UNITED STATES

NUCLEAR REGULATORY COMMISSION

+ + + + +

MEETING WITH ADVISORY COMMITTEE ON

REACTOR SAFEGUARDS

+ + + + +

FRIDAY,

DECEMBER 6, 2019

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Commission met in the Commissioners' Hearing Room at the Nuclear Regulatory Commission, One White Flint North, 11555 Rockville Pike, at 10:00 a.m., Kristine L. Svinicki, Chairman, presiding.

COMMISSION MEMBERS:

KRISTINE L. SVINICKI, Chairman

JEFF BARAN, Commissioner

ANNIE CAPUTO, Commissioner

DAVID A. WRIGHT, Commissioner

ALSO PRESENT:

ANNETTE VIETTI-COOK, Secretary of the Commission

MARIAN ZOBLER, General Counsel

ACRS MEMBERS:

PETER RICCARDELLA, ACRS Chairman

DENNIS BLEY, ACRS Member

WALTER KIRCHNER, ACRS Member

JOY REMPE, ACRS Member

P R O C E E D I N G S

10:03 a.m.

CHAIRMAN SVINICKI: Good morning, everyone, once again.

And now, we will begin the Commission's public meeting with the Advisory Committee on Reactor Safeguards. We conduct this meeting with a goal of at least annually to have an opportunity to engage the Committee in a more direct and active way. Throughout the course of the year, of course, the Committee takes up various technical matters before the staff. They meet with the staff and receive presentations; also, sometimes from a regulated entity, some licensees as well.

As a result of that engagement on technical topics, the Advisory Committee communicates with the Commission in a series of what we call letter reports over the course of the year. We will not in the course of this meeting discuss every single letter report that the Committee has put out. I think, in general, the Chairman of the ACRS, frequently at least, has on slides a listing of what those are.

Also, at least this year, I think they were all public reports. It's rare that they're not. So, I think they're also available to members of the public who might be tuning in to our meeting today, should their curiosity be piqued on any of the things we discuss today. The letter reports themselves are available.

And so, the topics tend to be ones that the Committee has recommended presentation to the Commission, and the same is true today. But I have served on this Commission so long that I feel like I always let a few years go and, then, I make a point, because I'm like, well, I've made that point in years past, but not everyone was involved and heard me make that point.

But the interesting thing to me -- I do like history and the curiosity of the ACRS -- is that it is kind of as old as atomic power in the United States in some ways, depending on when you would define the beginnings of that, and has been advising this Commission for the entirety of its existence, but also the Commission that we grew out of, which was the Atomic Energy Commission. So, the ACRS is as old as that. I sometimes think that they are as old as time, but they are not as old as time.

(Laughter.)

And it is certainly not a reflection on the composition of the Committee.

(Laughter.)

I simply mean that it's rare that something demonstrates such an enduring value that it continues in a pretty much unchanged form for that period of time.

One of the topics we will be discussing today, though, or I will certainly take up with the Committee, is their letter report on the Agency's transformation efforts. I appreciate the letter report that they wrote and look forward to engaging on that topic because, although the ACRS has been in

existence and has been a valuable input to both the Atomic Energy Commission and the NRC for many, many decades now, there's a lot changing in the world. So, I'll be curious to hear more about the Committee's thinking on that as well, in addition to their letter report.

But, before we begin, does any member of the Commission wish to add anything?

(No response.)

Okay. Well, hearing none, again, we will hear a series of topics, but we will lead off with the Chairman of the Advisory Committee on Reactor Safeguards, Mr. Peter Riccardella.

And again, you all tend to kind of have a flow where you hand off to each other. So, please, Chairman, take it away, and we're eager to hear the Committee's presentation.

MR. RICCARDELLA: Thank you, Chairman, and good morning to you and the other Commissioners.

I am going to lead off with an overview of our activities in the last year and, also, discuss our transformation efforts.

To my right is Walt Kirchner, who is Chairman of our NuScale Subcommittee, and he will be discussing the work we've done on the NuScale design certification application review.

To my left is Dennis Bley, who is Chairman of our Future Plant Designs Subcommittee, and he'll be talking about several letter reports we've prepared on advanced reactors.

And finally, to our left, to my far left is Dr. Joy Rempe, who is a member-at-large and Chairman of our Safety Research Program Subcommittee.

I'm going to also mention that I am the only person at the table who is not an MIT grad, at least among the ACRS members.

(Laughter.)

So, could I have the slide, please?

Accomplishments. Since our last meeting a year ago, we've issued 31 letter reports. Most importantly, have been on the NuScale design certification application, we've issued several reports. Dr. Kirchner will be talking about those in more detail. And also, the ACRS activities to support the NRC transformation, which I'll be summarizing.

Next slide, please.

Continuing on our accomplishments, we've issued three reports on advanced reactor topics, and as I mentioned, Dr. Bley will be discussing those at today's meeting. We've issued five reports on license and design certification renewals, four letter reports on vendor topical reports, and we've also covered a number of other topics which are listed here. I'm not going to read them all, other than the last one, which is our quality review of research projects that, as I mentioned, Dr. Rempe will be discussing today.

So, let's talk about ACRS transformation. The Committee engaged in a number of activities to assess the ACRS role in a transformed Agency. We were briefed by senior staff on the Agency transformation. We

conducted several ACRS retreats on the topic and discussed it at several of our Committee meetings. We solicited input from the EDO, from all current and several past Commissioners regarding areas in which past ACRS reviews have been most effective and impactful. And finally, we reviewed all the relevant Agency documents related to transformation.

Next slide. This isn't the correct slide. We're on slide No. 6, please.

We issued our letter report on October 5th, and that report contained -- I'm sorry, in October -- and that report contained five conclusions and proposed actions.

First, almost universal input from the Commissioners was that ACRS reviews provide an integrating perspective and they increased the quality and rigor of the work performed by both the staff and the industry.

Moving forward, though, in the new world that we are entering, we have decided that we will do several things. We will prioritize our reviews based on risk significance and the Agency transformation priorities. We will stay abreast of the staff transformation initiatives and we'll continue to contribute and adjust as appropriate. And finally, we implemented a number of measures to improve our operational efficiencies and reduce costs.

In reviewing this, we believe that there is no need for rule changes or legislation to implement any of these actions.

We haven't been sitting still on this. We've actually

implemented a number of actions already. We established a set of prioritization criteria for Committee review topics. Our Subcommittee Chairmen will use these criteria to evaluate various topics and make a recommendation to the full Committee as to whether a detailed review of that topic is necessary or not.

Significantly, we've developed with staff a modified, more effective process for our NuScale DCA phase 5 review. Phase 5 is our review of the SER with no open items. And rather than go through it again on a chapter-by-chapter basis, we've identified several risk-significant, cross-cutting issues, and we're going to review those issues and bring in the chapters as appropriate with those issues. Again, Dr. Kirchner will discuss this in more detail during his presentation. We have received positive feedback on that from both the staff and the applicant, on that new process.

We've already eliminated reviews of some routine, low-priority items. As I've mentioned, we implemented a number of process improvements to enhance our operational efficiency.

In summary, ACRS performs independent, integrated, multidiscipline reviews. Going forward, we intend to prioritize our reviews with a focus on those which have the most impact and value to the Commission.

Finally, I have to say that having membership with expertise covering the breadth of risk-significant issues is mission-critical to us. And as you mentioned, we've had several members retire in 2019 and we're getting

thin in a couple of areas that we need.

With that, I will turn the floor over to Walt Kirchner to talk about our NuScale reviews.

MR. KIRCHNER: Good morning, Madam Chairman, Commissioners.

I'm going to give an overview of our review of the design certification application from NuScale.

Next slide, please.

I'm just going to give several highlights from the DCA about the NuScale design and emphasize areas of difference from the large PWR fleet.

So, the NuScale Power Module is a small, modular, natural circulation derivative of a PWR, roughly 160 megawatts thermal, 50 megawatts electric per module. Each module is composed of a reactor core, pressurizer, two helical steam generators integral to the reactor vessel, and enclosed in a high-strength steel containment vessel.

The CNV, the containment, is maintained at a vacuum during normal operation. And so, that serves like a thermos bottle, or think of your coffee cup. This design minimizes piping outside of the reactor coolant pressure boundary, and with the exception of stainless steel sheath cables, there's no insulation within the containment. So, this minimizes concerns with debris, the GSI-191 item.

Next slide, please.

So, the core contains 37 roughly half-length, 17x17 PWR fuel assemblies. This is a commercially-proven fuel, albeit half-length. The fuel has been used in 22 PWRs since 1995. There are large margins versus its larger PWR counterparts, roughly half in terms of peaking factors. The core is surrounded with a stainless steel reflector, and that helps reduce peaking, which is important. Smaller cores tend to have higher peaking factors if you don't compensate in the design.

Each module has a dedicated decay heat removal system -- it's two systems actually -- and an emergency core cooling system. Regarding the decay heat removal system, one of the two independent systems is sufficient on its own to bring the reactor down to a hot standby condition. And then, the ECCS would actuate 24 hours after loss of power. It's sufficient to bring the reactor to a safe cold shutdown condition.

Next slide, please.

These modules -- 12 are envisioned -- would be housed in a large reactor building, largely immersed in a common pool of water. The pool serves as a passive ultimate heat sink for cooling during design basis events and beyond design basis events. And it's a common pool for refueling and spent fuel storage. This design provides very long coping times, beyond 72 hours, without the requirement for power or refilling the reactor pool.

Next slide, please.

So now, I'm going to turn more to our actual review and its status. We met the phase 3 milestone of August 27th this year. My numbers

are a little bit different than our Chairman's numbers. I'm talking about in total what we've performed in our NuScale review in terms of letter reports.

So, we've issued seven interim chapter letter reports covering all 21 chapters. We've issued eight topical letter reports actually covering nine topical reports from NuScale, and four topical reports remain to be reviewed. Actually, during our meeting this month, we are taking up the source term focus area, which I'll talk about in a little bit. And we have three remaining. Those are LOCA; AOOs, anticipated operating events, and rod ejection or reactor insertion accidents. And those three topical reports are scheduled to be reviewed in the mid-February timeframe.

Next slide, please.

For our phase 5 review, as mentioned by the Chairman, we have proposed doing cross-cutting areas of focused review based on lessons learned from our past design certification application reviews. We believe this is consistent with the NRC's strategy for emphasizing and transforming to a more risk-informed, performance-based, safety-focused review. And I think in the past the staff has used what they've called enhanced safety-focused reviews. So, this is similar in concept. The intent here is to do in-depth reviews of matters that are inherently cross-cutting and a systematic manner, more integrated approach, but focused on safety performance and risk.

Next slide, please.

What we are doing to, if you will, expedite our way through this, each member has taken on a lead for chapters, and they will each

perform a detailed chapter review, document that for completeness, and then, present that to our Committee. Then, the chapter lead will make a recommendation to the Committee as to whether a briefing is needed on the chapter or selected items from it. Often, those selected items will be covered in what's coming next, which is our focus area reviews.

Next slide, please.

Our currently-identified focus area, review areas -- that's redundant, sorry -- basically derived from our previous reviews and our letter reports and Committee deliberations, are ECCS and valve performance; helical-tube steam generator design; boron dilution and return to criticality; source term, which I mentioned we are currently reviewing this month, and probabilistic risk assessment, kind of a grand finale next spring.

Next slide, please.

This approach is a departure from the past where we reviewed the design certification applications often twice chapter by chapter. So, it's less resource-intensive for the staff and the applicant, and I think it's much more effective and focusing on safety. We've had favorable feedback from the EDO, from the staff, and the applicant.

Next slide, please.

So, this is my concluding slide and just kind of a status review of where we are. We are anticipating that all the SERs with no open items will be completed next week. We have already reviewed six chapters. The chapter leads have made their reviews and made a determination not to

ask for another briefing on their chapters. This month we looked at three more chapters. So, we are at now nine out of the 21.

Chapter 15 definitely requires a briefing. So, working with the staff, we're looking at, I think now it's going to be early March timeframe -- since the viewgraphs were prepared.

We are also working with the staff and we have now a schedule -- again, since the viewgraph was prepared -- for the March timeframe and to do the remaining focus areas.

And so, in conclusion, we're working with the staff to meet the June 23, 2020 target milestone. And I'll be welcome to taking any questions.

But I'll turn now to Dr. Bley, my colleague.

MR. BLEY: Thank you, Walt.

Good morning, Chairman and Commissioners.

I'm talking about three reports this time, thank you very much. But I've put them all together because they're closely-related, and they are three reports associated with the staff's vision and strategy for the review of non-LWR applications. That vision and strategy is aimed at non-LWR licensing readiness, and the staff describes readiness to be readiness to effectively and efficiently conduct its mission for designs, including fuel cycles and waste forms.

Could I have the next slide, please?

We reviewed the vision and strategy document when it first

came out and wrote a report on that a couple of years ago. In that report, the staff described six strategies for achieving readiness. In our report, we recommended that they focus on strategies three and five. That's the flexible review process and the technology-inclusive policy issues. And we recommended those because they really underlie all else that's done, and if you don't get those right, you would have to change a lot of other work you did. And the staff agreed and has done a fair amount of work there.

Well, they don't show it much on this screen. There are three orange boxes where we've already submitted reports. Under strategy three, it's the non-LWR design criteria. Under strategy five, we did the functional containment performance criteria, and just above that, the draft proposed rule on emergency preparedness for ONTs, other nuclear technologies. I'm sorry.

Today, we're going to talk about three of the strategies -- three, five, and two. First, we'll talk about, under strategy three, the Licensing Modernization Project. Next, we'll talk about siting your densely-populated areas, under strategy five. And the last one I'll bring forward is the one examining computer code identification and evaluation.

Could I have the next slide, please?

We'll begin with the Licensing Modernization Project, and in the first bullet you'll see it now has a new name. It's the Technology-Inclusive, Risk-Informed, and Performance-Based Approach to Inform the Content of Applications for Licenses, Certifications, and Approvals for Non-

LWR Reactors, which I'll refer to as "LMP," if you don't mind, for the rest of this talk.

(Laughter.)

It's anchored to NEI 18-04, and that document comes from a set of best practices from the past, from DOE, NRC, and industry previous activities that were assembled by the LMP into four reports, draft reports, and those eventually assembled into NEI 18-04. And in its Draft Guidance 1353, the staff endorses, with clarifications, the principles and methodology of NEI 18-04 as one acceptable way to determine appropriate scope and level of detail for parts of applications. Staff makes a strong point that the proposed approach neither exempts any design from existing regulations, nor addresses all regulations applicable to nuclear power plants.

Could I have the next slide?

The LMP has three primary objectives; that is, to identify licensing basis events; to classify structures, systems, and components, and to evaluate defense-in-depth.

The first of these objectives is to identify the licensing basis events, and in the LMP these come from scenarios defined in the Probabilistic Risk Assessment, the PRA. Each of those scenarios is tested against frequency consequence goals from NEI 18-04, and if it doesn't meet the goals, the designer has to either change the design, the procedures, or some administrative criteria to bring the frequency and consequence into agreement with those goals. There's also a total integrated risk that must meet

integrated goals. And finally, the LBEs include all the AOOs, the anticipated operational occurrences; all the design basis events and beyond design basis events, which are now defined objectively by PRA frequency results.

Next slide.

The classification of structures, systems, and components. The previous approaches before LMP that led to it all talked about classifying, using it to classify SSCs, but the paper that we reviewed, the draft paper that the staff is sending to you, extends and makes operational, provides a way for applying these concepts that were expressed earlier in NUREG-1860 and the NGNP white papers.

The SSCs are selected from important risk contributors from the PRA, and special treatment for each of these SSCs, then, is assigned based on importance to risk to control the frequency and consequences of the licensing basis events.

The defense-in-depth approach again provides an operational structure for the evaluation of defense-in-depth, and we think it bridges the gap between the framework that had been presented in the past, say in NUREG-1860, and viable regulatory action. It's something that can be actually used. It provides techniques to evaluate plant capabilities and programmatic controls with risk targets met without reliance on one single element of design, program, or defense-in-depth attribute.

The approach and the motivation for defense-in-depth in the LMP is to address uncertainty in frequency and consequences, as well as

other uncertainties that are not fully characterized in the PRA or that are non-amenable to sensitivity analysis. It includes an integrated decision panel, an expert panel, if you will, and they've had a number of -- "they," the staff and representatives in industry and from the old LMP project -- have had a number of tabletop exercises, working with parts of this program. The part dealing with the integrated decision panel has not yet been fully tested in any of those.

Can I have the next slide?

Our findings and recommendations in this area are:

First, that this is really an evolution of a licensing approach that's been under development for more than 30 years. It begins with the General Atomics and DOE MHTGR application back in the eighties and the review by NRC staff, that continued with the technology-neutral framework that became NUREG-1860 in the early 2000s, and then, was revised again in the NGNP white papers about a decade later.

The approach has three objectives now, and these weren't laid out in the earlier versions. People worried, how do you replace a whole regulation? Well, the idea isn't to replace all of a regulation, but to provide a basis to select the licensing basis events, to classify the SSCs, and to address the adequacy of defense-in-depth, which can go on forever if you don't have some framework for dealing with it.

We recommended adoption of this approach in our letter to you, and we thought the guidance document was adequate to support implementation of this program, although, as in I think two earlier letters, we

said there really isn't sufficient guidance for dealing with mechanistic source terms. And by that, if you want to look, really use your PRA, then every scenario has a different source term. And the path by which you get to core damage and release, then, would set the source term, and you would have to evaluate all those. And we think that's a very difficult process, but manageable, but it needs some guidance. So, we asked the staff to develop guidance on mechanistic source term, but we also recommended that 1353 be issued for comment.

We received a letter back from the staff. We just received it a couple of days ago. So, the whole Committee hasn't reviewed it. But, essentially, the staff agrees, and they've told us separately that they are developing mechanistic source term guidance.

Next slide.

We're moving to a new paper now. This is on population-related siting considerations. Siting has a long history of technical considerations and regulatory policy that began early in the fifties. We summarized some of that in our paper on functional containment.

It begins with the existing regulatory framework, which is pretty straightforward. And that is, it defines an exclusion area, a low population zone, and a population center distance.

The exclusion area is defined by the dose that you can receive at the boundary. And that is 25 rem total effective dose equivalent, TEDE, for the limiting two hours of the accident. In that exclusion area, the

licensee has complete control. It's within their boundaries.

The low population zone is a bigger area under which the population is small enough that effective actions could be taken to protect them. And it's also a 25-rem criteria, but that's over the entire passage of the cloud, so the longer period. So, that's a bigger area.

And finally, there's the population center distance. The plant shouldn't be any closer to a densely-populated area of more than 25,000 people for one and a third times the diameter of the low population zone.

Next slide, please.

And I apologize, you're going to see a typo on three of my slides.

Reg Guide 4.7 -- and I apologize for that; I don't know how many times I looked at this, but I didn't notice it -- it was written for large reactors, large LWRs. And it includes a population density criterion that's not in the regulation, but is there and its development was based on thinking of the potential source term from a large light-water reactor. And it states that the reactor should be located so that, at the time of initial plant approval, and within about five years thereafter, a reasonable time at which you might be able to anticipate growth, the population over any radial distance out to 20 miles around the site shall not exceed 500 persons per square mile. Also, the reactor should not be located at a site with a population density that is well above this.

Next slide, please.

In looking at what could be done for smaller, newer reactors, both where we expect lower chance of core damage and we expect much smaller source terms, the staff decided no change in regulation was needed in their draft paper. And in their draft paper, they looked at four possible options.

The first one is the status quo, which includes no expected design -- I'm sorry. It gives no consideration to the expected design improvements of new designs.

The second one gives some consideration to it, and it's strictly based on power. It's a scaling based on power which gives credit to the lower power levels. It's a little arbitrary, and some important design considerations aren't really considered in that approach.

Option 3 is a dose-based approach, and I'll talk about that on the next slide.

And finally, option 4 was to develop societal risk measure, which might have some nice parts to it, but there's great difficulty to do that with widespread acceptance.

Next slide.

In option 3, which staff called its dose-based approach, it provides new guidance in Reg Guide 4.7 again for SMRs and microreactors, a small modular reactors and microreactors, the new ones. The population density criterion would be changed because they're concerned about -- they and the developer are concerned that, with some of these smaller reactors,

there is really a great desire and benefit to putting them closer to populations. And both, if they're replacing, say, old coal plants or if they're providing power to isolated areas that might have a fairly high population density, but a fairly small population, it could be an industrial site or a small area out in the country somewhere.

They propose changing the density approach to limiting the density to 500 persons per square meter, but assessed to a distance equal to twice a distance at which you could receive 1 rem over a one-month period. And this is the approach the draft paper recommended. We haven't seen the one that actually is coming to you.

When we first saw that, it seemed pretty deterministic, and we had a long discussion with the staff about this. The approach is directly related to estimates of radiological consequences from the design-specific events, which is very good, but, then, it's, in a sense, risk-informed in that the 1 rem at one mile is consistent with approaches in the RMP, and it's also somewhat consistent with the EPA Protective Action Guidelines for relocation criteria.

Next slide.

Our recommendations and findings in this area are that we agreed with the staff that option 3 is reasonable, but we note that the SECY paper draft that we reviewed is written at a very high level, and important technical details were buried in footnotes and we needed help digging them out to really understand those things I talked about that make it seem risk-

informed. We think those details should be provided in a revision of Reg Guide 4.7 with some illustrative examples, which are always helpful for people trying to use the Reg Guide.

I apologize, this is the one we just received the letter on. The staff agreed with us, but the Committee hasn't seen it. The other one, the Committee already approved.

Let's go to the next one.

This is the last of the three papers, and it's on the advanced computer code evaluations. In their evaluations, the staff looked at NRC codes. They looked at DOE advanced multiphysics codes. They looked at commercial codes and international codes.

We've reviewed the available volumes. This is a big set they're putting together. This one is a lot of work for the staff, and they were really starting on this early when we said, you really ought to focus on three and five at first. But now they're well into this review.

We reviewed their volumes on design basis event analysis, fuel performance analysis codes, and severe accident codes. In all of these cases, the staff looked for knowledge gaps, two kinds of gaps, knowledge gaps in basic physics and chemistry and code gaps in things that haven't been implemented completely in codes as yet.

In the design basis event analysis codes, those evaluate how the machine works and whether the safety functions and systems are acceptable, and if the operating limits are met. They present code maturity

scores, and that has to do with those gaps, for each of the codes for each reactor type, each of the potential codes. But, in this volume, they drew no conclusions about which codes should be used, although there is a hint that probably NRC codes would be used for most things, and for some really new approaches, they might need the detailed computational tools which they've assembled in a package they call blue CRAB, to be local. And that includes both DOE codes and NRC codes.

For fuel performance analysis, the staff compared current fuel performance codes, NRC's FAST and DOE's BISON, and recommended FAST as a staff tool for confirmatory analysis. They used the same code maturity scores this time to lay out their development plan over the next two and a half years.

In the third one, the severe accident progression codes, these evaluate fission product inventory, transport, and resulting source terms. They identify regulatory needs and development plans using those maturity scores again. And the only code they really have to use for this is their own MELCOR code.

We had looked at these over a four-month period. We had a couple of meetings with the staff. And they were really doing a lot at once. They were doing those three volumes we looked at. Each one is pretty substantial. And they were doing two more, one on licensing and siting codes and one on fuel cycle codes that we haven't seen yet. And they put together an overview, which was kind of premature because we sensed an evolving

exposition of the staff's approach. We think they've coalesced in a good place, but they need to kind of organize and pull all this together.

Next slide.

We had findings and recommendations here as well. We found that the approach supports readiness of the NRC staff to review non-LWR reactor applications and it can help the staff understand the new designs. They'll get to exercise the codes on the new designs and see how they work. They're already doing some of that and they found it very useful.

The tools for staff confirmatory analysis, we think -- and I think the staff agrees from our discussions -- that they should be as independent as practical. They need to be validated. They need to be understood by the staff, and they need to be usable on the staff's computer resources.

Third, the staff needs to become familiar with the applicant codes to support timely reviews. They're already doing some of that. Some of their people are pretty well-versed in all of the codes now.

No. 4 -- I didn't call for the next slide. I apologize. I had my head down for a minute there.

The overview report should be revised to better explain how the approach integrates the evaluations using a coherent strategy. Their approach has really been evolving. I think they're there and we think they need to document it.

We made a suggestion in our recommendations that they

could use four principles to organize all this.

The first is simplicity. Keep things as simple as you can.

Completeness. You really need to be complete and cover all the bases, especially with new designs where you can't apply the old design basis accidents. So, you have to think it through from a clean sheet of paper really.

Working the problem backwards. Start at the source term and see how much hazard there really is, and then, work back to what you need to take care of that.

And finally, scaling down the level of effort as the hazard decreases.

No. 5, the staff should perform pilot studies using relatively mature designs and illustrate how the analysis should proceed. Now they've already done some of these in tabletops, but they haven't exercised everything. So, we think if they took some of the more mature ones which they've already done, but expanded those to have a complete pilot study, it would be good.

The staff indicates that its readiness is highest for the HTGRs and the sodium fast reactors, which is no surprise. There's been work on that for a long time. But they'll need substantial development for the gas fast reactors, the heat pipe microreactors, the molten salt reactors, and the molten salt fueled reactors.

So, that's where we stand on that one.

At this point, I'd pass the baton to my colleague, Dr. Joy Rempe, to talk about our research work.

MS. REMPE: Thank you.

Good morning.

If I could have the first slide, please?

Okay. This presentation does provide an overview of the process that the ACRS uses to assess the quality of research. Since its inception, ACRS has an essential activity. That's to review NRC-sponsored research, and that includes reviews of research conducted in support of specific regulatory activities, periodic reviews of important Agency research projects, our biennial review of the NRC's Safety Research Program. And since 2004, we have conducted quality reviews of selected research projects.

As indicated in the next slide, these quality reviews provide the Agency an independent evaluation of the quality and utility of research projects, and they conform with the 1993 Government Performance and Results Act for federal agencies that desire to have their research projects reviewed.

The process that we use to conduct the quality reviews is indicated in the next slide. It starts with us, first, selecting two or three projects from a list that's proposed by the Director of the Office of Nuclear Regulatory Research, or RES. We, then, assign three of our members to a panel to complete a detailed review of the actual project. As part of their detailed review, they hold an informal meeting with the cognizant staff from

the Office of Research, as well as the program office that sponsors the user need associated with the project, to better understand its scope. The panel will then, complete their detailed review and present their oral and written report to the full Committee for an open meeting to have a peer review.

The actual quality rating assigned to the project is finalized by the full Committee. As indicated in the next slide, we do have a fairly formal process that includes some documented evaluation criteria and weights, and the value tree tries to depict those criteria.

The ACRS emphasizes two characteristics in their definition of quality: that the documentation is appropriately provided to convey what the methods used were to obtain the results and that the results are adequately documented. And then, the second characteristic, as shown on the right, is that the results should adequately meet the research project objectives. As indicated by the weights associated with the two characteristics, ACRS places a higher emphasis that the results should meet the research project objectives. And you can see that we do have a .75 weighting factor for that characteristic.

For each of the two characteristics, we have defined subsidiary performance measures that are shown on this value tree in the lower tier along with their weights. The total score assigned to the research project is obtained by multiplying the score for each of these subsidiary performance measures by their weight and, then, summing the weighted scores of the two characteristics.

The scale that ACRS has constructed, along with the scores, the interpretation of the scores, was derived from GPRA, which has an overall objective to encourage improvement. The score of 5 should be interpreted as a satisfactory score and is associated with the fact that, although ACRS does encourage improvement and excellence in research, we also recognize that the Agency has limitations with respect to schedule and costs associated with their research projects.

The next slide lists the two projects that we did review in 2018: NUREG-2218, an International Phenomena Identification and Ranking Table Expert Elicitation Exercise for High Energy Arcing Faults, and NUREG/CR-7237, Correlation of Seismic Performance in Similar Structures, Systems, and Components.

In the report that we provided to the Director of Research, you'll find that we did assign each of these projects a rating of 5, which corresponds to their being a satisfactory, professional work that satisfied the objectives of the research.

We included in our report some detailed comments that identify areas where improvement could be provided, as well as good examples that RES should emphasize in future research projects.

Our 2019 quality review is underway, and we anticipate that the letter report will be finalized and issued early next year. But I would like to also note that, for 2020, in the spirit of transformation, we're engaged with discussions with the Director of the Office of Research about an alternate

activity that might provide more strategic benefit to the Agency.

And with your indulgence, then, in the next slide, or the last two slides, I'd like to briefly discuss our biennial research review, which is a different activity that ACRS performs. Our 2020 biennial research review is underway. This review continues to emphasize the guidance that the Commission provided to us in 1997 to look at the need, scope, and balance of the reactor safety research program; the progress of ongoing activities, and how well RES anticipates research needs and its position for the changing environment.

Since 1977, ACRS has conducted formal reviews of the research program that the Agency performs, and our process has evolved over the years. As indicated in the next slide -- and I'm sure many of you will recall -- we did change our process in 2018. We still continue to address the 1997 guidance, but we also try to emphasize providing a more succinct report that heavily looks at prioritization and identification of user needs and long-term planning.

In our 2018 report, we provided some higher-level recommendations, such as the need to emphasize enterprise risk in Agency research project selection, evaluation, and termination. We also provided some suggestions for longer-term strategies that we thought would help the Agency address emerging technical issues.

In our 2020 report, we're continuing to follow the process that we developed and used in 2018, but we're also asking the Office of

Research to help us understand how they're focusing and addressing the recommendations we provided in 2018. And this effort is underway and we anticipate it will be completed and our letter report issued on or before March of 2020.

With that, I'll turn it back to the Chairman.

MR. RICCARDELLA: Thank you.

That concludes our presentation, and at this time we're available to take any questions of the members at the table as well as other members in the room.

CHAIRMAN SVINICKI: Okay. Well, thank you again for the presentations. We know that, if it becomes necessary to respond to a question, I would ask, if it's someone not at the table, we do have the podium and microphone. I think the members of the Committee are familiar with that.

We begin the question-and-answer period with Commissioner Caputo.

COMMISSIONER CAPUTO: Good morning. Thank you all for being here.

Dr. Riccardella, I understand from your remarks the ACRS has spent time discussing transformation and learning about NRC's transformation efforts. Slide 7 notes that ACRS is implementing some process improvements. Would you please expand on how you expect transformation within ACRS to fundamentally alter the nature of how ACRS conducts its work?

MR. RICCARDELLA: Well, I think there are two aspects, what I would refer to as effectiveness and efficiency. Okay? Effectiveness is implemented by things such as prioritizing our reviews. We're going to not review less important items; review what is safety-significant and risk-significant. And the other aspect is looking at our processes, as we did with the NuScale design certification review, and come up with an improved, more risk-focused approach to doing that, those reviews.

In the area of efficiency, we've implemented the ability to have Skype attendance at meetings, whereby, if a member only has one meeting to attend during the week, he doesn't have to fly here or get here from home. He can Skype into the meeting. Well, we Skype if it's an open meeting. We can't use Skype for a closed meeting. We use a private phone line, a closed phone line.

We've also, where possible, eliminated mid-month meetings. We historically had the full Committee meetings the first week of the month and, then, subcommittee meetings during the mid-week. But we've asked the ACRS staff to look at how we can try to squeeze all those meetings or more of the meetings into that one week and, then, eliminate that mid-month meeting. In fact, we have done it twice so far this year, October and December.

And finally, we've also implemented a step whereby, if we write a letter and the letter basically agrees with the staff and has no significant findings, we put at the bottom of the letter, "No formal response to this letter

is required." And that saves, I think, a lot of staff time as well as our time in corresponding on things that are just pro forma.

COMMISSIONER CAPUTO: Okay. Thank you for that.

Dr. Riccardella, you also discussed how the ACRS performs its integrated, multidiscipline reviews. Then, on slide 15, Dr. Kirchner described a review process in which an ACRS chapter lead will perform a detailed chapter review and make a recommendation to the full Committee if a briefing is needed or to include items in a focused area review.

While the process may be more efficient, it may also empower individuals to steer the Committee's agenda rather than reflecting the integration of a range of views. How do you see the ACRS balancing that?

MR. RICCARDELLA: Walt, do you want to take that on?

MR. KIRCHNER: Sure. Thank you.

Well, I perhaps went through the process a little bit too quickly. The chapter lead will write one or two or however many pages are needed summary of that particular chapter. That is presented to the entire Committee and, then, we deliberate accordingly.

But if I could back up a little bit, again, the focus area reviews, the cross-cutting reviews, are based, by and large, on the full Committee's work in the preceding phase of the DCA review. So, what you have in terms of those five focus areas I mentioned is a consensus Committee position on topics that are of importance.

Again, at this phase, phase 5, we are looking at how the staff closed open items in phase 3 -- no, sorry about the phase numbering -- from their previous SERs with open items. What is important and what each of the chapter leads are looking at is how those open items were closed. For example, one chapter, 15, had numerous open items. And so, there the recommendation going forward is for us to conduct a full review of the chapter.

But I'm reasonably confident that we're not over empowering one of our members.

COMMISSIONER CAPUTO: So, is this approach only being used at this phase of the NuScale review or --

MR. KIRCHNER: Yes. Yes, at this phase.

COMMISSIONER CAPUTO: -- is that being used more broadly? Okay. Thank you.

Dr. Bley, on slide 35 and in one of the ACRS letters to the Commission, you stated that there are four principles which should underlie a coherent evaluation strategy: simplicity, completeness, working the problem backwards starting with the source term, and scaling down the level of effort as the hazard decreases. Just in general, the staff's approach on advanced reactor designs, do you feel like their approach thoroughly reflects this strategy or are there areas where they could use this strategy further?

MR. BLEY: I think they're evolving from look in detail at everything to a more risk-informed approach. And that's what we were

suggesting. I don't think they're there yet, but I think they're moving in that direction.

That came up in our review of the computer codes and physics/chemistry that underlie them. In their first report that came out, there was more of a we just have to do everything completely and maybe we have to use the most complex computer codes to do everything. And then, there evolved -- and I might be overstating this, but this was our sense -- toward the last one they finished, much more of we ought to use the simplest tool that we can to meet the regulatory need. If we can ensure safety with a simple approach, we should do that. We understand -- I'm speaking from what they told us -- we understand that some designers may really want to use these more complex codes to optimize their designs, but you don't really need them for all safety issues now. Especially with some of the microreactor designs, for which we don't have a lot of experience yet, there was thinking from the staff that they'll probably have to go in more detail, at least until they get their feet on the ground.

But I think it's a transition period and I think they're moving in the direction we suggested. The first set of things we looked at weren't close to that. The second set, they were talking more that way, but hadn't quite been writing it down that way yet.

They were going to revise their -- this is for the codes -- they were going to revise that overview document to reflect the strategy that's evolved. They were doing these five different code-type reviews

independently because they had so much work to do, and now that's all coming together and they didn't call it lessons learned, but that's really what's happening. We look forward to seeing that overview document that puts together the strategy for what they're doing. So, I think it's moving in that direction.

COMMISSIONER CAPUTO: Okay. Thank you.

Dr. Rempe, I'd like to ask you just for some views about our Office of Research, not necessarily about the quality of specific reviews. But just in keeping with the challenge going forward of forward-looking research that we need to be pursuing with advanced reactors, accident-tolerant fuel, and other challenges coming down the pike, does ACRS have any observations or advice for the Office of Research on how to risk inform their choices of research projects to make sure that we're dedicated enough to forward-looking issues and not necessarily focusing on continuing studies where phenomena are well-known and regulation is established and adequate?

MS. REMPE: Yes, thank you.

I think when we looked and made our recommendations in 2018, the recommendation about emphasizing enterprise risk is directly pertinent to your question, to look at the importance of these projects and which ones are selected and perhaps terminated.

This is my comment. It's not in our letter. But the Agency's research process is interesting because of the user need process.

So, although the Office of Research is over all the research, they have to address the user needs provided to them. And so, although we haven't completed our 2020 review, they have started to address our request that they do prioritize, based on enterprise risk, but they can't make that decision on their own. And I do believe the Office of Research is trying to engage the various offices that provide the user needs to have them review that prioritization, because it's not just their decision.

But, again, these latter comments are my own. They're not something that the Committee has come together on. But in our discussions in the 2020 review, this is what we're hearing and understanding. And how successful they are, it's going to have to take the whole Agency to support it.

COMMISSIONER CAPUTO: Sorry, if you would indulge one quick followup? So, your communication in that respect is only with the Office of Research? You don't have any input to the other offices who would be requesting these user needs?

MS. REMPE: That's true. We do the review of the research program. And so, we are aware of the user need, and, in fact, the quality review does invite cognizant staff from the program office that requests the user need. But, no, we do not go directly that way.

MR. BLEY: I'd like to toss one thing in. In preparing that biennial review, we often have meetings with the Research staff, and sometimes in the past they've brought the people who are developing the user needs from the other offices with them to discuss it.

COMMISSIONER CAPUTO: Okay.

MR. BLEY: But it's not a formal process.

COMMISSIONER CAPUTO: Okay. Thank you.

CHAIRMAN SVINICKI: Thank you, Commissioner.

Next, we will hear from Commissioner Wright.

COMMISSIONER WRIGHT: Thank you.

Good morning. I'm enjoying the presentations. I have to smile. You might have seen me smile earlier, I don't know, but some of the things that have come before us here, at how it intersects with things that I've gone through in my life I find humorous.

You mentioned that you're a non-MIT guy sitting on that side over there. About four years ago, I had the opportunity -- I was doing a study, part of the team with the Bipartisan Policy Center, and we had to go to Boston. We were actually on the campus of MIT doing a presentation. And I called my mother that night to say I made it to Boston okay and told her where I was at and what I was doing.

And it apparently impressed her because she brought it up to her Sunday school class, apparently. And the next Sunday when I went to church, a couple of little ladies out of her Sunday school class approached me, and one told the other, said, "You know David? That's Irene's oldest son. He is a Clemson grad, and I found out last week he went to MIT."

(Laughter.)

So, I assure you I did not graduate from MIT, but,

apparently, it impressed them enough. So, if it's a rumor down there, I'm just going to let it lie.

(Laughter.)

So, Peter, I'm going to come to you first. I appreciate hearing about the ways that the ACRS has kept informed and engaged in the transformation process. And I agree with EDO and with the Chair, who both noted that transformations efforts are not about changing who we are or our mission, but changing how we do our work and improve how we achieve our mission.

So, I'd like to hear a little bit more about the ACRS's experience thus far with transformation. You talked about engaging with the ACRS and the NRC staff and current and past Commissioners on transformation. Were there any themes in the input you received? Was there a common understanding or vision?

MR. RICCARDELLA: Well, what I did was I asked in one-on-one meetings with at the time the five current Commissioners and asked them what they felt were the areas in which the ACRS has been most effective. And then, I queried by email I think eight former Commissioners, and I got responses from seven of them. They all indicated what they thought. And then, what I did is I looked for common themes, common areas that they all mentioned.

Clearly, the one that received the most votes was our involvement in risk-informed decisionmaking, that several Commissioners

opined that the most important role the ACRS can play is to continue its firm support and advice regarding risk-informed decisionmaking. So, that was the No. 1 vote getter from pretty much everybody.

The others that received multiple nods were digital I&C, research reviews, and then, new technology and reactor types, our involvement in reviewing new technology and reactor types. Of course, those things have worked their way into our prioritization criteria going forward.

Although I would say that, in the new technologies and reactor types, from the past Commissioners, they were mainly talking about things like AP1000 and ESBWR. They weren't talking about non-LWRs. But, at any rate, that's the gist of the input that I received.

COMMISSIONER WRIGHT: So, let me ask you in a more global, I guess, level. Are there any Agency-wide transformation or innovation initiatives that you find particularly relevant to the ACRS?

MR. RICCARDELLA: Particularly what?

COMMISSIONER WRIGHT: Relevant.

MR. RICCARDELLA: Relevant?

COMMISSIONER WRIGHT: Yes.

MR. RICCARDELLA: You know, I think what I find is that, as we try to implement risk-based or risk-informed decisionmaking, it is sometimes difficult to overcome the momentum that's there to just blindly follow existing regulations, whether or not they're relevant to new reactors. We just had a topic yesterday where that seemed to come up.

COMMISSIONER WRIGHT: I've got one more for you and, then, I'm going to move to the next person.

So, I want to ask you a little bit more detail on a statement you made about maintaining the right membership and expertise on the Committee. You mentioned that maintaining membership with expertise covering the breadth and risk-significant issues is mission-critical.

MR. RICCARDELLA: Uh-hum.

COMMISSIONER WRIGHT: Has that been a challenge and, if so, what type of expertise has been most difficult to find? And why do you think that might be?

MR. RICCARDELLA: Well, because of the recent retirements, we are -- you know, one of the most important areas, as I mentioned, is risk. Right now, we have two members that are risk experts in PRA and risk, one of whom is Dr. Bley who has been trying to retire. But he has agreed to stay on until we get another risk expert onboard, so that they can overlap for a period of time. And so, that's one area of need.

And two of the recent retirees are people who have industry and plant management and operation experience. And so, we've gone from three people with that kind of background to one. So, that's the second area that we feel we need to fill.

COMMISSIONER WRIGHT: So, I guess for you or anybody else, since we're talking about the membership and the needs that you might have, are there any reviews that are on hold or that are being slowed

down because the ACRS doesn't have the experience to review it?

MR. RICCARDELLA: We haven't come across that yet. But I think if our risk expertise is gone, gets too low, that will happen.

MR. BLEY: Can I chime in?

MR. RICCARDELLA: Sure.

MR. BLEY: I want to chime in. If we hadn't gotten Dave, whom you just welcomed, at the time we did, we would have had some trouble. We would have been scrambling probably for a consultant in some of the areas he covers. He picked up some of the areas Dana Powers used to cover for us which were unique to Dana. So, that one wasn't a problem, but we came close to needing to go get some help that we hadn't done yet.

COMMISSIONER WRIGHT: Okay. Thank you.

All right. I want to go next to Walter. How you doing, sir?

So, thank you for the background on NuScale and the review that's going on, what's your all's involvement in it. And I'm glad that you're looking at lessons learned from past reviews and you're going to look at a way to do things more efficient and effective and safety-focused. I like that.

On your slide 14, which you noted that is on the phase 5 review about the cross-cutting review, I want to hear a little bit more about that. Who determined which items were cross-cut? I mean, was there agreement about which items were going through that process?

MR. KIRCHNER: The Committee. The answer is the

Committee as the whole determined that it's relevant to Commissioner Caputo's question as well.

Those are themes that actually derived from our phase 3 review and our letter reports and recommendations, and the Committee deliberated on these. So, you would see that -- I have with me all of our NuScale letters -- you would see that these five topics appear multiple times in multiple letters. So, these are areas where, also, the staff in their initial review, their initial SERs with open items, also had open items that touched each of these areas. So, there is considerable background. This is not an arbitrary list and it's certainly not one that I derived. It was the work of the Committee as a whole.

COMMISSIONER WRIGHT: Again, further on in your presentation -- I think it was on slide 17 -- but you talked about that it was more efficient and it was less resource-intensive. You think you saved some resources?

MR. KIRCHNER: Yes.

COMMISSIONER WRIGHT: Do you have any sense as to how much or what type of resources you saved?

MR. KIRCHNER: Well, I can give you an example without trying to rigorously quantify it. In the first review of the SER with open items, we did it chapter by chapter. Typically, that would require at least a handful, but on the order of five representatives from the applicant as well as five or more experts from the staff in each of the areas.

I'll pick one as an example. When we review Chapter 2, you've got all what I call the "ologies," meteorology, geology, seismicity, et cetera. So, this takes a large number of both applicant and staff attendance at a meeting to go through this and the travel and other time and effort/costs that are associated with it.

So, I would submit that in this second go-round, if you want to think of it that way, in phase 5, that the level of effort is probably at least halved in terms of cost and time and effort. And yet, I think the review is enhanced because -- and I'll give you an example of what was happening this very week -- we took up source term. Now there's the source term methodology report, a topical report that we were reviewing, but at the same time we had presentations on where that topical report touched base in the FSAR. And it turns out there's quite a few different chapters.

So, what we were able to do is have the right staff there, expertise, to go through in the same meeting the implications of that source term topical report, how that methodology plays out in a review of FSAR Chapter X, and Y and Z. And it's several chapters.

So, I believe that that worked out quite well. And we had rather an interesting meeting yesterday, and you'll have a letter report on that. So, that will be the first test of, if you will, this focus area approach.

COMMISSIONER WRIGHT: Thank you so much.

And I'm out of time, Madam Chairman. Back to you.

CHAIRMAN SVINICKI: Thank you again for your

presentations. In the time allowed to me, I'm going to have to down-select a little bit. But maybe what I'll do is talk about kind of what I'm thinking and reacting to as I, of course, read your letter reports over the course of the year, but when I listened to what you've highlighted here this morning. I think a lot of it is thematically related.

I mentioned kind of the origin story of the ACRS, and, of course, it goes back to the Atomic Energy Act. And so, when I think about what the Committee is advising the Commission on, the various topics that you've highlighted today, it's not so different from what the Agency as a whole is going through as it attempts to navigate a changing dynamic of the industry regulated which has the potential to shift somewhat dramatically here or present to the regulator a broader diversity of topics and systems to be regulated, whether they be reactors or advanced fuel types, with different materials maybe needing different tools like different codes. We talked about that today. So, fundamentally, requiring a pivot in the research program that Dr. Rempe talked about reviewing.

And so, my colleague was just asking you kind of about the composition of the Committee, the retirements you've had. It's also different from the Commission itself. So, the Commission, under law, is comprised of a certain set number of people. It is not enough people. The five people, no matter how brilliant they might be, could not possibly replicate the NRC staff's work. And yet, we have to arrive at fundamental conclusions about the adequacy of that work, about the appropriateness of the approaches that the

staff proposes to take to things.

The ACRS, as our advisory committee, is opining on those same areas. So, the law sets you at a maximum number of members. It's not quite the same as fixing you at a level, as we are fixed.

If the pivot for the Agency in reactor space is that you regulated 100 machines that substantially looked the same, now you might be asked to form safety and security judgments on a lot of different types of machines, and there might be fewer of them. We don't know, but they're going to look different. They're going to have different materials incorporated. They might require different computational work to arrive at these designs.

And so, the ACRS, again capped at a certain number of members, can't have a materials expert for molten salt and, then, also a criticality expert for molten salt. And then, you multiply that times the number of different reactor types. You have to kind of arrive at a composition, a skills composition, for the ACRS. And then, you also have to have methods of applying that capacity that are going to help you get to advising this Commission on this work scope that might be more diverse.

It also might be smaller. That's the other thing that I think is a complexity that my colleague's question raises. Is that, if the Agency as a whole gets smaller and has less work hours, you know, less work to do, should the ACRS size be scalable to the amount of regulatory work in front of the Agency? I ask that. I honestly don't know the answer to that question. I know that, under law, the Commission is not scalable. It's not like if there's

very little nuclear program in the U.S., there's only two members of this Commission. That's not how it works. So, I don't know the answers to those questions.

But I do think it's a worthy challenge for the ACRS to say -- getting all the way back to your transformation retreats that you held, I wasn't present and I don't know how broad-ranging your deliberation was as a group. But, for the ACRS at least, I'm almost think that the possible landscape that the NRC will confront that you will need to advise the Commission about could be closer to the people back in the 1960s who served on the ACRS, because you're facing maybe some more foundational uncertainties about the designs of new reactors, the tools being used to design them, and then, commensurate at the NRC side, the tools being used to assess the safety case for those new designs or fuel types or other things.

So, I think we both confront that. And I'm very heartened to hear Dr. Rempe talk about or telegraph to us that, in looking at the research program, you're entertaining with NRC's Office of Research how can we be giving strategic insights to the Commission about the marriage of maybe user needs identified research that is proposed to be done, and getting to the safety determinations. And I think baked in that, I hope, will be the element of readiness when we're looking at codes.

I have found myself in many discussions, different constituencies, but some of them, I'll admit, are Members of Congress who have to fund both DOE's work to prepare the country for potential advanced

reactors and NRC's work as well. And there's a lot of pushing us to use the tools that the designers and DOE are using. At first, I thought, well, that sounds like some good economy and some good fiduciary there.

But, then, I talked to the NRC staff and I heard what was presented by the ACRS today, and they're like: I don't need that in order to reach the safety conclusions. It's reasonable assurance of adequate protection. I'm not redesigning these reactors. I'm not a design consultant to advanced reactor vendors. So, why don't I just develop tools that get me what I need?

It's such a fundamental tension because, on the other hand, I thought, well, if the stuff that's more than you need is available, could you use it? So, I don't know the answers. But when I think about the ACRS advice, those are areas where your perspective would be super-helpful to me, just as an individual member of the Commission in trying to assess, as I said, the sufficiency of the staff's review, the adequacy of the approaches that they're going to take.

And so, maybe I'll pause there, since I did a lot of talking, and ask you if you want to react to anything.

Dr. Bley, the vision and strategy for non-light-water reactors has been out for a while, and then, the implementation plans. Did the Committee take any view of whether or not fundamentally stepping back three years on from publication of that, or four years or five years, would it benefit the NRC staff to look and see if the vision and strategy, maybe it could be

streamlined; maybe it could be simplified? Maybe the assessment of all of these different areas of focus, maybe four years into implementing, you would take a different view. Did the Committee talk about that at all? It wasn't really in your letter report. But would a refresh on that be useful at some point?

MR. BLEY: You know, I think a refresh is always useful.

The staff, has so far in the things they've brought to us, they were the things, have been the things we thought were the most important and we thought they needed to get right, to do this right.

CHAIRMAN SVINICKI: Yes, it is hard to argue with any of the areas, but I'm just --

MR. BLEY: But some of the other areas, I don't know that they would ever come to us, and we haven't dug into the ones that we hadn't pulled up at first when we looked at it. So, we could take another look, and I suspect, I would expect the staff has been doing that, but I don't know if they have or not. We haven't talked about the overall plan in a long time.

CHAIRMAN SVINICKI: And on that, and the codes and the research program, in the back of my mind is the fundamental concept of regulatory readiness. And I think that this is not direction, but I would just, as a recipient of your advice, say that, as you are looking at various areas, if the Committee formed a view of whether or not the activities the staff proposes to undertake will be getting the Agency to regulatory readiness, given the letters of intent and other things -- I mean, we've got some very novel things being

talked about by vendors, being submitted in 2020.

MR. BLEY: That's true.

CHAIRMAN SVINICKI: My time as Chairman, I'm just in my third year, but I have had to engage a lot of constituencies on our readiness, on advanced reactors. And I think we've been talking about chipping away at progress on the same things. So, there is readiness timely to need, and I think that the Committee could possibly have an expert view on some specifics of whether or not it will to get pace, which I know kind of gets to the management of the staff's work, which is an area that the ACRS kind of keeps itself separate from.

But I think technical readiness, technical regulatory readiness by the Agency, is interrelated to the pace at which they are moving. I know you often look at staff priorities. Prioritization becomes a key thing, and not just readiness, but is it going to be timely readiness for the way things are going?

And then, as I said, Dr. Rempe, I appreciate that the Committee is willing to explore on the research side whether or not the research program is plugging into the rest of the Agency's regulatory work in a way that will bring things timely to need, to support the licensing organizations in what they're trying to do.

And I know it sounds like a corporate or management judgment, but I actually think that it is an area where the Committee could really be helping the Commission with offering an assessment on that.

Did you want to say something quickly, Dr. Rempe?

MS. REMPE: Well, just briefly. I don't want to take any of your time. But I note that, when we were doing the DOE code reviews, we were in the midst of our biennial review and we actually did have the Division of Systems Analysis come and talk to us. And a lot of the discussions were similar and the same individuals were there. We probed more deeply.

I think that's where a lot of the recommendation came regarding emphasize simpler tools for these small reactors that are supposed to have increased safety margin. So, there is a lot of synergy in our reviews that way, and I think a lot of the revised approach may have happened between that meeting and the next meeting on the codes, and we are all looking forward to that overview document. And the implementation of the reference plants that Dr. Bley mentioned to assess the readiness will provide some great insights on where we are with respect to our tools.

MR. BLEY: Just a couple of more things in this same area. I had the sense -- when we first got started talking about the codes, we had DOE come in and brief us on the things they have been doing -- that we've got to use all this new stuff. And there was an early layout of, gee, we're going to use this set of the DOE codes and we're going to use this set of the NRC codes. Over time, the staff has evolved saying, do we really need that? And we had been kind of pushing that from the beginning, and I think that's true. That other meeting was symbiotic with the ones we were having here.

I just looked over everything in their plan. The six things

we've reviewed I think are the guts of it. I think they're well on the way. And I think we would still say those are the guts. The other pieces, a lot of that has been done or it's kind of continuing work, but these six are the ones that set them up to be able to look at new things coming in. And you have at least one coming in next year for sure -- well, as sure as that gets. But we're already seeing some of the products for one of the new designs. So, I think they're ready for it.

CHAIRMAN SVINICKI: Okay. And I appreciate that.

I'm over my time. I'll just kind of sum up by saying that I appreciate the Committee's dialog about transformation. The Agency in its regulated work does face a pretty dynamic landscape and would benefit from the ACRS continuing to look at not only any kind of judgments you feel are appropriate for you to render on whether or not what we're proposing to do will get the Agency technically where it needs to be to render these kinds of safety judgments, but also that you continue to be open to looking at ACRS processes and say, as NRC adapts, is there anything about the way we engage and appreciate the changes on the NuScale? But I could see that continuing to evolve. NuScale is, I often call it with the staff, the training wheels, because it looks like the work we have been doing than things that are going to come will look like that.

So, thank you for that. With that, thank you.

Commissioner Baran, please proceed.

COMMISSIONER BARAN: Thank you for all your work.

It's clear from the stack of letter reports you've generated, and the quality of those reports, that ACRS has had a productive year.

I'd like to get your thoughts, either collectively or individually, on the issue of population-related siting considerations for SMRs and non-light-water reactors. Dennis discussed your review of a draft staff paper that looked at some options for changing the regulatory guidance in this area. And as he mentioned, right now, NRC's guidance says that a new reactor shouldn't be sited at a location where the population density exceeds 500 people per square mile within a radium of 20 miles.

In the draft paper, the staff recommended what was in that paper called option 3, an approach where this population density restriction would only be considered out to a distance equal to twice the distance at which an individual could receive a 1-rem dose over a month in the event of a postulated accident. So, if a future reactor was much safer than an existing light-water reactor, had a much smaller source term, the reactor could end up closer to a more heavily populated area than the current 20 miles. And ACRS thought this approach seemed reasonable.

My understanding is that, when the guidance was originally developed before large light-water reactors, the Commission explicitly intended for siting to be an element of defense-in-depth that was independent of plant design. The staff's recommended approach would move away from that principle because it would depend on reactor design. The models and calculations used for the safety analysis would also be used for the siting

analysis.

How do you all think about that independent defense-in-depth factor, whether it's important for it to be independent, whether that still makes sense today or not?

MR. BLEY: I'll jump in, and this is my own opinion. Well, you have the Committee's opinion in the letter. So, we've indicated as a group that we think it's time to look more closely at that. I mean, back at the time that was developed, we, you, everyone thought 500 megawatts, 1,000 megawatts, and up. Nobody was thinking about 100 megawatts or even much, much smaller. And so, the thinking that went into it was really aimed at these. And the thought about what should you look at for a source term was anchored to a large LOCA and, for no particular reason, the core melts completely, and what happens, and with no consideration of likelihood or anything else. Well, that's just clearly not, to me, it's clearly not sensible for some of these very small designs to use that approach.

The idea of siting as defense-in-depth I think makes sense to me, and you need to consider it, but not assuming there's something there that's not there. That's a simple cut.

COMMISSIONER BARAN: In kind of trying to figure out the contours of the defense-in-depth, for a reactor that had a 1-rem accident dose at the site boundary, and maybe the site is pretty small -- we're not talking about a lot of distance -- would this approach essentially drop the guidance's population density restriction? I mean, if you double a very small lot, it's not

very much amount. And so, the population density restriction is very small at that point, right?

MR. BLEY: It would certainly get very small. Now, if we go way back, we started just putting these things out in the desert as far as we could and used a criteria that the predecessor to this Committee developed. And you get many, many miles you have to be away, and as you start making bigger ones, extremely far away. And then, we went to containments and to emergency safeguard features, and that allowed us to get back closer to populations.

But I forget when it was -- in the sixties? -- Ravenswood was going to be right in downtown New York. It didn't make it. We had not been happy about that, or our predecessors hadn't. Indian Point is 30 miles away. That's a little different.

But some of these very small ones, we haven't seen them yet. So, I think judgment for us has to wait until we really see a design. But if you really can get the bad accident and the dose is only 1 rem at the fencepost, I mean that's pretty low. I think it's easy to control.

But you have to be careful that we -- your folks as regulators; we as overseers, and the people designing it -- have been very creative and thoughtful in thinking of what accidents could happen. And that's not replicating the accidents that apply to big reactors.

COMMISSIONER BARAN: But this is kind of a philosophical question. The Committee's letter included observations I found

very wise. And so, I'll actually just quote you the three sentences.

"There is a tendency to believe in the perfection of new designs, especially when they are developed to eliminate the dominant failure scenarios in existing designs. However, one must remain vigilant. Remember that Nature provides surprises. There will be new accident scenarios and new combination of events to be considered that challenge our expectations and our assumptions about these advanced reactor systems."

And then, when I think about the recommended dose criteria approach, it assumes that we have a fairly comprehensive understanding of the risks of a new design. Do you see any tension between that general cautionary statement about imperfect knowledge and, then, the dose criteria approach to siting?

MR. BLEY: I see tension, but I think it requires wisdom and care. I mean, we put research reactors in downtown Cambridge, other places.

We reviewed the NIST reactor a few years ago, and then, you issued a license continuation, or whatever you call it, renewal for them. And their approach was to say, we let everything go that's in this reactor, and they have very small doses nearby. And kind of everybody said, yes, okay, if you can take kind of the worst thing you can do with this and it's not very bad, then you can have people much nearer to it.

I think that principle has been there since we started building containments and building engineered safeguards. We've now entered a

realm where we're getting some designs that are very small, and we haven't seen them yet, but we anticipate that they are going to be extremely small. We'll have to see what kind of doses can exist from that.

That's why we recommended you start from what's the hazard, the source term; what's the most you could get if you had it all? Then, start looking at your safeguards and your other things, but start from the little hazard.

COMMISSIONER BARAN: Another option discussed by the staff was option 2. It would base the size of the siting restriction on the size of the source term. And if I'm trying to think through pros and cons of different options, I could see how that would lessen the restriction for microreactors and small reactors. It basically accords with the principle of siting being independent of plant design, and it has the virtue of being relatively simple.

I gather from the Committee's letter and your comments earlier, though, that you all weren't really that impressed with this alternative. Can you share a little bit of your thinking about option 2 and focusing just on the source term as the key factor?

MR. BLEY: It's really just, first, it's assuming the source term ratios with the power level. It's assuming that the isotopic content and the form of a radiation you could get would be similar to what we've seen before. And I think those are things you need to think about. And it's probably a reasonable first cut, but I think there's much more.

And then, if we're going to really be doing what the LMP suggests, and really being careful that we're thorough, some things will get left out and they'll get picked up later. But you've really pushed the boundaries to make sure that you're considering the right accidents. Then, one ought to take some advantage of that and look at what's the best estimate you can make of the source term. We're not talking about using some of these extremely difficult codes to use. They're getting less difficult to use, from what the staff tells us who have been using them. But I think that's enough, yes.

COMMISSIONER BARAN: Okay. And I'll just ask about the other option discussed by the staff, which was to develop societal risk measures that considered factors beyond potential dose to individuals, such as economic and population displacement impacts of a postulated accident. I get the sense you were intrigued by this option, but thought it would be difficult to implement.

The Committee mentioned that land contamination could be suitable surrogate for societal risk and could potentially be incorporated into the dose criteria approach. Can you talk a little bit about the pros and cons of the societal risk or land contamination approach and whether you see a practical way to pursue that kind of approach?

MR. BLEY: I think there's a practical way to calculate it. I think it's important to consider. Yes, I've been involved in some work a long time ago trying to actually do this. I think where you run into trouble is when

you try to get multiple groups of citizenry, including stakeholders of all sorts, to agree that you've got the right societal risk factors and that you're evaluating them properly, and you're evaluating them most properly for the different populations in the area.

I just had a thought this morning, though, with some of these microreactors, if you're putting them in a higher density place, but small population, you're now providing both the risk and the benefits are accruing to the same people, which doesn't happen with the large reactors. And then, various other issues come up that complicate those kinds of goals.

COMMISSIONER BARAN: Great. Thank you very much. I enjoyed the discussion. You really probably should be earning time and a half today for it, contributing to different reports like that.

(Laughter.)

Thank you.

CHAIRMAN SVINICKI: Thank you.

Before we close, did any colleagues seek to have a short followup?

(No response.)

Okay. No? All right.

I think, for members of the Committee, again, thank you all.

And please don't run out of the room because I think there is a requested post-meeting photo of the ACRS member and the members of the Commission.

I just want to note that, often, you shouldn't let things get under your skin and you should kind of let them just slide off you. At least that's advisable these days. But the work of the NRC was criticized in something that was published this week, and I don't want to talk about it at length. But there was a statement in there that I can't move past. And it indicated that the use of engineering judgment is little more than mere wishful thinking. And so, I just disagree with that.

And I note that the ACRS often talks about the validity of the engineering judgment that the staff is making. So, I alert you that the use of that as a tool is under some sort of broadside attack. So, we all need to be thinking about it. I'm not really sure how we would do a lot of what we do without the use of engineering judgment and expert elicitation. But it's part of the challenge of public communication that we confront, I think.

With that, I guess I shouldn't have left that out there as a hanging chad. It's kind of a down note to end this meeting.

(Laughter.)

Thank you all, all the Committee members, for the work you do.

With that, we are adjourned.

(Whereupon, at 11:42 a.m., the meeting was adjourned.)