are here in One White Flint in Rockville, Maryland, and I believe Commissioner Wright is with us from his home in South Carolina.

And, of course, our ACRS members are hither, and yon as

they will be in their home offices, or other environs. So, leading the way as we probe further into the recesses of pandemic life with a hybrid meeting this morning. And I'll just note, I'll give my colleagues at this point then, an opportunity to make any remarks they'd like to make. Commissioner Baran?

COMMISSIONER BARAN: Thanks, Chairman. Welcome to our new members, and I just want to take a moment to echo what you said about Dennis. Dennis, you are really going to be missed. It's hard for me, it's been seven years that I've been on the commission, you've been on ACRS for that time, and longer, and just such an integral part of ACRS, you are really going to be missed. Your contributions to ACRS have really just been huge, and we have all benefitted from that, so thank you.

CHAIRMAN HANSON: Thank you Commissioner Baran. Commissioner Wright?

COMMISSIONER WRIGHT: Good morning, I really don't have much to add, except I do want to echo what Commissioner Baran said, welcoming the members, and also to welcome Mr. Bley. There's been a lot that I have learned in a very short time from this committee, and they're very, very important. So, we're going to miss the ones that are moving, and we really are welcoming, and look forward to working with the ones in the future, the new ones.

CHAIRMAN HANSON: Excellent, thank you Commissioner Wright. So, with that we'll begin with Dr. Rempe, who is vice chair of the ACRS. Dr. Rempe, the floor is yours. I think you're on mute Dr. Rempe. Well, not quite.

DR. REMPE: How about this, is this better?

CHAIRMAN HANSON: There we go, perfect, love it.

DR. REMPE: Thank you. Good morning, as you acknowledged, I am Joy Rempe, and I do serve as vice chair of the Advisory Committee on Reactor Safeguards. We do appreciate the opportunity to greet you today, and we appreciate the kind remarks that you've made in your opening statements today. Slide 2 shows the agenda for this briefing. First, I will provide a general overview of the activities that we've completed since our last briefing to you in December 2020.

Then Member Petti will summarize the ACRS advanced reactor activity, focusing on our review of staff's 10 CFR part 53 non-light water reactor rulemaking activities, and development of associated guidance. Member Brown will next discuss our most recent letter regarding unidirectional communication. And last, our chair, Matthew Sunseri will discuss our review topical report submitted by NuScale on the Control Room Staffing Plan.

Since our last briefing, we have produced 14 letter reports. As indicated on slide 3 -- hopefully slide 3 will come up soon -- several of these reports pertain to agency activity regarding non-LWR, and small modular LWR submittals. As mentioned previously, briefings by David Petti and Matt Sunseri will focus on two of these reports. As indicated on slide 4, we continue to review, and offer advance that -- excuse me -- offer advice for digital instrumentation and control and, mentioned earlier, Charles Brown will be discussing one of these reports today. As also indicated on slide 4, we have provided letter reports on several other topics, and today I'd like to highlight two of these reports. First, we completed our final review of the

multiyear effort by the Office of Regulatory Research to develop the Integrated Human Events Analysis System, or IDHEAS general methodology for assessing human reliability at nuclear power plants, as well as several applications for the IDHEAS methodology.

Issuance of this letter report also completes our response to a 2006 commission staff requirements memorandum directing ACRS to work with the staff, and external stakeholders on this topic. Second, we provided a report regarding the Office of Reactor Regulations review of the seven nuclear company submittals to address generic safety issue 191 at Vogtle Units 1 and 2.

This is the second application involving the use of risk information to resolve a generic safety issue associated with debris accumulation effects on long term core cooling, a topic that ACRS has followed for many years. Slide 5 highlights other ongoing ACRS activities that may be of interest. First, we do continue to follow agency transformation activities and initiatives. Since we last met with you, we were briefed by the staff on their EMBARK and Be riskSMART efforts.

We stayed abreast of staff efforts to prepare for advanced LWRs, as well as non-LWR submittals. In addition to briefing, our own ACRS staff keeps us informed by providing reports on relevant agency activities, such as meetings with stakeholders regarding advanced reactor licensing efforts. Second, we continue to implement improved processes for completing our own safety-focused reviews with increased operational efficiency.

Our Chair, Matthew Sunseri successfully led an effort for us to update our bylaws, carving out a new approach that we've adopted

over the last few years. Many of these improvements take advantage of the flexibility offered by the virtual meeting technologies that the agency acquired during the pandemic. As we observed staff efforts to focus on risk important activities, we've also tried to improve the effectiveness of our own activities, focusing on reviews that had the most safety impact.

Members debate whether optional letters will actually benefit the agency before we embark on the letter writing effort. We also are continuing efforts to respond to the RES request that in lieu of our quality reviews, we provide informal comments during information briefings on topics of special interest, such as the staff approach to address the loss of the Halden radiation testing capability, and the RES progress of Future Focused Research projects that are designed to close technical gaps and prepare the agency for new technologies.

Finally, as you indicated at the beginning of this meeting, there have been committee membership changes with several members departing, and two new members joining us. Today, I'd also like to note that we're pleased that you've approved our request for a new member, and inform you that the solicitation for this new member has now been posted in the Federal Register. This completes my overview, and I'd now like to call on member Petti to provide his report on advanced reactor activity. Dave?

DR. PETTI: Thank you Vice Chair Rempe. Today I'd like to talk to you about advanced reactor activities, the advice we're providing in part 53, fuel qualification and source term. Next slide please. So, first it's important to note that the advanced reactor technologies under consideration, and the sizes in which they're being developed really vary. Many of the technologies derive from the Generation IV initiative that started

around 2000.

We have things like sodium fast reactors, high temperature gas-cooled reactors, those are two at the top that I show. These also happen to be the two that DOE has provided funding for in the advanced reactor demonstration project. But there's also gas cooled fast reactors, lead cooled fast reactors, molten salt reactors, fluoride high temperature reactors, and even heat pipe reactors, as shown in the lower right, that's Westinghouse eVinci microreactor.

We also are being asked to look at fusion, and that ranges from fusion experience, so called next steps, to try to evaluate burning plasma physics up to fusion power plants where one has breeding blankets to close their fuel cycle, and the hazards are very different. They come in a range of sizes, microreactors tend to be less than ten megawatts thermal, but then many of these designs are larger modules with multiple reactors on a single site, up to probably around 600 megawatts thermal.

Next slide. The characteristics of these advanced reactors are very different than light water reactors. First, their hazards vary with power level and radionuclide inventory. Microreactors in the fusion experiments are similar in many ways from a hazard perspective to medical isotope facilities, test reactors, and even TRIGA reactors. Whereas the advanced reactors that are larger, and LWR SMRs tend to be more similar to the current fleet when one looks at it from a hazard.

But in all of these, we would expect reduced source terms with these technologies. This would affect siting, emergency planning with smaller EPZs and LPZs than the current fleet. They also have a high degree of passive safety, whether that be passive heat removal, they have

inherent characteristics that result in highly retentive fission product barriers, such as molten salt, and TRISO fuel, for example, that are very retentive of fission products.

They have strong negative reactivity feedback, cores with solid moderators, neutron leakage, and small sodium reactors, these are characteristics that really define a lot about the technology. And most of them, if designed properly, don't need AC power to operate safety systems. If we look at the reactor technology through a defense-in-depth lens, we find that there's much more emphasis on prevention, and much less on mitigation.

It's different than the current fleet, and the role of the operator is different. And you'll hear a little bit about that when Matt Sunseri talks about NuScale in the control room staffing, you'll see that illustrated. Next slide please. Let me talk a little bit about part 53. It's a very high level, top down approach, and it's flexible to be technology inclusive, and to cover the range of power levels, and hazards that I talked about earlier over the entire life cycle.

Starts with a safety objective, protecting the public. Discusses the safety criteria, these are the numerical values that are in the law today, for instance the 25 REM siting criteria, and then identifies what's the principle safety function that must be executed successfully to meet those criteria that's limiting the release of the radioactive material. And then there are supporting safety functions that must be accomplished to ensure that the principal safety function is met.

Those are things like removing the decay heat, controlling nuclear reactivity, controlling chemical energy. From that, then there are a

number of design criteria that are established that reactor designers must meet. A handful of them are technology independent, and those are in part 53 today, things like defense-in-depth, ALARA, QA, and the need for codes, and standards. But then there's a number of technology-specific design criteria that are required by the applicant to propose to the agency, and to be reviewed by the staff to be found acceptable.

For instance, there was a large effort by DOE and NRC to develop advanced reactor design criteria, and that's an example of those. This is still a work in progress. We meet with the NRC staff monthly on part 53, and many detailed comments from us. We think the approach is logical, and coherent, and we do support the approach being taken by the staff. Next slide please. One of the major comments that we have had to do with flexibility versus regulatory certainty.

With a rule this broad to cover this range of hazards, flexibility is really important. That's what the staff is hearing from stakeholders. The more specificity one puts into the rule, the more certainty there is, but the less flexibility, and so this is an inherent trade-off in part 53. As we've discussed with them some of the rationale behind the rule, we've asked them to try to embed more of it into the rule itself to help with clarity. We've asked for a better definition of the risk-based approach to the reliability of structural safeties, and components that replace the single failure criterion.

We've suggested that advanced reactor surrogate metrics are needed for the qualitative health objectives, not the ones that are used for the existing fleet core damage frequency, and large early release frequency, because those are not necessarily applicable in terms of the way

accidents evolve in some of these advanced technologies. And we've had many recommendations regarding clarity in the wording related to the safety analysis requirements, and those have all been accepted by the staff. Next slide please.

We've continued to stress in multiple letters, the need for systematic searches for hazards, initiating events, and accident scenarios. When one has a new technology, some sort of a systematic approach is necessary to compensate for, in many cases, the lack of operating experience with these technologies to make sure that biases are minimized, and there are a number of techniques available from other industries that can be applied.

We've recommended a licensing pathway like prototype testing remain to be available to applicants, particularly those that have very little operating experience. We noted that the schedule to issue all the needed detailed guidance looked very ambitious to us. Getting the rule out is a challenge, and then all the detailed guidance, which is where the rubber meets the road in a lot of ways, will be a challenge for the staff.

That said, we all felt that the staff's ability to graciously accept comments from all sources, and to seek resolution of competing requests is really quite commendable. They are getting comments on all ends of the spectrum, and their ability to balance that is remarkable to us. So, we felt to note it in the letter. Let me turn now to a couple of other activities that are underway. The first is fuel qualification, on the next slide, yes, thank you.

The fuel qualification for advanced reactors is an issue that stakeholders have talked about over and over again. And the staff has

developed a NUREG to outline the requirements that they see for fuel qualification. There's an assessment framework, and it focuses on the need for data, which we strongly support. And it includes requirements, for instance in fabrication, radiation performance, accident performance, source term, code V&V, quality, the need for data, all the important things that we tend to want to see in fuel qualification.

Also notable is that they plan to apply this framework using a high technology readiness and a low technology readiness fuel. A high technology readiness fuel would be the metallic fuel for starting fast reactors shown here in the upper right. A low technology readiness fuel is a carbide fuel with certain carbide cladding for a gas cooled fast reactor being proposed by General Atomics. We've also reviewed a topical report on fuel performance from KAIROS based on TRISO fuel.

And last year we reviewed a baseline particle performance topical report on TRISO fuel. There's also been a report on older legacy metallic fuel data from the old EBR II days that serve as a foundation for that fuel system. And actually this week in subcommittee, we reviewed the -- where the fuel is dissolved in the salt. So, lots of activity here, all coming together quite nicely, and actually critical in terms of supporting part 53.

Next slide please. We talked a little bit about source term. As you know, it's at the heart of many regulatory activities. It's a key onus basically, as one qualifies the fuel, the fuel is where the source term begins, so it tends to be owned by the fuel developers. It's important in the traditional safety analysis, but also in PRA. It affects public and worker safety, siting, emergency planning, and overall licensing.

But we note that the source term for the advanced reactors

differs from light water reactors. There's different source strengths because of the different power levels, and the isotopes; tritium for instance, is a major concern in lithium based molten salt, and in fusion, and that tends to be less of an issue in the current fleet. There's differences in what I call the degree of releasability. There's inherent retention in coolants like molten salt, in sodium, and in fuel forms like TRISO fuel.

The volatility, the timing, and the accident response, which is all part of the definition of source term is very different in these systems because of their different physical characteristics. We are basically seeing and will be seeing numerous upcoming source term related activities over the next three to four months. And so, as we were talking, ACRS felt that it was important to have a road map showing how all these pieces fit together.

We actually had a phone call with NRR, and they were on the exact same page, and recommended that they come to us, and show us how all the pieces fit together, and we take that horizontal view, which is so important I think for the ACRS. We see each of the topics separately, but this is one that integrates across the entire spectrum, and so we're very looking forward to that. And you'll see a letter on that some time next year.

Next slide please. So, in summary, I'll just say that the regulatory activities related to advanced reactors really are in full gear. Part 53 is a major undertaking by the staff; we find the approach coherent, and logical. The schedule to issue the detailed guidance that will be needed looks very ambitious, and the fuel qualification, and source term activities, which are really key underpinnings of the regulatory process are also underway. With that, let me turn it over to Member Brown to talk about the digital I&C work. Thank you.

MR. BROWN: Thank you Dave. I will be addressing our March 30th, 2021, letter to the commission on unidirectional digital communications, and digital instrumentation and control, and monitoring systems. Next slide. Background, our letter report of November 23rd, 2020, on Branch Technical Position 7-19, Revision 8. Guidance for evaluation of defense-in-depth, and diversity to address common cause failure due to latent defects in digital safety systems noted that the November 2019 version emphasized that interconnections between high safety significance, and lower safety significance systems should be through one way digital communication devices, rather than bidirectional devices that reduce independence, and defense-in-depth, and compromise control of access. Thus, the external plant access and compromised software in lower safety significance systems, or in plant networks do not compromise high safety significance systems. This language was deleted in all later revisions of the draft branch technical position, including Revision 8.

As a result, we recommended that Revision 8 be revised to ensure that interconnections between high safety significant systems, and those of lower safety significance are one-way, unidirectional, not implemented in software digital communication devices. Next slide please.

The staff response disagreed, stating that BTP 7-19, Revision 8 is guidance for staff reviewers, and cannot prescribe, or impose specific design requirements, such as those described in our recommendation. We strongly disagree that our recommendation unnecessarily imposes either specific design requirements, or a specific component design. In previous discussions, the staff has stated that they cannot review electronic controlled access, and unidirectional data

communications for internal digital I&C systems, or in plant to external systems during the design review phase. Instead, it is viewed as an operational issue, and cyber security concern during licensee programmatic review under 10 CFR 73.54, where guidance is provided by Regulatory Guide 5.71, Cyber Security Programs for Nuclear Facilities.

It's important to note the difference in the terminology that we've used in this particular slide. The ACRS is focusing on control of access in accordance with IEEE standard 603-1991, which is invoked in 10 CFR 50.55a(h), and part 52 for design of reactor protection systems, and safety systems. The staff still considers this a programmatic issue to be dealt with long after the reactor protection systems, and safety systems have been designed, manufactured, and possibly even installed.

Next slide please. In our March 31, 2021, follow up letter to the Chairman, our main points were that computer-based digital instrumentation, and control systems for reactor protection safeguards, and other reactor, and steam plant control and monitoring systems results in significant improvements in plant performance. Second, computer-based I&C systems drastically, and I want to emphasize drastically, increase the vulnerability for control of access to critical reactor protection systems, safeguards, and in plant networks through communication of digital data, and control systems.

With digital I&C architectures, and networks configured for bidirectional data communication using software, control of access is gravely threatened, and is not an abstract consideration. In plant systems and networks that control all plant operations are now susceptible to attacks from external plant sources that connect to the internet if they are using

bidirectional communications.

This results in a compromise of independence, defense-in-depth, control of access, three of the fundamental digital I&C design principles. I'd like to again note that our focus is on control of access; it's not a cyber security issue in our estimation. Next slide please. The problem is that cyber security, and other security controls are not addressed, and applied until the later phases of the life cycle that occur at a licensee's site, be it site installation, operation, or maintenance. By then, the digital I&C system architecture is potentially already designed, and ready for manufacture, or in the installation phase. Incorporation of unidirectional, not implemented in software, hardware-based data communication devices into the architecture, what that means is actually into the hardware at this late juncture in the process, would possibly require a license amendment, since it would be a licensing basis change with whatever delay and cost implications it brings with it. Next slide please.

Our next point was that Reg Guide 5.71 should be used during the design, and design review phase to ensure a strong defensive architecture is part of the design licensing basis. Reg Guide 5.71 describes a defensive architecture that is strong, and to the point, noting that all digital safety systems should be in the highest defensive level. It only permits one way data flow from higher level digital safety systems to lower level digital systems; prohibits communication from digital assets in lower security levels to digital assets in higher security levels; and notes that one-way communications should be enforced using hardware mechanisms. The point of our recommendation is to use the guidance of 5.71, and methods in that regulatory guide in the system design to ensure control of access to

reactor protection systems, and safety systems is maintained to the same level that reactor protection systems, and safety systems are for existing analog systems.

None of this guidance, and methods are in the SRP, Reg Guide 1.152, which is for computer applications to digital I&C. Branch Technical Position 7-19, which is diversity in Defense-in-depth, or ISG-06, which is a preliminary licensing operation to help explain to the applicants what is expected when they submit their application. Next slide please. The alternative of incorporating cyber security software into any operating system software for in plant systems and networks involved in protection, control, and monitoring is problematic on two counts.

First, cyber security software is primarily reactive. It mostly protects against attacks that have already been observed. Second, it would disrupt all critical operational functions of the protection system, and safeguards, and networks by imperiling those system's timely completion of programmed cycle operations. It would require constant software upgrades to maintain currency, similar to what we experience with laptops, and other systems that we deal with in our normal day-to-day operations, increasing the possibility then of introducing malware during the upgrades that allow cyber compromise, or I should probably say allow access where it was not intended. Next slide please.

Summary of the main points. Allowing the use of computer based digital I&C systems, and architectures, and networks configured for bidirectional data communication, or software configured unidirectional data communications threatens control of access, and compromises independence and defense-in-depth.

They compromise plant safety by leaving high and low safety significance systems open to the kind of attacks that have seriously impacted other industries and government agencies. We provided several of those in our letter to the Commission as examples of very severe applications of hackers gaining access. Next slide please.

Summary continued, we recommended that the Commission direction is needed for the staff to assure during design reviews, that only unidirectional hardware-based data communication mechanisms not implemented in software are used between high safety significance systems, and those of lower safety significance.

Consistent with the Be riskSMART, guidance to the staff would help cases where regulations provide flexibility, they are guidance after all, but overly rigid interpretation can be detrimental. This ensures at the design review stage, there are not any software deficiencies, or back doors within the in-plant networks, and systems that can be exploited by internet connected sources to access in plant systems and networks. Thus, independence, and redundancy, defense-in-depth are not compromised. Next slide please.

Activities following the ACRS letter. We have not yet received a formal response from the staff. We have observed in public documents, and a memorandum to the EDO dated April 14, the Chairman directed the staff to undertake a review, and within 90 days provide the commission information on how the issues raised by the committee have been addressed. The EDO established an independent team of experts to respond to these matters raised in the ACRS letter.

In a memorandum to the Commissioners that was dated

July 14, the EDO reported the results of the team evaluation as follows. The concerns identified by the ACRS letter do not identify a safety issue not currently covered by NRC regulations. Second, mandating hardware for unidirectional communication would not increase the level of cyber security protection. Again, their focus is on cyber security, not control of access.

Mandating hardware -- next slide please, I'm sorry. Mandating hardware unidirectional devices would add a regulatory burden, reduce flexibility, and make the NRC's regulations more prescriptive in an area where performance-based regulations have proved effective. However, the team concluded that specific guidance documents could be revised to encourage design certification applicants to consider the cyber security requirements during the design phase for future operating license, or COLs.

The team recommendation was then to revise Reg Guide 5.71 and 1.152, Criteria for Use of Computers in Safety Systems of Nuclear Power Plants, to make applicants for design certifications aware, that's a very key word there, of cyber security requirements, and cyber security controls to be considered during the design phase of nuclear power reactor design. Next slide please.

Revise BTP 7-19 to clarify how the inclusion of unidirectional digital communications could reduce the scope of the review of defense-in-depth and diversity. We weren't really concerned with reducing the scope, but more ensuring that we had control of access covered. The EDO evaluation, they accepted the team's recommendations and conclusions, and said the staff will be directed to revise these regulatory documents as soon as possible. Therefore, while we have not seen a

formal response addressed to the ACRS, as stated, the point of our recommendation is to ensure the designs meet the 10 CFR 50.55a(h) control of access requirements for control of access.

As a result, we stand by our letters of November 23, 2020, and March 31, 2021. We cannot evaluate specific proposed staff actions at this point, until we have seen the changes, or the proposed changes to the regulatory guides and branch technical positions. Next slide. I've completed my presentation, and I will pass it onto Matt for his section.

MR. SUNSERI: Thank you, Charlie. Good morning Chairman Hanson, and Commissioners Baran and Wright. Thank you for the opportunity to present the committee's view on the NuScale control room staffing topical report, we look forward to your interactions. Next slide.

This slide depicts the features of the NuScale design that differentiate it from the current fleet. Attributes such as the nuclear power module being immersed in a large reactor building pool that serves as a passive heat sink highlights one of the differences.

We considered several of these features as we evaluated the proposed staffing plans. Next slide please. The passive safety characteristics, and the enhanced safety margins of design combined with the simplicity of tripping a module, and placing in passive cooling mode help reduce the reliance on personnel action to maintain the safety of the plant. Once in passive cooling, much more time is available before operator action is necessary, thus giving back resources to the operating crew to devote to higher priority tasks.

Design demonstrates that minimal operator intervention is required within 72 hours for a wide spectrum of design basis events, and the

improved human system interface in the main control room design functionality displays are a real advantage for the operators. The at a glance displays, the tiered alarms, the multi module trending, and the direct links to procedures takes much of the burden off of monitoring and assessing off the operators, thus giving them more individual capacity to devote to oversight and control of the plant.

We took these features into account as we completed our review. Next slide please. We had two opportunities to consider the control room staffing needs. The first was during our review of the design certification application that we completed in July 2020. NuScale proposed at that time a minimum shift crew of six operators. Next, in its revised control room staffing plan, NuScale proposed operating up to 12 modules, with a minimum shift crew of three licensed operators, two of those being senior reactor operators and one reactor operator.

NuScale also proposed eliminating the shift technical advisor as a crew member, combining the functions with the shift manager SRO, and the crew. And before we go into the details of the evaluation, a little background might be instructive here. Next slide. The current staffing requirements are specified in 10 CFR 50.54. The regulation did not anticipate that there might be some day a design with as many as 12 reactors being operated from a common control room.

As Member Petti mentioned during his remarks, the role of the operator is different for these new reactor designs. The staff recognized that there would be issues for the multi module small modular reactors, and designed a two-part approach for addressing these issues. For the initial applicants that would be challenged with the requirements of 10 CFR 50.54,

the path forward was to proceed with exemption requests using the general framework of the standard review plan, in particular chapter 18, the human factors engineering section and the comprehensive human factors engineering review covered by NUREG-0711. Staff also has sound guidance for assessing exemption requests as referenced in NUREG-1791. For the second part of the approach, the staff plans to pursue rulemaking for the longer term as experience is gained from these early applications. Next slide please.

All right, so now let's get into some of the technical details. The technical basis for the staffing plan provided by NuScale is built on a series of staffing plan validation exercises. NuScale conducted two staffing plan validation exercises. The first was with two crews of six persons as specified in the DCA. The persons assigned to these crews were trained on the operating and emergency procedures. Scenarios for these validation exercises including a spectrum of challenging high workload operating conditions, including design basis events, beyond design basis events, multi module transient and upset events, and a large scale loss of main control room displays.

Acceptance criteria include performance within the specified batch completion times, establishing a performance indicator, and situational awareness questionnaires. We found the situational awareness questionnaires particularly interesting, because they provided good insights into what the operators knew about the scenario, and that they were making decisions for the right reason. Next slide please.

In the revised staffing plan validation exercises, a three person crew consisting of an SRO, senior reactor operator as the shift

supervisor, another senior reactor operator, and a reactor operator. The testing was repeated for a similar spectrum of events with different scenarios. This was done to ensure that the operators were not compromised or preconditioned with knowledge of the scenarios.

The two operating crews were able to successfully operate the plant with up to 12 modules, meeting all the task performance and evaluation criteria as demonstrated by the larger crews. And there were no high priority human engineering discrepancies, retesting, or corrective actions identified. Committee had in-depth discussion with NuScale on these exercises, and with staff on their safety evaluation. Next slide please.

The staff determined that the NuScale simulator test bed was adequately representative of an as-designed main control room. The test scenarios were audited, evaluated, and found sufficiently representative of plant operations and challenges. Successful performance of the task assignments in the spectrum of test scenarios for two different crews of three was determined to be a satisfactory demonstration of minimal crew requirements. So, the staff concluded that a 12 module plant can be operated safely and reliably by a shift that's three licensed operators from a single control room under high work load conditions. Next slide please.

This slide is mainly a summary of items that I've covered in a previous slide. The first four items deal with the design features. The fifth item is on the validation exercises. In addition to these points, and prior to COVID, we had the opportunity as part of our design certification application review to visit the simulated control room, and see firsthand the control room layout, configuration of displays, and how information is presented to the operators.

We also had an operator walk us through a couple of plant transients to give us a sense for in real-time, how the operators interact with the plant. This experience was helpful in our discussions with NuScale, and staff as we went through the validation exercises, and design features. And finally on this slide, for a NuScale plant with 12 modules, refueling activities will be occurring frequently. A provision for an additional senior reactor operator on the plant floor during refueling operations is intended to further remove burden from control room staff, and this is consistent with 10 CFR 50.54. Next slide please.

And as a final note on our review of the staffing plans, staffing validation activities were highly dependent on the simulated control room design attributes, such as the critical safety functions, and defense-in-depth monitoring and displays, the tiered alarm scenario scheme, and 12 module trend monitoring.

In our letter report, we recommended that the as-built main control room will need to be thoroughly tested to ensure that the same features used to validate the staffing requirements exist and function as intended. The last area to cover is the proposal to eliminate the shift technical advisor position. Next slide please.

Following the Three Mile Island accident, NRC required establishment of an STA position at all plants to provide independent engineering expertise and advice to the shift supervisor. It was recognized that when qualifications of operators were upgraded and human system interfaces were upgraded, the shift technical advisor could be eliminated. The Commission has encouraged licensees to move towards a dual senior reactor operator/shift technical advisor position for some time now.

NuScale has taken the function of the shift technical advisor and distributed them into the three person crews. These functions were largely tested during the validation exercises in conjunction with the enhanced control room design. It's for these reasons that we agree that for the NuScale design, sufficient justification exists to eliminate the STA position. And next slide.

So, in summary, NuScale's design, the simplicity with which modules can be placed in passive cooling, and the successful staffing plan validation exercises provide confidence that up to 12 modules can be operated safely with the proposed minimum three license operator crew. We recommended that the staff's safety evaluation report be issued. We also suggested that the minimum operating crews be supplemented with additional independent engineering expertise until sufficient experience is gained with multi module operation. This suggestion is aimed at addressing the unknown unknowns that sometimes are discovered during initial startup activities at first oft a kind plants. We look forward to reviewing applicant submittals tha reference the Nuscale control room staffing topical report, and this concludes my presentation, and I return it back to Vice Chair Rempe for closing comments.

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

CHAIRMAN HANSON: Thank you Dr. Rempe, and thank you to all of our presenters this morning. We're going to start the questions with Commissioner Wright.

COMMISSIONER WRIGHT: Good morning and thank

each of you for your presentations this morning. This committee's independent voice and advice on technical issues provides the NRC with critical insights to what we do, and I'd like to acknowledge all that you do, and have accomplished especially during the past 18 months as we've gone through this pandemic. And like the rest of us at the NRC, y'all, and the committee has adapted to that change and changing environment, and you continue to effectively meet your mission, which we're very grateful for. So, thank you for what you've done during these challenging times.

Dr. Petti, I'm going to start with you, thank you again for your presentation, and I'm very interested in the -- I guess the progress of part 53, as well as the committee's engagement with staff on the matter. So, if I understand correctly, the ACRS recommended that a graded approach, or PRA should be used, and I believe that's similar to the feedback that we received from other stakeholders as well.

As you pointed out in your remarks, the staff should be commended for its engagement for accepting comments from all sources, and I believe the same goes for comments on how to approach a graded PRA. So, has the ACRS engaged with the staff on how to best accomplish a graded approach to PRA, and if not, do you have any thoughts on how this could be best accomplished?

DR. PETTI: Good question, and very timely. In fact, we anticipate in subcommittee meetings, either in next month, or the month after, that this is one of the main topics. We've not talked in any detail with the staff on this, except to note that it would be interesting to see what they come up with. And so we haven't really heard anything else from the staff, they're working on it at this point. I think there are options out there. If you

look at just what's done in other industries, there's other ways to look at these, and it's hard to adapt them, not just adopt them, but adapt them for the situation here.

COMMISSIONER WRIGHT: All right, thank you. So, I'm going to stay with you. Another area I'm aware the staff has received feedback on is the use of ALARA, the as low as reasonably achievable principle. So, some stakeholders have indicated that while ALARA is a tenet of good safety practice, its application to advanced reactors may be too subjective, or ambiguous to include in part 53. Do you have any thoughts on this?

DR. PETTI: Yeah, I don't fully appreciate I guess the stakeholder response. Its requirement in the law already that ALARA be implemented. Reechoing it in part 53 is just a matter of completeness, if you will. It doesn't absolve them from ALARA, because that's already required under the radiation protection standards, whose number I can't remember right now, but maybe one of my colleagues remembers.

COMMISSIONER WRIGHT: Okay, thank you. So, I'm going to go to Joy Rempe and Matt Sunseri here, so thank you both again for your leadership on the committee. And I wanted to ask you about the agency's transformation and risk informing initiatives. I think that many of the staff's efforts, including the development of part 53 showed that the NRC staff is being intentional about developing new regulatory frameworks and licensing approaches that focus on the most risk and safety significant aspects of the designs.

And I see these efforts as our principles of good regulation at work. Staff is looking to leverage experience, and data to achieve our

mission in an effective, and efficient manner. Can you talk to me a bit about how, if at all, the ACRS is adapting its review approach to complement the staff's activities, and focusing on the most risk and safety significant aspects?

DR. REMPE: Do you want to go first Matt, or you want me to?

MR. SUNSERI: Well, it doesn't matter, you can go ahead.

DR. REMPE: Well, as I mentioned in my presentation, we are trying to focus on what aspects will have the most safety impact in our reviews. As you may recall, when we performed the NuScale review, we changed our process a bit when we went through -- after we did the individual chapters, we actually took a more integrated approach, and we tried to focus on risk important aspects of the design.

And although we're not in the main impact of future reviews, several applicants or design developers have come in with some submittals, not only for non-LWR designs, but also the small modular designs, and some of the medical isotope designs, and we are going forward with that process in our subsequent reviews. I believe we had some fairly positive feedback from the staff on that approach. Your turn, Matt.

MR. SUNSERI: Thanks. I think, Commissioner Wright, thank you for the question, I would only add to Chair Rempe, is that the Be riskSMART initiative that the agency is undertaking we see as a very valuable approach, and framework. We've even adopted it in some of our own letter reports that we've used to strike that balance. And we see the staff really working more to use that kind of thinking if you will, in their regulatory decision and process development. So, that's the only thing I

would add.

COMMISSIONER WRIGHT: All right, thank you. So, I'm going to stay with you again, another little follow up here. So, I'm also interested in your perspective of your committee's role with respect to advanced reactor design reviews. So, how does the committee see its role with respect to these reviews? For example, does the ACRS see its role as conducting an independent safety review of a design, or more as conducting a review of the staff's work for reasonableness?

MR. SUNSERI: Well, I can go first on that one. Our charter at the ACRS is to review matters of safety. So, we're always looking at these designs from the safety aspect. And our role in that is, depending on where an applicant comes in with their particular design, some of them are formal applications that are going through the process, and we collaborate with staff. Collaborate is not the right word, but we follow the staff. The staff conducts a safety evaluation, and then we weigh the applicant's information, and we weigh the staff's information, and we make our independent safety recommendations back to the Commission. And that's on the formal application, but a lot of the advance work is coming through in topical reports. So, it's coming through in pieces, and then we essentially do the same thing though, we interact with the applicant, we interact with staff, whether it's through their safety evaluation, or topical report, whatever document, if you will, is being presented for approval. But our focus is always on the safety aspects.

DR. REMPE: So, if I could add to this, I'd like to reemphasize a point that Dr. Petti made that has appeared in several of our letters. One of the more challenging aspects of these advanced reactor

designs is that they may present a different challenge. We have encouraged the staff, as well as applicants to start with a clean sheet of paper as they try and look at what the challenges are that might prevent them from achieving critical safety function.

And I think that it's important that ACRS have that independent review, and not only look at what the staff has reviewed, but also step out of the box if you will, and think about is there something about this design that might present a different challenge? And so that's why I think it's very important to have that independent review at this time.

COMMISSIONER WRIGHT: So, thank you, I'm going to follow up right there on what you just said. I want to see if I can get you and Matt to comment on this. So, as you know there's considerable interest in the time limits of NRC reviews of advanced reactor technologies. So, in order to make our important safety findings, we need to have the right resources in place so that we're not a barrier. So, can you talk to me a bit about how the ACRS plans to handle the reviews of the multiple advanced design concepts that we are expecting. Do you have the resources needed, and the processes in place to accommodate timely reviews of these multiple applications, and if not what is the committee doing to address these needs? And is there anything that we at the commission can do to assist?

MR. SUNSERI: Well, I'll start again, and Joy, give you some time to think about it. We do extensive planning for our reviews. We stay, we follow staff on the applicants, and how they're coming in, and regulatory action plans that are associated with that. In actuality, there are quite a few applicants in play right now. There must be, I would guess about a half a dozen or so things with various vendors that we are currently

reviewing, and we factor that into our schedule, our workload.

And right now, we always -- well, we periodically I would say, step back, and assess our capacity, and our workload, and our membership. We're allowed to have up to 15 members by regulation, by statute, and we treat that as -- not a guideline, but that's an upper limit. But we don't consider that to be, maintain that staffing level all the time. Currently we're at 11, and that is the staffing level that supports the work we've got coming in. We have some leaders leaving, and we've requested new. So, we're continuously evaluating our resource capacity against our workload that we currently have, and that we project to have, and we make recommendations to the commission when we believe we need extra help on that. We've made process improvements to help us get through these staffing reviews. Vice Chair Rempe gave a perfect example with NuScale, how we shortened that review, we got it done within the compressed time frame that it was specified in.

In addition, as you recall, that application had some challenges towards the end, some significant reviews had to be repeated, and we were able to adjust our workload and our schedule to accommodate that, and we got it done on time. So, I think we're open minded, and we're flexible, and we want to work with staff, and we certainly don't want to be an impediment to the completions. But you've got to keep in mind that we also aren't designing these reactors and we're doing the independent review.

So, we are at the tail end of the process. We are between the rock and the proverbial hard spot as they say, and so we're mindful of that, and we work hard to make sure that we stay as far ahead as we possibly can. Joy, anything you would like to add?

DR. REMPE: No, I think you've covered it very well. Again, I would like to remind you that we do appreciate your willingness to approve another member. It does take awhile to select a member and bring them on board, and have them come up to speed, so I think that that's important. And also our staff has been very good about keeping us aware of what's going on, because there are a lot of activities in this area. Thank you.

COMMISSIONER WRIGHT: Thank you very much, and Mr. Chairman, I don't have a countdown clock, but I'm pretty sure ten minutes is gone, so I'll pass it back.

CHAIRMAN HANSON: No worries at all Commissioner Wright, I think we have plenty of time this morning, so no worries there. Thank you all again for being here this morning. It's really a great pleasure for me to get these updates. Dr. Petti, I'd like to start with you. Regarding fuel qualification activities, what do you see are the key challenges with licensing fuel technologies for near term advanced reactors?

DR. PETTI: I think the major issues are related to having enough data, and the right type of data that supports safety analysis, basically. And so those data take a long time, that's just sort of the nature of the beast. You've got to irradiate fuel, you've got to irradiate enough fuel, you've got to put it through its paces from a safety perspective, there are special facilities that do that, and those just all take time.

There are pushes to accelerate that in the DOE, and I think that can help what I would call low technology readiness fuels, get them up the ladder faster so that you don't make a mistake, and have to go backwards. That's one of the big issues in fuel qualification, is somewhere

along the line, it uncovers itself in your testing that you didn't think of, and you've got to go back, and repeat something. And that's what takes it from a 10 year activity to a 20 year activity. So, that's really the biggest issue in my mind.

CHAIRMAN HANSON: Thanks. I'd like to follow up on just a couple of points you made on that. What's your kind of assessment, or perspective on the current availability of testing facilities to support the advanced reactors, and do you think that testing facility availability is posing challenges for the deployment of new fuel technologies?

DR. PETTI: Yes. I mean I think we have been briefed by the staff about the Halden facility being closed, and that really impacts for instance accident tolerant fuel. For the advanced reactor fuels, most of them are done at the advanced test reactor in Idaho. It is highly subscribed, and saying that, if we have another test reactor, if today we said we needed another test reactor, by the time that would be built, and ready, it's too late.

We kind of are where we are, we've got to hope that the French facility, the Jules Horowitz reactor can come online soon, it's faced delays. But we really are paced by the existing infrastructure. And if we were smart enough, and looked 10, 15 years ago, we might have been able to see this coming, and made different decisions, but that's not where we are.

CHAIRMAN HANSON: Yeah, thank you for that, and I think that it's an interesting problem that you know. One of the other things you touched on, it made me think of the accelerated fuel qualification initiative, which I know is something primarily at the Department of Energy, but there's been some interactions here with the staff at NRC as well, and I

just wanted to see if you had some thoughts about that effort.

DR. PETTI: So, as I said, I think it can be very valuable early when you've got a fuel that really hasn't really been tested, and you've got ideas, and thoughts, and the models can help you think through problems, whether that be performance, or even fabrication. I've made something, and it looks weird, we don't understand it, it's not in the spec, is it going to be good, or is it going to be bad, what do the models tell us?

So that you don't have to irradiate it, and then see what happens. You can try to do it in advance. So, I think early on in the process, when you've got a very low maturity fuel, it helps. But in the end, even the people in the DOE complex, I've had lots of discussions with them, they agree that there has to be testing of, let's call it fuel off of a true production line, that's a fair representative of what would be put in the reactor, and to do a final proof test to show that everything that's been done to date works. That's the key lynchpin. You can accelerate getting there, but still doing that, and standing up a fuel vendor to make these new fuels at production quantities is not a simple task. It's overlooked by many. I spent a lot of my career doing this for the TRISO fuel program, so I lived it. It's very difficult, it's time-consuming. So, there's still big hurdles even with the acceleration that just have to do with the engineering of getting a fuel vendor ready to make this stuff, and do a final proof testing of it.

CHAIRMAN HANSON: Thank you, yeah, very interesting stuff. I really appreciate that, of course that's my hobby horse, as many people know, is the data, data, data on this stuff being really important for validation and regulatory decisions. But kind of speaking, teeing off of that data, I want to go in a little bit different direction on, and ask you a question

Dr. Petti, on probabilistic risk assessment.

And I'm curious about this, you talked about a graded approach I think to PRA with Commissioner Wright, and what is -- we have some really novel designs for advanced reactors out there, where we might not necessarily have the kind of data that you might want, or might need to populate a PRA, and I'm interested in your thoughts about kind of what is your confidence level, and the ability of non-light water reactor PRAs to support regulatory decisions that maybe rely heavily on the PRA, like the licensing modernization project. And how do you see the challenges of quantifying the reliability of new and novel passive systems, and the uncertainties associated with the potential performance of those systems?

DR. PETTI: Right. I think it is an issue in one sense of, let's call it a traditional or historic sense of how it's been applied to the existing fleet. But there's a number of other tools in the risk analyst toolbox that come from other industries. There's new chemical plants being developed with new processes, how do they deal with this? And there are techniques that one can use to estimate the frequency of events where you don't have a lot of operations data.

The other thing that I think people forget is that we anticipate that these reactors are going to be significantly -- have significant margins to the regulatory limits. So, you can allow more uncertainty because you're further away from, whether it be 25 REM, 1 REM, whatever the number is that you're looking at. And so you don't need the precision that you do necessarily for a light water reactor.

And so that's where some of these other techniques can be helpful, and that's why we keep pushing on making sure you understand

what the potential events could be at the beginning. That's really the most critical thing I think, in these designs, is what are going to be your safety functions, what are going to be the systems to implement them? What are those events that will be most important, and where do you think they're going to fall in the consequence and frequency space?

A lot of that can be done in a very qualitative sense, because, for instance some of these micro reactors, their hazards are so much lower that one doesn't need all the precision that one uses for the current fleet.

CHAIRMAN HANSON: Thank you.

DR. PETTI: I would call on any of my other colleagues that have expertise, like Dennis, if he feels there's something he can add.

CHAIRMAN HANSON: Yeah, happy to hear it.

DR. BLEY: I don't have very much to add to that, I think you covered it pretty well. We have had experience in both abbreviated forms of PRA, and the thing we've learned from that, the thing I've learned anyway, is there are places you can make conservative simplifications, but the place you can't make simplifications is in the very beginning, identifying the initiating events, and the scenarios that could lead to damage. You have to do that very thoroughly.

In some of the other areas, you could do better. Now, in a few of our earlier letters, we mentioned on some of these designs, especially where you're going to have fairly small source terms compared to LWRs, the right place to start is at the end, is what could be the source term, and then work backwards, and see what you need to protect against that. So, that's one of the things. We look forward to hearing where the staff's been going

on this, I know they've been working on it.

CHAIRMAN HANSON: Yeah, thank you. I look forward to more of your insights, it just has big implications for how we look at these designs, and I look forward to more of the ACRS's advice on this. As long as I have you both, now that I've engaged both of you, I do have one kind of last question, I'll beg Commissioner Baran's forbearance here just for a second.

The current preliminary part 53 language includes, or proposes to include quantitative health objectives, and can you share the committee's thinking on this, and whether there could be some unintended consequences in making quantitative health objectives regulatory criteria?

DR. PETTI: My sense is we need good metrics for the advanced reactors, and that's what we've told the staff. We know that it's not easy, but that we need something beyond the qualitative health objectives that are there. We're hoping, we gave them a couple of ideas as I recall, some NUREGs that were done, where this was looked at. But we have not heard anything back from them. I'm thinking is it something fairly simple that can be done based on the large margin that exists, for instance, to the regulatory limits and from that try to make some estimates. Dennis, do you have any thoughts?

DR. BLEY: Well, back when we were talking about this with the staff, we had really two concerns. One was in some cases it could be difficult to apply the quantitative health objectives. The staff has assured us that at least in many of the places they've looked, that can be done reasonably well. The other thing we were concerned about was the original layout with the two-tiered approach with the quantitative goals being in the

second one. And we had trouble seeing the benefit of having things separated in that way, and as far as I know, most of the committee still sits in that spot.

DR. PETTI: Yes, and the staff has moved away from that two-tier structure, you weren't at our last meeting Dennis, but they've not removed any requirements, it's just sort of the way it's been presented in the language.

DR. BLEY: Okay, that makes sense to me, I'm glad. I look forward to seeing the transcript.

CHAIRMAN HANSON: Well, thanks to you both, and with that, I'll hand it over to Commissioner Baran.

COMMISSIONER BARAN: Thanks. Well, thank you for your presentations, and all your work on the committee. It's incredibly valuable to the agency. I'd like to start by asking about the staff's new guidance on assessing volcanic hazards. This guidance is relevant to advanced reactors, because some vendors are considering sites in the Pacific Northwest or Alaska, where there are active volcanic regions. Based on my read of the letter, it sounds like ACRS thought the guidance was a good start, but noted that research is needed to establish the impact of volcanic hazards on the performance of equipment and personnel inside, and outside the facility. Can someone tell us a bit more about what research would be needed for volcanic hazard analyses to be effectively performed for new reactor siting?

DR. REMPE: So, I'll start, but then I'd like to let Dennis follow up, since he was the lead on that letter. But I believe our concern was primarily associated with how the releases associated with a volcanic

hazard, ash, for example, might affect other facilities nearby, as well as the reactor. And actually the staff response, actually concurred with that recommendation, and said they were aware of IAEA research on that topic, and they intended to follow that research. And if I could, I'd like to invite Dennis to weigh in, if he has any additional insights he'd like to share.

DR. BLEY: I think we laid it out in a letter, but it's been awhile, I don't remember exactly what we said there. But the ash problem is especially troublesome, because that ash can be extraordinarily fine, and a number of the members have had experience, or are aware of anecdotal evidence where very, very fine sand fines, or ash finds its way into places you can't imagine, into systems that appear to be sealed.

And there's very little good information documenting that issue, and that's the place we thought needed a fair amount of work, because the ash can cover a fairly wide area. It's not like the lava isn't going to go all that far, as long as you're not right close, you're probably okay with that one. But the ash issue is pretty important.

COMMISSIONER BARAN: Thanks, that's helpful. Can you give us a sense, what's the current state of knowledge of equipment failure rates caused by volcanic hazards, for example the very fine ash that you refer to. Is there good data on that, or that really is the research gap? And I guess more broadly, maybe just tie it a little bit to how far along is the probabilistic risk assessment in this area?

DR. BLEY: As far as I know, there's very little recorded data or research in the area. The place I first encountered it was working with some folks from Dubai early on when they were starting to look at nuclear, and they were telling us about the sandstorms that roll in there, and

they find those very, very small fines in those kind of storms getting inside systems that they had thought were sealed and it wouldn't get in.

So, they had that high on their list, and so far I haven't seen any data that links that to failure rates, and I think that's the place we've got the hole.

COMMISSIONER BARAN: Okay. And what's the committee's view of the level of detail in the staff's guidance? Would it be helpful for the guidance to include more detail about how the hazard analysis should be conducted, or what's your sense of that? My sense reading the letter was that it sounds like the guidance is largely a compilation of information that's out there. And less in terms of how do you go through each step of an analysis. Can you talk a little bit about that? Do you think it's hit the right spot? Do you think with more time, you'd want to see a greater level of detail in the guidance?

DR. BLEY: Well, a key point for where we are at this time, I think it's probably at an appropriate level. It narrows down who has to look, and how hard they have to look, and refers to some other guidance, especially from the IAEA, that's more thorough and detailed. So, I think it's setup right. When this truly becomes an issue, I think they have the resources and the sources to draw on, to ferret out in a little more detail. But I think they've got it at maybe an appropriate level for now, and save that one gap on what do we do about the ash problem.

COMMISSIONER BARAN: Okay, thanks.

MR. SUNSERI: Dennis, this is Matt, remind me, I think this is one of the guides that was going to be table-topped with a vendor, was that right, am I remembering that right?

DR. REMPE: That's true Matt, I'll step in here, but staff in the response that they had posted that request out, and they had not had anyone willing to step up to the table yet.

MR. SUNSERI: Oh, I thought there was one, okay, that's my fault, sorry.

COMMISSIONER BARAN: Okay, great, well thanks. I look forward to seeing that down the road if someone ends up wanting to tabletop it. Let me turn to the issue of operating staffing for a 12 module NuScale facility. The NRC staff and ACRS were satisfied that three licensed operators, without a shift technical advisor, would be sufficient to operate 12 of these reactors. That's obviously far fewer operators than we have in existing plants.

Dennis prepared a white paper on the question of the shift technical advisor in particular, and that's a position of course that's been required since the Three Mile Island accident. Dennis, your white paper discussed the risk of group think, and the value of having an independent assessment capability during an event. Can you talk a bit about that? And then share your thoughts about whether the shift technical advisor role is needed for this particular NuScale design.

DR. BLEY: Sure, I'd be delighted to. And I agreed with the rest of the committee, so these weren't, that little paper wasn't submitted as additional comments, but it's an area I've been interested in since this first began. And I watched the development of the STA position for the first two to five years, they got fairly young people with degrees and put them in the plant, and nobody paid too much attention to them. It took awhile for them to come up to speed, and I think be useful.

From my own background, I've seen places where having an independent set of eyes who is not engaged in the operations has saved many an odd situation. I've seen places where, that apparently independent set of eyes jumped in, and took over, and once they were enmeshed in the problem, they didn't have the clarity they had before. So, I really liked having that independence.

A few years back, Halden did some work that kind of surprised them, and I mentioned that in the letter. They did experiments where they put the STA in the control room with using the same displays as everybody else, with their own displays in a separate place. And they found that this role, the independent oversight worked very much better when they were separated from the operating crew. The crews really like having a qualified person available to help, but it made a difference not having that set of eyes.

Now, there's a few things about NuScale that set it apart, and for me, the one that allows me to be more comfortable with this is the ability, if something starts acting up in one of the modules, they can very easily shut it down, and put it into its long-term cooling mode, and don't really have to look at it again. The two visits I was with out to visit NuScale, I saw a number of exercises on the simulator, and it appears that their training really emphasizes that. The computer systems, and alarm screening tools are very good to let them know when something starts happening in a module. They'll try to work on it with one person, and if they get to the point, either it's getting complicated, or some other problems start to develop, they can quickly eliminate that unit from their further consideration. That kind of simplicity makes me more comfortable there

than I would be in any other facility I know of. So, the independent oversight isn't, to me, as essential given their ability to pick things out of the picture quite easily. So, that's where I came down on this.

COMMISSIONER BARAN: Well, and that's very helpful. Thinking back to the presentation today, it sounded like part of the committee's recommendation or preference would be maybe in that early period, when everyone's still learning how to operate these reactors, or in the early period of operation of the reactors, they maybe do have something like that position present for a period of time. I don't know if anyone wants to comment on that. Whether that kind of aspect of the ACRS view is really reflective of the issues you're raising now.

DR. BLEY: Well, Matt might want to talk to this more than me, but we're saying it for the reasons you suggested Commissioner Baran, but on the other hand, every startup I've seen, everybody, from the vendors, to the operating plant bring extra people in to keep a close eye on it, and make sure everything's going well. So, it's almost gratuitous. It's going to be there anyway, but for the reasons we were talking about, it's especially useful.

COMMISSIONER BARAN: Okay. Matt, did you have anything to add on that?

MR. SUNSERI: No, Dennis covered it exactly right, so nothing to add.

COMMISSIONER BARAN: Okay, great, well I'll stop there. And again Dennis, just you're going to be so missed, and just these kinds of perspectives that you bring, and your thoughtful way of approaching these issues based on all the experience that you have, it's really hard to

replace. You've got some great colleagues still, and obviously we're going to keep relying on them, but we're going to miss having you there. Thank you.

DR. BLEY: Thanks very much.

CHAIRMAN HANSON: Thank you Commissioner Baran. And thanks to the ACRS today, thanks to Chair Sunseri, and Vice Chair Rempe for kind of moderating. I want to once again extend a warm welcome to Dr. Bier and Mr. Halnon, and also a sincere thanks to Dr. Riccardella and to Dr. Bley, who once again kind of showed his insight, and his helpfulness in our discussion today. So, best wishes to you Dr. Bley. And with that, thanks again to my colleagues.

I think we had a really good discussion today, these are complex issues, and we sincerely value the contributions of the ACRS. And with that, we're adjourned.

(Whereupon, the above-entitled matter went off the record at 11:29 a.m.)