Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: 662nd Meeting, Advisory Committee on Reactor Safeguards (ACRS)

Docket Number: N/A

Location: Rockville, Maryland

Date: April 4, 2019

Work Order No.: NRC-0261 Pages 1-281

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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662ND MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THURSDAY

APRIL 4, 2019

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T3D50, 11545 Rockville Pike, at 8:30 a.m., Peter Riccardella, Chairman, presiding.

COMMITTEE MEMBERS:

PETER RICCARDELLA, Chairman

MATTHEW W. SUNSERI, Vice Chairman

RONALD G. BALLINGER, Member

DENNIS BLEY, Member

CHARLES H. BROWN, JR. Member

MARGARET SZE-TAI Y. CHU, Member

MICHAEL L. CORRADINI, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

HAROLD B. RAY, Member

JOY L. REMPE, Member

GORDON R. SKILLMAN, Member

ACRS INVITED GUEST:

DAVID PETTI

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

HOSSEIN NOURBAKHSH

ALSO PRESENT:

BRIAN ARNHOLT, NuScale

MICHAEL CASE, RES

MICHAEL CHEOK, RES

ALEXANDER CHERESKIN, NRR

SARAH FIELDS*

RAYMOND FURSTENAU, RES

SCOTT HARRIS, NuScale

RAUL HERNANDEZ, NRO

ZACH HOUGHTON, NuScale

RON LaVERA, NRO

NICHOLAS McMURRAY, NRO

CORRIE NICHOL, NuScale

RYAN NOLAN, NRO

ZACKARY RAD, NuScale

ALEXANDRA SIWY, NRO*

ANGELO STUBBS, NRO

ED STUTZCAGE, NRO

OMID TABATABAI, NRO

GETACHEW TESFAYE, NRO

BRIAN THOMAS, RES

ROBERT VETTORI, NRO

*Present via telephone

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P R O C E E D I N G S

(8:30 a.m.)

CHAIR RICCARDELLA: Good morning. The meeting will now come to order. This is the first day of the 662nd meeting of the Advisory Committee of Reactor Safeguards.

I am Pete Riccardella, chairman of the committee.

ACRS was established by the Atomic Energy Act and is governed by the Federal Advisory Committee Act or FACA. The ACRS section of the U.S. NRC public website provides information about the history ACRS and provides FACA-related documents, such as our charter, bylaws, Federal Register notices for meetings, letter reports, and transcripts of all full and subcommittee meetings, including all slides presented at the meetings.

The committee provides its advice on safety matters to the Commission through its publicly available letter reports.

The Federal Register notice announcing this meeting was published on March 18, 2018 and provided agenda and instructions for interested parties to provide written documentation or request opportunities to address the committee, as requested

by FACA -- as required by FACA. In accordance with FACA, there is a designated federal official for the meeting. Today's official is Mr. Michael Snodderly.

During today's meeting, the panel will consider the following: NuScale's design certification application and the NRC staff's safety evaluation report for Chapters 9, 10, 11, 12, and 16; the Biannual review and evaluation of NRC's Safety Research Program, and preparation of ACRS reports.

As reflected in the agenda, portions of the sessions on the NuScale design and certification application and the NRC staff's safety evaluation reports for Chapters 9, 10, 11, 12, and 16 may be closed in order to discuss and protect information designated as sensitive or proprietary information.

There is a phone bridge line. To preclude interruption of the meeting, the phone will be kept in a listen-only mode during the presentations and committee discussions. We have received no written request for comments or requests to make oral statements from members of the public regarding today's sessions.

There will be an opportunity for public comment, as we have set aside ten minutes in the

agenda for comments from members of the public attending or listening to our meetings. Written comments may be forwarded to Mr. Michael Snodderly, the designated federal official.

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

The committee would like to introduce and welcome Dr. David Petti, our invited expert. Dr. Petti is not yet a member of the committee and, therefore, will not participate in deliberations. However, we want to take this opportunity to welcome him to ACRS. And hopefully, he will be joining us soon as a full member.

With that, I would like to officially start the meeting and I look to Mike Corradini to kick it off, please.

MEMBER CORRADINI: Okay, thank you very much, Chairman.

So as the members know, we are going through the Phase 3 part of our review of the NuScale DCA on staff's review on it with open items. And today, we have five chapters. So it is a

challenge for both NuScale to present certain items from our subcommittee meetings, which we had in previous on March 20th and 21st, as well as the staff's review of their SERs for all five chapters.

So I am not sure which of NuScale I should point to to start you guys off. Is it Zach?

MR. HOUGHTON: Yes.

MEMBER CORRADINI: Zach, take it away.

MR. HOUGHTON: Thank you very much. For a quick introduction, I am Zach Houghton, the Mechanical Design Engineering Manager with NuScale Power.

MR. HARRIS: I'm Scott Harris, Mechanical Systems Supervisor.

MR. NICHOL: Corrie Nichol. I'm in the Remote Handling and Refueling Group.

MR. RAD: I'm Zack Rad, Director of Reg Affairs, NuScale Power.

MR. HOUGHTON: All right. So I want to say first, thank you very much to the committee for allowing us this opportunity to come back. We just wanted to come back in this full committee presentation today to provide a little bit more design information on the reactor building crane, the reactor building pool, and the pool liner.

Hopefully, in this we can address some of the specific comments that we heard during the subcommittee meeting.

And really the goal here is to provide some more design information on the fundamental designed-in protection features of the crane. We are going to give a little bit more information on the testing and ITAAC associated with the crane that is in our design certification application. And we are going to talk a little bit about the defense-in-depth features that we have designed into the plant, again, to address some of the specific comments that we received.

And so with that, I will turn it over to Corrie to talk about the crane.

MR. NICHOL: Okay, so this first slide is really a summary, sort of a review of what we talked about last time.

I wanted to mention that the reactor building crane is designed to be an ASME NOG-1 Type 1 crane, which meets the NUREG-0554 requirements. It is also designed to be a Seismic Category 1, which means that it is required to withstand the stresses of an earthquake, as well as being required to retain the load in the event of an earthquake.

The movement system uses redundant position control system interlocks and I will talk about those more in more detail.

The reactor building crane was deemed to be risk-significant, which kicks it into the Part III of our quality control program. Essentially, this includes the appropriate augmented requirements from the specific requirements for the quality control of the crane are spelled out in SRP Section 9.1.5, NUREG-0554 and 0612, and Reg Guide 1.13.

The reactor building crane is non-safety because it was deemed to not perform any of the functions that meet the regulatory definition of being safety-related. Having said that, the design standard, the ASME NOG-1 Type 1 design standard is the best standard that there is for cranes, the most conservative design standard that there is for cranes -- the most conservative design standard that there is.

MEMBER SKILLMAN: Let me ask this, please. Safety-related is really focused on integrity of the reactor coolant system pressure boundary, the ability to shutdown, cool down, and prevent offsite release.

You stated just a minute ago that the

design of the crane is Seismic 1 that includes holding the load under design-based earthquake.

Is there any instance where the load can get away and any of the three requirements that are part of safety-related in Definition 50.2 can be violated?

MR. NICHOL: So that is really a question about what performs those safety-related functions and the things that perform those functions are components of the reactor module itself, not components of the crane.

MEMBER SKILLMAN: Yes --

MR. RAD: If I might, for a second. Sorry, this is Zack Rad.

This really is about the strict definition of safety-related. So because the postulated events involving the reactor building crane and the module fall outside of Chapter 15 and design-basis events, the reactor building crane doesn't meet the definition of a safety-related SSE. However, as Corrie pointed out, it is still designed to the highest standard for overhead gantry cranes in the nuclear industry.

CHAIR RICCARDELLA: Could we go back one slide, please?

You know you listed all these augmented requirements that you applied. Would you do anything differently if the crane were designated safety-related?

MR. RAD: In terms of design and construction, the answer is no.

CHAIR RICCARDELLA: Okay, thank you. But you qualified that in terms of operate -- then what would be different?

MR. RAD: In operating, also no. There would be an increased burden with no commensurate increase in safety. That is our position.

CHAIR RICCARDELLA: Okay, thank you.

MEMBER BLEY: I have a follow-up question from our subcommittee discussion about this and other items which are not safety-related and we are told, therefore, don't come under tech specs. But if they are risk-significant, they ought to come under some form of special treatment that to me is sort of like tech specs.

So, does the crane come under any of those criteria?

MR. HOUGHTON: Well, some of that would be determined during the -- you know in the plant program space. So that would be up to the applicant

but we would expect that it would be under maintenance rule program. The applicant will have to develop the maintenance rule program. So we would expect it to be in there.

There are also ITAAC associated with the reactor building crane. So that is something that would be unique because of its risk-significance and our recognition of its importance in the design. And we will talk specifically about what those ITAAC are in this meeting today.

MEMBER SKILLMAN: Thank you.

MEMBER RAY: Just to be clear -- I think you have been clear but to reinforce it, this is something that is not part of the spec and scope of supply but is the responsibility to procurement by the COL holder. Is that right?

So we are talking about requirements that that license has to meet or that applicant has to meet.

MR. HOUGHTON: Correct, the requirements in the design certification would have to be met by the applicant.

MEMBER RAY: And by the applicant, you mean the COL applicant.

MR. HOUGHTON: Yes, the license holder

for the plant.

MEMBER RAY: Correct. Okay, thank you.

So the point is it needs to be clear in this certification what the requirements are that that entity has to meet.

MR. HOUGHTON: Yes, we agree. And again, a lot of these requirements that we will talk about fall under the auspice of calling it NOG-1. So this slide will give some more detail on exactly what that means but that does set a series of very strict requirements that the applicant will have to meet.

MEMBER RAY: Okay, that's the point. Thank you.

MR. NICHOL: So I wanted to give a brief overview of the interlock system and the control system of the reactor building crane but I want to make it clear. So there is a user interface software control system that operates on the crane. What we are going to talk about though, is independent of that.

There is a separate system that operates on PLC to control all of the limit switches and the interlock systems. So the crane itself has redundant hoist overtravel limit switches. That

includes upper limit switches and lower limit switches, has redundant hoist overload systems. It has interlocks to detect slack rope and drum rope mis-spooling, hoist overspeed, unbalanced load.

There is also an interlock system related to the use of the fuel handling machine. When the fuel handling machine is active, the reactor building crane, which shares some of the space in the refueling pool, is prevented from accessing that space in the refueling pool to prevent interaction.

The bridge and the trolley also have overtravel limits.

And we mentioned this in the subcommittee, there is a restricted path and handling -- restricted handling path and speeds. I mention the speeds on the slide there, 30 feet per minute per traverse and two feet per minute per hoist. Those are controlled on this secondary PLC system. And of course, there is an operator in the loop.

I would like to point out, though, that in all of our analyses, the operator action was not credited for preventing any unwanted scenarios.

MEMBER BROWN: Can I ask a question?

The redundant limit switches, the way it is phrased, I presume these are mechanical and independent of any software PLCs or are they programmable type when it switches which utilize software?

MR. NICHOL: These all operate on the PLC system.

MEMBER BROWN: So they are controlled by your software, basic software, and the same, I guess, would apply to the interlocks.

MR. NICHOL: Right. That's correct.

MEMBER BALLINGER: Is it possible for these to all be defeated by a human?

MR. NICHOL: Of course --

MEMBER BALLINGER: Even a non-human.

MR. NICHOL: Of course a determined person would be able to defeat the limit switches but there are redundancies in the design. It would take a concerted effort for someone to defeat the interlock systems.

MEMBER BROWN: My memory is going back to the instrumentation in your MCS, your module control system network, where most of these systems process through that network. At least based on the latest responses we got from you, all that network is now isolated from the plant network via a

hardware-based one-way unidirectional communication. So there is no connection to the internet.

So a compromise of the network was you could get into these PLCs and modify the software, or override, or take control of the interlocks should be only susceptible to internal administrative control type stuff. Am I working? Is my brain calibrating this correctly?

MEMBER CORRADINI: You're asking is your memory correct?

MEMBER BROWN: Yes. I think I brought this up in the last meeting we had and I'm just -- now, you've been a little more complete with the details here and that's why I'm trying to calibrate myself.

You know one of the biggest concerns we have had is external access. Internal access has always been administratively controlled. So the only failure is if you've got isolation from the outside world, in other words, nobody can connect into that network, then you are really subject to software failure -- I don't want to call them software failures. There is no such thing as a software failure, all hardware, by and large, memory locations.

MR. RAD: We have got an SME in the audience that can help answer this separation question first.

MEMBER BROWN: Okay. It's not -- I guess my point being is how redundant is -- is your PLC a single operation type circumstance or are there redundancies in it in terms of how it operates? In other words, a single command cannot tell it to do this, that or the other. There is something else that monitors that independently, that is independent of the basic operational software.

I didn't see -- there was no mention of this in your DCA.

MR. ARNHOLT: I'm Brian Arnholt with NuScale Power. I can answer your first question regarding --

CHAIR RICCARDELLA: Can you get closer to the mike?

MR. ARNHOLT: I'm Brian Arnholt with NuScale Power.

I can answer your first question regarding the security of the system. For this particular system, an adversary would have to have -- would have to break multiple physical security

barriers and administrative barriers to get access to the system. So you are correct. You understand this correctly.

MEMBER BROWN: Based on the response we had in the Chapter 7 stuff, I understand that network is isolated.

MR. ARNHOLT: That's correct.

MEMBER BROWN: So it is internal administration.

My concern now is that all of these interlocks and the redundant limits, if they are all controlled by software, what type of software -- what have you all requested or how do you make sure that that software has some redundancy within it so that a single command failure can't result in overriding or actuating crane operations, or interlock, or limit switch operations?

MR. ARNHOLT: And I will maybe let Corrie speak to the details but the NOG-1 standard, if I am correct, governs the requirements on how you design those systems.

MEMBER BROWN: NOG-1 is --

MR. NICHOL: So specifically to your question, there is a software operating system for the crane. That is independent of the PLC system

that handles all of the interlock systems and the limit switches.

MEMBER BROWN: So there is two different sets of processes, in other words.

MR. NICHOL: Correct.

MEMBER BROWN: Two different systems associated with that, then.

MR. NICHOL: That's correct.

MEMBER BROWN: They are not built into the normal operating pick up, move --

MR. NICHOL: No. No, these are all independent of the normal operating system, the normal commands/functions that are used to control the crane.

So this is a redundant system to the user interface normal operating system.

MEMBER BROWN: Okay. Is it one PLC then that would control all the redundant limit switches and all the interlocks?

MR. NICHOL: It is.

MEMBER BROWN: So a single command failure within it could --

MR. NICHOL: So within that PLC, that is correct, but these are also implemented in the user interface control system. So a single --

MEMBER BROWN: I don't know what that means.

MR. NICHOL: Well, the control system is going to have limits programmed into it and specific commands programmed into it to allow the operator to do the operations that are necessary. This is independent of that.

MEMBER MARCH-LEUBA: So there will be software-implemented limits and controls in the computer and, on top of that, the PLC for the user's interlocks --

MR. NICHOL: That's correct.

MEMBER MARCH-LEUBA: -- independent of that.

MR. NICHOL: That's correct.

MEMBER MARCH-LEUBA: So redundant and diverse.

MR. NICHOL: Right.

MR. RAD: I think it is also important to recognize that --

MEMBER BROWN: Hold on. I just want to make sure I understand what you were trying to get specifically stated.

In the basic software for controlling, moving it around, and everything else, there are

already a set of limits programmed in. The PLC system you are talking about is an independent system --

MR. NICHOL: Yes, it is.

MEMBER BROWN: -- with an additional -- with the same set of or whatever the equivalent set of limits and interlocks is. Is that what you were saying?

MEMBER MARCH-LEUBA: That's what I understood he said.

MEMBER BROWN: I am now getting that flavor. I didn't get that the last time.

MR. NICHOL: Yes. That is correct.

MEMBER BROWN: So you have got independent systems then monitoring it.

MR. NICHOL: Right.

MEMBER BROWN: Okay, Mike is trying to speed me up over here and I'm not going to do that because I want to --

MEMBER BALLINGER: These speed limits are under load or no load because it is 30 feet per minute traverse.

MR. NICHOL: That's under load.

MEMBER BALLINGER: That would be under load.

MR. NICHOL: Right. And that's from recommended speeds in NOG-1.

MR. RAD: It's probably also important to note that all of these are in accordance with the endorsed standard, the ASME NOG-1 standard. So these aren't proposed by NuScale as part of the application. These are in accordance with the endorsed standard.

And I think we will get -- there is more to this on the next slide.

MEMBER BROWN: Well I'm just trying to make sure that clarified that the control is separate from an independent watchdog interlock system, similar to a governor on a TG set's overspeed system being independent from the control system.

MEMBER MARCH-LEUBA: Yes, our concern --

MEMBER BROWN: That thought process, that's all I'm talking about.

MEMBER MARCH-LEUBA: Our concern is that a standard that is good to move a container out of a ship might not be good enough to move a live core around 11 more cores.

MR. NICHOL: Right. So --

MEMBER MARCH-LEUBA: I would like, if I

could offer. I mean if unloading a core -- a ship allowed to do 30 feet per minute, I would go all three. That's what I would do.

MR. NICHOL: So in addition to those systems that are active, the software user interface control system and the PLC system, there is a third system that is the E-stop system.

And the emergency stop system is hardwired, it is physical relay controlled and it is independent of any software on any of the systems. So in the event that a user hits the E-stop system, it cuts power to the motors and cuts power to the brakes. When the power is removed from the brakes, the brakes set and the crane stops.

And again, this system, per NOG-1, is required to be independent of any of the controls that are used for normal operation of the crane.

MEMBER MARCH-LEUBA: And this is the proverbial red button?

MR. NICHOL: Correct.

There are also redundant physical -- oh, sorry.

MEMBER SKILLMAN: I respect what you have just communicated.

Operating experience shows that there

are other plants that have used fuel handling systems with this degree of sophistication. So this is not new but I think the degrees of redundancy that you have provided are admirable.

For the E-stop system you just mentioned, can an I&C tech jumper around it? You don't have to answer that question but I have been on a bunch of CNRBs and almost every one of the fuel handling accidents has been where maintenance has jumpered the control system because they just wanted to move six inches over here or ten inches over there and, as a consequence, they've defeated a stop.

So I accept what you are telling us but our caution is not without foundation.

MR. NICHOL: That's appreciated.

MEMBER SKILLMAN: Thank you.

MR. NICHOL: So I started to mention there are redundant physical load controls systems. By physical load control, what we are talking about are the hardware physical pieces of the system that are required to lift and hold the load. That includes the gearboxes on the drum, the cables on the drum, and the brakes on the main hoist. Those are all redundant. There are two independent

systems and the redundant systems are capable in themselves, by themselves, of fulfilling all of the load control functions.

So in the event that a cable were to break, there is a redundant cable that would then hold the load. And the same goes for the gearboxes and the brakes on the main hoist.

So the question came up in the subcommittee in the event that there is a failure of the load lift control system and for these postulated failures, this includes a failure of both the user interface control system, and a failure of the PLC system, and a failure of the operator to act.

In that event -- I mentioned there are redundant upper travel limit switches that are part of the PLC system. In the event that neither of those succeed in functioning, per the ASME NOG-1 Type 1 standard, the crane is required to be able to withstand a two-blocking event. Two-blocking is where the lower load block of the crane comes up in contact, some portion of the crane, to where it stops.

In the event that that happens, the crane is designed to be able to withstand that event

without dropping the load. If that were to happen, the reactor module will be raised to the top of the crane travel. That puts the base of the module just under 29 feet off the floor. In that position, the fuel is covered, shielding is maintained, and the passive cooling is active.

In the event of the failure of the travel control system, because the traverse speed is limited, the operator is monitoring the motion and would be able to act. For the end of travel, the end of the bridge, and the end of the bridge runway, there are energy-absorbing hard stops that, again, are designed such that an impact by the crane into these hard stops would not result in loss of load.

MEMBER BALLINGER: Are these hard stops adjustable, in terms of location?

MR. NICHOL: No, these are just end of travel hard stops.

MEMBER BALLINGER: Just end of travel.

MR. RAD: I think probably an important note might be on somebody's mind is that 29 feet is the assumption for postulated events in Chapter 19 for module drop. So their operator action limit switches are not assumed in those postulated event scenarios that are analyzed in Chapter 19.

MR. NICHOL: So we mentioned about the digital I&C design and development. So the design of any software components for the reactor building crane follows our -- follows a rigorous quality assurance program.

The software integrity level is what determines what portions of that program are active. And the reactor building crane, because it is risk-significant and non-safety, that invokes Software Integrity Level 3. And for Software Integrity Level 3 or 4 digital I&C, it is required to undergo an independent verification and validation.

There is more information on the Digital I&C Software Quality Assurance Program in Chapter 7 of the DCA.

So the things that are tested; there are a series of things that are tested in the initial testing of the reactor building crane system. The first one is E-stop functionality.

These, by the way, are all in the DCA in Chapter 14.

The E-stop functionality is tested. Of course basic controls and components are tested. There is a full load test and we will talk more about what the full load test for a NOG-1 Type 1

crane in a couple slides.

The speed test, the speed limits are tested and the limiting function is tested. So shifting into high speed under load is tested to verify that it won't, the crane won't shift into high speed.

During the initial testing of the crane, the crane is also made to two-block, which means that the upper limit switches are intentionally defeated to cause the crane to go into a two-blocking situation.

The redundant brake functionality is tested independent of each other for the redundant systems. And there is also a lowering speed and a lowering brake test that is tested.

Again continuing on to -- oops, I think you went -- oh, no, that is correct. Sorry.

So continuing on with what is specified in the DCA, again the rated load test and the site acceptance testing, those are per ASME NOG-1 for all of the hoists, the main hoist, the auxiliary hoist, and the wet hoist.

The rated load test is also conducted on the hardware lifting fixtures, the module lifting adapter and the lift fixture.

Prior to all of these testing, there is a requirement for instrument calibrations to be completed. That is in the DCA.

The components are tested. I mentioned controls and interlocks are tested. There is also a test for loss of power, or loss of control, or a seismic event. The crane is equipped with a seismic sensor so that in the event of an earthquake, it stops and holds the load.

Load path verification I mentioned. This includes verifying that the maximum speed limits are enforced, verifying bridge and trolley movement. There is a microspeed function that is active as the crane approaches certain locations in the plant to slow it down so that accuracy can be attained.

There is a test for the main hoist movement, the rotation of the main hoist test to verify full seating of the module in the operating bay.

Now, we get to the ITAAC requirements. These are called out in the DCA as well.

The ITAAC includes testing of the hoist machinery, inspection of the machinery, verify that there are redundant load paths, and test the

structural components.

I mentioned about the two-blocking test and overload tests. The auxiliary and wet hoists are tested in the same way. That is called out separately as a separate ITAAC in the DCA.

The load test I mentioned, there is a full-rated load test at 100 percent of the rated load of the reactor building crane, which is the weight of the module. There is also a 125 percent of rated load test that is conducted on the reactor building crane and the auxiliary and wet hoists.

The other ITAAC requirements for the crane include nondestructive examination of the as-built welds on both the reactor building crane and the wet hoist.

The module lifting adapter single load path components are tested to 300 percent of the manufacturer's rating and dual load path to 150 percent. And then also those welds are evaluated per NDE.

And then there is an inspection called out for the lift arms and the pinned clevis on the lift arms of the module lifting adapter.

MEMBER SKILLMAN: Will these same ITAAC be applied to the other fixtures that will be used

to lift the other components independent of the module?

You've got the shield curtains that fit over each bay and there are some other relatively heavy loads. They are not as heavy as the module but they are peculiar in geometry, such if they were to get loose, they could jam in the bay. They could jam safe load path. They could become wedged and they could injure the liner.

So my question is for those other fixtures, do those have the same level of ITAAC for their construction and testing.

MR. NICHOL: So they are not called out specifically in the ITAAC requirements.

MEMBER SKILLMAN: Should they be?

MR. NICHOL: They would fall under the ASME NOG-1 Type 1 or the ANSI N14.6 standards. So they would fall into the same rigor of inspection but they are not specifically ITAAC requirements.

MEMBER SKILLMAN: Okay, thank you.

MEMBER CORRADINI: Let me make sure I understand the ITAACs. So these are -- this testing will be done with the -- I kind of go to the next question -- with the concept of the largest load, not all intermediate loads. That's what I'm trying

to understand.

Not all of these ITAACs are load-dependent. They are essentially performance on the system. Is that correct? That's how I read these.

MR. NICHOL: That's correct. Some of the ITAACs are just performance of the system.

MR. HOUGHTON: Any other questions on the crane and crane controls before we move on to the pool? And we will start with the pool liner presented by Scott Harris.

MR. HARRIS: Yes, so there is a couple of discussions that happened during the last meeting and so we wanted to revisit this topic a little bit more.

Just to review the liner functions, so just reiterating the pool liner, the main function is to protect the reactor building concrete from the borated pool water. And then a secondary function is to use the channels, which are associated with the pool liner, to direct any leakage down to the reactor building sumps. The pool liner is designated Seismic Category 1 and so in addition to that, we have several sumps throughout the reactor building and each one of those sumps has a high sump alarm in addition to a high leak rate alarm.

In addition, let's talk a little bit more about the reactor building floor slab. This came up a little bit during, again, with the reactor building crane last session.

So the floor slab is ten feet thick of reinforced concrete and it has been analyzed to withstand a module drop from the maximum hook height without damaging the concrete in such a way which would cause significant damage to the reactor building concrete and loss of ultimate heat sink.

MEMBER CORRADINI: This will be re-discussed in Chapter 3, I assume.

MR. HOUGHTON: Correct.

MEMBER CORRADINI: Okay, thank you.

MR. HARRIS: And if the pool liner were to rupture, it would result in negligible loss from ultimate heat sink inventory. Essentially if the liner ruptured, you are just filling in the gaps of the channels so it would settle down a matter of inches or a foot but no significant loss of ultimate heat sink inventory.

MEMBER SKILLMAN: Let's talk that through --

MR. HARRIS: Okay.

MEMBER SKILLMAN: -- since we are going

talk liner -- before we talk liner in Chapter 3. But since we are in Chapter 9, based on your DCA, the liner is one-quarter of an inch thick.

MR. HARRIS: Uh-huh.

MEMBER SKILLMAN: And it is basically a membrane for the entire pool and it is all one-quarter of an inch thick. The hydrostatic pressure at the bottom of that pool is about 25 psi; 60 feet times .434, round about.

If you get a small hole, the water will find a way to find the elevation of the pool or the wooden sump, right?

MR. HARRIS: Correct.

MEMBER SKILLMAN: And I would suggest that if you were to drop, probably not from 29 feet but from six or eight feet, a tear might give you a four, five, six gallon a minute leak. Q equals ab every time. At 25 psi, you can have a roaring leak.

MR. RAD: I think it is important to recognize that the safety-related function of water retention is satisfied by the concrete pool.

MEMBER SKILLMAN: I got that. I think you are going to have in part of your tech specs an exigent application for operation for 11 live reactors with a live pool leak or do something to

make sure that the membrane is sufficiently robust that even a moderate scuffing or drop will not injure it.

And I think that is more of a commercial decision than a design decision. I will spot you that. I got that.

But I will tell you, from a number of experiences I have been involved in, if you do have a pool liner leak and you've got a fairly large burden of tritium, you are on a short time clock to do something about that, whether you have to inject sawdust, goo, hydrostatic cement.

The difference is you can have 11 live reactors and the one that you are moving may have a full burden of decay heat and may be a brand new one, too. But I think that the bidding is different in this case because you have got potentially 11 live reactors, depending on the water for decay heat removal and for shielding.

So I think it is worth re-thinking the importance of the liner in this application.

I will make one more comment and stop. The most distant liner on your safe load path from your refueling equipment will see 120 module moves in 60 years, 30 per bay, left and right, is 120 in

the intersection. And as you come the whole way back to the adjoining bays that are closest to your refueling equipment, that part of the safe load path will see 720 module moves.

And I would suggest that, as you explore the traffic density, you may want to think twice about the importance of the liner, particularly under the defined safe load path horizontal section of the liner. Thank you.

MR. HOUGHTON: I want to take one second to address one of the statements. I heard you mention tech specs and the pool level.

So for tech specs, we do have tech specs related to pool level at two different points. So we have a 68-foot pool level tech spec, which supports the -- really supports the crane. So that is for movement of the crane during normal operation and that's because of the buoyancy that we take credit for and the pool is accounted for in the crane load.

But we also have a pool level tech spec at 55 feet and that tech spec is there to protect the cooling that we need to support safe shutdown in an emergency core cooling situation.

So it is important here from the pool

liner perspective, when we talk about potential leaks of the pool liner, that's why the importance of the alarms, and the sumps, and the pool liner in directing that leakage to the sumps gives the operator sufficient time to take action.

So they would see the pool level lowering relatively slowly. When we think about the 7 million gallon cool, we have a significant amount of time between that 68-foot level and the 55-foot level. And also those sumps all have independent isolations as well. So there are actions that the operators can take to reduce the amount of leakage to take time to take whatever corrective action is needed, depending on the event that they've seen.

And of course, we have multiple ways of providing makeup inventory to the pool as well.

So again, from a defense-in-depth standpoint, we certainly appreciate that consideration --

MEMBER SKILLMAN: I understand your level of argument and I would defend that with you.

Are you going to have a tech spec on rate of leakage from the pool because you pool is both a shield and your decay heat removal system? Are you going to have a rate of leakage, the

combined output of all of the sumps that are monitoring? If say you are 26 gallons a minute combined sump, are you going to have a tech spec that says at this level, even though we can maintain the level because we've got 7 million gallons and the level change is very easily controlled, we will do something to the plant because we have something going on in the liner that is adverse to safety?

MR. HOUGHTON: That would be a function of operational programs. Operational procedures will determine what actions operators take to stay within their tech specs.

MEMBER SKILLMAN: But how will you --

MR. HOUGHTON: And that is similar for any tech spec.

MEMBER SKILLMAN: How will you choose that number?

MR. HOUGHTON: That would be chosen by the operators during the operational -- development of the operational programs and procedures. We wouldn't choose that number today.

MEMBER SKILLMAN: Okay, thank you.

MEMBER CORRADINI: But let me just make sure. You are not -- the way I heard Member Skillman asking questions, there is going to have to

be something. You are saying the COL -- the owner-operator would have to pick that as part of their operational program. It's not that there wouldn't be a number. There would be but it's not defined yet.

MR. RAD: Correct. Right or it would be limited by another limit, perhaps your offsite release limit. You mentioned tritium. You might not be able to continuously drain your sump at an unlimited release rate from your reactor pool liner to your reactor building sumps.

MEMBER BALLINGER: Is there going to be a seam between the vertical walls and the base mat in the pool?

MR. HARRIS: Yes.

MEMBER BALLINGER: Because when these are poured, they are not continuous but is there going to be a seam?

MR. HARRIS: So the liners, as you are constructing your --

MEMBER BALLINGER: Not the liner, the concrete.

MR. HARRIS: I'm not sure. You're talking about where the vertical wall meets the horizontal.

MEMBER BALLINGER: Right, the vertical wall and then there's this -- is that vertical wall going to be poured on top of an existing concrete base?

Typically when you build these kinds of things, that is usually what happens and that's where the leaks actually occur. If you own a house, you will find that out. It's actually a house with a concrete foundation.

MR. HARRIS: So there is a channel that runs along that horizontal and vertical seam. That is where our vertical leak channels collect. And so if you have any leakage on the wall, it would collect in that channel, along that seam, and then directed to the sumps.

MEMBER BALLINGER: Okay but you say there is going to be a seam there so that if you were to flood the pool between the liner and the wall, that seam --

MR. RAD: I don't think we have information on the exact pouring of the concrete at this point in time.

MEMBER BALLINGER: Because that is typically what happens and this is a monster pool with a lot of head on it. And so if you're going to

get a leak out into the dirt, that is where it will happen.

MR. HOUGHTON: Well again, as Scott mentioned, that's why we would have a liner there that would collect the leakage, a protective barrier between the pool and the environment. And so that would give the operators indication that there is leakage in that area.

So the pouring of the concrete details, as Zack mentioned, we wouldn't have that today but we do have a sump there to collect leakage so that we would know if there was a leak and then the operators would take action on stopping that leak.

MEMBER BALLINGER: Long-term, if there is a seam there where you even get a small amount of leakage that is below a limit, you end up with a tritium problem.

MR. HOUGHTON: Again, you would see that leakage coming into your sumps before it would go to the environment.

MEMBER BALLINGER: You could see the leakage when it got into the sump but it might also be leaking under the seam.

MR. HOUGHTON: Understood.

MR. HARRIS: So moving on to the next

topic, reactor pool mixing came up during the last session as well. And I just wanted to give a little bit of an overview of the two cooling systems that serve the ultimate heat sink.

So the first one is the spent fuel pool cooling system. This has two 1250 gpm pump and heat exchanger trains. The other one is the reactor pool cooling system. This has three 1250 gpm pump and heat exchanger trains.

And so at minimum, during minimum heat load, you have at least one train of each system operating. So one spent fuel pool cooling train and one reactor pool cooling train. This combined operation results in 3.6 million gallons a day being turned over within the ultimate heat sink.

And so if you consider that 3.6 million for a 7 million-gallon pool, that is half the pool getting turned over every single day. And that's just the minimum heat load. Obviously, that increases as you bring in other modules and have other spent fuel pool heat input into the ultimate heat sink.

MEMBER MARCH-LEUBA: Can you spell out RPCS, SFPCS, and PCUS? What are those things?

MR. HARRIS: Spent fuel pool cooling

system and reactor fuel pool cooling system.

MEMBER MARCH-LEUBA: And PCUS?

MR. HARRIS: Oh, poll cleanup system.

MEMBER MARCH-LEUBA: Thank you.

MR. HARRIS: And so within each system there are sample points on the discharge of these pumps and I will show that on the next slide in a moment.

In addition to the sample collection devices, there are also conductivity monitors on the discharge of these pumps and that is important to note because these conductivity instruments can be monitored in a way to identify -- so if you have a difference in your conductivity measurements, that could be an indication that you don't have a proper boron mixing within the pool. So it helps the operators identify an issue and they will research it.

MEMBER SKILLMAN: Scott, are the flow rate to each bay controlled by an orifice or are they controlled by a, if you will, a throttle valve, a globe valve, and a valve that is set by an operator?

MR. HARRIS: Yes, if we can go to the next slide. So this is a diagram of -- a rough

diagram of those two systems. And the systems are designed such that the pipe being -- it's all balanced so you have equal flow through each suction and equal flow through each discharge and there are balancing valves to help you do that as well.

MEMBER SKILLMAN: And the injection point is at the bottom of the bay or at the top of the bay?

MR. HARRIS: It is in the top of the bay. So one of the design criteria we use is not to have piping below our tech spec pool level. The main reason for that is so that you don't inadvertently drain the pool with a siphon or suction.

MEMBER SKILLMAN: So what ensures that there is not a temperature gradient where the cooler, if you will, different foreign concentration is at the bottom of the pool and the warmer, at a different concentration, is at the top of the pool?

MR. HARRIS: So one other thing I would like to just point out is that the only time fuel is open to the ultimate heat sink of the reactor pool is either in the spent fuel pool racks or a refueling pool.

So the boron concentration isn't as much

of a concern in the operating bay because you are not exposing the water to the fuel. So the only area of concern is the refueling pool, the spent fuel pool, and you have an easy ability to take samples from those locations.

MEMBER SKILLMAN: Thank you.

MR. HARRIS: And so I mentioned the sampling points and the conductivity instruments and I just want to point out that those locations on both systems with the circle and the x. And you can see that if you had both systems -- well, with both systems operating in the spent fuel pool, you are taking suction on one side and discharge on the other side. The same for reactor pool cooling system; you are taking suction from the refueling pool and discharging to each operating bay.

And lastly, I just want to discuss how boron concentration is controlled in the ultimate heat sink. So there are two tech specs that would cover this.

The first one is your shutdown margin. So at minimum, per Surveillance Requirement 3.1.1.1, you are going to be measuring your pool boron concentration every 24 hours, if you have fuel in the erector flange pool with the module is in the

refueling pool.

And of course, every time you go from load 1, 2, 3, 4, 5 and in reverse, you are going to be taking samples to verify your boron concentration so you can do your shutdown margin calculation.

In addition to that for Tech Spec 3.5.3, you are going to be measuring your ultimate heat sink boron concentration every 31 days or every six hours after you are adding inventory greater than 15,000 gallons.

MEMBER CORRADINI: So the Chapter 14 things we have yet to get to so, those we will see in the ITAAC.

The details you went through in terms of sampling, mixing, and crane, those still reside or are documented within 9 or in separate documents?

That's what I can't remember. I am looking hopefully to see.

MEMBER REMPE: So to add to that, during our subcommittee meeting, this question was asked by Member Bley. And I believe that you, Scott, mentioned -- said that it's not specified yet where you're sampling. And so now you've given us a slide that talks about where it is sampled.

MR. HARRIS: I'm not -- I'm more

speaking to the capability of where we can sample.

MEMBER REMPE: To where you can, not --

MR. HARRIS: Right. The specific sampling locations would be developed in procedures and those figures are not developed yet.

MEMBER REMPE: That's what you said at the subcommittee meeting. Okay.

MR. HARRIS: And with that, that concludes our presentation.

MEMBER CORRADINI: Members, any additional questions?

MEMBER MARCH-LEUBA: Since we have a little time, you may not be the right person to answer this question. Our other favorite topic is CVCS, the chemical volume control system.

I am reading through the description that the way to control the flow of the CVCS is through variable speed pumps, which of course are on displacement so they always produce the same power and to this they use a different volume. But it also says that makeup is never incidental to mechanical, so it is a manual operation. Is that correct?

I mean just following shutdown, not during normal operation.

MR. HARRIS: So you are asking is the makeup an automated operation?

MEMBER MARCH-LEUBA: Correct.

MR. HARRIS: The operator has to acknowledge any makeup operations.

MEMBER MARCH-LEUBA: Any makeup operation needs the operator to push a button.

MR. HARRIS: Yes.

MEMBER MARCH-LEUBA: And then --

MEMBER CORRADINI: Say that again slower, please.

MEMBER MARCH-LEUBA: Any makeup operation requires operator to push a button.

MR. HARRIS: So an operator would get an indication that he needs to make up RCS. And he would -- he or she would have to acknowledge that operation.

So it is not automatically makeup.

MEMBER CORRADINI: So there is not continual charging in letdown?

MR. HARRIS: There is continuous recirculation in the CVCS but not continuous letdown or charging of the system.

So the CVCS is under RCS pressure in its recirculation loop.

MEMBER CORRADINI: Thank you.

MR. HARRIS: The makeup pumps --

MEMBER CORRADINI: With recirculation, you would not inject without operator action --

MR. HARRIS: Correct.

MEMBER CORRADINI: -- or letdown.

MR. HARRIS: Correct.

MEMBER CORRADINI: Okay, fine. All right, then I understood it. Thank you.

Okay, so we will change out and go to the staff.

And are we doing 10 -- I am going to have to ask the staff. Are we doing 10 first or --

MR. SNODDERLY: Ten first.

MEMBER CORRADINI: Ten first, okay.

MR. HOUGHTON: Thank you.

MEMBER MARCH-LEUBA: Did I miss my opportunity? I'll ask the staff.

Mike, before you introduce, can I make an additional comment on the record and maybe an answer from NuScale?

MEMBER CORRADINI: Sure.

MEMBER MARCH-LEUBA: Okay. On a previous slide you said that shutdown margin is verified by Tech Spec 3.1.1.

MEMBER CORRADINI: Say it slower and louder.

MEMBER MARCH-LEUBA: On the previous slide, you mentioned the shutdown margin is verified every 24 hours by Tech Spec 3.1.1. I am looking at the generic tech specs and shutdown margin -- the Tech Spec 3.1.1 applies only modes one through four, with refueling being number five.

So can you explain? You seem to thinking for refueling shutdown margin a tech spec that doesn't include --

MR. HARRIS: This is Scott Harris, NuScale.

So before you enter, as you are going -- you might not be doing it in mode 5 per tech spec but for conservatism, the operators would be performing shutdown margin calc at least once or twice a day -- or once per shift.

So and before you go from mode 5 to mode 4, getting back into startup as you are closing up the module, you are going to be taking boron samples.

MEMBER MARCH-LEUBA: I see the first to the pool with boron refueling subcriticality. That is mode 5. I am not worried about getting to mode

4.

I am worrying while during mode 5 you have to guarantee that the pool, the UHS has sufficient boron for refueling. And Tech Spec 3.1.1 doesn't have it.

MEMBER SUNSERI: You are going to have 11 other modules that are in mode 1 during that --

MR. HARRIS: These are written per module in the tech specs.

MEMBER MARCH-LEUBA: What is the shutdown margin for refueling? Because the shutdown margin in Chapter 4 applies to operation with the lid closed. But it requests a ppm, a particular ppm of boron. Think about it.

MR. HARRIS: Okay, I'm not sure if the question --

MEMBER CORRADINI: I don't think we're communicating. Are you with this question?

MR. HARRIS: I'm not sure if I understand it.

MEMBER MARCH-LEUBA: When I hear shutdown margin, I think my reactor is in mode 1. I shut down --

MR. HARRIS: Right.

MEMBER MARCH-LEUBA: -- and I go

subcritical.

When I think refueling, I think the pool water that is going to go into the containment and probably the top of the vessel has to have sufficient ppm.

MR. HARRIS: Uh-huh.

MEMBER MARCH-LEUBA: I don't see tech spec 3.1.1 doing that. Maybe you have a different one but --

MEMBER BLEY: Because it defines it isn't looking, it doesn't apply in the refueling mode is what you said earlier, modes one through four.

MEMBER MARCH-LEUBA: Yes, I don't even see where the shutdown margin for refueling is specified.

MR. HARRIS: It may not say specifically. It may not use the word refueling in there but, as you were coming down from modes one, two, three, four, you are going to be doing those calculations.

MEMBER MARCH-LEUBA: Think about it. Do you understand my problem?

MR. HARRIS: I think so.

MEMBER MARCH-LEUBA: Okay, think about

it.

MEMBER CORRADINI: Can I just try it again? Because I don't think you guys are on the same page.

I think what he is asking is when I have got one of the modules sitting over there and refueling, the refueling pool has to have a tech spec in terms of the boron concentration. That is what I thought you were asking.

MEMBER MARCH-LEUBA: That is correct.

MR. HARRIS: And you would be verifying with that other tech spec, 3.5.3 so that every 31 days or every six hours, you also are verifying the ultimate heat sink boron concentration. So you already know your boron concentration for the pool if you have a module sitting in refueling or not.

MEMBER CORRADINI: So 3.5.3 is the appropriate one --

MR. HARRIS: Yes.

MEMBER CORRADINI: -- that points to what he is worried about.

MR. HARRIS: That's more specific for the pool itself.

MEMBER MARCH-LEUBA: That one is more specific, yes. So your slide was pointing me in the

wrong direction.

MEMBER CORRADINI: For his question.

MEMBER MARCH-LEUBA: Yes.

MR. HARRIS: Does that answer your question? Okay.

MEMBER CORRADINI: Okay, Omid, are you going to lead us off?

MR. TABATARAI: Yes, sir.

MEMBER CORRADINI: Take it away.

MR. TABATARAI: Okay. Good morning. My name is Omid Tabatarai and I am the Lead Project Manager for Chapter 10 of NuScale's DCA. We are here today with my colleagues to present to you the results of our evaluation of Chapter 10.

I will let my colleagues introduce themselves before I get started.

MR. STUBBS: I'm Angelo Stubbs.

MR. VETTORI: Bob Vettori.

MR. McMURRAY: Nico McMurray.

MR. CHERESKIN: Alex Chereskin.

MR. TABATARAI: Okay, before we get stated, I just want to recognize our colleagues who contributed to the Safety Evaluation Report and evaluating Chapter 10. We presented the results back in March, on March 21st, during the

subcommittee briefing, and we informed the committee that the staff's evaluation was based on Revision 1 of the DCA.

We had 12 RAIs issued. All of those questions have been responded to. We don't have any closed -- I'm sorry -- open items and the confirmatory items have already been addressed in Revision 2 of the DCA.

We did not have any follow-up actions or questions from the subcommittee members. So hopefully, this meeting will go as quickly as the subcommittee one.

With that, I will let Angela Stubbs get us started.

MR. STUBBS: Okay, good morning. Again, my name is Angelo Stubbs. I'm a senior reactor systems engineer in the Office of New Reactors.

Today, as Omid mentioned, we will be presenting you our summary on the review of Chapter 10, which covers power and conversion systems -- the steam and power conversion systems.

My presentation -- go back to the previous slide.

Okay, on this slide, there is a list of the areas that I am going to be covering with my

part of the presentation. So it starts at the turbine generator and goes through the condensate and feedwater system back to the steam generator. So, next slide.

I want to start with the staff's review of the turbine generator, the turbine bypass system and the turbine generator gland sealing system. These systems are not safety-related. They are not used or present for accident mitigation, or for establishing or maintaining safe shutdown. They are located in the turbine building, the turbine generator building, and they are not in close proximity with any SSCs that are important to safety.

In our review, we reviewed these for compliance with GDC 4 for the turbine generator the turbine bypass system. And GDC 60 was the primary concern for the turbine gland sealing system.

The results of our review are summarized on this slide. The staff found that the turbine generating system -- the turbine generator and the turbine bypass system to be in compliance with GDC 4. The one thing I think I would like to note is that the compliance with GDC 4 with regards to protecting the SSCs important to safety from turbine

generator failure and generation of turbine missiles for NuScale is accomplished by barriers -- protecting the SSCs by barriers.

Generally we see turbine overspeed lookback and our guidance in SRP 10.3 looks at what is needed for that. In this case, they are doing it with the barriers and that is a review that is included in the Chapter 3, Section 3.5.1.3 looks at turbine missiles and protection from turbine missiles.

The staff also found for the turbine gland sealing system that it was in compliance with GDC 60 and 64, since it provided the capability of monitoring and controlling the release of radioactive effluents to the environment.

Next slide.

The next area I will cover is the reviewer of the main condenser, the condenser air removal, and the circulating water systems, which the circulating water system removes the heat from the main condenser.

These systems again, like others, are not safety-related and they are not used or credited for accident mitigation. And we reviewed these for compliance with GDCs 4, 5, 60, and 64. Next slide.

Okay the results of the review is the staff found that because they are not located in proximity of important to safety SSCs and that when we looked at water discharge as a result of main condenser failure or circulating water systems failure, the plant would direct the water away from important safety SSCs.

Then we found that failure of the systems would not adversely affect the SSCs important to safety and that they were in compliance with GDCs, 2, 4, and 5. And the GDC 5 was looked at because the circulating water system is a system that is shared by multiple modules.

We also found that GDC 60 and 64, the system to be in compliance with those because they provided monitoring and control of radioactivity to the environment. Next slide.

So next is the condensate and feedwater system. On this slide is a summary of the review results of this -- or the review that was performed on this.

It is similar to other condensate and feedwater systems for other PWRs. Again, the system is not safety-related but the thing here is in order to assure proper operation of the DHRS, feedwater

isolation is necessary and also feedwater isolation supports the containment isolation.

These are included as part of the containment isolation system in Chapter 6 in the NuScale design. We reviewed them just to make sure that they were designed and we did see that they were safety-related and they were Seismic Category 1.

MEMBER SKILLMAN: Angelo, how will those valves be protected against a high-energy line break?

MR. STUBBS: Okay, those valves -- you're talking about the containment isolation valves?

MEMBER SKILLMAN: Feedwater isolation valves that are safety-related.

MR. STUBBS: Okay.

MEMBER SKILLMAN: They are required to ensure that decay heat removal will be successful.

MR. STUBBS: Right.

MEMBER SKILLMAN: I have been involved in a number of plants. Good old feedwater runs all through the turbine building. And oh my, goodness, gracious, there is a line right next to the other line and that one is required and it's not protected

against --

MR. STUBBS: Okay and this is covered in Chapter 6 but the isolation valves -- my understanding is the isolation valves are all located very near the reactor vessel. And actually, the turbine building is separated from -- is in a separate building, where the line actually runs out of the reactor building to the turbine building for this design.

MEMBER SKILLMAN: Okay so there is a line in the turbine building. And I think what you are saying is that the valve in the turbine building is not relied upon for isolation.

MR. STUBBS: Correct. The valve that is relied upon is located in the reactor building.

MEMBER SKILLMAN: Thank you.

MR. STUBBS: Okay, so the next slide.

Okay so again, we looked at it to see whether its failure could impact anything and we also looked at it to see that the isolation valves were designed to the seismic and were included in the safety-related.

And we found that for the feedwater, the condensate feedwater system that the GDCs 2, 4, 5, 45, 46, and 10 CFR 20.1406 was complied with. And

the 45 and the 46 was dealing with inspection and testing because, like we just mentioned, they are relied on to provide a pressure boundary for DSRS operation -- I mean DHRS operation. Next slide.

Okay, the auxiliary boiler system, among the things it does is it supplies steam for the modular heatup system. It also supplies steam for turbine gland sealing and other things when we don't have the main steam system up and running but it is similar to those of other PWRs.

It is not safety-related. In this case, it is used primarily during startup.

Failure of the system is accounted for -- I don't know what it means that they are accounted for but it will be looked at in Chapter 15 if there was a system issue because it is part of the interface with the CVCS system but it doesn't have a safety-related function. The CVCS is non-safety-related.

MEMBER CORRADINI: So let me ask because you guys explained it last time.

MR. STUBBS: Okay.

MEMBER CORRADINI: Somebody explained it last time.

So this is used to do heatup of what is

injected in the heatup system for normal startup.

MR. STUBBS: This provides --

MEMBER SKILLMAN: Let me answer the question and then offer a question.

MR. STUBBS: Okay.

MEMBER SKILLMAN: The aux boiler system provides steam to the CVCS heater for modular heatup.

MR. STUBBS: Correct.

MEMBER SKILLMAN: CVCS is sitting there at 2200 psig, reactor coolant system pressure. Right?

MR. STUBBS: I'm not sure.

MEMBER SKILLMAN: So my question to you is I have got a low pressure steam system feeding a heat exchanger that is in a high pressure reactor coolant system system. How is the AVS protected for leakage from the reactor coolant system back into the aux boiler system?

MR. STUBBS: Okay, the aux boiler system, I believe that portion of it is a high pressure portion. I think the other portion that provides the gland sealing steam is low pressure. So it's two different loops for the aux boiler system. So I don't know that we have that much of a

mismatch in pressures for that system.

MEMBER SKILLMAN: I think I would like to hear NuScale talk about this for a minute.

MR. STUBBS: Okay.

I think -- am I mistaking Zach Houghton --

MEMBER SUNSERI: There is a NuScale representative coming.

MR. HOUGHTON: Hi, this is Zach Houghton with NuScale.

So the auxiliary boiler system that provides heat for module heatup would be around 1100 pounds. CVC would be normally operating around 1800-1900 with head of the pump.

So we do monitor for leakage and there is radiation detection in the aux boiler and in CVC for looking for potential bypass there but it would be through monitoring that we would look for potential leakage from the high pressure CVC to the auxiliary boiler system.

MEMBER SKILLMAN: Thank you.

Thank you, Angelo.

MR. STUBBS: Okay and the only other thing is -- well I mean, again, it is an interface with the module heatup system, which is part of the

CVCS system. The other heat loads is just for the plant, steam heat loads that are provided normally when the main steam system is in operation, and at plant startup, and plant shutdown, at times when you don't have any steam available, the aux boiler system fulfills that.

And we found that it was in compliance with the applicable regulations.

And that concludes my part of the presentation. If there are any other questions --

MEMBER SUNSERI: Not so much a question but just a comment. We understand your review of the missile protection requirements and we understand that you are relying on the -- or NuScale is relying on the barriers that we discussed in Chapter 3. We are going to withhold our judgment of the adequacy of missile protection until we review the integrity of those barriers in Chapter 3.

Just give me a heads up on that.

MR. STUBBS: Understood.

MR. STUBBS: Any other questions?

MEMBER KIRCHNER: And Matt, just to follow on to that, though, did the staff look at a spectrum of missiles and how that might impact the auxiliary systems that could be exposed like CVCS or

others?

MR. TABATARAI: I think that -- well, that issue is still under evaluation. So we are not completely aware of where they are in terms of review.

Bob?

MR. VETTORI: Okay, thank you.

My name is Bob Vettori, Office of New Reactors. I want to review the main steam system.

Next slide, please.

Okay, this is the regulatory basis that we used, GDCs 2, 4, 5, 34. We have been through this before so, let's go to the next slide, please.

Okay, we used the NuScale design-specific review standard 10.3 on this one, rather than the regular SRP. The next two bullets, a little bit of a discrepancy between how NuScale designs their system and how we reviewed the system. NuScale designs and defines the main steam system as only the portions from the flanges immediately downstream of the containment system main steam isolation valves up to the turbine stop valves. And we performed the review consistent with the system boundaries that are defined in the DSRS 10.3.

So the next bullet is ITAAC for the

safety-related portions are located in DCA Part 2, Tier 1. The technical specifications and associated bases are located in Chapter 16 of this SER. There were no COL items.

We did issue five RAIs. All have closed and are resolved. Next slide, please.

So, therefore, our conclusion is the staff finds that NuScale design satisfies the relevant requirements as described in the Regulatory Basis.

Do you have any questions? Thank you.

MR. McMURRAY: Good morning, everyone. My name is Nico McMurray. I am a materials engineer in the Office of New Reactors. I am here to talk about the steam and feedwater system materials.

Next slide. Applicable regulations were GDC 1, GDC 35, Appendix B criterion 13, which was specifically related to cleanliness control, and then 10 CFR 50.65, which is the maintenance rule.

For everyone's awareness that the portion of this review, as was alluded to from Bob, is the non-safety related portion. So GDC 35, emergency core cooling, was not applicable.

The specific guidance was the SRP Section 10.3.6, as well as NRC Generic Letter 89-08

erosion corrosion, or similar, also known as flow-accelerated corrosion, then an EPRI research report which was also related to flow-accelerated corrosion. Next slide.

So the staff reviewed the materials in the main steam system, the condensate feedwater system, turbine generator system, the auxiliary boiler system, their associated subsystems. Specifically, the portions of the system that are outside the CNV and not safety-related.

The containment isolation valves and the decay heat removal system are under Section 6.1.1 and then the steam generator system is under Chapter 5, for the materials specifically.

The systems are Quality Group B, as was reviewed in Chapter 3, and therefore, they are designed ASME B31.1. And then in addition, NuScale states that the design meets the guidance of the generic letter in the EPRI research report.

So the selected materials and the design minimizes the impact of flow-accelerated corrosion. Next slide.

NuScale has a COL item that the COL applicant will provide a flow-accelerated corrosion program in accordance with the Generic Letter and

the EPRI research report. And the confirmatory items that were open to close some RAI responses specifically related to flow-accelerated corrosion, the impact of piping systems to ensure that these non-safety related systems versus safety-related are part of the NuScale model, and then also for controlling contamination.

Any questions? All right, I will turn it over to Alex.

MR. CHERESKIN: Good morning. My name is Alex Chereskin and I am a chemical engineer in the Office of the Nuclear Reactor Regulation. I will be covering the three sections up on the screen here, which are secondary water chemistry, the condensate polishing system, and feedwater treatment system. Next slide, please.

So the regulatory basis for this review was General Design Criterion 14 with respect to corrosion-induced failure of the reactor coolant pressure boundary. Review guidance used for this review was the standard review plans Sections 5.4.2.1; 10.4.6; and Branch Technical Position 5-1.

Other guidance uses was the Electric Power Research Institute Pressurized Water Reactor Secondary Water Chemistry Guidelines, and also the

Nuclear Energy Institute Steam Generator Program Guidelines.

Next slide.

So the condensate polishing system, feedwater treatment system, and their subsystems are not safety-related and do not perform a nuclear safety function. The purpose of the condensate polishing system is to provide cleanup capability for the secondary water and maintain the condensate quality through filtration ion exchange. The condensate polishing system and feedwater treatment system work in conjunction to control the secondary water chemistry consistent with the parameters in the EPRI Secondary Water Chemistry Guidelines.

And there are no open or confirmatory items for Sections 10.3.5 or 10.4.6.

There was a confirmatory item for Section 10.4.11, however, that was addressed in Revision 2 of the DCA. And the staff determined that the condensate polishing system, secondary water chemistry, and feedwater treatment systems sections meet the applicable regulatory requirements discussed in the previous slide.

Are there any questions for these three sections?

MEMBER CORRADINI: Any questions, members?

Okay, so I am going to look at the chairman and say we can be at break here and then come back at ten o'clock to take on the other four chapters from the staff. Is that okay?

CHAIR RICCARDELLA: Yes, that sounds fine.

(Whereupon, the above-entitled matter went off the record at 9:46 a.m. and resumed at 10:01 a.m.)

MEMBER CORRADINI: I think we have enough people to begin. So I'll turn it back over. But wait, let's make sure we're on the record. Okay.

And staff will be supporting Mr. Tesfaye. But he's going to do it all alone. Poor chap.

MR. TESFAYE: Yes.

MEMBER CORRADINI: It's all yours.

MR. TESFAYE: Thank you. There is a slight mistake here. I'm not only the Chapter 9 Project Manager, I'm also the Chapter 11, 12, and 16 Project Manager.

As you all know, Chapters 11 and 16 were

supposed to be presented in February. Because of the snow, we were forced to combine all these four chapters in March.

So, I'm trying to handle this a little bit differently. The staff will be supporting me from the audience. And I will be introducing their names for the record. And I have one person joining us on the phone.

And again, I'm Getachew Tesfaye, I'm the Project Manager for Chapters 9, 11, 12, and 16. Greg Cranston is the Lead Project Manager for the evaluation project.

The staff has completed its Phase 4 safety evaluation report with open items, and presented them to ACRS Committee on March 20 and 21 of this year. As I will show on the subsequent slides and safety evaluation reports contain open items that will be addressed in Phase 4 of the review process.

Phase 4 activity has already begun with the formal issuance of Phase 2 SER for Chapters 9 and 16 in February. And of course Chapters 19 -- 9 and 16 in February and 11 and 12 in January.

Some of the open items contained in the Phase 2 SER has already been resolved. And the

remaining open items are on track to be resolved in the next few months.

During the Subcommittee meeting, the staff presented in detail, their major findings, the open items, NAS where we believe there was ACRS interest. There's no past experience.

In today's presentation, I will give a very high level overview of each Chapter to give you an opportunity for additional questions you may have, that have not been addressed by the staff during the Subcommittee meeting, or NuScale in today's presentation.

Chapter 9 is auxiliary systems. It has five major sections. Section 9.1 fuel storage and handling, and the reviewers for this section are Alex Siwy, she is hopefully joining us by phone.

Alex, are you there?

MS. SIWY: Yes. I'm here Getachew.

MR. TESFAYE: Thank you. And the rest of the staff is here. Raul Hernandez, Alissa Neuhausen, and Andrew Yeshnik.

Section 9.2 is Water Systems. And the reviewers are Chang Li, Angelo Stubbs, Nan Chien, and Bob Vettori.

Section 9.3 is Process Auxiliaries. And

the reviewers are Raul Hernandez, Tony Gardner, Edward Stutzcage, Bob Vettori, Hanry Wagage, and Ryan Nolan.

Section 9.4 is HVAC, and the reviewer is Nan Chien. And finally, Section 9.5 is Other Auxiliary Systems. And the reviewers are Bob Vettori, Dawnmathews Katathiveettil, Fanta Sacko, and Nan Chien.

And again, all the staff members are here in case there are any questions.

MEMBER CORRADINI: So, the way you have this organized, we -- you want us to ask questions directly at this point for Chapter 9. Is that correct?

MR. TESFAYE: Yes. When I go to the next slide.

MEMBER CORRADINI: Okay.

MR. TESFAYE: Next slide being this. Section 9.1, one of the open items in Section 9.1 involves a proposed COL information item to make the structure and also the fuel rods, including which calculus simply drops scenarios.

A COL information item. The staff is currently evaluating the adequacy of the COL information item.

The second open item deals with the tensile material qualification program, critical characteristics during fabrication. And the staff expects a quality response to the RAI associate with this open item.

All seven open items in Section 9.3 are associated with the recently submitted exemption request for post-accident sampling system.

The one open item in Section 5.3 involves an evaluation in Chapter 8 to determine if there are safety-related circuits. In order for the staff to confirm if Reg Guide 1.75 is satisfied.

Are there any questions for Chapter 9?

MEMBER RAY: Yes. ITAAC is an acronym for inspections' test analysis and acceptance criteria, and used helpfully with a number of inspections and tests for the hoists that will be included in specific ITAAC and in the applicable ASME and ANSI standards.

The analysis and acceptance criteria part of that for the main hoist is going to be, as I understand it, in accordance with the ASME NOG-1. Which is entitled Rules for Construction of Overhead and Gantry Cranes.

I don't know at this point, but I

presume construction includes the design of hoist controls. And things -- relative things like single failure vulnerability, reliance, and operator action, in the event of single failure, et cetera.

But given the unique functions of the main hoist in this case, has the staff concluded that requirements of NOG-1 are sufficient?

MR. TESFAYE: Okay.

MEMBER RAY: Again, the key point is, the unique functions of this hoist.

MR. TESFAYE: Thank you. Raul Hernandez will address that. Raul?

MR. HERNANDEZ: Yes. The staff evaluated the reactor frame, the staff views the most -- not one is the most complete standard for a crane. It's the most limiting one.

And the staff found that it was adequate.

MEMBER RAY: And with regard to the controls, for example, does it include the design requirements relative to say single failure of the control system?

MR. HERNANDEZ: The NOG-1 addresses all aspects of the control. It could be -- there is the -- the cranes are designed such that no single

failure would cause a drop of loads.

This is a section dealing with controls. And there are some requirements for testing too.

MEMBER RAY: Okay. Well, as they say, the testing part of it, excuse me, and the inspections required prior to operability, I think at least a number of them have been addressed.

This is more a requirement about design requirements, including the control system. And I understand you to say that the staff looked at it and found it acceptable to this case.

And that's my question. And I'm just repeating what I understand you to say.

MR. HERNANDEZ: Yes. We found it acceptable.

MEMBER RAY: Okay.

MEMBER REMPE: I'd like you to elaborate a little bit more about the open item on 9.3. It is related to the exemption request.

But my understanding is the staff's review of that exemption request is pending the staff's review on the revised source terms, correct?

MR. TESFAYE: No. This is -- this is pending the completion of the exemption request that was submitted, I believe January 31.

MEMBER REMPE: And it's not at all related to the review of the source terms?

MR. TESFAYE: It is sort of related to that. But, if the exemption, if the evaluation is accepted, all those RAIs associated with the open items will be closed.

MEMBER REMPE: Okay. So let me make sure I understand. Because you said, well, it is -- sort of relates to the source term.

The staff hasn't finished their reevaluation of the source term. Will the exemption request be processed independent of the source term request?

MR. TESFAYE: That's correct.

MEMBER REMPE: Oh, okay. I just wanted to make that clear.

MR. TESFAYE: Yes.

MEMBER REMPE: Thank you.

MEMBER KIRCHNER: Well, I have a question on, let's see, it would be 9.5 I think, CVCS system, or 9.3.

In your assessment of that system, did you find it risk significant or not?

MR. TESFAYE: Okay. Ryan Nolan will be addressing your question.

MR. NOLAN: The review of whether the classification of a system is risk significant or not, is something performed by the PRA reviewers in Chapter 19.

The overall classification of every system is in Chapter 3. We would assist the Chapter 3 reviewers in determining whether or not it meets the definition of safety related or not.

The determination of risk significance is within the review area for the PRA branch. And I know they did look at this system.

They reviewed the written as process that NuScale has followed. And it is documented in Chapter 19.3.

MEMBER CORRADINI: Well, for the system, this open system that Member Kirchner is asking about, this has already been evaluated?

MR. NOLAN: So this system is identified as a B2 system. So, -- well, with the exception of containment isolation valves and then the demand isolation valves.

So, with the exception of the isolation function, the overall system is considered non-safety related, not risk significant.

MEMBER KIRCHNER: Well, but then that re

-- it remains for you to do the Chapter 19 review.

MR. NOLAN: Correct. The discussion on how the staff evaluated the risk significance of that system is more appropriate for Chapter 19.

MEMBER KIRCHNER: But you haven't done that yet? You've made a statement that it's not risk significant.

MR. NOLAN: Currently --

MEMBER KIRCHNER: Currently.

MR. NOLAN: I'm talking about how NuScale identified the classification system in their application.

MEMBER KIRCHNER: I understand how they did it. I'm wondering how -- what your review concluded?

MR. NOLAN: So, the staff evaluated that in Chapter 19. And then I think, I don't know when Chapter 19 is scheduled to come in front of the Subcommittee. But, I think it's within the -- a couple months or so.

MEMBER CORRADINI: Are you satisfied? I think I understand what he's saying.

MEMBER KIRCHNER: Yeah. I heard what he said. Okay. Thank you.

MEMBER CORRADINI: Other questions about

Chapter 9 before the -- I think you're planning to move on.

MR. TESFAYE: Yes.

MEMBER CORRADINI: Any other questions on Chapter 9?

(No response)

MEMBER CORRADINI: Okay. Hearing none.

MR. TESFAYE: Chapter 11, radioactive waste system. The Lead Technical Reviewer is Zack Gran. He's in the audience.

This Chapter has two open items. The open item in Section 11.1 involves design basis spent fuel fraction. And the NRC staff has further questions on -- as design basis spent fuel fraction is related to the source term for radiation shielding and ventilation system.

The open item in Section 11.2 involves assessing the dose consequences from the catastrophic failure of an outdoor tank containing radioactive material. That open item has now been resolved.

Are there any questions for the staff on Chapter 11?

MEMBER CORRADINI: I guess I want to make sure, that's not reflected in the draft SER

that we've seen?

MR. TESFAYE: No. It's not. There isn't --

MEMBER CORRADINI: So this is post-R --

MR. TESFAYE: Post-RAI, yeah. As in --

MEMBER CHU: So this only has one open item.

MR. TESFAYE: Right now. Yeah, as I indicted earlier, when we issued Phase 2 SER, we closed Phase 2. And then we start Phase 4.

So all those open items are now closed. And they will be reflected in the Phase 4 SER.

MEMBER CORRADINI: I understand that. But what I want to make sure of is, that what we heard in the Subcommittee in detail, that the tank failure was still considered an open item in the draft SER that we have.

MR. TESFAYE: That's correct. Yes.

MEMBER CORRADINI: Okay. Fine. Margaret, I'm sorry. I didn't mean to interrupt you. If you had other questions.

MEMBER CHU: That's okay.

MR. TESFAYE: Any other questions, comments, in Chapter 10?

(No response)

MR. TESFAYE: Okay. Thank you. Chapter 12, radiation protection. There are three reviewers. The Lead Reviewer is Ron LaVera. And --

MEMBER CORRADINI: Can we just go back to 11, just so --

MR. TESFAYE: Sure.

MEMBER CORRADINI: I'm sorry I'm -- you're efficient enough that you're faster than I am thinking.

So, the remaining open item in Chapter 11 is a verification that all the value used relative to the source term for the DFFF are properly considered in terms of radiation zones and appropriate shielding?

MR. TESFAYE: That's correct. I mean, that -- Zack Gran can elaborate it.

MEMBER CORRADINI: No. I just want to make sure I'm --

MR. TESFAYE: Okay. That's correct.

MEMBER CORRADINI: I properly characterize it in my mind. That's all.

MR. TESFAYE: Yes. That's correct.

MEMBER CORRADINI: Okay. All right. Thank you.

MR. TESFAYE: And I've already

introduced the technical reviewers. Chapter 12 has 29 open items. Sections 12.2, 12.3, and 12.4 have several open items.

As we explained during the Subcommittee meeting, the staff is currently conducting an audit to review material that was not submitted as part of the RAI responses associated with some of the open items.

Once that audit is completed, we will continue the evaluation of the response. Some of the open items are awaiting supplemental information or responses to a new RAI that was issued in Phase 2.

And a good number of the RAIs in these sections involve the accident source term methodology change. And we've had several meetings with the applicant to discuss this revised methodology.

And we expect the applicant to submit revisions three of the topical report this month. And once we receive that then those RAIs associated with that methodology change will be evaluated and addressed in Phase 4.

MEMBER BALLINGER: Are a number of these RAI resolutions, are any of them likely to result in

very large changes in the SER?

MR. TESFAYE: Large changes you said?

MEMBER BALLINGER: Yeah. Changes that would be significant if we're writing a letter.

MR. TESFAYE: That's a relative term. Some of them will just probably go away without any major change.

Some may involve a discussion of the new revised methodology. I would assume.

MEMBER BALLINGER: In particular with the source term.

MEMBER CORRADINI: But I just want to make sure.

MEMBER BALLINGER: A reaction with the source term, yeah.

MEMBER CORRADINI: But I think what Member Ballinger's question is, is that the -- I want you to repeat one thing that I guess I didn't hear clearly.

So the revised source term topical report revision is due in shortly?

MR. TESFAYE: Yes. By April 17 actually. Yes.

MEMBER CORRADINI: Oh. But all the open items that are -- there's at least, not if you sign

that, --

MR. TESFAYE: Oh, seven.

MEMBER CORRADINI: But a major fraction of what you're identifying in terms of radiation source is really dependent upon what that -- the proposed source term is.

MR. TESFAYE: Yes.

MEMBER CORRADINI: And everything is being left open per --

MR. TESFAYE: Until we evaluate the revised methodology.

MEMBER CHU: A lot depends on the audit result, right?

MR. TESFAYE: And some of them do involve materials that are being reviewed as part of the audit.

MEMBER CHU: And then the audit would be done when?

MR. TESFAYE: Today actually.

MEMBER CHU: Today? Oh.

MEMBER CORRADINI: Other questions by the Members?

MR. TESFAYE: Any questions?

MEMBER CHU: And I'm going to ask what Ron asked. Is it possible because of the accident

report that in redone, is it possible, it would impact significantly of some of the other stuff?

I'm emphasizing the word significantly.

MR. TESFAYE: I don't think so. Significantly can mean anything. But in my opinion, it's just confirming the new source term that is out of this new methodology, will bound or will be, will cover the remaining issues in these open items.

Ron maybe can help you with this since it's been asked by two Members. Maybe you can address this question.

MR. LaVERA: So, I'm Ron LaVera. I'm the lead reviewer for Chapter 12. So, the alternate source term proposal that's expected to be received from NuScale will in essence reduce the amount of activity that's considered for a design basis accident.

But where that's going to impact us, it's going to reduce the activity that we have to consider for stuff like post-accident sampling, or vital area emission doses.

And it will also impact what's considered for equipment qualification. And then how do we bridge that gap between equipment qualification, which will have a much reduced source

term, and equipment survivability.

So, those are the kind of issues that will play out as a result of the proposed change in source term.

MEMBER BALLINGER: But no effect on EPZ?

MR. LaVERA: Chapter 12 doesn't look at EPZ. That's Chapter 15, Michelle Hart.

MEMBER CORRADINI: I think we're getting some -- I'm going to speak for myself, I think we're getting ahead.

I think he's answered your question, which was the four areas that will affect you. And we've yet to see the others.

And that's about the best we know at this point.

MR. TESFAYE: I can answer that. I don't think it's going to affect EPZ. They will be using the same format system for siting and control room.

And as Ron mentioned, I think this impact will probably be in equipment qualification. And also it has -- since it has some impact on post-accident sampling, they have requested the exemption request.

MEMBER REMPE: Just to follow up on that

thread a little bit more, because I don't have your SD in front of me. The reason why the exemption request is there, is, I think, they can get it without going and doing the post sampling, right?

I mean, they'll get the information a different way. So that's why you're saying the source term review does not affect that exemption issues -- exemption request. I'm having trouble talking.

MR. TESFAYE: Yes. Maybe I should ask Ed Stutzcage to step up to the mic and probably elaborate a little bit on what the exemption request entails.

MR. STUTZCAGE: Yes. The exemption request is basically a request to not have to evaluate the dose that you would take to take samples during an accident.

But, and part of the basis for that is they have other means to get that information. Such as the amount of core damage through -- under the bioshield radiation monitors or the core exit thermocouples.

They have hydrogen monitors in the lines that they have to use the sample lines to evaluate the -- well, to get the gas to monitor.

But yeah, they have other means to get that type of information. That the sampling would only be used as a contingency plan if it was needed.

MEMBER REMPE: If the -- again, hypothetically, if the revised source term is so low that those remote means can't detect such a low thing, I guess I would think this does depend on your revised source term.

And I'm not so sure that it doesn't in your evaluation.

MR. STUTZCAGE: So, the revised source term, NuScale's proposal is to revise the source term for equipment qualification and for possibly for aspects of GDC 19.

That the proposal isn't really to revise the source term for things like post-accident sampling and if there are any vital area mission doses. But the exemption is ma -- yes. The exemption is a proposal that we don't have to evaluate.

It's saying they don't need to do sampling except under a contingency plan.

MEMBER REMPE: But you're very comfortable with whatever we're doing with the revised source term for the qualification. Not

affect the magnitude of the source term.

MEMBER CORRADINI: I don't think you want to say very comfortable.

MR. STUTZCAGE: No. We're -- we didn't even have their topical report yet. So, --

MEMBER REMPE: Well, I would be saying a different answer to the question that I asked earlier today.

I think that you should be evaluating the exemption after you evaluate the revised source term request.

MR. STUTZCAGE: It's kind of, it's sort of linked together, that is true.

But again, the exemption is requesting that the sampling only needs to be looked at under contingency plan space. And that they have these other means to detect it.

So, --

MEMBER REMPE: Are you going to go ahead and evaluate the exemption without waiting on the source term?

MR. STUTZCAGE: No. No, that is -- so, it's together.

MEMBER REMPE: Well, I would be saying it does depend -- it will be done after the source

term is evaluated. I would be thinking that would be an important thing.

And I thought that's what your SER had said when I read it a while ago.

MR. STUTZCAGE: Yeah. It's linked together. Yes.

MEMBER REMPE: Okay. Thank you very much.

MR. STUTZCAGE: No problem.

MEMBER CORRADINI: Any other questions of the other staff member?

MR. TESFAYE: Ron.

MEMBER CORRADINI: Any other questions for Ron?

(No response)

MEMBER CORRADINI: Thank you.

MR. TESFAYE: Okay. All right thanks. Now on Chap -- the last Chapter is Chapter 16, technical specification. The Lead Reviewer is Craig Harbuck and Bob Tjader is also the Chapter 16. And they both are here.

This Chapter has 22 open items. A significant number of the open items, Craig can correct me, but has end results since we issued the SER.

MEMBER CORRADINI: Say again?

MR. TESFAYE: A significant number of these open items have been resolved.

MEMBER CORRADINI: Okay. But again, --

MR. TESFAYE: Not closed, but they are probably confirmatory.

MEMBER CORRADINI: But again, just so that that all the members are aware, so we're evaluating it based on the submitted SER at that stage.

So, from our standpoint these are still open.

MR. TESFAYE: They are open items. They are listed as open items in the Phase 3 SER.

MEMBER CORRADINI: Thank you. Fine.

MR. TESFAYE: But, I'm just reflecting the status. Like I said, we are in Phase 4. And we have closed some of the open items.

Again, I don't see any show stoppers in these open items. And I expect them to be closed in the next couple of months.

Anything additional? Craig, you want to say at this stage? Or are there any questions on Chapter 16?

Craig had a very lengthy presentation

for you in the Subcommittee meeting. And --

MEMBER CORRADINI: Any other questions by the members?

(No response)

MEMBER CORRADINI: Okay. Does that conclude your presentation?

MR. TESFAYE: That's correct.

MEMBER CORRADINI: Okay. So, I think at this point, is there anything that the members want to ask that may lead us into a closed session?

(No response)

MEMBER CORRADINI: I think not. But I want to make sure that we give all of the members a chance. Otherwise, I'm going to turn to public comments.

(No response)

MEMBER CORRADINI: All right. Okay. So, as the phone line is being opened for the public to make comment, I'll turn to the audience and ask if there's anybody in the audience who wants to make a comment?

MS. FIELDS: Yes.

MEMBER CORRADINI: Hang on. We're still waiting for people in the room. I hear somebody on the phone line. Wait one second. Anybody?

(No response)

MEMBER CORRADINI: Okay. Let's turn to the public line. And I already know it's open since we heard someone. So, go ahead and make your comment please.

MS. FIELDS: Yes. This is Sarah Fields. My comment is that I don't feel like there's been --

MEMBER MARCH-LEUBA: Mike, is she going to speak up?

MEMBER CORRADINI: Excuse me, excuse me, ma'am. Could you speak a little louder? We can barely hear you.

MS. FIELDS: I do not know whether anyone is considering a (inaudible) after this is associated with the transfer of spent fuel into storage canisters and then to casks. And the long-term source of those canisters and casks as transported offsite.

MEMBER CORRADINI: I think we get your question. And we have our Federal Designated Officer, which will come back to you to try to make sure we get you an answer offline.

MS. FIELDS: Thank you.

MEMBER CORRADINI: Oh, point to where that is. We only take comments at this point. We

can't answer questions at this point.

MS. FIELDS: I understand.

MEMBER CORRADINI: Okay. Did you have another comment, ma'am?

MS. FIELDS: No. Thank you.

MEMBER CORRADINI: Okay. Is there anybody else on the public line?

(No response)

MEMBER CORRADINI: Okay. Hearing none, we can close the public line. And I'll turn it back to you Mr. Chairman. We are completed with this portion of the meeting.

CHAIR RICCARDELLA: Okay. And there is going to be no post for you?

MEMBER CORRADINI: Nope.

CHAIR RICCARDELLA: Okay. So, I would suggest that we get into the letter writing.

MEMBER CORRADINI: In fact we could reconfigure ourselves and we'll get the copies for the members. And we can go through an initial read through if that would be all right?

CHAIR RICCARDELLA: Yes. That would be good.

MEMBER CORRADINI: Okay. And we're off the record.

(Whereupon, the above-entitled matter went off the record at 10:30 a.m. and resumed at 2:06 p.m.)

CHAIR RICCARDELLA: The meeting will come to order. I'll turn the meeting over to Dr. Rempe.

MEMBER REMPE: Thank you. And thank you for coming today. But before we start this session, I just want to give the members some background information.

And remind you back in 2017 we agreed to revise not only the format of a biennial research review, but also the approach we used to conduct that view -- review.

And although we've revised our process, I want to note that we still adhere to the guidance that the Commissioners provided to us in their 1997 SRM. Namely that we're going to examine the need, scope, and balance of the Reactor Safety Research Program.

And we're also continuing to adhere to the Commission's directive that we consider how well the Office of Research anticipates research needs, and how it's positioned for the changing environment. This presentation by Ray and his

colleagues is the first step of this revised process.

And last time we completed our review, we found that this first meeting was very helpful in helping us establish what the -- his -- Ray's or the Director of Research's goals are, his vision for RES, his perspective RES needs, and how ACRS input can be help to him.

And I also want to acknowledge that we want to use this first meeting as an opportunity to evaluate how RES is eval -- responding to our two primary recommendations from our prior report.

Which were, the current process to prioritize Agency research could be improved by performing a systematic assessment that emphasizes enterprise risks in research project selection, evaluation and termination.

And that RES should develop long term strategies to address emerging technical issues, support development and maintenance of needed analytical tools and databases, emphasize activities that improve regulatory efficiency, and identify and preserve needed core competencies.

After today's meeting, we're going to hold three information meetings with each of the RES

Division Directors, to obtain a more detailed understanding of ongoing research in their areas. Namely, the Division of Engineering, the Division of Systems Analysis, and the Risk Analysis Division.

And in advance of these meetings, the ACRS lead for each area will develop a list of questions that they will provide to the Division Directors, similar to what we did last year.

So today, of course we always welcome member comments, but if we get into too much detail about specific research that's going on in each division, I'd ask you to collect your additional questions and send them to the three ACRS members who lead the subsequent review meetings.

And I'll go through their names right now. Matt Sunseri is going to be leading the Division of Systems Analysis.

MEMBER SUNSERI: No. Engineering.

MEMBER REMPE: Oh, excuse me, the risk -- yeah, the Division of Engineering. Walt Kirchner will be leading the Division for Systems Analysis with you. And Vesna Dimtrijevic will be leading the review of the Division of Risk Analysis.

And with all that, I'll turn the meeting over to Ray.

MR. FURSTENAU: All right, thank you Dr. Rempe. And thank you Chairman and Committee Members. This is my first appearance to the ACRS.

And I've been in meetings before, but have never had the opportunity to speak to the Committee. And my first obviously as the Office Director.

And I want to give just a few seconds on my background. I'm new to the NRC about since July in this position.

And prior to that I had over 30 years in the Department of Energy in Nuclear Energy Programs. About 28 years in Idaho overseeing programs and nuclear facility operations at the Idaho National Lab. And then three years at the Headquarters Office downtown.

But when I was asked if I would take the position as Research Director, I hesitated for about a millisecond, because it was as far as the point where I was in my career, I just thought it was a great opportunity.

So, I'm really thrilled to be here and working at the NRC. I got -- as you already know, I've got great Directors and staff that, you know, make my job a heck a lot of easier.

So, I'm looking forward to this opportunity to talk about the research programs and my priorities. One of the first things I did when I assumed the Director's position was the -- was signing out a response letter to the last biennial report. How time flies.

And I remember at that time, I think my only major contribution to that report, because I wasn't familiar with all the programs, was to make sure our response wasn't as long as your report.

(Laughter)

MR. FURSTENAU: And so it just barely -- it just barely made that. Anyway, I'll go on now.

But, I'm going to give a little bit of an overview. And you can see here the agenda. And then I'll be turning it over to the Division overviews and then any discussions that folks may have.

And for me as well, I kind of see your input, your questions and your help as a preview to a research program review that we're going to have with the Commission on May 30. So, this will be very helpful for us to help prepare for that meeting as well.

At a glance, I think -- of course, I'm

new to this position. We don't have a Deputy right now. Ed Hackett, who many of you knew, retired at the 1st of January. And that position is vacant.

But as I mentioned, the Division Directors, who will be speaking here soon, they're the same as who worked here before. Do a great job for me, and really understand and appreciate the role of research in the NRC.

At a glance, one of my personal priorities is to really understand the NRC budget and the budget process. And learn how to use it to promote the benefits of research to the Agency's mission.

I think many of us come from an engineering background or research background where budgets, I guess I could say, are sometimes distasteful to worry about. But, in the end, they kind of drive everything.

And I think it's important, especially at more of the senior management level, to understand how you can make the budgets work of you. Especially in a budget austere environment, which I think we're in right now.

The point of having this pie chart is to just show you from a budget standpoint, many of you

know, it's structured -- the NRC structured the budget by business line.

And we support the business lines through the product lines. And the lion's share of our funding coming from the operating reactor business lines.

But, I think by doing this, this -- again, this is my opinion. By having the budget structure the way it is, it puts an extra, I think, I wouldn't call it burden. That's the word I'm using.

But, another burden on research to really show the value that research brings to the Agency. And I'm really a believer in that.

By having the budget structure sometimes, there's product lines under business lines, I think research could get undervalued sometimes. But, I want to make sure that the Agency as well as the Committee, understands or -- how research better plays into the missions of the NRC. Next slide.

MEMBER REMPE: Ray --

MEMBER SUNSERI: Ray, before you -- who wants to go first? Go ahead Dennis.

MEMBER BLEY: All right. Me?

MEMBER SUNSERI: Yeah.

MEMBER BLEY: Okay. Ray, I kind of agree with everything you said. But the one that troubles me a little, and maybe it's up here, is with everything focused on current user needs, where are the things you see out five, ten years from now, where we need to develop knowledge, methods, whatever you would do in RES, where do they fit?

Are they just under new reactors and advanced reactors? And by the way, what's the difference between those two ledges?

MR. FURSTENAU: Well, new reactors -- advanced reactors may have something that's not under the fee -- non-fee recoverable as well. So, you'll have advanced reactors under a non-recoverable.

But you'll also have new reactors. Things like the NuScale activities and things like that. But --

MEMBER BLEY: Does new reactors mean they're light water reactors? Or --

MR. FURSTENAU: Yes. It can. Yep.

MEMBER BLEY: Okay. It can?

MR. FURSTENAU: Yep.

MEMBER BLEY: Can it mean something

else?

MEMBER SUNSERI: It sounds like they've got an application though pending or something.

MR. FURSTENAU: Yeah. We'll support --

MEMBER SUNSERI: That distinguishes, right?

MR. FURSTENAU: We'll support that. Right. Right.

MEMBER SUNSERI: Yeah. But once they apply, then they're faint, right?

MR. FURSTENAU: How about if I -- and you guys have got to correct me on format here. I don't want to -- as far as how you guys work on this stuff, if I'm not able --

MEMBER BLEY: We interrupt you a lot.

MR. FURSTENAU: Okay. And --

MEMBER REMPE: And you just have to sit there and take it.

(Laughter)

MR. FURSTENAU: I considered it an accomplishment. I got through the first slide, so.

(Laughter)

MEMBER CORRADINI: It is the last time.

MR. FURSTENAU: But, I was planning to talk to that more here as we --

MEMBER BLEY: Okay.

MR. FURSTENAU: As we get into a couple of the slides.

MEMBER BLEY: That's fine. That's a good answer.

MR. FURSTENAU: So, because it does tie into some of the other things I wanted to talk about in the overview, if that's okay. Yeah.

MEMBER SUNSERI: So Ray, this may be on your list of things to weave in also, but one thing that we learned the last time we did review is -- let me back up for a second.

Our charter is to look at the Agency's research program. And oftentimes what that focuses on though is your specific area.

MR. FURSTENAU: Sure.

MEMBER SUNSERI: And we learned last year that there are research activities done by other divisions or departments throughout the agency.

So, what are your thoughts about getting your arms around all of the research and representing the Agency's research program for us to look at?

MR. FURSTENAU: Yeah. I mean, that's a

good question. I think as we -- I'm finding that out as well.

I mean, when you look at this pie chart here like with the operating reactors for example, and it works somewhat the same for the others. We're driven in research mostly by user need requests of some sort. It can be a program -- more detailed in the program plan.

And so, we're working with a business line of corresponding organizations. And many times they have people that more or less are involved in research as well.

But, this is meant to show really how much we have applied towards our -- what we're supporting in those business lines.

But, you're right, getting a hand -- or wrapped around, okay. How much is really research across the agency, not just within the --

MEMBER SUNSERI: Right. And I'm not suggesting that it all has to fall under your authority or anything like that. I mean, we're not trying to tell you how to do business.

But, it seemed like, you know, holistically the Agency's research ought to be directing to some resear -- Agency beneficial

outcomes, right?

MR. FURSTENAU: Of course.

MEMBER SUNSERI: And who is responsible for that I guess? I'll just leave it open ended.

MR. FURSTENAU: Okay. I mean, that's something I think as we get into the more detailed Division discussions later on.

And that's what it all leads to. You've got a -- you've got some sort of a reason to tie the research to the end result.

I think that's a big challenge for research as well. I see we've got just excellent technical people in the Office of Research. Just unmatched. I've been very, very impressed with that.

I think a thing that we need to do better on is okay, how do you articulate the value and benefit of that research in, you know, sometimes 30 seconds or less?

Because when you're trying to defend the value and benefit of the research to the Safety and Security Missions, and trying to make, you know, the decision makers on budget calls on okay, what's more important, sometimes getting too detailed on what the research is, kind of loses the thought of the

value of it.

So, I think part of our task is to better articulate the value of research so it can more stand on its own. And inevitable decisions that have to be made on budgets and such.

MEMBER REMPE: So, you're kind of approaching where I would add to what Matt's question is. Is that with our recommendation about prioritization, having extra research that is not part of that prioritization project can cause some difficulty.

And so that's why we encouraged in our last review that you be cognizant of all the Agency's research. And not just those that RES is designated to be over.

MR. FURSTENAU: Yes. I agree with that. And I'm going to be talking a little bit about the prioritization process coming from the recommendations that ACRS and others, I mean, with regard to the prioritization of research. And how that fits into the, I guess, the bigger picture of wherever the research is going to be done.

So, I'll try to cover that in a bit.

MR. CASE: Just to add in a little bit. I don't think there's a lot of research that's not

occurring in Research. Especially as resources start to shrink, some of those things that were maybe on the margins, are getting transferred back to Research.

So things like codes. So I'll talk in my presentation, NRO was doing some code development work that is probably more traditionally research work.

So as they started to come back to NRR, they said hey, I really shouldn't be doing this. And so we're going to be assuming that.

So, there's not that much out there. Not as much as in the past. Maybe not as much as a few years ago.

But it's coming back to Research. There's not a large amount of research that's being performed outside the --

MEMBER REMPE: So the pie chart only includes your budget. None of this other research activity stuff at this time.

And so it would be good to know at some point, is it less than 10 percent, or what it is at this point.

MR. CASE: It's mainly the high level waste. That's sort of where research was being

conducted, because it was different.

MEMBER REMPE: Um-hum.

MR. CASE: So, we'll take a look and see if we can bang out a number or something.

CHAIR RICCARDELLA: So, the dollars and FTE, that truly is an and?

MR. FURSTENAU: Well, yes. The contract -- the dollar amount is the contract dollars. And then the FTE are the federal ones.

CHAIR RICCARDELLA: I understand.

MR. FURSTENAU: Yes.

MEMBER CORRADINI: Okay. That's where I was going.

MR. FURSTENAU: Yes.

MEMBER CORRADINI: It's the sum of the two then?

MR. FURSTENAU: Yes. The sum of the two. One is not included in the other. They're both separate.

MEMBER CORRADINI: And -- yeah.

MR. FURSTENAU: Okay? All right. I think this kind of tee up some of the other discussion we'll have. I think a big goal of research would really help the Agency to be ready.

You know, whether it's for tomorrow's

technology. But, and that really should be a main focus of NRC research.

We have to support licensing and oversight of innovative technology and designs. Because you're -- even when you're driven, I think, by the business lines, by the operating reactor business lines, when licensing actions are coming in, a lot of them are coming in because someone, a licensee wants to do something different.

And that something different usually involves a new technology. And so, we should do our best to be cognizant.

And that's where I'll get into external awareness of well, stay tuned in to what's going on out there, so we can our best from a regulatory decision making standpoint to be ready for that.

And activities having a balance between confirmatory and participatory research. That's an area where I'll discuss again, discuss a little bit later.

My sense right now is since the time we've been here, I think we don't do enough of the anticipatory research. I think we could do a better job of that.

I think the budget structure is set up

such that it tends to drive toward more of the confirmatory research versus the participatory, because it's a user need-based thing. And I'm not going to say that that's the only reason.

But, in order to be ready, kind of, I think research, a big role of research is to stay, again, stay tuned into what's going on out there and see what new technologies might then be taken by a licensee or new reactor, an advanced reactor vendor coming in.

And we need to be ready for that. We can't wait until a license request or a licensing action comes in.

MEMBER CORRADINI: So, anyhow, I'm getting ahead. But, is it regardless whether it's NRO, NRR, or NMSS, whatever, both confirmatory and participatory comes from then as user need?

Or do you have a base budget in either confirmatory and participatory that you can choose independent of each?

MR. FURSTENAU: There is no separate bucket.

MEMBER CORRADINI: There is something now?

MR. FURSTENAU: No.

MEMBER CORRADINI: Okay. So whether it's anticipatory or confirmatory, it's got to come from one of the other offices?

MR. FURSTENAU: That's correct.

MEMBER BLEY: Have you thought about how you would sell the need for anticipatory research that isn't coming in yet?

MR. FURSTENAU: Yeah.

MEMBER BLEY: If that, to get kind of funding that you need to do important anticipatory research.

MR. FURSTENAU: Yeah. I have thought about that. And I think that -- I haven't had discussions with like our CFO or the Commissioner or anything like that.

But, I guess to draw a parallel, I think that I'd like to see something like just a nominal funding. I see it akin to like a laboratory LDRD type arrangement.

Where, you know, you've got people being able to think out of the box, think ahead of this type of research that might not be driven by an immediate license request. And there's some sort of a peer review process that allows for that type of work to be done.

I think a big draw of it, is it helps retain top talent. It helps draw top talent. Because it can show that even as a regulatory agency that we're trying to stay up with what's going on out there.

And then somehow we use a process that's maybe outside of the user need. There's already a process, and I'm trying to remember what it's called here. Yeah, feasibility studies process.

I think we talked about that. Let's talk about some like in NUREG-1925. But, I think a part of that -- so it's a process of how to get ideas coming in whether at the -- within, you know, the user need type process or outside of it.

But, I think then once that says it might be a good idea, there's no way to necessarily fund it unless the business line picks that up. And so that's where I think that we need to look at how can we take those ideas further and show those?

I don't know, my experience with LDRD, it maybe let's say, a half million dollars a year for three years. And then if it doesn't pan out, you say okay, we gave it good shot.

Because it is risk. That's what research ought to be doing, is taking on risk for

the Agency. And where we see research going. And it may not turn out. We may not get a licensee come in with something.

MEMBER BLEY: Is there a way to? Or do you already cooperate with DOE?

MR. FURSTENAU: I'll get --

MEMBER BLEY: Just kind of ideas. Just kind of like that.

MR. FURSTENAU: I'll get to that as well. Yeah. That's kind of --

MEMBER BLEY: But they'll be happy to wait.

MR. FURSTENAU: So, right. And if I don't --

MEMBER BALLINGER: I have a question.

MR. FURSTENAU: Yeah?

MEMBER BALLINGER: What is your definition of anticipatory?

MR. FURSTENAU: Well, I look at anticipatory -- that's a good question actually. I guess I'll give you my view of anticipatory.

I think the confirmatory, we're kind of -- this -- we're kind of responding to the day to day needs of the licensee, --

MEMBER BALLINGER: Uh-huh.

MR. FURSTENAU: The line organization. And that ought to be our top priority. I have no disagreement with that.

But to me the anticipatory would be okay, you've got these line organizations like New Reactor Office, or NMSS, or NRR. They've got those day to day activities in front of them.

We ought to be the organization that thinks beyond that. We ought to be anticipating the next big thing that might be out there.

MEMBER BALLINGER: So would you consider sending a staff member to a conference on additive manufacturing?

MR. FURSTENAU: Absolutely.

MEMBER BALLINGER: As part of anticipatory, that definition?

MR. FURSTENAU: Yes.

MEMBER BALLINGER: Anticipate.

MR. FURSTENAU: Uh-huh. Yes. I would. I'm not suggesting that the business lines don't think about those things.

MEMBER BALLINGER: But you also said that there's no vehicle for doing that now though. Did I miss it? There's no budget for doing that.

MR. FURSTENAU: Well, there's no budget

for doing it. Some of that you can fit under the business lines.

And if you talk with the business lines about it to show that there's benefit to them for doing that. But, it's a -- it's not where I'd like to see it though.

MEMBER BALLINGER: So which way does the conversation go? Does the business line come to you and say, we'd like you to send somebody to a conference on additive manufacturing?

Or do you go to the business line and say we'd like to send somebody to additive manufacturing?

MR. FURSTENAU: It can go both ways. It can go both ways. Yep. All right. We'll go onto the next slide.

I think the external engagement is important to really any research organization. And you know, we engage regularly with these organizations.

I've really been a promoter of engaging with DOE. I encourage my -- I still know, you know, some folks at DOE and how the DOE system works.

And DOE, and I think you can do this and maintain regulatory independence. I don't think

it's incompatible at all.

But, there's clear indications like in Congress for example, that they expect DOE and the NRC to engage with each other. They don't want us to spend money twice on the same thing if we can share expertise, share data, share capabilities.

And DOE, when they're planning for their programs, I'm not speaking for DOE, but recollecting when I was there, in many of the applied programs, which the Office of Nuclear of Energy for example, most of that is applied activities.

If somebody's not going to use the investments they're making, whether it's in codes, or testing capabilities, and if somebody is going to use it, whether it's a vendor or whoever, eventually it's going to be coming to the NRC for licensing then.

So, if the tools or the facilities don't have value too eventually licensing, then they're not successful.

So, I think it's absolutely vital that we maintain good relations to DOE. Tell them what type of things we see as helping us answer licensing questions in the future.

For example, modeling and simulation.

Because I know you've been very involved in reviewing the NEAMS codes for example, or the CASL codes that have been developed by DOE with DOE funding, but we're involved in much of that as well.

You'll hear more details of that from Mike Case later.

MEMBER REMPE: So Ray?

MR. FURSTENAU: Uh-huh?

MEMBER REMPE: On this slide I see you put the VTR.

MR. FURSTENAU: Uh-huh.

MEMBER REMPE: And I was involved in some meetings last week where I was very disappointed that they're developing this design for this 60 billion dollar plus test reactor. And now they are just going to put in essentially static capsules, not loops with different fluence.

And I asked, well, what, you know, how did that come about? And who's overseeing that? And they said, oh, and they showed me a table with all the design developers and some lab folks.

And I didn't see the NRC involved. And I tried to emphasize to the folks involved at that meeting that it was important to have the regulator involved.

Because after 60 billion dollars, if you've developed some sort of test, fast test reactor and the regulator says, I'm not going to approve something that doesn't have flowing coolant of whether it's molten salt or sodium, or whatever, helium, you know, that could be a problem.

And so, I don't know how to emphasize it other than to speak out in meetings. But it seems like the NRC ought to be there somehow or other saying, well, they approve that data. It's sufficiently prototypic.

And I don't think that you guys are involved. And so, I think that's an area where research ought to find a way to make sure they get involved more.

MR. FURSTENAU: We actually have been involved in the VTR. We're developing an MOU with DOE right now on how the NRC will -- and particularly research, how we'll be involved in that activity.

And so I think, you know, they're not -- that is not going to be, that machine is not going to be licensed by the NRC.

MEMBER REMPE: They're going to go through authorization.

MR. FURSTENAU: But, I think, you know, there's a lot that's being done there with let's -- for example, it's going to be a fast reactor, sodium cooled fast reactor technology that could be, you know, a lot we -- well, there will be a lot we can learn at the NRC on that technology that might apply to future licensing actions if somebody decides they want to build a sodium cooled fast reactor.

So, we are involved in the -- what DOE is doing with the VTR.

MEMBER REMPE: I know you are involved on the authorization.

MRM. FURSTENAU: Yeah.

MEMBER REMPE: On how it will be authorized. But DOE really doesn't have an authorization for a start up of a new reactor.

So they do need some input that way. But the actual design, and what they select, and those selections, and how good those selections will be, I'm not seeing that yet.

And so it's just something I wanted to bring up here today.

MR. FURSTENAU: Yeah. All right. Well, I think, you know, whatever is done, you know, the data wherever it comes from, whether it's from the

VTR or from Halden or from let's say old EBR-II data or FFTF data, I think from a regulatory standpoint, the pedigree of that information, that's where it will be important to the NRC.

MEMBER REMPE: Right. And so the time to get involved is early on.

MR. CASE: A couple of extra. We did do the early on thing. We got involved in the evaluation of alternatives so that we could get our foot in the door.

The reason I would be a little bit hesitant about working on the design, because our intention is to help them with the review. So that would present a conflict of interest.

MEMBER REMPE: Maybe so. But this is something that's supposed to help the taxpayer get some advanced reactors up and running.

And if you don't get involved in the design, and then you say, well, that's a very nice design, it's safe, go ahead and start it up. But oh, by the way, the data aren't going to be useful for licensing the subsequent whatever type of advanced reactor.

That's -- again, I think I've made my point by harping on this enough today. But that's

something I -- and instead of having that table with just a bunch of design developers, who may not understand what's really needed for regulatory approval, and some lab folks, I think you ought to have some regulators there too.

And you're going to be involved in the authorization. But DOE is supposed to authorize start up of that.

So, I think you need to be involved a little bit more. Just one member's off the cuff remark here. I know.

MEMBER CORRADINI: Since we're on a technical topic that we're not supposed to get on. My -- I can see where Joy is going.

But I think you've got to be real careful that you don't cross this magical boundary.

MR. FURSTENAU: Um-hum.

MEMBER CORRADINI: You can observe the design and caution. But you can't tell them, well the way to solve this and to solve the regulation is X.

MEMBER REMPE: But caution is where I'm going. No flowing coolant might be a caution you might want to think about.

MR. FURSTENAU: I wanted to mention a

couple of other things on engagement. Another one with DOE.

I think some of you may be familiar with a couple of the acts that were signed into law last, late last year. One being the Nuclear Energy Innovation Capabilities Act.

And we're developing an MOU with DOE on that right now. It's a high level. But, it really gives that ability for -- and it's pretty specific in the Act that we really just turn the provisions of the Act into an MOU with DOE on sharing data, sharing capabilities.

And I think it will just -- we're doing a lot of that already. But it just reinforces what Congress is expecting between the two Agencies.

So, I think that's good. And DoD, we're doing some work with them. No research work. But, they're asking for support on micro reactors, how to best regulate, you know, what are options for micro reactor regulation.

They're looking at a couple of concepts. One that might be mobile. And one that might not be mobile. Two different organizations in DoD.

But I mean, I think it's important to look at organizations like DoD and DOE, is because

they're good barometers for what we might be seeing in the past, because that's where the funding is at.

And you, especially when you're looking at advanced concepts, and I think all of you realize it's not for the faint of heart when it comes to how much it costs to get something designed, reviewed, licensed, built. And DOE's role in helping that deployment, is something we have to pay attention to.

So, it's a -- we have a good partnership. Of course with EPRI as well. And I think our international partners, we really have to leverage the payback we get by collaborating with other countries and other Agencies.

So, I think we will, well, I know we'll continue to do that.

MEMBER KIRCHNER: Ray, do you have any contact with NASA?

MR. FURSTENAU: Yes. Yes, I do at --

MEMBER KIRCHNER: Because they are kind of pioneering micro reactors again.

MR. FURSTENAU: Yes. And they're doing it both with the -- yeah, they have a design. I think they tested this, a small test at Los Alamos on one.

But they're looking at propulsion as well as power production. And we're still actually participating in a safety guideline review development from OSTP which involves many agencies. It involves EPA. It involves DOE. It involves NRC. So, we are -- we are tuned into NASA's work as well.

On planning and reporting of research, I guess I added the word planning, budgeting and reporting of research. Because it's all really tied together.

I think that since the last time our planning and reporting of research and, you know, the suggestions from your committee as well as from the Commission and others, we have to get better at doing that.

And that's -- to me, that's part of getting the visibility of research as well. We use such a thing called the Enterprise Project Identifiers, EPIDs.

And you can debate whether they're detailed enough, too detailed. It -- I mean, that's certainly, there's valid questions on that.

But it's kind of a mechanism that's being done, and to roll up into budget requests. So, that helps with the budgets. It's helped in the

execution. How people's time is charge.

But one thing we started this year that I really think will be helpful in the end, is the research started this year, this calendar year, program reviews with the business line leads to support that strategic alignment.

I think it goes to what you were talking about a little bit, Joy, at the beginning. Is how do we align across the business lines and other restrictions. So that's being done.

MEMBER CORRADINI: Ray, what does that exactly mean?

That means in the past, if NRO needed X, the NRO person that needed X never saw how it was progressing?

MR. FURSTENAU: No. Well, maybe let me go into it a bit further. Let me see if I answer your question.

(Simultaneous speaking.)

MR. FURSTENAU: Yes, I'll give you an example. I think a lot of just excellent work done.

When you're dealing with the user need request type things, you know, you've got that back and forth that goes on, you know, with the requester and the researchers and the branches and the

divisions to look at, okay, this is what research needs to be done.

And then you sign off on that. We go out and do that. That's done really well. And so, within those division alignments within the respective organizations, good work is done in that area.

But, what I wanted to do is, okay, that's all good and we want to continue to do that, but how do we get better alignment more strategically across the product lines within the business line?

For example, we did the -- just last week with a lot of the DE programs, and then with Mike Cheok's work in risk analysis, product lines with NRO.

So basically, we do summary level reviews. This is what we're doing for you. This is why it's relevant. This is how much we've spent on it on the past.

Here's milestones that show what we're doing, and kind of take that step-back look is, how does that all fit in to what's important to the business lines?

You may have a division that says, this

is important to me and what I'm doing, and then that's all good, but how does that fit in to the overall agency priorities? For --

MEMBER REMPE: So to be more specific, would you have Mike and Brian and Mike -- all three there listening to this review?

And so, if you have some -- I'll pick on one project.

If you have someone who likes HRA and thinks it's really what they need, and Mike Case or Brian Thomas say, well, I don't think that's as important as whatever I'm doing with fire analysis, or something like that -- or thermal hydraulics -- do you have that kind of interdisciplinary discussions with prioritization?

MR. FURSTENAU: Oh, I'll get into that.

(Laughter.)

MEMBER REMPE: Okay.

MR. FURSTENAU: We may need --

(Simultaneous speaking.)

MEMBER REMPE: I was too early?

(Simultaneous speaking.)

MR. FURSTENAU: -- prioritization of that.

MEMBER REMPE: Okay.

MR. FURSTENAU: But, I mean, the program review is a new thing we're doing to try to make sure that we're in alignment at like, the Ho Nieh -- Brian McDermott, director, deputy office director -- so they can see what's going on acrossed, and where we -- from our standpoint, what we're doing for them, and why it's important.

MEMBER REMPE: So it would be limited to the Office of Regulation? And they would look at all the projects that --

(Simultaneous speaking.)

MR. FURSTENAU: Well, right now, that's -- I mean, we've got to kind of take it one step at a time. Right now, it's within the business lines.

But by doing it by product line within the business line -- for example, with NRR, you're getting the majority of it right there.

And then, of course, NRR and NRO are going to be merging soon, so it'll be the lion's share, or anything.

Anyway, but we'll be doing that with the other activities as well. So we've just started that to get to strategic alignment.

Now, project prioritization is important. You folks brought it up in your last

review. It was really a recommendation.

We'd been getting it specifically in the high-level budget guidance we received from the Commission for the FY21 budget preparation. The need for projects prioritization.

So, what we're doing right now -- and the directors have really been the lead for that.

So I'll jump over to this slide because it really starts to talk about the prioritization effort there.

What we did was develop criteria for how to prioritize things. And I mean, that's always open for discussion.

But it's a methodology, and I think it gives you that first cut at weighting these areas under mission demand and resources.

And that pie chart kind of shows you the relative weighting of those different areas.

And then we're doing that by activity. And we've got about -- what is it?

About 120 activities all together on our list of activities, and we're prioritizing each one of those by this prioritization matrix.

And then the divisions get together, and then do a one-to-one comparison to get a sanity

check, and to see, okay, does this make sense, as well?

So it's an objective way. So you get numbers, but we also have to remember that the numbers are assigned based on judgments.

And so, it's qualitative, but we've got very knowledgeable division directors and branch chiefs, and PIs that I think have done a really good job.

We're right in the middle of that right now, of prioritizing of these activities.

And then, what we'll do -- and that's our research prioritization.

Then, what we're going to be doing here in the next week or so is providing our list and our prioritization to the business lines and the CFO to see what feedback we might get from them.

And we're prioritizing it regardless. All the business lines are intermingled together on this. It identifies the business line, but it's a listing of all the research activities.

MEMBER CORRADINI: So, are the Commissioners aware of all this new activity? This seems new to me, that I'm not familiar with it. They're aware?

MR. FURSTENAU: Yeah. They asked for it in their planning guidance.

MEMBER CORRADINI: Okay. Because I think this is a beneficial way to at least to look at the big picture of how you are doing things.

MR. FURSTENAU: Yeah. And we'll mention it when we talk to the Commission in May, as well.

MEMBER CORRADINI: Good.

MR. FURSTENAU: Yep.

MEMBER REMPE: Is there a document that'll be produced that's records all this effort that you're making to prioritize?

MR. FURSTENAU: Yes. Here's my -- it may be my inexperience with the NRC. I don't know at what point it's going to be releasable.

MEMBER REMPE: Even if it were shared, we don't always have everything that we see in the public eye, but will it be shared with the ACRS so we can review it at all?

Or just to see the level of detail, not to try and say no --

(Simultaneous speaking.)

MR. FURSTENAU: (INTERPOSING) Oh, I --

MEMBER REMPE: (CONTINUING) -- we've decided -- because there was a five versus a two,

but to understand the process.

MR. FURSTENAU: I'll have to work with Andrea and the staff. I don't have a problem with that, but I don't know at which point it can be.

It's being provided as a deliverable that we have to the Commission for the FY20 budget.

MEMBER CORRADINI: Again, this is a personal opinion, but my thought is, I trust you guys if you're developing some sort of measurement product for your internal use.

I'm more interested in anecdotal examples in risk and engineering and systems analysis, so the common person can say, yeah, this is good that Research is doing this so that they're checking that it's across the lines beneficial, not just in this one narrow area.

That's what I heard you say, so --

MR. FURSTENAU: Yes, right. Correct.

MEMBER CORRADINI: Anecdotal examples to me are very important because once you get to the Commissioners, they're going to hear the process, but if you can say, in this area we did this, we did that.

Because of that, this was sunsetted, this was approved to be anticipatory and very

important five years from now. Those sort of anecdotal things, I think, are very helpful.

MR. FURSTENAU: Yeah. I agree with you. That's correct.

MEMBER SUNSERI: Yeah. This might be what you're saying, Mike, but I'll say it differently.

It seems to me if we're making a valued judgment on the quality of the overall research program, it's good to know what's not being done.

I mean, we see what's being done, right? Your list of all your projects and the things you're doing and the money you're spending.

But what things did you cull out? That would be important for us to know, as well.

MEMBER CORRADINI: Yeah. To put it another way, you've got a plate.

Once you add something to the plate, something, given with fixed resources, something falls off the plate.

That sort of thing would be important to cull out, I think is what Matt is getting at.

MEMBER SUNSERI: Yes.

MEMBER CORRADINI: And the reasoning for it, because it might have been something that was an

ended project.

It solved a regulatory decision. It affected a regulatory decision and now is passed and done, et cetera.

CHAIR RICCARDELLA: So, Ray, let me ask you. Is this like a rating system where you're going to assign points in each of these areas?

MR. FURSTENAU: Yes.

CHAIR RICCARDELLA: And they're weighted by the pie chart?

MR. FURSTENAU: Correct.

CHAIR RICCARDELLA: Okay.

MR. FURSTENAU: Yep.

MEMBER REMPE: So again, I agree that, yeah, we don't need to see the exact document, but I'd like to have a feel for the depth.

Did, you know, people just put a number there, or how much description?

And so, maybe with the anecdotal examples you can give us that much of a flavor.

But we'd asked to see something to document the process last time we did this review, and that's why I'm pushing that now.

MR. CHEOK: So, for each one of those sub-bullets under mission demand and resources,

there is a weighting scheme for each one of those different items.

And we will assign a high, medium, and low. And we have guidance on what high, medium, and low fall, in terms of potential risk impact or generic fleet applicability.

And given all that, there is a weight awarded for each one of those sub-bullets, which will then get summed up to a final scale, so to speak, so we can --

(Simultaneous speaking.)

CHAIR RICCARDELLA: And the end product would be a list of all the projects with a score for it, right?

MR. FURSTENAU: Yes.

CHAIR RICCARDELLA: Where everything is brought from top to bottom?

MR. FURSTENAU: Yeah. Right. That's correct.

MR. CASE: Just to give you an idea, for some of the members that have been here for a long time, when you rate our NUREGs, you use the same process.

So you use a set of criteria, and then you did a hierarchical evaluation, and you assigned

weights. That's the same process.

CHAIR RICCARDELLA: Yeah, but --

MR. CASE: Except we do it with all those factors. And then somebody goes through and does it. And in the end, you produce a score.

CHAIR RICCARDELLA: Right. But that's just looking at one or two projects. You'd be looking at every --

(Simultaneous speaking.)

MR. CASE: Every one.

MR. FURSTENAU: Yep.

MR. CASE: And so, these cut across every project. There are some things they don't do well. But for most projects, they work reasonably well.

MEMBER REMPE: This helps to hear about this.

MR. FURSTENAU: Yep. So, and that process -- that first go at this is almost, almost done.

MEMBER REMPE: Okay.

MR. FURSTENAU: Okay. On the biennial recommendations, we've talked about some of this already, but the long-term strategies -- and I think some of the things I've talked about before,

especially like, on the external engagement, for example, is really key to our long-term strategy.

We've got to kind of know what's going on around us to help develop the long-term strategies. And we're doing, like I mentioned on here, the Strategic Workforce Planning.

And I think our research is probably as far along as any of the organizations within the NRC that I can tell, as far as that Strategic Workforce Planning.

Meaning, looking ahead three, five years or more, what are our core capabilities going to be within the Office of Research, and how do we plan and staff accordingly?

CHAIR RICCARDELLA: You know, there's that futures document that was prepared, and that thing had so many different possibilities your staffing could do.

MR. FURSTENAU: Yeah. On the futures assessment. Yeah.

CHAIR RICCARDELLA: Depending on which way you went in that futures assessment, you could have a totally different conclusion as to what your future set staffing will be.

MR. FURSTENAU: And the Strategic

Workforce Planning, that was an activity that was initially done -- and we were in the pilot -- I think it was called the pilot phase of that -- was done even before that futures assessment was done.

So they are related to that. But you're right. Dependent on which quadrant you pick, it could be quite a different story.

And you know, the one action -- that fourth one that -- we talked about that one already. The feasibility study process.

The processes exist, and I'm not critical at all of that process, but by not having specific funding, I'm concerned that some of our ideas could die because of the funding, and how to get the funding for those.

I think that Number 2 -- I'm jumping back ahead. I covered 3 and 4. But Number 2 on the maintenance needs for computer codes.

We're looking at that right now as well, that look at our inventory of what codes do we have right now that are under NRC control?

What do we still need? And what do we put in archives? What do we let -- and not maintain? What ones do we maintain? Which of DOE's new codes might we pick up on later?

So that work is being done. We'll agree with that part of the recommendation, and are doing that. The next slide.

And on the focus areas, like the very first slide on where the majority of our effort is going to, is to supporting our program offices on their licensing and oversight functions, the improving realisms, and on our analytical models.

It's really, how do we help reduce uncertainties? No matter which direction that goes, reducing uncertainties. That's what a lot about what research is about.

And preparing for oversight of the emerging technologies. And we talked about that somewhat already.

Accident tolerant fuel's a big office-wide priority, as well as advanced reactors. I might mention -- for Mike Corradini, and you mentioned about an anecdotal example here.

And this is kind of internal debating, but when you're looking ahead as far as agency priorities, and accident tolerant fuel, for example, is a high agency priority.

And we're looking at the internal debates on preparing budget activities.

Well, you know, individual organizations and NRR, for example, will have their budgets, and may not be able to cover all high priority items for, let's say, accident tolerant fuel.

And that's where program reviews and that check at the more strategic level by deputy office directors and office directors, with research's help, can say, hey, ATF is a high priority.

Some of this research that may get on an unfunded list, for example, based on the budget allocations broken down. Is that really where you want it?

If it's a high priority, we need to figure out how to base fund that, regardless of whose budget it's coming from. And I think it's --

MEMBER CORRADINI: I assuming you're saying -- assuming it's got to get done because it's coming in front of the agency as a regulatory decision?

MR. FURSTENAU: Correct.

MEMBER CORRADINI: Okay.

MR. FURSTENAU: Correct. And that should cross any division. And that's the value, I think, you get out of program reviews and that

higher level discussions. That's a hypothetical one for right now, but --

(Simultaneous speaking.)

MEMBER CORRADINI: My sense though, if I were in your shoes, I'd pick ones that the Commission is paying attention to.

MR. FURSTENAU: Well, and I think these last two are certainly ones that the Commission is paying attention to.

Certainly Congress is paying attention to as well, that, you know, even when you look at funding within the agency's budget on advanced reactors.

And I think within the NRC, it does us all good to be as ready as possible for what comes in on advanced reactors.

So, I think that -- you know, coming here to the NRC, I may add, I was, you know, wrapped up in the myth that, oh, we can do all we want in DOE to promote this stuff, but it'll fall into a black hole once it gets into the NRC.

And that's just an unfair myth. I either have gotten educated or come to realize that that's really not the case.

And I think by having that, you know,

outwardly engagement with potential, you know, newcomers and with DOE, and being in these forums where we can -- well, we can say what the NRC can do that we're not -- you know, research, or any other parts of the NRC don't need to be mysteries.

We need to be out there more and be as ready as possible.

MEMBER BALLINGER: We were talking on the side because we have a May 1 subcommittee meeting on --

MR. FURSTENAU: Yeah, right. Yep. So.

MEMBER BALLINGER: As a personal note, if you would like, I will supply you with a stress corrosion crack photo that's A, from a U.S. reactor, and B, less than 25 years old.

MR. FURSTENAU: Fair enough. So. You know, see, what you just said is always the danger of putting photos, because somebody's going to know more about the photo than I do. So.

MEMBER BALLINGER: The person who took those photos is dead.

MR. FURSTENAU: Okay. All right. So. Sir, you will not see that one again. How about that? All right. Okay. Next. With that, I'm going to turn it over, the people that are

a lot smarter than me on the individual division activities.

So I'll turn it over to Brian Thomas, director of the Engineering Group. Unless anybody has any other questions of me right now? Okay, thanks.

MR. THOMAS: All right. Good afternoon. So, I'm going to talk about the Division of Engineering.

And of course, we provide research support to all the program offices in all respects, with regard to engineering matters, as well as -- you know, I tend to break it up into a couple of bins.

Engineering matters and material science, if you will, because we do a fair amount of work with regard to material degradation, material and component integrity and performance, and look a lot at the structural makeup of various materials utilized in different aspects of the power plant.

So, basically the Division of Engineering provides the expertise for research support for engineering issues related to operating reactors. That's the predominant -- most of our demand comes from the operating reactors.

I would say it's on the order of about

90 percent of the work we do is in support of the operating reactor business line.

We do have work with materials, with regard to storage and spent fuel management.

We also have work with new reactors, we have work in the advanced non-light water reactor area, as well as we provide support for NSIR.

And I will offer that -- speaking of areas where the majority of the work is performed by that program office, and not necessarily by research, from my perspective, in terms of the services that we provide, NSIR has the least demand on the Office of Research.

However, we are working towards trying to figure out just what should research and engineering be constructed of to support NSIR, such as looking closer at areas like cybersecurity, looking at physical security, and so forth.

But we're working very closely with NSIR to try to figure out what is the construct of that research?

So, in addition to providing engineering support for those areas, we have the unenviable responsibility of managing some of the agency-wide programs that cut across all of the agencies.

Programs such as the Management of Reg Guide Updates. You know, the reg guides.

The Generic Issues Management Program. As well as the long-term feasibility research studies.

And I'll speak a little bit about some of the products that -- at least the direction in which we're headed with feasibility studies, with regard to longer-term research.

So with that said, we bring to bear the core expertise in the areas of seismology, geotechnical engineering, structural engineering.

As I said, the material science areas. Corrosion, metallurgy.

And of course, some of the areas that has to do with the development of methods to examine those materials, and look at the integrity of those materials, NDE, some of the computational codes that is utilized to get that work done.

Some of the measures that we also look to determine what should be some of the preventative and mitigative techniques and measures that should be employed to -- when you look at it from a degradation standpoint -- or when you look at it from the standpoint of performance.

As well as provide expertise in electrical engineering, instrumentation and control, and I'm just looking over the list here to see if I left anything out.

I think that basically covers it. The branches that -- we have five branches that provide this support, right?

We have the Component Integrity Branch, the Corrosion and Metallurgy Branch.

Some branches are multidisciplinary, like the Instrumentation, Controls, and Electrical Engineering Branch.

And then I mentioned the Reg Guide Updates and Generic Issues Branch, as well as Seismic, Geotechnical, and Structural Engineering Branch.

Five branches. Some of them multidisciplinary. In some areas, we have branch chiefs and technical leads because of the span of control.

So, before I move on to these different areas and, you know, talk about the functional areas of research that are provided to the program offices, a couple of topics that you touched upon, I just want to talk about a little bit.

So, we talked about confirmatory research and anticipated research, and I would offer that in the area of anticipatory research, you just didn't mention the AM, you know, the advanced manufacturing technology, I would say yes, that's -- you know, from an anticipatory standpoint, that's an area in which we're looking at, to what extent will we need to get ready, if you will?

You know, what we're going through right now from an anticipatory standpoint is to better understand the technology, better understand who's doing what with respect to this technology, better understand, you know, any of the literature that's out there on the technology, as well as trying to understand what's the construct of our regulatory infrastructure?

And what's needed, if you will, from a gap analysis standpoint of the regulatory infrastructure, so that we're better positioned to do any sort of reviews, should we see any submittals on the part of licensees, with regard to AMTs.

MEMBER MARCH-LEUBA: How about digital I&C and cybersecurity? I'm sure that's rife for anticipatory.

MR. THOMAS: Oh, yes and no. Digital I&C is

one of the highest priorities, and I will speak to that with what we're doing there.

But it's one of the highest priorities within the agency. There is a lot of advancements in the technology there.

And so, we are examining what those are. The biggest challenge there currently is to better enable the industry so that they can make broader use of, you know, that technology.

So, I'll speak to a little bit of what's going on there, in terms of enhancing the infrastructure to accommodate that.

So, I would say that digital I&C is a -- you know, it's a challenge of today. Not so much anticipatory as it is --

(Simultaneous speaking.)

MR. THOMAS: -- it is a today issue.

MEMBER REMPE: So, I'm going to interrupt here because we have to go through all three divisions, and this is what I tried to convey at the beginning of this.

Write your questions down, and in this case, send them to Matt. He's going to be doing the lead for compiling the questions to interact with Brian before we have the division-specific meetings.

MEMBER REMPE: Speak up.

MR. THOMAS: All right.

MEMBER REMPE: Sorry.

MR. FURSTENAU: Well, could I add? Joy, if I may, I'd ask the -- because we've got about a half hour left.

MEMBER REMPE: Right.

MR. THOMAS: Ah.

MR. FURSTENAU: We may need to keep to ten minutes for each division right now.

MEMBER REMPE: Yeah, and I apologize, but --

MR. THOMAS: (INTERPOSING) No, that's all right.

MEMBER REMPE: (CONTINUING) -- that's the way it goes.

MEMBER SUNSERI: We'll have the opportunity to dig in deeper with you later.

MR. THOMAS: Yeah. I will offer that the work in SLR -- if you recall, that's that -- you know, we just received an SLR application and that's under review.

But that worked to support -- subsequent license renewal started about 12 years ago or more, where we are looking at the expanded material

degradation assessment to look at the areas in which we had -- what are the degradation phenomena? Do we have knowledge of those areas, and what are the areas of high uncertainty?

And I'll speak to some of the remaining issues that are being covered on the SLR.

But I would say an SLR is a very good example where we had long lead time, anticipatory research, and support of our recent review that we're conducting of an application for subsequent license renewal.

If you turn to the next slide, this just gives a broad overview of the different key areas that I mentioned, the different branches, and primarily, it's focused on identifying the key focus areas in each of those branches, which I'll speak to.

You can see that we do have a resource allocation there, and it gives you a sense of the apportionment of the research -- you know, resources, within the division.

You know, most of our resources are in the materials arena, followed by lots of activity in digital I&C and electrical engineering, as well as not too distant behind is the seismic and structural

work.

Okay, I've been told to pick up the pace. Let's turn to the next slide.

So, as far as the component integrity, corrosion, and metallurgy area, you can see there some of the work that's being done.

I talked about capabilities to evaluate and analyze components and their performance, and so forth.

We are working on enhancing our computational modeling capabilities. For example, xLPR and FAVOR.

We are assessing material degradation with respect to the operating reactors, and that's looking primarily at what's going on with the vessel internals, including vessel embrittlement, but primarily the focus mostly is on the internals.

As well as we are looking at the non-light water reactor materials that's needed, and that's somewhat anticipatory, in that we are doing a gap analysis to determine what do we need to focus on there?

Next slide. In the electrical engineering I&C area, primarily right now, we're really assisting the business line leads with the

instrumentation and control work, which I think you're familiar with.

There's a lot of tactical -- we call them tactical activities, aimed at better enabling the industry to make digital mods and digital upgrades.

I think you're familiar with things like the risks in ISG-06, and so forth, which we've been providing assistance with.

We are also looking at some issue-specific areas like CCF, embedded digital devices, as well as risk insights into performing I&C reviews.

With respect to cable, cable aging, and equipment management, equipment aging, equipment qualification, we're doing a lot of cable testing.

We're looking at the feasibility of doing LOCA tests. Also looking at submerged cables, and then of course, we're aging the cables up to 80 years to look at what's the integrity of the cable throughout that time frame?

Similarly, in digital I&C -- and this gets in a little bit into what we're doing in cybersecurity -- we're looking at EMPs and GMDs, and the resiliency of not just the plant, but the

systems within the plant, to survive certain --

(Simultaneous speaking.)

MEMBER CORRADINI: There's a status report on resiliency relative to EMP that I guess I was just made aware of. Do you know what I'm talking about?

MR. THOMAS: The Stuckenberg report?

MEMBER CORRADINI: Yeah.

MR. THOMAS: Yes. I'm very familiar with that.

We're having discussions with them and there are quite a few meetings planned. There is a meeting planned for the end of April with them and industry.

We'll focus on the report, focus on homeland security and what they have to share with us, in terms of what their concerns are, and of course we'll share NRC's perspectives.

As you can see here, it covers workload trends also on these slides. I'll move on, but basically in all of these areas, we're trending down through to 2023.

And the seismic and structural would be your technical area.

Primarily, this is an area where we've -

- of course, we had the Fukushima event. There was lessons learned from the Fukushima event.

And so, those lessons are now being utilized to help enhance our tools and methods, like the Shack method, the method of calculating seismic hazards, looking at going from probabilistic to deterministic, and really being more -- I mean -- sorry about that -- going from deterministic to probabilistic.

And being more -- at least laying out the approach and the method of doing that analysis. Similarly, we -- in the structural arena, of course the advanced non-light water reactors.

There is -- and this I would offer up as some long-term anticipatory research that work on base isolation.

Advanced non-light water reactors seem to have a stronger drive and demand for utilization of that technology.

We did work on that back in 2007 time frame, and now, you know, it's materializing and coming to fruition.

And then, if you would turn to the next slide. I know I'm moving a little fast here, but the agency program support area, which I talked

about with regard to reg guide updates, and so forth.

We'll put a plug in for -- we recently had a request from the Commission to look over the entire landscape of regulatory guidance that we have, and look at what's our frequency of updating that guidance?

You know, what's the practice as far as reporting on it and utilization of it? And we do have some variances between different offices.

Different offices use different approaches in terms of what's their baseline, what's the construct of their baseline guidance documents?

Some offices, for example, NMSS have NUREGs, even though they're starting to have some reg guides in that office.

But unlike NRR that has predominantly reg guides that, you know, endorses certain methodologies. And with that --

MEMBER KIRCHNER: May I ask? About the last bullet.

Regarding advanced reactors in a generic sense, we've got this large body of knowledge, and incorporated in reg guides for the existing fleet.

I think a lot of it may be generically

applicable. I'm thinking of things that aren't technology-specific, like fire protection, or whatever -- seismic analysis.

But have you done kind of a scoping study of what kind of investment's going to be needed in reg guide development to accommodate these?

Right now, we have gas and molten salt and liquid metals.

Have you kind of looked at the waterfront to see how much effort would be needed to update the Division 1, or whatever you'd call them, for the operating reactors to those reg guides for application in your reviews of advanced reactors?

MR. THOMAS: So far --

MEMBER KIRCHNER: It seems to me, you know, the --

MEMBER REMPE: So, I'm going to again ask you to save that question, send it to Matt, and let's discuss it at -- because we're just going to run out of time --

MEMBER KIRCHNER: No, this is a much broader question. I'm not asking about getting into things.

MEMBER REMPE: Right.

MEMBER KIRCHNER: It seems, you know, the complaint often is -- Ray kind of alluded to this. You know, that the problems in the NRC, the cost of review is excessive, and so on.

A lot of that has to do with the majority of what's put in front of the NRC, but also it depends on how ready the NRC is, in terms of reg guide space.

As we go to a more standard space, performance-based review of advanced concepts -- so I'm just curious whether there is an NRC-wide review, since it lands in your RES and in your court?

Looking at what's needed, what kind of investments are going to be needed to be ready in the standard review plan? Which makes great use of reg guides as a resource.

So it's an open-ended question almost, but I started thinking about where and what you would focus on as these -- you know, we'll probably talk with Michael about what codes need to be developed for these different technologies.

MR. THOMAS: Right.

MEMBER KIRCHNER: But more in the

regulatory of, you know, what is needed there to get one step beyond the advanced reactor GDCs?

MR. THOMAS: Right. And so, I would offer that we have done a partial examination of that specific to the materials.

And we had Oak Ridge. In fact, we just received a report from Oak Ridge that did a gap analysis, and we just received it a couple of days ago.

Gap analysis, in terms of what do we need to address from a -- what do we have in terms of regulation?

What do we have in terms of codes and standards? What's out there that would better enable us to get ready for the advanced reactors?

So I say it's partial because we have bought some efforts utilizing the standards forum, where we reach out to all the SDOs and DOE, and so forth, and EPRI, where we asked a question -- to come back and tell us what they're there for.

It's included in the technical working groups in these areas. The folks that are focused on these designs.

MEMBER REMPE: Again, let's just hear about that more when we have the individual meeting.

Okay? Because we only have 13 minutes left, okay?

MR. THOMAS: Yeah.

MEMBER REMPE: Go ahead.

MR. CHEOK: So, I will talk about the Division of Risk Analysis.

We have four branches, and I will talk about the functional areas and the focus areas in my upcoming slides.

Next slide please. So this gives you an idea of how we allocate our 38 FTE and $10,000,000. And I will not go too much more into this except to show you the slide.

The next area. So, in PRA tools and methods development, this is done in the probabilistic Risk Assessment Branch.

This branch supports the reactor oversight process, our regions. It facilitates the implementation of risk-informed regulations.

So, NRR is into this process for risk-informing our licensing processes. And we support that process.

We will expand PRA infrastructure to address merging technical areas and different designs. And we will support continuous advancement of the PRA state of the practice.

So if you look up there, I'll point out two focus areas. In terms of SPAR model updates, you know, we continue to update the models in areas such as different initiators.

We now have -- all our SPAR models have seismic models in them. We have 22 all-hazards models.

We have eight low-power shutdown models. And we have two Level 2 models.

So, we can apply these models as cases are needed, and for licensing purposes, or for oversight purposes.

In terms of Level 3 PRA, we will come to brief the subcommittee in August of this year, and you know, we are making good progress in terms of where we are in Level 3 space.

We are now finishing up on four reports that can be publicly available.

And so, we will discuss those four reports, and they will cover pretty much the internal events and floods, and full power from Levels 1 to Level 3.

MEMBER BLEY: Mike, can I sneak in a question on the SPAR models?

I read something recently about the

staff moving away from the SPAR models and using the licensee's models. Is that something real, or is that some proposed thing?

MR. CHEOK: And so, there's always been discussions, especially by some faction of industry that, you know, we should use more of the models.

We continue -- I mean, we had several studies done as to why we should use our models.

And essentially, I think we will stick with using the SPAR models because it provides us with an independent tool, with the licensing and everything else.

MEMBER BLEY: That's enough. Yeah.

MR. CHEOK: So, looking forward. Obviously, the Level 3 PRA project will be ending soon.

We are increasing our workload in helping risk-inform security, with cyber and physical.

We will work with Brian and his staff in all our -- in terms of risk-informing digital instrumentation and control.

And we will also look at PRA research needs for advanced reactors. For example, dynamic PRAs.

So this addresses something that you all said earlier. Dynamic PRAs has been around for a long time.

In the past, when we had wanted to do this, there was really no good reason to do this, and to sell this to our program offices.

With advanced reactors, we see simpler systems, we see passive systems, we see thermal hydraulic phenomenon, and we see operator actions that can be very easily incorporated into a dynamic PRA.

And so, you know, our business partners see the same benefit. And so, we will, you know, continue to go into looking at the benefits of dynamic PRA.

Next slide please. So this is the work for all the Performance and Reliability Branch. Essentially, what we do there is to collect and analyze data, and to do a risk-informed study of plant events, where we trend performance reliability for different equipment systems, we trend initiating events, and we provide a trend of the accident sequence precursor events, that we analyze on an annual basis to see how we are doing as a regulator, and to see how industry is doing in terms of their

programs.

So, this is not focused on individual plans. It's on the fleet performance as a whole.

So, the workload trends is we are trying to be more efficient in terms of data collection and evaluation.

And what we are trying to do there is to delve more into data analytics and artificial intelligence, so that we can use the tools here to help us look into a bigger set of data -- even for the current set of data, how we can better use the data we see.

How we can -- for example, search for errors of commission, or multiunit risk, or something like that. That's not easily done now.

And you know, and so, we can also do things like, help looking at data, potentially help our regions focus where they can do inspection.

So again, towards data analytics and artificial intelligence.

MEMBER REMPE: So, are those discussions ones that are thinking about trying to collaborate with this increased use of data analytics and AI with industry, or with DOE, who I also see saying the same thing -- oh, we need to do this?

MR. CHEOK: And so, yes and yes. We are working with EPRI on this, and they're working with all our federal partners on this.

Analysis of fire and external events. So, that's three priority areas at this point. The first is on the generic issue on aluminum high energy arcing faults.

The last time we talked with the subcommittee, you know, you all asked us to look at the overall picture, and to look at what you're doing before you charge forward and do more tests.

We have done that. We have worked with our Generic Issues Branch. And we have defined a generic issue assessment plan, which was issued in August of 2018.

We have started our first series of tests. Basically, for these tests, they're looking to better define the zone of influence for a HEAF event, and you know, not just for the PRA, but also to define areas how you can better mitigate, or how you can prevent HEAFs.

Well, closely aligning this with our data and OpE work so that we can align this with our risk analysis, so that we have initiating event frequencies that go with this HEAFs, so that we can

do a proper risk analysis on the safety significance of these events.

MEMBER BLEY: Mike, I don't know if we got any information on it, but with some of the newer passive designs, and going to electric power systems that are not 1E, I wonder if any of them are starting to use aluminum, and if that work becomes more important.

MR. CHEOK: You know, at this point, we do not have that kind of information.

I mean, so work like this could inform licensees, or potential licensees and applicants on, you know, this is something you see, maybe you may want to stay away from it.

MEMBER BLEY: Okay. So, going to close out, you might be enhancing the models?

MR. CHEOK: We will be enhancing the models.

(Simultaneous speaking.)

MR. CHEOK: But more importantly, I think it's going to be lessons learned for, you know, this is what you can do to prevent and mitigate the HEAFs, given the fact that this is what testing is showing us, and this is what you can do when you're designing new plants, et cetera.

So, fire PRA realism, you know, work in the industry and terms of defining better heat release rates for the cabinets.

Cabinet fire to fire propagation, looking more at OpE in terms of, you know, giving credit for manual suppression, giving more credit for the fact that not all fires are made equal, so to speak.

And so, we will continue to work on that, and we are working on a PFHA, the probabilistic flood hazards analysis, so that we can better account for flooding events, as opposed to be looking at just a probable maximum flood and things like that.

So, the trends here is we basically will be closing out on a generic issue by FY20.

We'll be looking at things like, you know, they are a potential fire risk for the advanced reactors, in terms of the materials they are using, and work -- as you said, lessons learned from our generic issues.

Next slide on human factors and reliability.

Again, in this case, I will be fast because we have a September briefing of the

subcommittee on what we're doing, in terms of IDHEAS-G, and we are making good progress on that.

We are, as a matter of fact, applying some of those principles in terms of trying to incorporate FLEX equipment into our SPAR models.

We also incorporating ideas like that into things like non-destructive examination, what's the operator contribution NDE?

Our workload trends is -- you know, we'll be focusing a lot more on the advanced and the new reactors, in terms of HRA and human factors.

And in this cases, we do have the digital I&C and the advanced control room concepts. The few -- and you know, the new concepts for operation.

So, what's HRA? Human reliability analysis. How does human factors play into these things?

So, how does these things affect? That's what our future focuses on for this branch. And I think that was all my slides. Mike Case?

MR. CASE: Hey, fantastic. The Division of Systems Analysis. Good afternoon. It's actually great to be here. Thanks for the opportunity.

I'll try and be brief. A couple of

insights per slide. We can do the details later. We love to talk about the details.

Just on this slide, that's the functional statement. Not very much interesting there. And that DSA has four branches. And that'll come into play as we move down the line.

When you wrote the letter last time, you had recommendations up front, and then you talked about each division in the back, and you didn't put any recommendations there, but you sort of told us the things that we're interested in.

So just a little review, if you haven't read it lately, here's what you were thinking about.

MELCOR, MACCS modernization, non-LWR testing and data needs, code modularization, code consolidation, access to high performance computing, aging workforce and having backups for the aging workforce, and then collaboration in general.

And then collaboration with DOE, and specifically -- and I'll try and hit those as I go through.

This is a repeat slide from the last time. Last time, we had four branches and they mapped the five functional areas.

We added a functional area in the last

couple of years. And that's down at the bottom. That's advanced reactors.

It's really an interesting area. It's pretty large resource-wise. 20 percent.

It's an area where there's good skill-building capabilities, in that it presents to us what I call expert level work, which is great to have in the office, because that's how I can create experts, by giving them expert level work.

And then it really influences all the functional areas. So those resources really feed back into the five areas. We were a big tools outfit. We're still a big tools outfit.

The tools are the same as the tools the last time, except for one. Down there on the bottom, you see DOE tools.

We've been trying to work more collaboratively with DOE, and collaboratively use their tools.

So it's going to help us in a couple ways. I very well may use them in the future for non-LWR activities.

So, it will save me time and energy and resources if I do that. So it has that advantage.

And then, it also has another advantage,

in that it brings new ideas into the organization.

So, I get my fuel performance code developer, who works with FAST, and I have him interact with the BISON folks, which is the DOE parallel code.

He's close to brilliant. He sees what they do, you know, in the computing areas, and he'll make FAST do that.

So it has another -- you know, it brings new ideas to the area, and people mimic them. So it's a great initiative, I think.

Okay, moving on to the thermal -- so this is one of the functional, the thermal hydraulics.

It was always somewhat -- it's a big licensing support type area, so we support the user offices in some of their confirmatory analysis, and you're pretty familiar with them.

So that first one is MELLA Plus. So you know from your MELLA Plus reviews, the quality of their work. And they also help with the NuScale reviews.

So I don't know whether you've got to some of the thermal hydraulic areas and NuScale, but once again, some of that is backed up by research

work that comes out of this area.

We have a pretty robust international engagement in the area.

You know, we have a CAMP program, and in many of the areas, we have these code sharing programs that brings resources back to the area that we reinvest in code development.

And then, we work very well with CSNI. And we sort of flipped the paradigm in the past couple of years on CSNI.

So normally, we would join their projects, and then we have some projects going on in the United States, like the RBHT Facility up at Penn State. So, it does thermal hydraulic tests.

So we sort of flipped the paradigm. We took our program and introduced CSNI to those, so that we can get people to join our project, and that cuts down our expenses 50 percent.

Workload trend is down. I also included on each side -- Ray mentioned that we do Strategic Workforce Planning. So, we were the pilot office. What it results in is strategies.

So in each of these areas, I listed the strategy of the skill that we're really focusing on in that area.

And so, for thermal hydraulics, it's the code development skill. What we found is that having people on our staff that can do code development is just a real game changer for us.

And so, that allows us to save resources, and then we can more quickly pivot some of these ideas into the codes. So it's a great skill, so we went after that.

And then, on almost every area, we have this strange bullet that says, only application-specific code development funding in FY21.

And so, you can't see these numbers, but what happens is that when we did the prioritization of all the research tasks, there are two things at the top.

One is ATF, one is high burnup fuel. And so, those are very much agency-focused. We invested a lot of our resources in those two activities.

Since the pie doesn't grow, those resources need to come from other areas. A lot of them came from the other functional areas.

So, these functional areas, we still have code maintenance. We have that fully funded. But our code development abilities are pretty small.

So there's not much funding, so we can't do much code development.

So we have to work with the program offices -- that, if they have specific projects that we need to work on, well, they need to give us not only the funds to execute the project, but also give us enough money so that we can keep the codes up to form that project.

So, it puts a little squeeze on the resources.

MEMBER CORRADINI: I understand your explanation, but I want to make sure I understand. Your point is, the user need has to cover both?

MR. CASE: Correct.

MEMBER CORRADINI: Okay.

MR. CASE: And it didn't have to in the past, in that if I needed a feature in order to do the MELLA Plus run, I had enough code development, you know, resources to modify SCALE or modify FAST, in order to make it happen.

MEMBER CORRADINI: Okay, thank you.

MR. CASE: Okay, on to fuels and neutronics. This is the area that has the two top projects for research.

And that's accident tolerant fuel, and

high burnup, and enrichment of fuel designs.

It's not that they don't do other very good work. They support NMSS very well on things like, in this spent fuel management area, they do some BWR burnup credit work that's been very successful.

And then, we also have the 50.46c rulemaking, which we worked on in the past. It's still up to the Commission.

And so, that may have some work when the Commission gets done with their review of that. In the international area, we had a sweetheart deal with the Halden research reactor. It provided us tons of data at a very low cost.

Unfortunately, it is closed down now, so we have to work on to something new. So we haven't really -- yes, go ahead.

MEMBER CORRADINI: Sorry, I thought you were finished that thought. Go ahead and finish that thought --

(Simultaneous speaking.)

MR. CASE: Yeah, we haven't really come up with replacements for that.

MEMBER CORRADINI: Well, it was my impression though that ATR has an idea of changing

their loop structure to do some of that. And also, I thought that NRC was still analyzing the -- what I'll call the curtailed experiments of Halden. Am I misremembering?

MR. CASE: Correct. No. That's true.

MEMBER CORRADINI: Okay.

MR. CASE: So we're still working with the residuals at Halden. And so, we funded the project for, you know, the two remaining years. But we're sort of trying to think of, you know, what's going to replace the data for Halden?

And so, it could be domestic, it could be international, it could be a mixture of all of them. But we just haven't figured that out yet.

MEMBER CORRADINI: Okay. Well, so, the chairman's going to watch over me here, but my impression was DOE is thinking of making an investment into ATR to essentially do LOCA testing for some of these questions where you need experimental data.

Can NRC -- I'll use the word piggyback -- on that experimental testing that might be needed, or help guide it, so that it's appropriate?

MR. FURSTENAU: Yeah, I don't see why not. As far as putting in new loops in the ATR, you

mean?

MEMBER CORRADINI: Yeah.

MR. FURSTENAU: Yeah, I don't see why not. I think our involvement would be what type of information were we getting out of Halden that is a value to us in making regulatory decisions?

Now, how they do it and what they want to invest in, they'll decide that, but I think DOE wants that input.

MEMBER REMPE: Yeah, I would hope that you're being real aggressive about giving DOE that input because of the way the Atomic Energy Act is written, where the secretary has an obligation to provide you access to facilities to perform your regulatory oversight.

And so, I'm not hearing that. But you are telling them what you need?

MR. CASE: Oh, we're 100 percent engaged.

MEMBER REMPE: Good.

MR. CASE: Both the program office and research.

MEMBER REMPE: Good.

MR. CASE: Especially on ATF. High burnup is a little bit of a newer issue. So we

haven't even settled on the user need yet for high burnup.

But that's really -- the moneymaker issue is high burnup is not accident-tolerant fuel.

MEMBER REMPE: Giving DOE insights on what's needed I think is an important thing.

MR. CASE: Yeah.

MEMBER CORRADINI: Well, I mean, the only other thing I guess I was going to mention is that you guys are probably as well-aware, because EPRI just released its ATF March report.

And they point to high burnup as more of a motivator than whatever -- what ATF used to stand for.

MR. CASE: Right. Okay. Brian's reminding me to go fast.

MR. FURSTENAU: Yep.

MR. CASE: Well, increasing workload. Richard Lee, who runs this area -- the Strategic Workforce Planning thing that we figured out is that Richard has four specialties in the branch.

Criticality, severe accident, fuels, and neutronics. Which is that, I can't get everybody to specialize in one thing.

So, what we're doing is creating people who have both skills. And so, as we move into the future, we want people who have maybe severe accident and neutronics.

Then when I get short on neutronic skills, I have people that I can move to the area. Okay, next.

Accident progression and source term. Source term -- believe it or not, things like the alternate source term is still around that creates source term type problems for us to be involved in.

So it's still an active area. This is probably our best area of international engagement through CSARP.

And then the CSNI projects on source term and severe accidents are great leverage items. They're things that would otherwise not be done if you didn't have that leverage.

Unfortunately, the fiscal pressure is probably going to push us out of some of those areas.

So when we get to some of these source term areas, we have to take a pretty careful look to see whether we can move on to the next source term type experiment. One of the --

MEMBER KIRCHNER: So, Mike -- so in a case like -- to make it real, NuScale's going to come forward with a new source term proposal. Is Research involved in that?

MR. CASE: Oh yeah, we were the ones that pointed out that -- what they proposed would not work. So yeah, we've been technically involved in that.

(Simultaneous speaking.)

MEMBER KIRCHNER: So, then they went back. So you are technically involved?

MR. CASE: Yeah.

MEMBER KIRCHNER: Okay. That's encouraging. Thank you.

MR. CASE: And then the one I worry about is the Fukushima Forensics. It's down the road. It's something that's not going to occur soon.

It's really a treasure trove of severe accident information.

And I don't want to miss the treasure, but I worry a little bit that it's so far away, and as people get more frugal, that we might crowd it out, so I want to keep my eye on that one.

Downward trend. Rebuild the severe

accident phenomenology.

You know, you mentioned that I have an aging workforce. I went back and looked.

We now have a young workforce. So, you look in these branches, and the people that are leading these technical areas are young.

So, we have backup. But you know, the thing that they need is expert level work. It's going to take them ten years to turn into an expert, as long as they do expert level work.

So, we're really encouraged that we have that work to give them, and they're good people, and they'll be there. It's just a matter of time.

Okay, consequence analysis. There's a list of thing -- you know, they're an interesting bunch. They're always running in the background.

A lot of times, you don't know they're there, but they're the technical brains behind some of this stuff.

So, the best one is emergency planning zone size reductions. That's an NSIR-led rule. But the technical basis that establishes that is a MACCS calculation.

So these people are really good. They're running in the background of a lot of

things. And so, we just don't want to forget them.

They do international engagement not as well as the others.

Their short-term issue is that MACCS was, you know, sort of devised as a code that worked well with large emergency planning zones.

It's not as good in near-field activities. And so, what the future is, is SMRs, non-LWR reactors. They're all things that are near-field.

So that's one of their things that they're working on, is how do I prepare for the future so that I can technically contribute to those?

Okay. Radiation protection. Quite a few codes in this area.

You guys were cute. I said, aren't there a lot of codes here that are sort of doing about the same thing?

That's where you came up with the code consolidation thought. And I thought I could never do it because they were all spread around. And I didn't think I could do it.

But then we got a little bit of help from NRO, in that NRO had control over one code. So

they took the effluent codes and they combined them into one.

So now they got merged with NRR, so now we have people over there that understand the value of code consolidation.

So, we're going to try that with the atmospheric codes.

And then when we wrote our non-LWR code development plan in the radiation protection area -- it's not quite done -- but what we said to do was, why don't you organize around the models?

And so, they'll list for atmospheric dispersion models that are in the different codes -- and so, the challenge is how can we go from four to one.

So, we sort of took your advice and we were able to get it out in the field.

Down in the workload trends, this is an area where we actually lost a skill through retirement.

That's the advanced dosimetry skill. So, we want to rebuild that. And so, it's a ten-year journey. The hard part is that we don't have any expert level work.

So, we're looking at things like farming

people out to NCRP, or farming them out to the lab to do expert level work. Okay.

MEMBER CORRADINI: I don't think I understand what that means.

That means that you have more people than work, or you have a lack of people that you're trying to train up?

(Simultaneous speaking.)

MR. CASE: No, I have a lack of a skill.

MEMBER CORRADINI: Lack of a skill. All right.

MR. CASE: And so, I have the people. It's how do I get them the skill? So, advanced dosimetry is a expert level skill.

MEMBER CORRADINI: Okay. Excuse me.

MR. CASE: Okay. Advanced reactors. I don't have to say much other than, you know, it's another area where we sort of took your advice.

So, your advice talked about testing and data needs.

So when we originally started to do some of our code development plans, we sort of wrote them, here's what I'm going to do this fiscal year, and here's what I'm going to do next fiscal year.

We said, hey, we want to know how do you

get to the finish line?

And so, what we are trying to do is to get them to write down sort of the validation steps and their data needs.

Once I see that, we're going to start to work with DOE and say, hey, DOE, look -- you know, if you want us to use your DOE code, here's some validation things that you need to run for us.

Or if we say, hey, we need some testing done. Hey DOE, you need to get this testing done so you can validate the codes.

So, once again, we sort of internalized your advice and tried to write a broader plan.

These are coming to you -- at least some of them -- on May 1, so you'll have plenty of interaction on this that you probably don't have to do in this context.

But to summarize, you know, the interaction that we have around the research program actually is really valuable to us.

So, you guys give us some ideas. And quite frankly, they're pretty practical ideas.

And so, there's not a one of those ideas that you all highlighted to us that we haven't worked on.

And so, I really appreciate this interaction, and I appreciate the advice that you all give us.

MEMBER REMPE: Oh, did you want to say anything in closing, Ray?

MR. FURSTENAU: No, I think that's -- we ran over already, so I apologize.

MEMBER REMPE: Well, it was part -- I'm sure mostly our fault. But I wanted to take this opportunity to thank you for giving us a presentation that was directed back at our recommendations.

Because I think that's a new part of this revised approach that I think is very helpful, and I'm looking forward to the upcoming three meetings.

And with that, I'll turn it over to the vice chair.

MEMBER SUNSERI: Okay. So, is there any members of the public in the room that would like to make any comments?

(No audible response.)

MEMBER SUNSERI: Anybody on the phone line that would like to make any comments?

(No audible response.)

MEMBER SUNSERI: All right. With that done, we'll close this part of the meeting.

We will take a break here for 15 minutes and resume at 4:05, at which time we will pick up letter writing on the NuScale.

So at this point, we are off the record, and adjourned until 4:05.

(Whereupon, the above-entitled matter went off the record at 3:49 p.m.)

April 2, 2019 Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Submittal of Presentation Materials Entitled "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0

The purpose of this submittal is to provide presentation materials to the NRC for use during the upcoming Advisory Committee on Reactor Safeguards (ACRS) NuScale Full Committee meeting on April 4, 2019. The materials support NuScale's presentation of Chapter 9, "Auxiliary Systems" of the NuScale design certification application.

The enclosure to this letter is the nonproprietary version of the presentation entitled "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions, please contact Carrie Fosaaen at 541-452-7126 or at cfosaaen@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

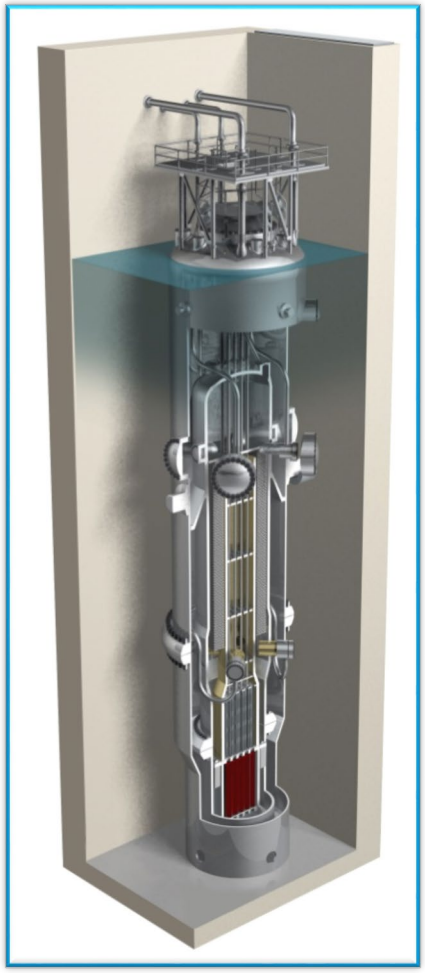
Distribution: Robert Taylor, NRC, OWFN-8H12
Michael Snodderly, NRC, TWFN-2E26
Samuel Lee, NRC, OWFN-8H12
Gregory Cranston, NRC, OWFN-8H12
Getachew Tesfaye, NRC, OWFN-8H12

Enclosure: "ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0

Enclosure:

“ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems," PM-0319-64807, Revision 0

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvallis, Oregon 97330 Office 541.360-0500 Fax 541.207.3928
www.nuscalepower.com



ACRS Full Committee Presentation: NuScale Chapter 9, Auxiliary Systems

PM-0319-64807
Revision: 0

Template #: 0000-21727-F01 R5

Presentation Team

Scott Harris

Supervisor, Mechanical Systems

Corrie Nichol, Ph.D.

Refueling and Remote Handling

Zackary Rad

Director, Regulatory Affairs

Zach Houghton

Manager, Mechanical Design

Reactor Building Crane

- RBC Design
  - Designed to ASME NOG-1 Type 1 (Meets NUREG-0554 requirements)
  - Designed to be Seismic Category 1 (Required to withstand earthquake stress and retain load.)
  - Movement uses redundant position control system interlocks
- Risk Significant
  - RBC has augmented Quality Control per Part III of the QAPD (because of Risk Significance)
  - Augmented requirements conform to regulatory requirements. (SRP 9.1.5, NUREG-0554, NUREG-0612, and RG 1.13)
- Non-Safety
  - The RBC doesn't perform any functions that meet the regulatory definition of safety-related.

RBC Control System

- Redundant limit switches
  - Hoist overtravel (upper limit switches, lower limit switches)
  - Hoist overload
- Interlocks
  - Slack rope and Hoist drum rope mis-spooling
  - Hoist overspeed
  - Unbalanced load
  - Reactor building crane-fuel handling machine (FHM) interlock
  - Bridge and trolley overtravel limits
- Safe Load Paths
  - Restricted handling path and speed (30 ft/min traverse, 2 ft/min hoist)
  - Operator monitored

RBC Control System

- E-stop system
  - Physical relay controlled – no software
  - Cuts power to motors and brakes (stops motors, sets brakes)
  - Independent of any controls used for normal operation
- Redundant Physical Load Control Systems
  - Redundant gearboxes, cables, brakes on main hoist
  - Redundant elements are all capable of performing their function individually at full load

RBC Control System

- In the event of failure of load lift control system:
  - Redundant upper travel limit switches
  - Two-blocking capable (Hard upper limit doesn't damage RBC)
  - Raise to top of travel – fuel still covered, shielding maintained, reactor module base is 29 feet above the floor
- In the event of a failure of travel control system:
  - Traverse speed limited, operator monitors motion, speed is slow enough to enable operator to protect from impacts (30 ft/min)
  - Energy absorbing hard stops, designed to protect in event of redundant limit switch failure (at end of travel for bridge and trolley)

Digital I&C Design and Development

- Design and development of any RBC software-based components follows a rigorous quality assurance program to ensure high quality and reliable operation based on the safety and risk significance.
- RBC Software Integrity Level (SIL)
  - RBC is nonsafety-related, risk-significant which invokes SIL 3
  - Independent verification and validation is required for SIL 3 and SIL 4 digital I&C.
- NuScale Digital I&C Software Quality Assurance Program described in DCA Section 7.2.1, and complies with ASME NQA-1-2008 and NQA-1a-2009

Initial Testing Program

ASME NOG-1 and Other Required Controls Testing (from DCA Table 14.2-52 and 14.2-52a)

- E-stop functionality
- Functional testing of controls and components
- Full load test
- Test limit switches
- Test speed limit at full load
- Two-blocking
- Brake function (redundant brakes for hoist and travel)
- Lowering speed limit and lowering brake test

Initial Testing Program

Prerequisites

- Site Acceptance Testing
- Rated Load Test – ASME NOG-1 – Hoists (Main, Aux and Wet)
- Rated Load Test – ANSI N14.6 – MLA and NPM lift fixture
- Instrument Calibrations completed

Component Testing

- Controls – interlocks and limits on RBC motion tested
- Loss of Control/Power or Seismic event – Results in no movement of bridge trolley, all hoists and brakes are set

Initial Testing Program

Component Testing (continued)

- Load Path Verification includes:
  - speeds - max limits enforced
  - bridge/trolley movement - toggles from full speed to microspeed when in proximity to reference locations – other NPMs or load path boundary
  - Main hoist movement – elevation enforced and proximity
  - Main hoist rotation
  - Full seating of NPM in reactor bay receiver

ITAAC

ITAAC 03.10.01

- ASME NOG-1 Inspection of main hoist machinery – redundant and non-redundant structural components – bridge, trolley, wire rope drum, hook, drive train, two-blocking and overload

ITAAC 03.10.02 and 03.10.03

- ASME NOG-1 Inspection of aux and wet hoist machinery – same scope as ITAAC 03.10.01

ITAAC 03.10.04

- ASME NOG-1 main hoist Full Load (100%) and Rated Load (125%) testing

ITAAC 03.10.05 and 03.10.06

- ASME NOG-1 aux and wet hoists Full Load and Rated Load testing

ITAAC

ITAAC 03.10.07

- ASME NOG-1 NDE of RBC as-built welds

ITAAC 03.10.08

- ASME NOG-1 NDE of wet hoist as-built welds

ITAAC 03.10.09

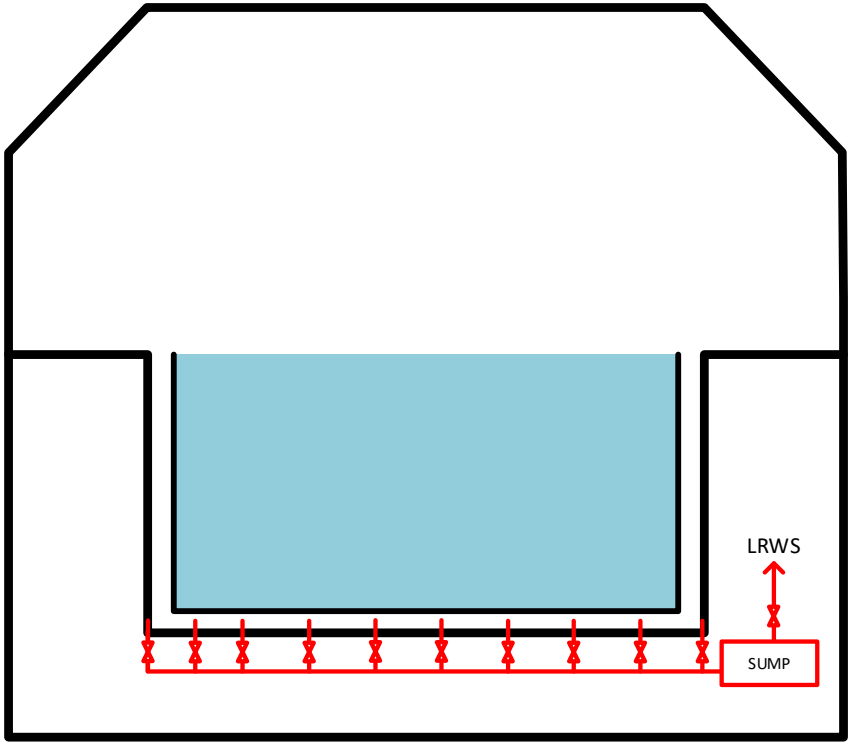
- ANSI N14.6 MLA single load path tested to 300% of Manufacturer's rating
- ANSI N14.6 MLA dual load path tested to 150% of Manufacturer's rating
- ANSI N14.6 MLA load bearing welds undergo NDE testing

ITAAC 03.10.10

- ANSI N14.6 MLA inspection of lifting arms and pinned clevis

Pool Liner

- Liner Functions:
  - Protect concrete from the borated pool water.
  - Collect pool leakage and direct to sumps.
- Seismic Category I
- High sump level alarms in control room



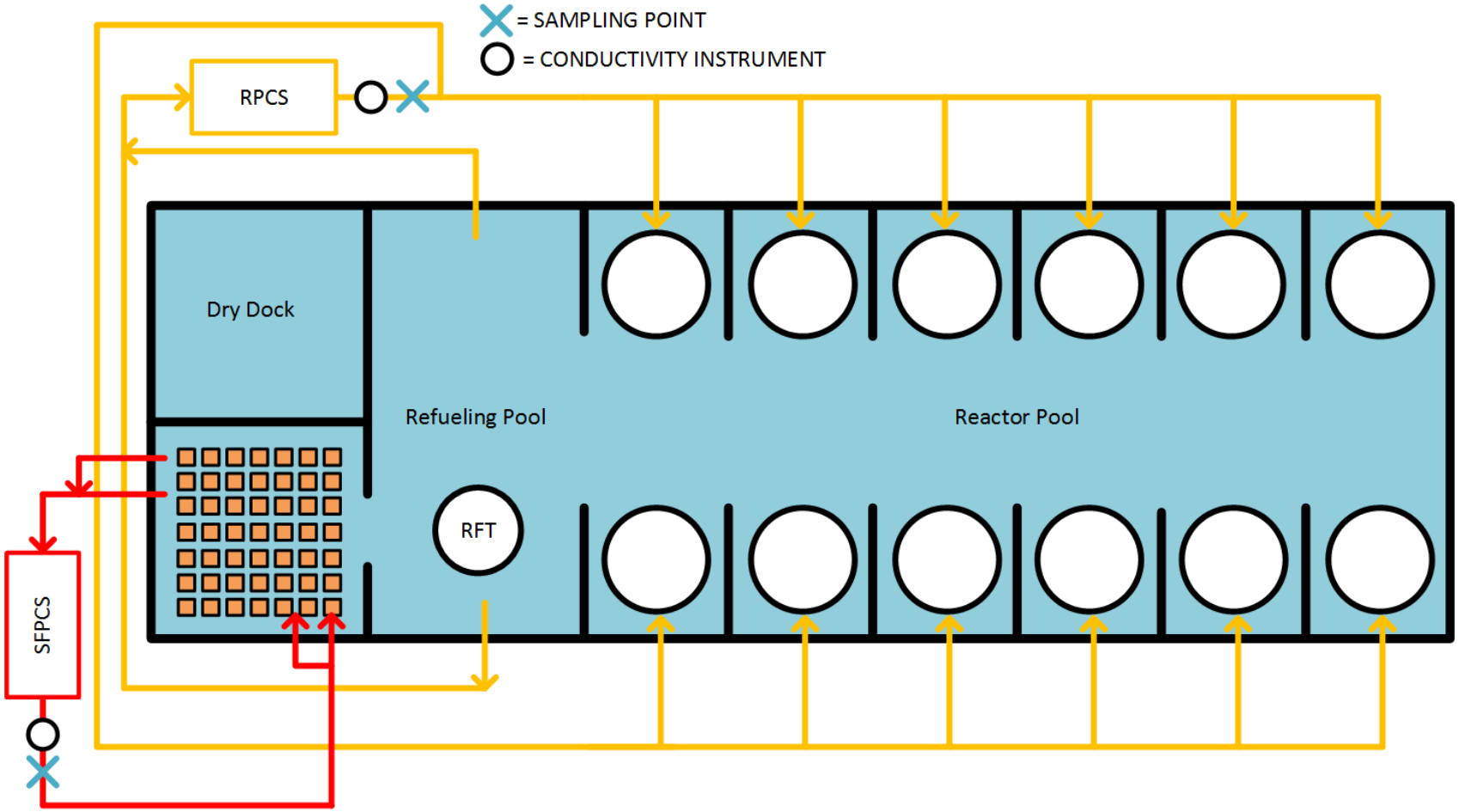
Pool Liner

- RXB floor slab is 10 feet of reinforced concrete
- RXB floor slab is capable of withstanding a module drop from maximum hook height without damaging the concrete in such as a way as to cause significant damage to RXB concrete
- Pool liner rupture would result in negligible loss from UHS inventory
  - Flooding would fill gaps and channels between liner and RXB concrete

Reactor Pool Mixing

- Spent Fuel Pool Cooling System
  - 2x 1250 gpm pump & heat exchanger trains
- Reactor Pool Cooling System
  - 3x 1250 gpm pump & heat exchanger trains
- Combined minimum operating flow (1 SFPCS / 1 RPCS)
  - 3.6 Million gallons / day (~7 Million gallon pool)
- Sample points on discharge of RPCS, SFPCS, and PCUS
- Conductivity monitors on outlet of RPCS, SFPCS, and PCUS
  - Conductivity mismatch between systems could indicate a difference in boron concentration between pools

Reactor Pool Mixing



Reactor Pool Mixing

- Shutdown Margin verified by TS 3.1.1
  - SR 3.1.1.1 (will use samples from RPCS to verify pool boron concentration)
    - Every 24 hours
- UHS boron concentration verified by TS 3.5.3
  - SR 3.5.3.3
    - Every 31 Days
    - And within 6 hours after each solution volume increase of ≥ 15,000 gal

Acronyms

- ANSI – American National Standards Institute
- ASME – American Society of Mechanical Engineers
- aux – Auxiliary
- CNV – Containment Vessel
- DCA – Design Certification Application
- E-Stop – Emergency Stop
- FHM – Fuel Handling Machine
- ft – feet
- gpm – gallons per minute
- I&C – Instrument and Control
- ITAAC - Inspections, Tests, Analyses, and Acceptance Criteria
- MCS – Module Control System
- min – minute
- MLA – Module Lifting Adapter
- NDE – Nondestructive Examination
- NPM – NuScale Power Module
- PCS – Plant Control System
- QAPD – Quality Assurance Program Description
- PCUS – Pool Cleanup System
- RBC – Reactor Building Crane
- RFT – Refueling Tool
- RG – Regulatory Guide
- RPCS – Reactor Pool Cooling System
- RPV – Reactor Pressure Vessel
- RXB – Reactor Building
- SFPCS – Spent Fuel Pool Cooling System
- SIL – Software Integrity Level
- SR – Surveillance Requirement
- SRP – Standard Review Plan
- TS – Technical Specification
- UHS – Ultimate Heat Sink

Portland Office
6650 SW Redwood Lane,
Suite 210
Portland, OR 97224
971.371.1592

Corvallis Office
1100 NE Circle Blvd., Suite 200
Corvallis, OR 97330
541.360.0500

Rockville Office
11333 Woodglen Ave., Suite 205
Rockville, MD 20852
301.770.0472

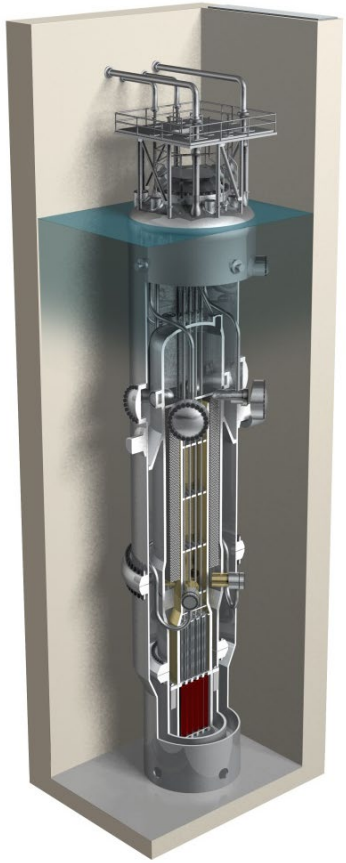
Charlotte Office
2815 Coliseum Centre Drive,
Suite 230
Charlotte, NC 28217
980.349.4804

Richland Office
1933 Jadwin Ave., Suite 130
Richland, WA 99354
541.360.0500

Arlington Office
2300 Clarendon Blvd., Suite 1110
Arlington, VA 22201

London Office
1st Floor Portland House
Bressenden Place
London SW1E 5BH
United Kingdom
+44 (0) 2079 321700

http://www.nuscalepower.com
Twitter: @NuScale_Power



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Presentation to the ACRS Full Committee

NuScale Power, LLC (NuScale)

Design Certification Application Review

Safety Evaluation with Open Items: Chapters 9, 11, 12, and 16

AUXILIARY SYSTEMS

April 4, 2019

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Project Managers:

Greg Cranston – Lead Project Manager

Getachew Tesfaye – Chapter 9 Project Manager

Chapter 9: Auxiliary Systems

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Technical Reviewers:

Section 9.1 - Fuel Storage and Handling	Alexandra Siwy - SRSB Raul Hernandez - SPSB Alissa Neuhausen - SEB Andrew Yeshnik - MCB
Section 9.2 - Water Systems	Chang Li - SCPB Angelo Stubbs - SCPB Nan Chien - SCPB Bob Vettori - SPRA
Section 9.3 - Process Auxiliaries	Raul Hernandez - SCPB Tony Gardner - MCCB Edward Stutzcage - RGRB Bob Vettori - SPRA Hanry Wagage – SCPB Ryan Nolan - SRSB
Section 9.4 - Air Conditioning, Heating, Cooling, and Ventilation Systems	Nan Chien - SCPB
Section 9.5 - Other Auxiliary Systems	Robert Vettori - SPRA Dawnmathews Kalathiveettil - EICA Fanta Sacko - EENB Nan Chien - SCPB

Overview of FSAR Review

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Section		Number of Open Items
9.1	Fuel Storage and Handling	2
9.2	Water Systems	0
9.3	Process Auxiliaries	7
9.4	Air Conditioning, Heating, Cooling, and Ventilation Systems	0
9.5	Other Auxiliary Systems	1
Total		10

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Chapter 11: Radioactive Waste System

Technical Reviewer: Zachary Gran

Overview of FSAR Review

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Section		Number of Open Items
11.1	Source Terms	1
11.2	Liquid Waste Management System	1
11.3	Gaseous Waste Management System	0
11.4	Solid Waste Management Systems	0
11.5	Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems	0
Total		2

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Chapter 12: Radiation Protection

Technical Reviewers:

- Ron LaVera – Lead DCD Chapter 12 Reviewer
- Ed Stutzcage – DCD Chapter 12 Reviewer
- Zach Gran – DCD Chapter 12 Reviewer

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Overview of FSAR Review

		Number of Open Items
12.1	Ensuring that Occupational Radiation Exposures are As Low As is Reasonably Achievable (ALARA)	0
12.2	Radiation Sources	9
12.3 &4	Radiation Protection Design Features	20
12.5	Operational Radiation Protection Program	0
Total		29

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Chapter 16: Technical Specifications

Technical Reviewers:

- Craig Harbuck – Lead Chapter 16 Reviewer
- Bob Tjader – Chapter 16 Reviewer

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Overview of Technical Specification Review

Section		Number of Open Items
16	Technical Specifications	22

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Safety Evaluation with Open Items: Chapter 10, "Steam and Power Conversion System"

NuScale Design Certification Application

ACRS Full Committee Meeting
April 4, 2019

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Protecting People and the Environment

Agenda

- NRC Staff Review Team
- Summary of the NRC Staff's Review
- Sections 10.2, 10.4.1-10.4.5, 10.4.7, and 10.4.10
- Sections 10.3
- Sections 10.3.6
- Section 10.3.5, 10.4.6, 10.4.11
- Abbreviations

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NRC Staff Review Team

- NRC Technical Reviewers
  - Angelo Stubbs, NRO
  - Robert Vettori, NRO
  - Nicholas McMurray, NRO
  - Alexander Chereskin, NRR
  - Ryan Nolan, NRO
  - Gregory Makar, NRO
  - Thinh Dinh, NRR
  - Dennis Andrukat, NMSS
- Project Management
  - Omid Tabatabai, Senior Project Manager
  - Greg Cranston, Lead Project Manager

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Summary of the Staff's Review

- NRC Staff's safety evaluation report (SER) is based on DCA, Rev. 1,
- During the review, the NRC staff issued 12 RAIs containing 37 Questions,
- SER contains no Open Items and six Confirmatory Items,
- ACRS Subcommittee briefed on March 21, 2019 – No follow-up questions/actions
- NuScale has incorporated information in Rev. 2 to the DCA to address staff's Confirmatory Items.

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Staff's Evaluation of Sections:

10.2 Turbine Generator (TG)
10.4.1 Main Condensers (MC)
10.4.2 Condenser Air Removal System (CARS)
10.4.3 Turbine Gland Sealing System (TGSS)
10.4.4 Turbine Bypass System (TBS)
10.4.5 Circulating Water System (CWS)
10.4.7 Condensate and Feedwater System (CFS)
10.4.10 Auxiliary Boiler System (ABS)

Presenter: Angelo Stubbs, Senior Reactor Systems Engineer, NRO

Turbine Generator and Associated Systems

Review Summary

- The staff reviewed the following systems associated with the TG:

  Turbine Generator, Turbine Bypass, Turbine Gland, Sealing
- The systems are not safety-related and are not used for accident mitigation.
- The TG and the TBS was reviewed for compliance with GDC 4
- The TGSS was reviewed for compliance with GDC 60 & 64.
- The TG Building does not contain SSCs important to safety

Turbine Generator and Associated Systems

Review Results

- The Staff found that the Turbine Building contains no equipment needed for safe shutdown and all SSC important to safety are housed in the reactor building and control building which the applicant indicates will be designed to protect against turbine missiles. The staff therefore finds that that TGS and TBS are in compliance with GDC 4 since failure of the systems will not adversely affect SSC's important to safety .

- The staff also found the TGSS to be incompliance with GDCs 60 and 64 since the system is provided with the capability of monitoring and controlling the release of radioactive effluents to the environment.

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Condenser, Circulating Water and Associated Systems

Review Summary

- The staff reviewed the condenser, condenser air removal, and circulating water systems for compliance with GDCs 4,5,60 and 64.
- The systems are not safety-related and do not share piping or components with safety-related systems.
- The systems are not located in proximity of important to safety SSCs
- Water discharged as a result of CWS or MC failure will be directed away from SSCs important to safety.
- The systems are provided with the capability of monitoring and controlling the release of radioactive effluents to the environment.

Condenser, Circulating Water and Associated Systems

Review Results

- The NRC staff reviewed the MC, CARS, and CWS and found the design to be in compliance with GDC's 2,4 and 5 since the they perform no safety-related function, and they are located inside the turbine building which contains no important to safety SSCs. The failure of these systems will not adversely affect SSCs important to safety.

- The Staff also found that since the MC, CARS, and CWS to be in compliance with GDC 60 and 64 based on the fact that the design provides for the capability of monitoring and controlling the release of radioactivity.

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Condensate and Feedwater System

Review Summary

- The staff reviewed the condensate and Feedwater System for compliance with GDCs 2,4,5,45,46 and 10CFR20.1406
- The CFWS is not safety-related and not used during or after an accident
- The feedwater system isolation is necessary for proper DHRS operation.
- Feedwater isolation valves are safety-related and seismic Cat. 1

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Condensate and Feedwater System

- **Review Results**

- The NRC staff reviewed the Condensate and Feedwater System described in Sections 10.4.7 of the NuScale Design certification application using guidance provide in Design Specific Review Standard (DSRS) 10.4.7.

- The design was reviewed for compliance with GDCs 2,4,5, 45, 46 and 10 CFR 20.1406.

- The Staff found the Condensate and Feedwater System to be in compliance with the above regulations.

Auxiliary Boiler System

Review Summary

- The staff reviewed the Auxiliary Boiler System for compliance with GDCs 2,4,5,60,64 and 10CFR20.1406
- The ABS is not safety-related and not used during or after an accident
- The ABS is a shared system that provides steam to the module heatup system.

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Auxiliary Boiler System

Review Results

- The design was reviewed for compliance with GDCs 2,4,5, 60, 64 and 10 CFR 20.1406.

- The Staff found the Auxiliary Boiler System to be in compliance with the applicable regulations.

Staff's Evaluation of Section

10.3 Main Steam System

Presenter: Robert Vettori, Fire Protection Engineer, NRO

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Regulatory Basis

- GDC 2, requires that SSCs important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.
- GDC 4, requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.
- GDC 5, requires that SSCs important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.
- GDC 34, requires that a system to remove residual heat be provided
- 10 CFR 50.63, requires that a nuclear power plant have the ability to withstand for a specified duration and recover from a station blackout as defined in 10 CFR 50.2.

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Staff's Review of Section 10.3

- The NRC staff reviewed the Section using NuScale design specific review standard 10.3, "Main Steam Supply System."
- The NuScale design defines the MSS as only the portions from the flanges immediately downstream of the containment system (CNTS) main steam isolation valves (MSIVs) up to the turbine stop valves.
- The staff performed its review consistent with the system boundaries defined in NuScale DSRS 10.3, "Main Steam Supply System." The main steam system extends from the outlet of the reactor pressure vessel (RPV) steam plenum (on the secondary side of the SGs) up to and including the turbine stop valves.
- ITAAC for portions of the safety related SSC of the main steam system are located in DCA, Part 2, Tier 1.
- The staff evaluation of technical specifications and associated bases are located in Chapter 16 of this SER.
- There are no combined license information items associated with the MSS.
- Five RAIs were submitted concerning Section 10.3, all are closed and resolved.

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Conclusion

- The MSS for the NuScale design satisfies the relevant requirements as described in the Regulatory Basis.

Staff's Evaluation of Section

10.3.6 Steam and Feedwater System Materials

Presenter: Nicholas McMurray, Materials Engineer, NRO

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Regulatory Basis

- 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records," requires that SSCs important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.
- 10 CFR Part 50, Appendix A, GDC 35, "Emergency Core Cooling," states that a system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.
- 10 CFR Part 50, Appendix B, Criterion XIII, "Handling, Storage and Shipping," requires that measures be established to control the handling, storage, shipping, cleaning, and preservation of materials and equipment to prevent damage or deterioration.
- 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," requires that power reactor licensees monitor the performance or condition of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions.

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Review Guidance

- NUREG-0800, Section 10.3.6, “Steam and Feedwater System Materials,” Revision 3, dated March 2007
- Generic Letter 89-08, “Erosion/Corrosion- Induced Pipe Wall Thinning,” dated May 1989
- Electric Power Research Institute, NSAC-202L-R3, “Recommendations for an Effective Flow-Accelerated Corrosion Program,” Revision 3, dated May 2006

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Staff's Review of DCA, Section 10.3.6

- The staff reviewed the materials of the MSS, CFWS, TGS, ABS, and associated subsystems. These systems are outside of CNV, not safety-related, and do not perform a nuclear safety function.
  - The CNTS isolation valve and DHRS materials are reviewed in Section 6.1.1, "Engineered Safety Feature Materials"
- Systems are designed to ASME B31.1 and Quality Group D
- The design meets the guidance of GL 89-08 and EPRI NSAC-202L-R3, and the selected materials minimize the impact of FAC.

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Staff's Review of DCA, Section 10.3.6

- **COL Item 10.3-2:** A COL Applicant that references the NuScale Power Plant design certification will provide a description of the flow-accelerated corrosion monitoring program for the steam and power conversion systems based on Generic Letter 89-08 and the latest revision of the Electric Power Research Institute NSAC-202L at the time of the COL application.
- **Confirmatory Items 10.3.6-1, 10.3.6-2, and 10.3.6-3**: Include information from RAI responses in to the next revision of the DCA related to FAC, the impacted piping systems, and controlling contamination.

Staff's Evaluation of Sections:

10.3.5	Secondary Water Chemistry
10.4.6	Condensate Polishing System
10.4.11	Feedwater Treatment System

Presenter: Alexander Chereskin, Chemical Engineer, NRR

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Regulatory Basis and Review Guidance

- 10 CFR Part 50, Appendix A, GDC 14, “Reactor Coolant Pressure Boundary,” requires that the reactor coolant pressure boundary (RCPB) be designed, fabricated, erected, and tested to ensure an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture.
- The NRC staff reviewed the Section using NUREG-0800, Sections 5.4.2.1, 10.4.6, and Branch Technical Position 5-1.
- Electric Power Research Institute, “Pressurized Water Reactor Secondary Water Chemistry Guidelines,” Revision 7, dated February 2009.
- Nuclear Energy Institute, NEI 97-06, “Steam Generator Program Guidelines,” Revision 3, dated January 2011.

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Staff's Review of DCA, Sections 10.3.5, 10.4.6, and 10.4.11

- The CPS, FWTS, and associated subsystems are not safety-related, and do not perform a nuclear safety function.
- The CPS provides condensate cleanup capability and maintains condensate quality through filtration and ion exchange.
- The CPS and FWTS are designed to control secondary water chemistry parameters to values consistent with the EPRI Secondary Water Chemistry Guidelines.
- There are no open or confirmatory items for Sections 10.3.5 or 10.4.6.
- The staff's review determined the CPS, secondary water chemistry, and the FWTS meet the applicable regulatory requirements.

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Abbreviations

ABS	Auxiliary Boiler System
ACRS	Advisory Committee on Reactor Safeguards
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CFWS	Condensate and Feedwater System
CNV	Containment Vessel
COL	Combined License
DC	Design Certification
DCA	Design Certification Application
EPRI	Electric Power Research Institute
FAC	Flow Accelerated Corrosion
FSAR	Final Safety Analysis Report
GDC	General Design Criteria
GL	Generic Letter
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
MSS	Main Steam System
NRC	Nuclear Regulatory Commission
NRO	NRC Office of New Reactors
SER	Safety Evaluation Report
SSC	Structures, Systems, and Components
TGS	Turbine Generator System

Research Program Review

Advisory Committee on Reactor Safeguards

April 4th 2019 TWFN 3rd Floor

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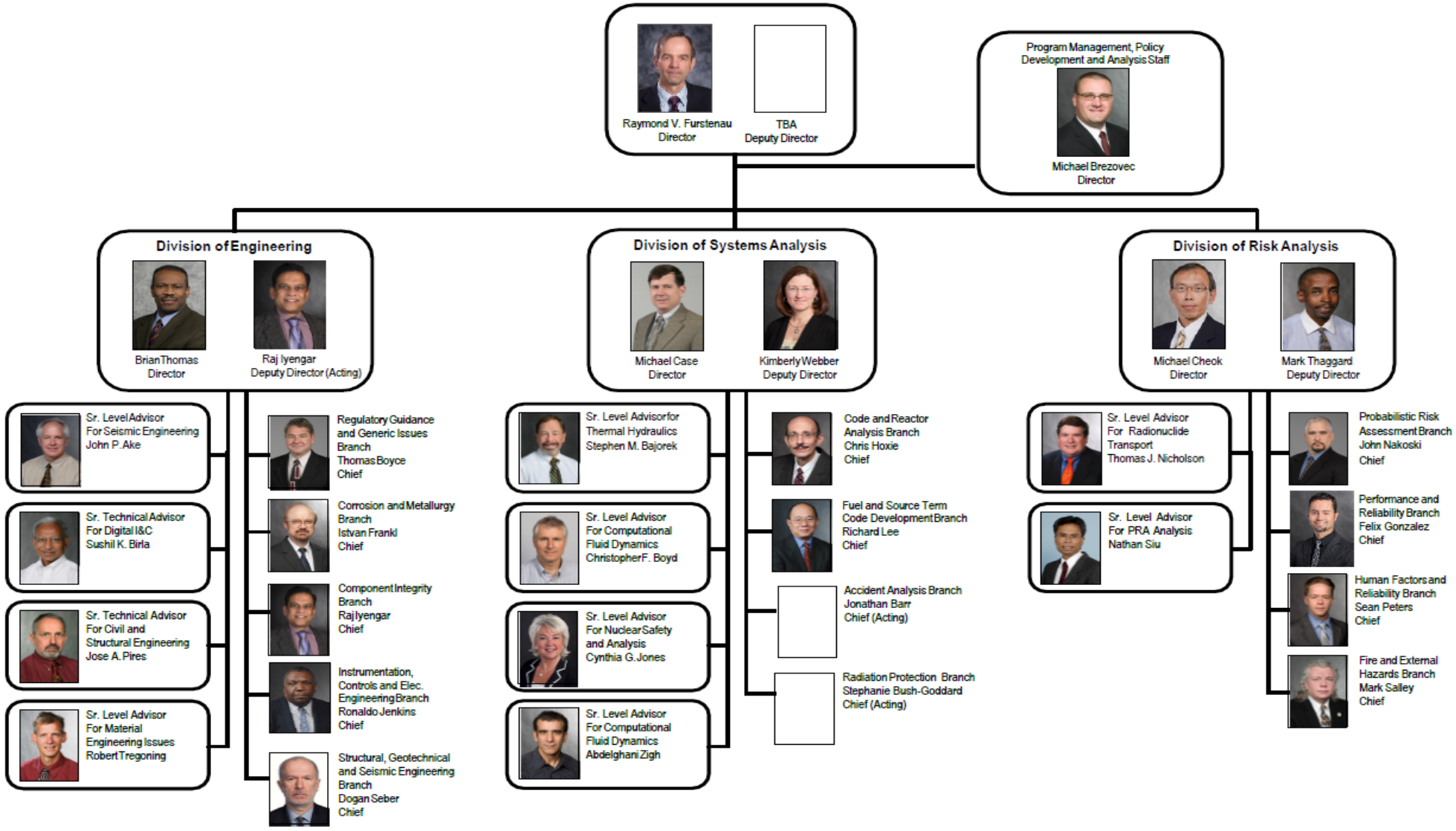
Agenda

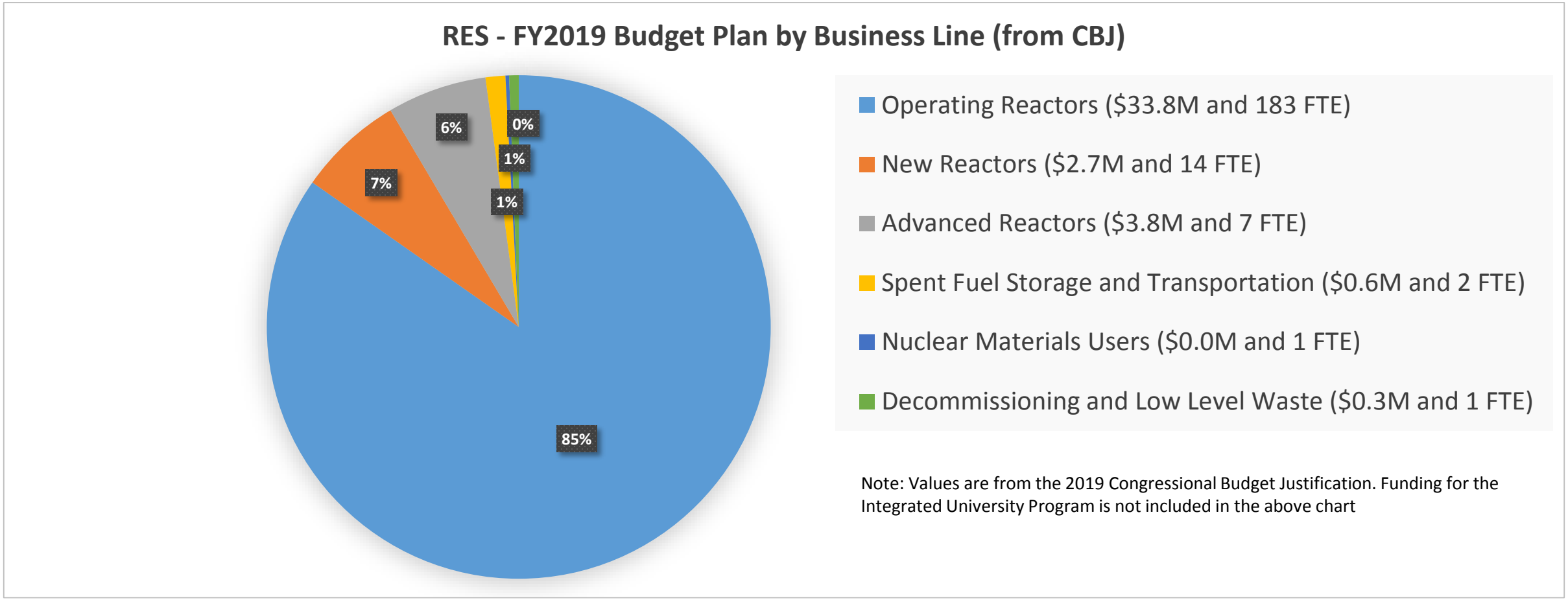
- Office Overview
- Readiness, External Engagement, Planning and Reporting of Research
- ACRS Recommendations
- Office Focus Areas
- Division Overviews
  - Engineering
  - Risk Analysis
  - Systems Analysis
- Discussion

Office at a Glance: RES



Program at a Glance

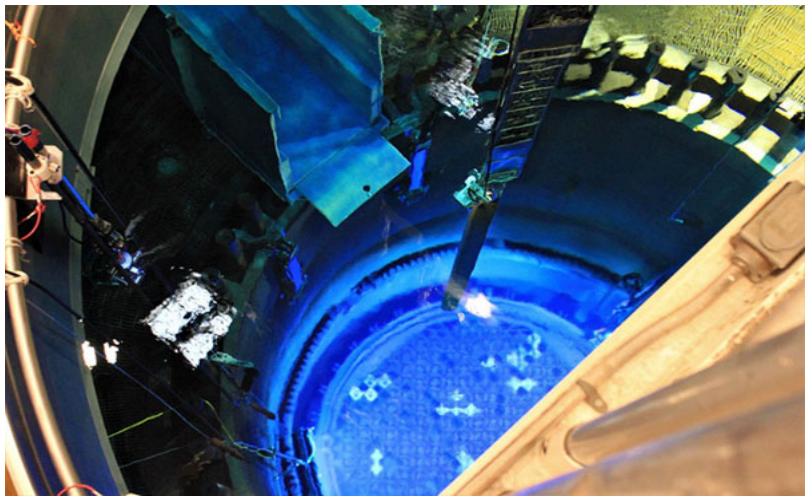
- Conduct research to support regulatory functions
- Research activities are scoped through work agreements with Program Offices



Note: Values are from the 2019 Congressional Budget Justification. Funding for the Integrated University Program is not included in the above chart

Ready for Tomorrow's Technology

- Agency research must support licensing and oversight of innovative technology and designs
- Activities must be a balance of confirmatory and anticipatory research to ensure readiness
- Biennial ACRS Recommendations align with this vision of a regulatory research program



The first lead test assembly containing ATF rods being loaded in a U.S. commercial power reactor at Southern Nuclear's Edwin I. Hatch Nuclear Plant in Baxley, GA, in February 2018 (photo courtesy of Southern Nuclear).

External Engagement

- RES regularly engages with DOE, EPRI, DOD, other Agencies, and industry stakeholders on topics of mutual interest
- RES utilizes domestic and international partnerships to leverage its resources
- Significant collaborative research is performed in the areas of computer codes, fuels, materials, emergency preparedness, fire, human factors, and external hazard safety

VTR
VERSATILE
TEST REACTOR

Planning and Reporting of Research

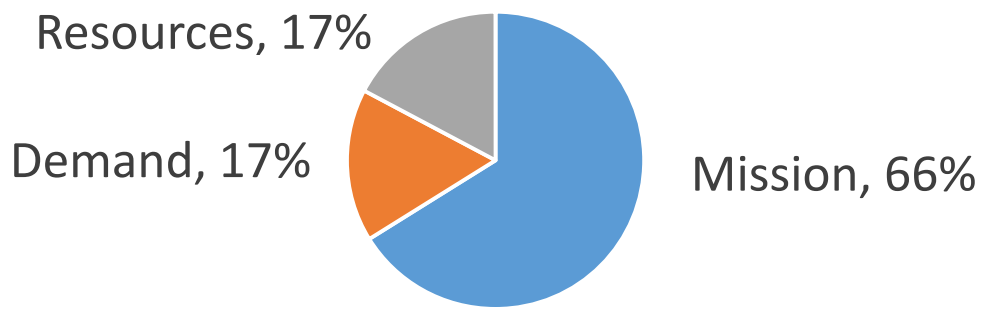
- RES has significantly enhanced the planning and reporting of research activities
- Use of Enterprise Project Identifiers (EPIDs) facilitates the budgeting and execution of research activities
- Program reviews with Business Line leads support strategic alignment
- Project prioritization assesses the relative importance of research activities in meeting the Agency mission

ACRS 2018 Biennial Recommendations

Recommendation: Prioritize agency research with emphasis on enterprise risk management of research activities

Action Taken: RES developed a numerical scale to determine the relative priority of research projects by weighing factors related to the mission impact, workload drivers, and resource needs

- Mission
  - Potential Risk Impact
  - Business Line Safety Priorities
  - Deterministic Evaluations
  - Improving Uncertainty and/or State of Knowledge
  - Generic Fleet Applicability
- Demand
  - Level (Internal Driver)
  - Function (Internal Driver)
  - External Drivers
  - Staff Skill Development (Internal Driver)
- Resources
  - Leverage
  - Anticipated Completion
  - Contract Costs (per year)
  - FTE (per year)



ACRS 2018 Biennial Recommendations

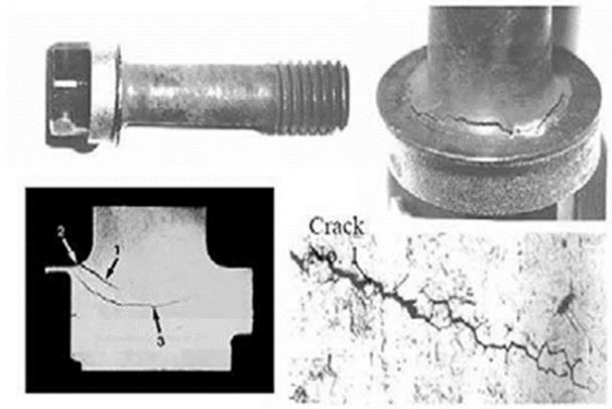
Recommendation: Develop long-term strategies to address emerging technical issues, support development and maintenance of analytical tools and databases, and preserve core competencies.

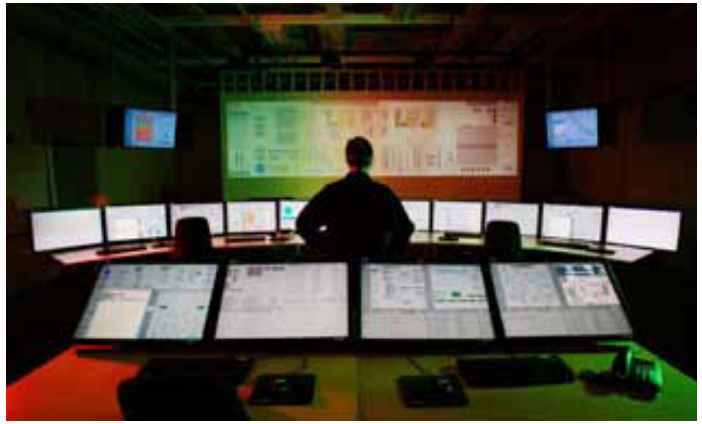
Actions Taken:

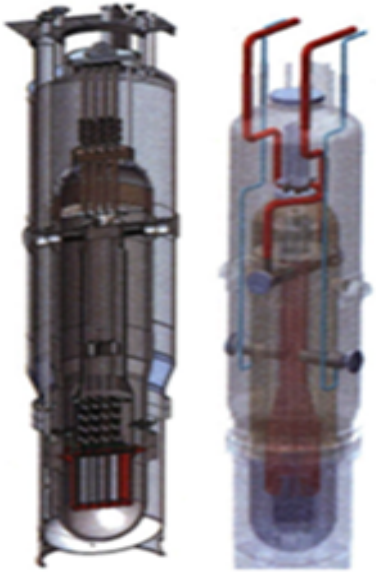
1) Developed and implemented comprehensive research plans for new technologies (e.g., Advanced non-LWR, ATF, Advanced Manufacturing) focused on early engagement with industry and identifying key knowledge gaps for licensing and oversight
2) Systematically assessing maintenance and development needs for RES computer codes to support a durable framework for ensuring their continued viability and adaptability for ATF and Advanced non-LWRs
3) Conducted Strategic Workforce Planning activity to align staffing, training, and knowledge management with workload demand in core technical areas
4) Implemented Feasibility Study Process to broaden consideration of anticipated research needs beyond near-term Program Office requests

Office Focus Areas

- Provide support to Program Offices for near-term licensing and oversight functions
- Improve realism in analytical models and the use of risk-insights to better inform regulatory decision-making
- Prepare for licensing and oversight of emerging technologies
  - Accident Tolerant Fuel (ATF)
  - Advanced reactors







Overview of Research Activities

- Engineering –Brian Thomas
- Risk Analysis – Mike Cheok
- Systems Analysis – Mike Case

Division of Engineering Overview

- Provides technical expertise and research support for engineering issues related to operating reactors, new reactor design and siting, and spent fuel management
- Provides management for agency-wide programs related to Regulatory Guide updates, Generic Issues, and standards development
- Maintains core expertise in seismology, geotechnical engineering, structural engineering, corrosion, metallurgy, non-destructive examination, component integrity analyses, electrical engineering, and instrumentation and controls engineering
- Consists of 5 branches:
  - Component Integrity Branch
  - Corrosion and Metallurgy Branch
  - Instrumentation, Controls, and Electrical Engineering Branch
  - Regulatory Guide and Generic Issues Branch
  - Seismic, Geotechnical, and Structural Engineering Branch

Division of Engineering Overview

In FY19, the Division of Engineering has approximately 74 FTE and $15.2M in contract funds across the following research areas:

Research Areas	FY19 Resource Allocation	Key Areas	Contacts
Component Integrity	27%	xLPR, PFM, NDE, RPV, piping and other components, ANLWR materials	Raj Iyengar
Corrosion and Metallurgy	24%	Aging management, IAD, PWSCC, Steam generator, AMT	Istvan Frankl
Electrical Engineering	9%	Cable aging, equipment qualification, electrical systems	Ronaldo Jenkins, Kenn Miller
Instrumentation and Controls	13%	Risk insights, CCF, EDD, near-term tactical, long-term modernization	Ronaldo Jenkins
Seismic	8%	Seismic hazards, site response, RIPB	Dogan Seber
Structural and Geotechnical	10%	Irradiated concrete, ASR	Dogan Seber
Agency Program Support	8%	RG updates, GI Program, Codes and standards, Feasibility Studies	Thomas Boyce

Component Integrity, Corrosion, and Metallurgy Overview

Priority areas:

- Enhancing in-house computational modeling and capabilities for probabilistic and deterministic analyses
  - Completing documentation and development of Extremely Low Probability of Rupture (xLPR) Code
  - Developing regulatory guidance for probabilistic fracture mechanics applications
- Assessing materials degradation in operating reactors
  - Completing research on primary water stress corrosion cracking in 2021 – 2023 timeframe
  - Replacing Halden irradiated-materials testing capabilities
- Evaluating research needs for advanced non-light water reactor materials and advanced manufacturing technologies

Workload trends:

- Generally decreasing workload for operating reactors
- Assessing potential for increased workload on advanced reactor materials and advanced manufacturing

Electrical Engineering, Instrumentation, and Controls Overview

Priority areas:

- Supporting update of regulatory framework for digital instrumentation and controls (DI&C)
  - Streamlining guidance and acceptance criteria for LARs (ISG-06)
  - Addressing technical knowledge gaps (CCF, EDD, risk insights)
- Assessing cable aging and equipment qualification for long-term operation
  - Testing cables in irradiation and thermal exposure
  - Evaluating condition monitoring techniques
  - Considering need for LOCA testing
- Resilience and reliability of DI&C systems
  - Assessing effects of electromagnetic pulse (EMP) and geomagnetic disturbances (GMD)
  - Evaluating threat environment and regulatory needs for cybersecurity evaluations

Workload trends:

- Decreasing workload in cable aging and electrical systems evaluation
- Potential for increased workload on EMP and GMDs

Seismic, Structural, and Geotechnical Engineering Overview

Priority areas:

- Assessing structural performance for long-term reactor operation
  - Testing properties of concrete exposed to irradiation and alkali-silica reaction (ASR)
  - Participating in international cooperative program on aging of post-tensioned structures
- Commission-directed work on post-Fukushima seismic hazards
  - Updating seismic source characterization models for Central and Eastern U.S.
  - Site response for seismic events
- Enhancing efforts on risk-informed, performance-based seismic evaluations
  - Assessing use of consensus codes and standards
  - Updating of Regulatory Guide 1.208

Workload trends:

- Decreasing workload as concrete testing for irradiation and ASR is largely completed by 2021 – 2023
- Seismic workload remains generally level

Agency Program Support Overview

Priority areas:

- Assessing frequency for updating regulatory guidance
  - Responding to Commission SRM to assess value of incorporating lessons learned from updates versus resource requirements
  - Draft COM-SECY provided to OEDO in March 2019
- Continuing program support for High Energy Arc Fault Generic Issue
- Coordinating participation in Standards Development Organizations
  - Ensuring coordination, communication, and common prioritization across Offices
  - Engaging stakeholders on standards development for advanced reactors

Workload trends:

- Assessing close out of Generic Safety Issue 191
- Potential for increased workload on standards development needs for advanced reactors

Division of Risk Analysis Organization

- Probabilistic Risk Assessment Branch – Support the reactor oversight process, facilitate implementation of risk-informed regulation, expand PRA infrastructure to address emerging technical areas and reactor designs, support continuous advancement in PRA state of practice
- Performance and Reliability Branch – Collect, analyze, and disseminate operating experience data, analyze accident precursor events at nuclear power plants, support PRA standards and guidance development
- Fire and External Hazards Branch – Conduct fire safety research, and conduct flooding and other external events research to support hazard reviews and PRA modeling
- Human Factors and Reliability Branch – Provide human and organizational factors support for new and operating reactors, and develop improved HRA methods and data to support PRA analyses

Division of Risk Analysis Overview

The Division of Risk Analysis has approximately 38 FTE and $10.3 M in contracting support in FY19 across these areas:

Research Areas	FY19 Division Resources	Key Areas	Contacts
PRA Tools and Method Development	31%	Level 3 PRA project, SAPHIRE, SPAR	John Nakoski
Assessment of Plant Performance and Equipment Reliability	20%	ASP program, OpE data collection and analysis, risk assessment guidance	Felix Gonzalez
Analysis of Fire and External Hazards	31%	HEAF, Fire PRA realism, PFHA, external hazards	MarkHenry Salley
Evaluation of Human Factors and Human Reliability	18%	HRA data collection (SACADA), HRA method development (FLEX, IDHEAS), Human Factors (contol room design, NDE, etc.)	Sean Peters

PRA Tools and Methods Development

Priority areas:

- Level 3 PRA project
- SPAR model updates (routine updates, FLEX, external hazards)
- SPAR models for new reactor designs
- SAPHIRE code maintenance and updates
- Updates to risk assessment guidance documents

Workload trends:

- Level 3 PRA project to be completed in FY22
- Increased workload in risk informing security
- Increased workload in risk insights for digital instrumentation and controls
- Increased PRA research needs for advanced reactors (e.g., Dynamic PRAs)

Assessment of Plant Performance and Equipment Reliability

Priority areas:

- Collect and analyze data on NPP operation
- Analysis of Potential Accident Sequence Precursors
- Development of consensus standards on PRA and develop guidance on the application of approaches and methods that support the use of risk tools in regulatory decisionmaking

Workload trends:

- Increasing efficiency in data collection and evaluation and in event assessments resulting in decreasing resources in these areas.
- Increase in research into data analytics and artificial intelligence to evaluate nuclear and non-nuclear OpE and insights from this OpE.

Analysis of Fire and External Hazards

Priority areas:

- Generic Issue on aluminum High energy arcing faults
- Fire PRA realism
- Guidance for performing probabilistic flood hazard assessments
- Support for post-Fukushima flooding reevaluations
- Support on issues related to geochemistry and environmental transport (e.g., radon barriers for uranium mill tailings)

Workload trends:

- Closeout of HEAF generic issue (GI-018) in FY20
- Completion of post-Fukushima activities
- Initiate investigation of potential fire risk for advanced reactors

Evaluation of Human Factors and Reliability

Priority areas:

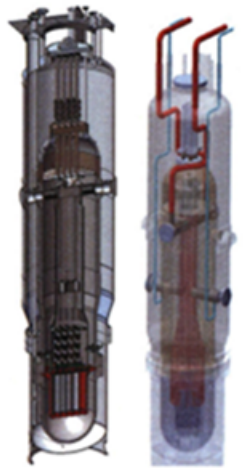
- Updating human factors review guidance to account for changes in plant design and operating procedures
- HRA data collection to support HRA methods (SACADA)
- HRA method development (FLEX methodology, IDHEAS)
- Human Factors of Non-Destructive Examination

Workload trends:

- Complete efforts to support analyzing the use of FLEX equipment (FY19)
- Increasing efforts on HRA methods and human factors guidance updates to support advanced reactor licensing

Division of Systems Analysis Overview

- Plans, develops, and directs research programs in the following areas neutronic and criticality safety; fuel, thermal-hydraulic, and severe accident analysis; accident sequence and source term analysis; offsite consequence and dose assessment analysis; and radiation protection analysis.
- Develops analytical capabilities to be used in support of risk-informed regulatory decisions for a wide spectrum of conditions, including normal operation, accident, and severe accident conditions for current, new, and advanced reactor designs.
- Consists of the following 4 branches:
  - Accident Analysis Branch
  - Code and Reactor Analysis Branch
  - Fuel & Source Term Code Development Branch
  - Radiation Protection Branch



NuScale Reactor

Division of Systems Analysis Overview

The Division of Systems Analysis has approximately 62 FTE and $9.2M in contracting support in FY19 across these areas:

Research Areas	FY19 Division Resources	Key Tools	Contacts
Thermal-Hydraulics Analysis	18%	TRACE, SNAP, and CFD	Chris Hoxie, Chris Boyd, Ghani Zigh, Steve Bajorek
Fuels and Neutronics Analysis	23%	PARCS, SCALE, FAST	Richard Lee
Accident Progression and Source Term Analysis	11%	MELCOR	Richard Lee
Consequence Analysis	13%	MACCS, WINMACCS, and SecPop	Jon Barr (acting)
Radiation Protection Analysis	16%	RADTRAD, RASCAL, GALE, VARSKIN, HABIT, and RESRAD, REIRS, and AO	Stephanie Bush-Goddard (acting)
Advanced Reactor - Implementation Action Plan for Code and Tool Development	20%	DOE Tools, FAST, SCALE, MELCOR, MACCS	Steve Bajorek

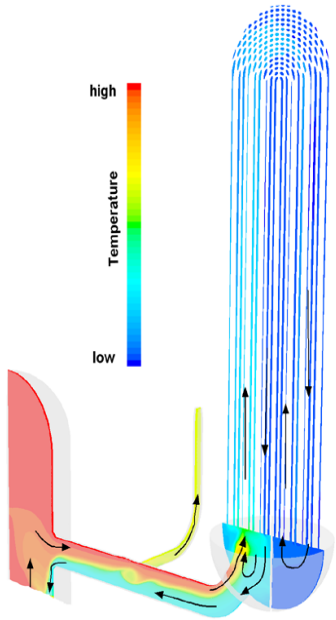
Thermal-Hydraulics Overview

Priority areas:

- Licensing and Operational Support
  - License Amendment Request (LAR) support of Extended Reactor Operating Range (i.e., Brunswick, Browns Ferry)
  - Complete NuScale Review (NuScale Research Plan)
- International Engagement
  - Code Application and Maintenance Program (CAMP)
  - CSNI engagements and continued use of international and domestic capabilities (e.g., Rod Bundle Heat Transfer at Penn. State)

Workload trend:

- Downward trend
- Enhance code development skill
- Only application specific code development funding in FY21

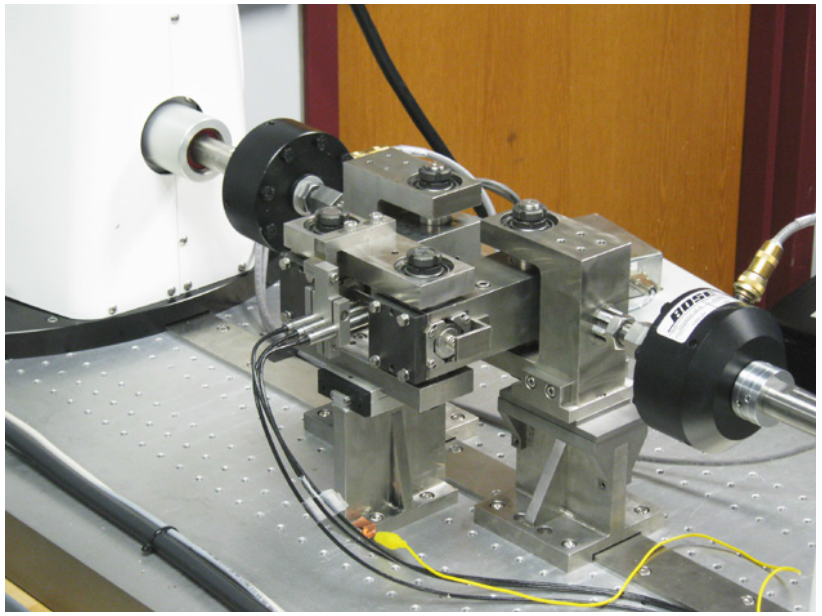


Hot Gases during a Postulated Severe Accident using CFD

Fuels and Neutronics Overview

Priority areas:

- Licensing and Operational Support
  - Accident Tolerant Fuel Plan
  - High Burnup and Enrichment Fuel Designs
  - BWR Burnup Credit
  - 50.46c Rulemaking
- International Engagement
  - Follow-on to Halden
  - Studsvik Cladding Integrity Project Part IV (SCIP-IV)



Testing of Irradiated Materials

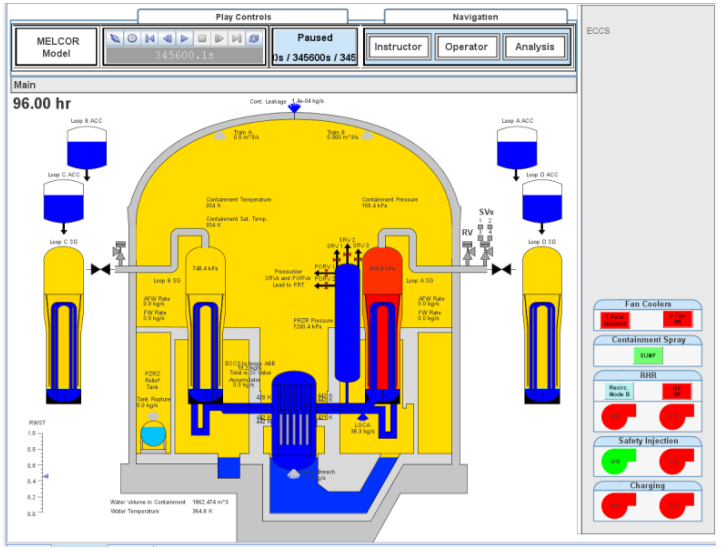
Workload trend:

- Increasing workload
- Interoperability among codes (NRC & DOE)
- Enhance code development skill; improve cross-skill flexibility

Accident Progression and Source Term Overview

Priority areas:

- Licensing and Operational Support
  - Application of Alternate Source Term (RG 1.183)
  - Standardized Plant Analysis Risk (SPAR)
- International Engagement
  - Cooperative Severe Accident Research Program (CSARP)
  - CSNI source term and severe accident projects
  - Maintain and lead the Japanese, DOE, and industry cooperation on Fukushima forensics.



Severe Accident Progression using MELCOR and SNAP

Workload trend:

- Downward trend
- Rebuild severe accident phenomenology expertise
- Only application specific code development funding in FY21

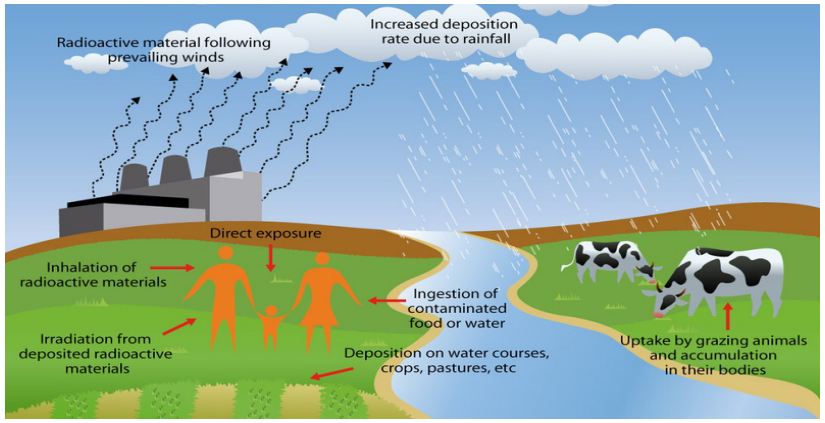
Consequence Analysis Overview

Priority areas:

- Licensing and Operational Support
  - Completing SOARCA and Summary UA report to identify accident progression and consequence analysis insights to support risk-informed decision-making
  - Emergency Planning Zone (EPZ) size reductions
  - Complete state-of-practice atmospheric and economic models for consequence analysis
  - Support for updated cost-benefit analysis guidance
  - Level III PRA
- International Engagement
  - Cooperative Severe Accident Research Program (CSARP)

Workload trend:

- Downward trend
- Improve MACCS near-field atmospheric modeling capability
- Only application-specific code development funding in FY21



Exposure pathways involved in consequence analysis

Radiation Protection Overview

Priority areas:

- Licensing and Operational Support
  - Support Incident Response and Dose Assessment using RASCAL and RADTRAN
  - Decommissioning Support using RESRAD, MILDOS, and VSP
  - Identify consolidation opportunities across code suite
  - Monitor and support select low-dose research
- International Engagement
  - Radiation Protection Computer Code Analysis and Maintenance Program (RAMP)

Workload trend:

- Downward trend
- Rebuild advanced dosimetry technical expertise
- Only application specific code development funding in FY21

Radiation Worker Taking Measurements

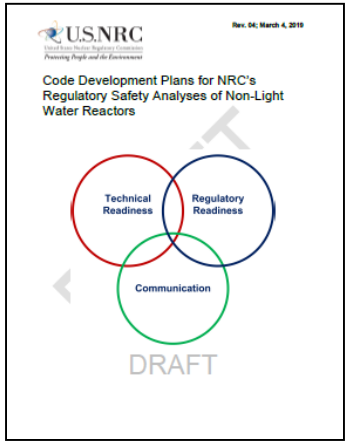
Advanced Reactor Code Overview

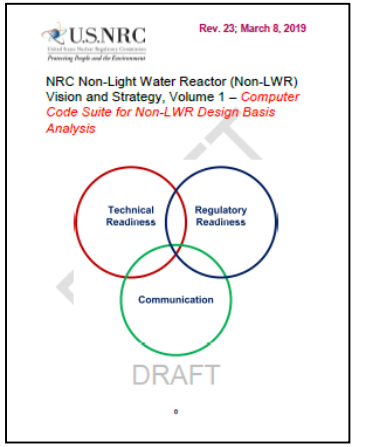
Priority areas:

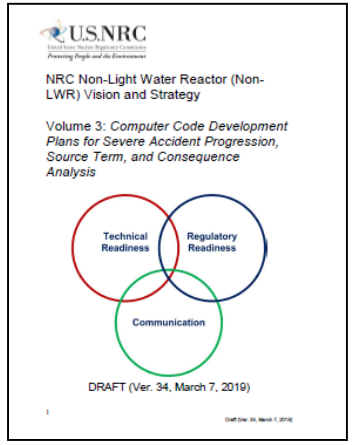
- Licensing and Operational Support
  - Advanced Reactor Code Development Plans
    - Overview of our Code Development Approach
    - Confirmatory Analysis Capabilities for Design Basis Accidents (Volume 1)
    - Fuel Performance (Volume 2)
    - Beyond Design Basis Accident and Offsite Consequences (Volume 3)
    - Radiation Protection Licensing, Siting, and Dose Assessment (Volume 4)

Workload trend:

- Increasing workload
- Broaden non-LWR skills
- Leverage DOE capabilities







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  - https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML18236A507
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Acronyms

- ACRS – Advisory Committee on Reactor Safeguards
- AMT – Advanced Manufacturing Technologies
- ANLWR – Advanced Non-Light Water Reactor
- AO – Abnormal Occurrence
- ASR – Alkali-Silica Reaction
- ATF – Accident Tolerant Fuel
- BWR – Boiling Water Reactor
- CAMP – Code Application and Maintenance Program
- CSARP – Cooperative Severe Accident Research Program
- CBJ – Congressional Budget Justification
- CCF – Common Cause Failure
- CFD – Computational Fluid Dynamics
- DI&C – Digital Instrumentation and Controls
- DOD – U.S. Department of Defense
- DOE – U.S. Department of Energy
- EDD – Embedded Digital Devices
- EPID – Enterprise Project Identification
- EPRI – Electric Power Research Institute
- EPZ – Emergency Planning Zone
- FAST – Fuel Analysis under Steady-state and Transient
- FTE – Full Time Equivalents
- GALE – Gaseous and Liquid Effluents Code
- GI – Generic Issue
- HEAF – High-Energy Arc Fault
- HRA – Human Reliability Analysis
- IAD – Irradiation-Assisted Degradation
- IDHEAS – Integrated Human Event Analysis System
- ISG – Interim Staff Guidance
- LAR – License Amendment Request
- LOCA – Loss of Coolant Accident
- MACCS – MELCOR Accident Consequence Code System
- NDE – Non-Destructive Examination
- NPP – Nuclear Power Plant
- OEDO – Office of the Executive Director for Operations
- OpE – Operating Experience
- PARCS – Purdue Advanced Reactor Core Simulator
- PFM – Probabilistic Fracture Mechanics
- PRA – Probabilistic Risk Assessment
- PWSCC – Primary Water Stress Corrosion Cracking
- RADTRAD – Simplified Model for Radionuclide Transport and Removal And Dose Estimation
- RAMP – Radiation Protection Computer Code Analysis and Maintenance Program
- RASCAL – Radiological Assessment Systems for Consequence Analysis
- REIRS – Radiation Exposure Information and Reporting System
- RES – Office of Nuclear Regulatory Research
- RG – Regulatory Guide
- RIPB – Risk-Informed, Performance, Based
- RPV – Reactor Pressure Vessel
- SACADA – Scenario Authoring, Characterization, and Debrief Application
- SAPHIRE – System Analysis Program for Hand-on Integrated Reliability Evaluations
- SCALE – Standardized Computer Analyses for Licensing Evaluation
- SCIP – Studsvik Cladding Integrity Project
- SNAP – Symbolic Nuclear Accident Package
- SOARCA – State-of-the-Art Reactor Consequence Analyses
- SPAR – Standardized Plant Analysis Risk
- SRM – Staff Requirements Memorandum
- SWP – Strategic Workforce Planning
- TRACE – TRAC/RELAP Advanced Computational Engine
- UA – Uncertainty Analysis
- xLPR – Extremely Low Probability of Rupture Code