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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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NUSCALE SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

JANUARY 23, 2019

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room 3D50, 11545 Rockville Pike, at 10:46 a.m., Dennis Bley and Harold Ray, Co-Chairs, presiding.

COMMITTEE MEMBERS:

DENNIS BLEY, Co-Chair

HAROLD RAY, Co-Chair*

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR., Member

MARGARET SZE-TAI Y. CHU, Member

MICHAEL CORRADINI, Member

VESNA B. DIMITRIJEVIC, Member*

JOSE MARCH-LEUBA, Member

GORDON R. SKILLMAN, Member

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

ALSO PRESENT:

DOUG BOWMAN, NuScale

PROSANTA CHOWDHURY, NRO

AMY D'AGOSTINO, RES

RYAN FLAMAND, NuScale

CARRIE FOSAAEN, NuScale

BRIAN GREEN, NRR

AMANDA MARSHALL, NSIR

LAUREN NIST, NRR

STEVE POPE, NuScale

MAURIN SCHEETZ, NRR

TIM TOVAR, NuScale

*Present via telephone

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P R O C E E D I N G S

10:46 a.m.

CO-CHAIR BLEY: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards, the NuScale Subcommittee. I'm Dennis Bley, Chairman for today's Subcommittee meeting.

Members in attendance are Ron Ballinger, Dick Skillman, Charlie Brown, Jose March-Leuba, Margaret Chu, Mike Corradini. On the phone line we have Harold Ray, and we are expecting Vesna Dimitrijevic.

Mike Snodderly is the Designated Federal Official for this meeting.

The Subcommittee will review the staff Safety Evaluation Report with Open Items on Chapter 13, Conduct of Operations, and Chapter 18, Human Factors Engineering, to the NuScale design certification application. Today we have members of the NRC staff and NuScale to brief the Subcommittee.

The ACRS was established by a statute and is governed by the Federal Advisory Committee Act, FACA. That means that the Committee can only speak through its published letter reports. We hold

meetings to gather information to support our deliberations.

Interested parties who wish to provide comments can contact our office requesting time after the meeting announcement is published in The Federal Register. We also set aside 10 minutes at the end of the day for members of the public who wish to make a comment. Written comments are also welcome.

The ACRS section of the U.S. NRC public website provides our Charter, Bylaws, letter reports, and transcripts of all full and subcommittee meetings, including the slides presented there.

This meeting was not noticed in The Federal Register because of the closure of the federal government. But we are here today. The meeting has been noticed on the NRC public website, and some members of the public have been notified of this meeting directly. The meeting was announced as an open/closed meeting. And let me take a break right here and mention how we're going to do that. It's a little different than shown in the agenda.

At some time during the first session this morning, we will reach a point where NuScale will go into a proprietary briefing. At that point, we'll close the meeting and turn off the public phone line.

We expect to be back following lunch at 12:45. It might be as late as 1:00. But, at that time, the public phone line will be open again, and it will be an open meeting. And there will be another closed session at the end of the day today. But, before we go into that closed session, we'll ask if there are comments from members of the public.

No written statement or request for making an oral statement to the Subcommittee has been received from the public concerning this meeting.

A transcript of the meeting is being kept and will be made available. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume so they can be heard.

And for you guys who have never been here before, today in this room the mics never shut off. So, you'll always be on.

We have a bridge line established for the public to listen to the meeting. To minimize disturbance, the public line is kept in a listen-in mode until we invite comments.

To avoid disturbance, I request that

attendees put their electronic devices in the off or noise-free mode.

We'll now proceed with the meeting. But, before I turn it over to NuScale, there are a couple of things I want to mention.

I received some notes from members of the Committee, trying to read through the DCD and the SERs on this work. From there, some things aren't completely clear.

I'll just mention to everybody, only three or four of us who are now on the Committee were on the Committee in July of 2015, when we visited the plant. And I think only two of those three or four actually went there.

We saw some things that you can't find in the DCD or the SER. If you read a little further, like the report we were provided on staffing, you'll find another reference to another report called "Conduct of Operations," which, unlike Chapter 13, really tells us how you operate the plant inside the control room.

The one thing that was quite confusing to many of us was, with six operators, kind of who does what? And NuScale and the staff will touch on this today, but they might not go quite as far. So, I want

to get this out for all of you at this point.

There are six SROs. Three of them function much like in other plants. The shift manager, the control room supervisor, and the STA, pretty much the same as we're used to seeing. There are three ROs, and those reactor operators, one of them -- they designate him RO1 in that report I mentioned. It's RP-0215-10815, "Concept of Operations". It tells you how it works the way we saw it.

And how it works is that that first operator, RO1, runs all 12 plants. You don't divvy the reactors up among all six operators. One person runs all 12.

When you read the SER, you'll see a lot of "We meet the criteria laid out in this NUREG" and in this B&O report, but you don't see anything of the sort that, when I was there, gave me some confidence in this approach.

And the two things that really anchor this are kind of the cleverness of the main control panel with different colors, different flashing signals. I don't remember about the sounds. But it made it very easy for the one operator who's running all 12 to identify problems in any of the 12 units and sort of

have an initial ranking of what could be most important. That lets them do what they want to do and focus properly.

The second thing is, the philosophy tends to be, if things get busy, because you can with this plant, you throw a switch and you go into the passage shutdown mode, passive cooling. And then, the operator can pretty much ignore that unit while they work on others. So, if they get an accident on one unit, the one guy takes it. If it gets too confusing or they get something on another unit, he hands it off. And when it reaches the point that there's more than people can do, they put them into the safe mode.

And you don't find that anywhere in the stuff we've read. I'm curious as to why not. I'm going to ask the staff about that when we get to Chapter 18, because it seems to be the key to making this thing work properly.

All of that said, it gives you some perspective for when we get to Chapter 18. And at this point, we're back to Chapter 13.

And I'm going to turn it over to Doug Bowman, who will do our first presentation.

Doug?

MR. BOWMAN: Good morning. My name is

Doug Bowman. I'm the Supervisor of Plant Operations at NuScale Power.

Dr. Bley, I appreciate all your questions, and I think we'll answer some of them in this presentation. But, of course, if we don't, we know we'll get questions from you.

And we will go into the background and history of how, a little bit about how we arrived at the conduct of operations that you guys observed in 2015.

A little bit about me. I have been at NuScale for nearly five years now, working either as an individual contributor performing human factors engineering and operations work or now in my role as the Supervisor, Plant Operations. Prior to that, I worked on the commercial side of the nuclear industry for 24 years. I was Senior Reactor Operator licensed at both D.C. Cook and Byron, held many different positions at both plants from engineering through operations, work control, training, a wide variety of positions, and took the opportunity in 2014 to come to NuScale and work.

Also with me today is Ryan Flamand. Ryan, you want to talk a little bit about yourself?

MR. FLAMAND: Sure. My name is Ryan

Flamand. I work with Doug in plant operations, have done a lot of the work on HNB as an individual contributor.

Specific to Chapter 13, I was involved in the development of conduct of operations, which will be part of what the question I think we might be able to answer today or help answer; and also, a generic technical guidance, which is the basis for the emergency operating procedures.

Previous to that, similarly to Doug, I have 15 years commercial operating experience as a Senior Reactor Operator licensed at Palisades. I also was a reactor operator and also an equipment operator for a period of time.

Previous to that, I was six years in the Navy, a reactor operator on the USS California.

So, that's it.

MR. TOVAR: Good morning. My name is Tim Tovar. I'm the Manager of Plant Operations at NuScale Power.

I've been with the company for about six and a half years now. My background, I started with a mechanical engineering degree from RPI. I want into the Navy to help pay for that, actually. Seven years in the Navy as a submarine officer, was a radcon

officer on a tender during my shore tour for a couple of years.

Then, went into civilian nuclear power, licensed at Robinson Nuclear Power or Robinson Nuclear Plant as a Senior Reactor Operator. Held the positions of Operations Manager and Radiation Protection Manager there. Went to First Energy and was the Fleet Outage Manager for three years there, and then, came to NuScale.

So, I've got a C7, 14, and 3, and six and half years' worth of nuclear experience.

MS. FOSAAEN: Hi. Good morning. Carrie Fosaaen. I am a Licensing Supervisor with NuScale. I've been there for three and a half years now.

Prior to that, I was in commercial nuclear as a licensing individual at Monticello Nuclear Generating Plant. And previous to that, I did a year in decommissioning.

My bachelor's is in nuclear engineering and a master's in health physics.

And I've been involved with this team for about the last year.

MR. BOWMAN: So, I'll go a little bit more into our operational staff --

CO-CHAIR BLEY: But, before you go

ahead --

MR. BOWMAN: Sure.

CO-CHAIR BLEY: -- if we raise any questions that your answers would move into the proprietary area, it's up to you to say we'll pick that up in the closed session. Okay?

MR. BOWMAN: Sure. Absolutely. We'll protect our proprietary. Thank you.

I went through the introductions. I'd like to go through a few more introductions. I believe we're a little different than a typical nuclear vendor. So, right now on staff, the group that did the work, we have 18 previous licensing director operators. We've held licenses at a wide variety of plants covering three different vendors. So, you can see the list up there on the board. In total, we have 569 years of nuclear experience and 16 former Navy nuclear veterans.

So, our background I believe is a little unique compared to the typical vendor. We have a lot of operations background, and operations was brought in very early to the NuScale design, recognizing the unique challenges that were going to be placed by the fact that we believe we needed fewer operators to operate these plants.

A little on logistics. So, "Conduct of Operations," Chapter 13, is primarily a collection of combined operating license holder actions to describe the structure of the organizations and programs that support plant operations. It also gets into qualifications and training of the individuals in the organizations.

So, as Dr. Bley mentioned, this presentation is in two parts. There will be a non-proprietary portion first, which will be actually relatively short, and then, we have a proprietary version, which really goes deeper into the details of the Generic Technical Guidelines.

And the Security and Fitness for Duty Programs will not be covered as part of this. Although they are a part of Chapter 13, we are not covering them in this presentation.

All right. So, organizational structure. Section 13.1 included "See all actions to describe the corporate or home office management and technical support organizations, onsite operations organizations," and then, the qualifications for each management -- all the positions that are listed there.

13.2 lists all the training programs. So, this includes the initial and continuing License

Training Program for the Reactor Operators and Senior Reactor Operators. And then, there's a list of programs that are required for initial and periodic retraining in qualifications. This is the list from 10 CFR 51.20, the list of training programs that are required.

Section 13.3 covers the emergency plan. It does include some description that comes out of the standard plant design. And that really is regarding the Technical Support Center. So, it provides descriptions for the ventilation systems for the Technical Support Center, communication systems, the TSC workstations, the emergency response data systems. And then, there are three COL actions contained in there to develop the Operation Support Center, the emergency offsite facility, and the overall emergency plan.

MEMBER CORRADINI: I had a question, but I'm not sure if -- are you done with 13.3 now --

MR. BOWMAN: Yes.

MEMBER CORRADINI: -- and you're about to go to 4?

MR. BOWMAN: I'm going to move on.

MEMBER CORRADINI: Okay. So, you have a plethora of acronyms. Explain to me what an "ISV" is,

and when is it done? Because that connects to the open item in this section.

MR. BOWMAN: Correct. So, Integrated System Validation is the final test of the Human Factors Engineering Program. Integrated System Validation is a test of the procedures, the human-system interface, and the operators, to ensure that they can safely operate the plant under the conditions we've set. So, that is an open item because we completed testing in September of this year, and we are currently working through completing the report of that testing effort.

MEMBER CORRADINI: Oh, so on your simulator, or what I remember to be the thing, it has already been done? You just have yet to document it and show it to the staff?

MR. BOWMAN: That's correct. We've completed all the testing required for ISV.

MEMBER CORRADINI: Okay. Okay. Somehow that escaped me.

MR. BOWMAN: Okay.

CO-CHAIR BLEY: Well, it's not in what we read.

(Laughter.)

MR. BOWMAN: It isn't. It is an open

item.

MEMBER CORRADINI: Okay. You helped me. Thank you.

CO-CHAIR BLEY: So, this -- and we'll ask the staff about this -- if this is complete, when you respond finally to the staff, that hits an awful lot of the open items that are in the SER.

MR. BOWMAN: That's correct.

CO-CHAIR BLEY: Maybe 80 percent of them. I'm just guessing off the top.

MR. BOWMAN: And I actually have a slide at the end that I'll go through and --

CO-CHAIR BLEY: Oh, okay.

MR. BOWMAN: -- delineate each open item, how we believe it's going to be closed.

CO-CHAIR BLEY: We had a question from one of the members who's not actually here and a couple from other members. They pointed to this section. So, I think that's a place to bring it up.

Here it speaks of the fact that the number of modules is up to 12. The question was, is this the place that's actually set or is it set somewhere in other parts of the DCD?

MR. TOVAR: The --

CO-CHAIR BLEY: Yes, go ahead.

MR. TOVAR: To answer your question, the design certification application is written around 12 modules. And our staffing was geared towards operating up to 12 modules.

CO-CHAIR BLEY: And if you operate less than 12 modules, if somebody puts in less than 12, two questions came up. One is -- well, three questions maybe -- one is, do you operate the way you planned to operate with 12 with a fewer number, if there's only one or two or three? The same staffing? Or would that be a COL thing that somebody might want to change?

MR. TOVAR: For the licensed operator staffing --

CO-CHAIR BLEY: Yes.

MR. TOVAR: -- what we have written is up to 12 operating --

CO-CHAIR BLEY: So, 1 to 12 --

MR. TOVAR: Correct.

CO-CHAIR BLEY: -- it applies?

MR. TOVAR: If there's any operating units, then, currently, we have the requirement for six licensed operators.

CO-CHAIR BLEY: Another question that came up was, if a utility decides to build one of these

with less than 12 modules -- say they're going to do three at first -- are all of the common systems going to be installed at that time? Or could there be something less than what we see for the supporting systems?

MR. TOVAR: I would say that we don't have any official like written documentation for this, but the reactor building and all the common systems associated with that would have to be built and, essentially, installed. The option to only build --

CO-CHAIR BLEY: As described, all of them?

MR. TOVAR: As described. There may be some components that may be installed at a later date, but, essentially, all the piping and everything that goes through the walls, all that would have to be really laid out.

The option, if we only had six or less modules to only build one of the turbine buildings, and then, build the second turbine building at a later date, would be a possibility. But, again, this is --

CO-CHAIR BLEY: Is that something that would require an amendment to the -- well, I forget how you describe it -- that would come up during the COL, and it would be an exception to the design cert?

MR. TOVAR: I think that there would have

to be a bit of engineering work if there was plans to build like a two-unit, four-unit, six-unit NuScale plant. Because there would be some impacts, if nothing else, from the seismic aspect of it. If you only built one building, it may have some impact.

But, again, I'm getting out of my area of expertise, and we don't have anything written down as far as this goes. The design certification application is for 12 units, and the understanding is that, to make it cost-effective, the customer is going to install over a period of time the 12 units.

CO-CHAIR BLEY: The 12 units? Well, we'll take this to the staff, too, because it seems to me, if you did something less, it would mean an exception to the design cert, a change to the rule at the COL stage. So, we'll see what they have to say about that.

And the other question I remember people passing around was: suppose you built three, and then, you're going to add another three. Nobody was able to find anything that described, if you're doing, essentially, construction work while you're operating three units, three modules, what kind of controls need to be in place to allow that construction work to go ahead? And we didn't see anything written about that,

or at least I didn't.

MR. TOVAR: Correct. We have COL action items that describe generating the procedures that would control those activities. So, we don't currently have any of those procedural guidance, any of that procedural guidance --

MEMBER CORRADINI: So, that falls to the owner/operator of the plant --

MR. TOVAR: Correct.

MEMBER CORRADINI: -- to define how they would modify or even stop operation, commercial operation of a plant as certain construction operations are taking place? They would have to develop the procedures to decide what turns on and what turns off, et cetera?

MR. TOVAR: Correct. In our construction plans, it's always been envisioned that we would have the facility built. We'd install a module, and while modules were being installed, subsequently, that we could start up and operate the modules that were ready to be operated. So that we could, basically, be commercially generating power and a revenue stream as the rest of the plant was built out.

CO-CHAIR BLEY: So, as you see it, this is an item for the COL to deal with?

MR. TOVAR: Yes, as far as the specific procedures --

CO-CHAIR BLEY: Because construction work could be threat to the operating.

MR. TOVAR: Correct, but --

CO-CHAIR BLEY: And it's dependent on how it's done.

MR. TOVAR: If you look at the actual what it takes to install a module, it's very similar, essentially, to a refueling actually.

CO-CHAIR BLEY: A refueling, yes.

MR. TOVAR: And you're limited to moving one module at a time, just due to the equipment to assemble those modules. So, it really is no different from the refueling activities that would take place. And you could have up to 11 modules operating when you're moving the module to do the refueling activities.

MEMBER SKILLMAN: I have a bunch of questions, but every question I have is from documentation that is marked confidential. So, I'm going to wait until the end for that confidential period. But let me ask one or two questions.

A hundred and sixty megawatt reactor, small by comparison. NuCore's are up to 4,000

megawatts. You were at Cook and Byron. Byron is a big plant, real big. And you were at Palisades, medium size. And you were at Brunswick.

MR. TOVAR: No, I was at Robinson.

MEMBER SKILLMAN: Robinson.

MR. TOVAR: Yes.

MEMBER SKILLMAN: Medium big.

MR. TOVAR: Right. I also spent time as a Fleet Outage Manager at Perry, Davis-Besse, and Beaver Valley.

MEMBER SKILLMAN: Well, big, middle, and small.

(Laughter.)

I was on the Oversight Board for FENOC for a long time.

But here's where I'm going with my question. Please stick with me. A hundred and sixty megawatt reactor. Between the three of you, you've got some significant PWR experience with big machines. What is it in the FENOC -- excuse me -- in the NuScale training that is going to make sure that the one reactor operator that might be looking at 12 plants on the indications that Dr. Bley was talking about isn't complacent in thinking he or she is looking at process heating units versus a live core reactor that has real

consequences for an accident?

I ask this question based on the No. 1 lesson we learned out at TMI-2, and that's respect for the technology. I think we're so comfortable with no scrams. We operate 24-month fuel cycles. We go almost breaker to breaker. We have crews on watch right now that have never experienced a trip. So, it's easy to get lulled into believing an accident can't happen, a trip won't happen, and when it does happen, all the automatic systems are going to take over.

Here is a man or a woman looking at one, two, three, six, maybe 11 units, with a module being moved. What makes sure that individual really understands that this is not just a little process heating unit, 160 megawatts, but this is a live core plant that can have a loss-of-coolant accident, even though it's very, very improbable and you only have these two high-impact human factors items? What keeps them focused?

MR. TOVAR: A couple of things. One is, I think one of the things that we did bring to NuScale is the operating experience. Now the 18 licensed operators, previously licensed operators, that we saw is just the people that are currently on staff and

currently within the operations group. That doesn't take into account Dale Atkinson, who was the Chief Nuclear Officer up at Energy Northwest. It doesn't take into account other folks that are scattered throughout the organization with their operating experience. And it doesn't take into account the people that have cycled through our organization that have had tons of operating experience and input into this.

So, one of the things that we're very proud of is that operating experience, that we have baked in a lot of the human factors into the human-system interface that helps as far as reducing human errors and, basically, ensures that the operator is less likely to make mistakes.

So, we do those things, but in Chapter 13 it's training. Now there is a COL action item to develop that. I certainly would expect that we carry on the current culture in the nuclear industry in training our operators to understand that nuclear is special. Reactivity, radiation, residual heat, and that they fully understand and internalize that, the special nature of that.

I think the operating experience that we have with Fukushima, with TMI, with Chernobyl, and the

realization that an event like Fukushima can happen and whole countries can shut down their entire nuclear industry, essentially. You know, Germany is an amazing example of that, where they have taken and said that they're going to shut down all their nuclear power plants. It's incredible.

So, we have the use of OE that we have also incorporated into our design and we'll incorporate into our training, to make sure that folks understand those important aspects of nuclear power.

Then, of course, we have the regulator that essentially enforces that, to make sure that we have programs that do incorporate operating experience and the training programs are accredited, and we have the operators who are licensed and have to go through that process. So, there's a lot of checks and balances to make sure that, as NuScale grows up and actually starts to operate, that we do incorporate the respect for nuclear and make sure that we don't become complacent.

The fact that we have six licensed operators and the oversight from a shift technical advisor, the concurrence advisor, shift manager, all in the control room watching these folks as they control the reactors also is very similar to a current

control room. And I'm sure we'll carry on that "nuclear is special and deserves respect" mentality.

MEMBER SKILLMAN: I appreciate the explanation. Let me kind of hang onto this topic and pull one more string. And I don't think this is proprietary. If it is, then I'll wait for later.

It appears as though the whole conduct of operations is designed around three critical safety functions: reactivity, decay heat removal, protection of the containment, those three. Is there room for any others? If I look at your PRA, if I look at your Chapter 15, if I look at your Chapter 18 and your Chapter 13, my view is there's something missing.

And here's what I think it is: if you have knowledge of Millstone, what got Millstone into trouble was that they were moving fuel before 96 hours. Remember that? They had not allowed that fuel to decay.

I know of no other facility where you can have a live reactor and you can be moving 36 assemblies 25 or 30 feet away from that live reactor. And you do that with a 734-ton module. You can be actually emplacing a new one that's fresh or removing one that is decaying to your maintenance stand.

Doesn't that create a different type of

safety function independent of your Chapter 19 that says it can't happen? Isn't that a different, a fundamentally different environment?

Think about it. You're on watch at Byron. When you move fuel, the head's off or the head's on. The fuel is in the pool. And you're back to Ops. That fuel is being handled by someone else. It's not your operators. Or, if it is, they're not on shift for the reactor. They are working with maintenance or they're working with other crews.

Here you're actually moving a module adjacent to one, two, five live modules. Is there another critical safety function beyond reactivity, decay heat removal, and containment that deserves a different level of attention and perhaps a different piece of staffing?

MR. TOVAR: I believe I understand your question. I think the answer is, no, that there's not another critical safety function. I think it's an important aspect of our design that needs to be understood and controlled. I think that any technology has risks associated with it. When you are refueling a reactor and lifting the head over that vessel, there's inherent risks that go with that.

MEMBER SKILLMAN: But you're not lifting

over a vessel here. You've got four or five or six or 11 living, breathing, 160-megawatt plants, cores, and you're moving a 734-ton machine 25-30 feet away. And the protection for that is your crane, your super single-failure-proof crane.

MR. TOVAR: Well, we have training, qualifications, and our NAV1 crane.

MEMBER SKILLMAN: And I'll bet if one of you had been at ANO-1, you might be thinking twice about the answer to my question. I think the crane issue and module handling may have a requirement for a CSF, in addition to the three upon which you have your staffing. Let me ask you to consider that before you reject it.

MR. TOVAR: I struggle to differentiate too much between a current operating plant and the actions that they take when refueling and lifting a heavy load over the core, and certainly we've had --

MEMBER SKILLMAN: Is that core at power?

MR. TOVAR: No, sir.

MEMBER SKILLMAN: I didn't think so.

MR. FLAMAND: I think it's a great question and it's very thought-provoking. One thing I would say is, to put it in perspective as well, those three safety functions -- and maybe this doesn't

apply to the question -- do apply to each of the individual operating units. So, it's not that there's three safety functions as a site. So, if something were to happen and that crane affected one of the other units, those have independent three safety functions. So, if it affected containment or if it affected reactivity, that would be shown for that unit's safety function.

The other piece I guess I'd like to just bring up is, because we've had discussions on how to generate three -- again, that's different from other designs. Some aspects of what would be traditional safety functions have been incorporated.

So, for instance, what came to mind when you were talking about refueling is water level and how much water is there while I'm doing this refueling activity, so that I have shielding for the folks above, and all that. There's tech specs for that ultimate heat sink level. And the ultimate heat sink is incorporated into the core heat removal safety function.

So, sometimes our simplification of three safety functions -- and I don't know how much you've had a chance to look at it, but it might include things that might traditionally be -- like at my

plant, it would have been an ultimate heat sink kind of safety function on its own, where that's part of heat removal for us. I don't know if that helps.

MEMBER SKILLMAN: No, I agree with you. The CSFs are applied to each core. I got that. I'm kind of saying, what happens when your crane doesn't perform the way it should and you end up with a dropped module that might affect two or three operating modules? That's where I'm really going with this.

Let me stop here because all my homework is really kind of peeling back on this one issue, not to give you the raspberries, but just to raise this one issue. The NuScale design is unique in the whole world because you're moving a 734-ton machine near operating cores contemporaneously. And I don't think there's anything fundamentally wrong with that, but I believe that that develops perhaps some scenarios that have not been addressed in staffing, have not been addressed in Chapter 18.

So, I'm raising it here on Chapter 13 because you might say, as head of Ops, you know what, we might peel out special teams to do those movements, and we might consider the single-failure-proof crane from a different perspective. It might have some

safety functions that the NUREGs really might not have explored for operating plants.

I can tell you for a fact the TMI-2 cleanup was stopped for three months because we couldn't get the crane qualified. I can tell you for a fact that TMI-1 refueling was halted because the brakes didn't set on the puller crane and it was inching down one inch at a time, and we didn't have a safe place to put that head, 160 tons.

So, I've been through a number of these events at Three Mile and in the consulting that I did for 10 years at other plants. It's almost as if the crane issues are kind of aux operators take care of that; contractors take care of that.

But, in the NuScale design, the crane is front and center of the operating units. And I believe that's different, and it might require a thicker magnifying glass as you put together your staffing plan and as you look at Chapter 18.

MR. TOVAR: One thing I will mention is that NuScale does envision having a dedicated refueling team assigned to it with a licensed operator on that team.

MR. BOWMAN: That was going to be my mention, too. We right now in our staffing plan

envision a Senior Reactor Operator, either fully licensed or a limited fuel handling license, in charge of any module movement. So, indeed, Operations will be, at a minimum, supervising that activity.

In the current fleet, if they did an activity like that -- and I don't believe this would change for us -- you would put together a team to do that activity. They would be briefed. They would be high-level to management oversight to ensure that that activity went properly and that appropriate contingency actions were put in place.

But it is a normal activity to happen. But all those pieces have to be in place for that to go on. So, there's a great deal of oversight that I would anticipate in place for any module movement that went on at a NuScale plant.

MEMBER SKILLMAN: But let me make my final point. And that is, what's different here is you're moving adjacent to live cores at power. When we did it, the reactor was shut down. We would be on decay heat for two weeks. We had all of the protections and all of the admin that you just mentioned, Doug. So, I fully understand that.

What I'm saying is, in this design, there is a unique feature that may need a different level of

attention. It isn't going to be normal ops when you've got 11 machines that are at power and you're dragging this 734-ton machine 25 feet away from all 11 of them.

So, let's pick it up in the proprietary session when I can refer to the documents. But I really challenge you on that.

Thank you.

MR. TOVAR: Thank you.

MEMBER MARCH-LEUBA: Don't go so fast.

Mr. Chairman, I noticed he has some questions for the closed session. I have some questions for the closed session. And I noticed that we have half an hour scheduled for the whole thing. So, we may want to be flexible.

CO-CHAIR BLEY: We have to control things a bit. So, let's see what happens.

MEMBER MARCH-LEUBA: Well, I mean, I think the closed session would probably be more important than the open session.

CO-CHAIR BLEY: Thank you.

MEMBER MARCH-LEUBA: But, that said, I have an open session question, too.

CO-CHAIR BLEY: He's only got like two more slides for the open session.

Go ahead.

MEMBER MARCH-LEUBA: So, don't get me wrong, I'm a computer guy. I love computer procedures. Data cycles is something I admire. I mean, once I was in a 767 flight simulator in the lounge in the Rome Airport, and they let you go and play with it. And they let me land the 767 on the Venice Airport, and I accomplished it. All you have to do is push one button and extend the flaps. That's all you have to do to land a 767. And I messed up 50 percent of the thing; I pulled the flaps too fast.

(Laughter.)

But, with that said, in your training, the problem I'm having is these computer procedures are great, but we claim, I think, to minus 25 failure probability, which is really currently low. And when you claim those low probabilities, you have to worry about -- and I'm going to raise Charlie's blood pressure right here -- you're letting the computer run your facility. They exercise a computer that knows all the signals, knows all the procedures, and tells you what to do.

In the training, who gets precedent, the computer or the pilot or the operator and the paper procedures? If the operator with the paper procedures

sees, hey, the computer is telling me something is wrong, and I don't believe you, when you're training who takes precedent?

MR. BOWMAN: So, I can try to answer part of that. In the Generic Technical Guidelines, we have, obviously, the -- I'm going to be careful here not to pass into the proprietary realm -- the HSI evaluates the critical safety functions we've discussed and determines if one is being challenged, and provides the operator with that information. And then, he has to go take action.

Also, he's basing all that information off of our best qualified instrumentation; the computer is. And then, right now, right now the role of the STA is the STA backs that up. So, it provides an independent, the STA provides an independent check of the human-system interface to ensure that the correct decision is being made within the EOPs.

So, he is independently looking at his best indications in a different manner than how the HSI is looking at them to back it up. And that's one example I can give you where we have the human built in to back up the computer in this case.

MEMBER MARCH-LEUBA: But is that part of the training?

MR. BOWMAN: Yes.

MEMBER MARCH-LEUBA: Do you emphasize, "Don't believe the computer; rely on it, but don't believe it."?

MR. BOWMAN: Correct. So, any training program I've been involved with, you have to believe your indications, unless you can be shown that they are wrong. But you have to question your indications all the time to ensure they're working properly.

MEMBER MARCH-LEUBA: It's different to read a needle with what the pressure is and having a complex computer algorithm --

MR. BOWMAN: Right.

MEMBER MARCH-LEUBA: -- running on God knows what platform, that can be on a blue screen of death anytime. If you claim only 10 to the minus 3 probability of failure, I'll give you that, but when you claim 10 to the minus 25, nothing has that probability of failure.

And while you're thinking, let me give you an example of that Air France flight that was going over there in the Atlantic. And they were going at 40,000 feet and 600 miles per hour. And the computer decided that they were stalling. And the computer and the pilot, they started fighting with each other, and

at the end the plane ended up on the bottom of the Atlantic.

MR. BOWMAN: So, I'll go back. I'll try to do a better explanation. What the STA is looking at is, physically, not a computer per se; it is part of our fuel programmable gate array system, part of our safety system. He's looking at those indications that are the best qualification that he can see in the control room. The computer algorithm is taking that information separately and doing an assessment.

MEMBER MARCH-LEUBA: But the problem I'm having --

MR. BOWMAN: But that's the safety, that's the safety aspect of it.

MEMBER MARCH-LEUBA: For the last 15 years, I've been an operator in this plant, and the computer has always been right. And suddenly, the computer gets a wrong indication because a mouse chews through a cable, or something.

MR. BOWMAN: Sure.

MEMBER MARCH-LEUBA: That's going to be part of the training. Say, "Rely on the computer, but always verify." And I get the idea that maybe we have too much overreliance on the computer.

MR. TOVAR: I'll say that Chapter 13 has

COL action items for the development of the training program. But, because we completed the Integrated System Validation, we had the opportunity to develop quite extensive training for the Integrated System Validation operators. We hired 22 contract operators and put them through a training class that was, roughly, seven months long -- five and a half months long. Trained them on the NuScale design. They had, most of them, all except for two had no background in the NuScale design. So, we trained those folks.

And one of the things that the NRC staff expressed during our pre-application engagements was exactly that, a concern over failure of the I&C system, and so forth. So, during that training, we did train them on failures of the I&C system. And we understand the importance of the operators to be able to function and keep the core safe, even in the worse-case I&C failures. And in some cases, we took, essentially, the entire control room and took that out.

To me, it's very confusing, as an operator, to have those displays up and displaying, but you know that the system has failed. And what it's showing you is a frozen screen from 10 minutes ago. So, to me, that's very disorienting, as an

operator.

But the crews that we put through that, the training and the actual testing performed those actions well.

CO-CHAIR BLEY: Let me follow that up just a second. I'll get right back to you.

If you fail the whole computer system all at once and it goes black, that's really not the worst thing.

MR. TOVAR: Yes.

CO-CHAIR BLEY: The worst thing is when you get something in between. Some things are right; some things are wrong.

MR. TOVAR: Sure.

CO-CHAIR BLEY: Did you do any of that kind of testing?

MR. FLAMAND: So, we did do -- and I don't know if we're going to talk about this in one of the slides -- but you might back up a little bit. The control room has multiple different computer systems. That's the first time I've heard the low probability number and it's pretty good. But it's probably because each unit has what's called module control, a non-safety computer system with redundant components within it and redundant servers. So, there is

failover and redundancy there.

To get to your question, during this ISV testing and previous staffing testing, we did do where we took a workstation down or we took one of the servers down to see what would happen. The effect and how we showed it wasn't much because it goes over to the failover. And then, we also showed, if you take everything down, and that, basically, as you kind of alluded to, isn't as hard.

We also showed -- and I think this was just probably from not the official OE, but just operator daily OE. I'm used to, hey, this valve didn't move because it's been in the same position for the last year, and now it gets a demand signal. So, we tried to show those kinds of failures. So, hey, if an automation expects a valve to respond when it didn't, you know, there's ways of timing, or whatnot, that the automation can help the operator.

And then, if you're out of bounds, again, these computer-based procedures are non-safety, and the safety systems are separate and --

MEMBER MARCH-LEUBA: The problem I'm having is that software has ways of taking you and failing in the most unusual ways. Really, with software, my car-driving software, I mean, it's great.

But --

MR. BOWMAN: But, you know, highlights of the system that the STA is verifying is not software-based. It does not use software. The system that the STA is using to verify the indications is not software-based. It is programmable gate arrays. So, they do not run software. They're really running a logic network. It's a very different technology than a software-based computer.

MEMBER MARCH-LEUBA: If PGAs are software, they cannot even modify this thing.

MR. BOWMAN: Right, but they're burnt in and they can't be subject to code. They can't be modified once they've been tested and verified.

MEMBER MARCH-LEUBA: Yes, but there is a combination of variables that makes the logic give you the wrong answer.

MR. BOWMAN: Right. But, again, I can't overstate the fact that the STA is independently assessing those variables and looking at them in an entirely different way than the software is.

MEMBER MARCH-LEUBA: And to the 10 to the minus 3, I'll give you that anytime. We don't even have to justify it. But 10 to the minus 25, no.

MEMBER BALLINGER: I would suggest that

somebody on your staff get a hold of a book called The Glass Cage.

CO-CHAIR BLEY: Either way, just for the Committee members, Jose was right; this meeting might go to 8:00 or 9:00 tonight.

(Laughter.)

At least, let's not be repetitive, if we can help it.

MEMBER MARCH-LEUBA: We haven't started the tricky questions.

MR. BOWMAN: Ready to go on? Okay.

All right. So, Section 13.4 establishes the operational programs necessary to safely support the plant. There's a long list of those programs that have been built in the current fleet, and this is our COL action item to have the COL build those programs, a large range of things from pre-in-service testing down to the road to fire protection, security, and et cetera. So, that list is in front of you.

And then, plant procedures and --

CO-CHAIR BLEY: Can I interrupt you as you begin?

MR. BOWMAN: Sure.

CO-CHAIR BLEY: This one really bothers me. As you've said, you've now got 18 formally-

licensed operators. You've spent a lot of time with trying to come up with a display that would really allow the operators to follow the 12 reactors well. You did a lot of training. You've experimented with procedures. You've tried different kinds of manning things. And finally come up with something you think is pretty good.

And then, instead of getting a set of operating procedures that match exactly what you've been doing, you put this on the COL applicant who's never seen a plant like this before. That bothers me. I don't know why the EOPs should be a COL action item. Have you got EOPs you're going to give them?

MR. BOWMAN: Yes.

CO-CHAIR BLEY: And they might modify them?

MR. BOWMAN: Well, we have Generic Technical Guidelines, just like the existing industry uses, you know, Westinghouse, ERG, or GERG. So, we have the basis for the procedures, and we'll provide them a writer's guide on how they'll be developed.

CO-CHAIR BLEY: You don't actually have procedures your operators have been using?

MR. BOWMAN: Yes, and I will get into that --

CO-CHAIR BLEY: Yes, you don't, or, yes, you do?

MR. BOWMAN: Yes, we do. Yes, absolutely --

CO-CHAIR BLEY: Okay. I'll wait for closed session. That's good.

MR. BOWMAN: Yes, I would say that's a good closed session question. We answer some of that in the closed session.

CO-CHAIR BLEY: Okay. Because I didn't find much help in most of what I read.

Go ahead.

MR. BOWMAN: Okay. So, there we go. Okay.

So, part of Section 13.5 includes the COL action item to ensure plant-specific emergency operating procedures are developed. And the staff, during the review of that, requested that we provide them a set of Generic Technical Guidelines as part of the DCA.

So, our goals for development of these were that we provide an entirely symptom-based set of procedures, unlike some of the current industry which uses a mix of event-based and symptom-based procedures. We wanted the status to be easily

assessed by the operator. Given the number of units they had to look at, we needed a quick assessment capability. And we wanted the OPs to be fully integrated in the human-system interface. And I will show you that in the closed session. I think we do that in the closed session.

And also, we wanted a single set of procedures that would address all post-accident actions. So, our Generic Technical Guidelines that we've developed cover the legacy emergency operating procedures, severe accident management guidelines, LOLA or loss of large area, extended loss of AC power, and extensive damage mitigation guidelines in the current procedure set, which are typically broken out in separate procedure sets that the operator has to transition between based on conditions.

So, how did we start work on the development of the Generic Technical Guidelines? There are several pieces to this. One of them was the critical safety functions that Mr. Skillman alluded to. Another piece of it was, we had to go and find all the actions that we had committed to in the DCA.

Now we present this as though we went and looked for them. In all honesty, we were integrated into the development of these actions the entire time

they were being worked on as part of the DCA.

So, PRA, if they were proposing an action, they would come and talk to us about what they thought we should do, and we would provide a discussion and some guidance on how to build that.

Anyway, so the places we went and looked are Chapter 7, which Chapter 7 is the I&C failure section where the defense-in-depth analysis is contained. And there are no credited actions there.

FSAR Chapter 15, which is the plant design basis for the design-basis events, and there are no actions in there.

Chapter 18, human factors engineering task analysis and associated reference. One of the things that people probably don't highlight enough is Chapter 18 actually asks our subject matter experts to develop actions to see if they believe there are actions that need to be taken. So, we used our SMEs as well. However, there are no credited actions there. We did develop actions there.

CO-CHAIR BLEY: I'm sorry, I was saving this until later. Between Chapter 13 and Chapter 18, and maybe more in the SERs, if it weren't for the I&C guys, I would say these reports were the most cluttered with acronyms I've ever tried to find.

(Laughter.)

So, what was that last acronym you said? S-E --

MR. BOWMAN: Subject matter experts, SMEs.

So, in our case, our subject matter experts were the people I alluded to at the beginning of the presentation, the 18 operators, former licensed operators we had which developed our Chapter 18 task analysis, which you can say task analysis and procedures in the same breath for us. They're one and the same to us.

So, FSAR Chapter 19, which is the PRA actions, those actions assumed in beyond-design-basis events. In that case, there are seven actions there.

And then, Chapter 20, which are the -- again, it is called beyond design basis, but Chapter 19 is the PRA evaluation; Chapter 20 is the chapter where we have taken those -- for example, ELAP, extended loss of AC power, and extensive damage mitigation guideline actions are in there. So, there's two actions in there.

Chapter 21 is the multi-unit design considerations, and there are none. And then, system requirements and limitations, as defined in the system description documents, which is our own engineering

documents. We also found --

MEMBER SKILLMAN: Let me just offer an insight here. And neither of these two citations that I will make are proprietary.

From your Chapter 19, it is 19.1.6.2 on page 19.1-102. "Key insights. Key insights from LPSD, low power shutdown events. Module drop accidents are the dominant contributors to core damage."

Then, you write, "The calculated probability of such events is low, and a large release does not occur from a dropped module, even if the containment is damaged due to radionuclide scrubbing by the pool." That's dandy as long as your pool hasn't been damaged by the module drop.

The second citation from your Chapter 15, and this is what really got me going on this question. "NuScale Power Module Drop Accident is 15.7.6 in your Chapter 15. "The use of this single-failure-proof crane precludes the need to perform low drop evaluations. As a result, no design basis accident analysis has been performed to assess the radiological consequences of a nuclear power module drop accident."

So, at least as I see it, your critical safety functions screen out this whole topic because

of the dependence on that single-failure-proof crane, or the reliability, your assumed reliability of that crane, and the assumption that you'll get enough scrubbing that, even if you drop the module, it's not a problem.

But the real issue for me is not just a dropped module; it's the consequence. If that crane fails or if the reeving fails or the brakes fail, you can have a module, 734 tons, bump into one, two, or three other modules. And it seems to me that that raises the bar. I think that's a different deal, and I think we ought to be talking about it. I think your own documentation, if you weave it together a little differently than the way you have woven it together, you might come to that same conclusion.

So, let me stop there until we get to the proprietary session.

MR. BOWMAN: Right. So, that's a great segue because the next thing we're going to do is -- my presentation for the open part is done. And we give a list of acronyms as our last slide.

CO-CHAIR BLEY: Okay. We don't have your slides for the closed session yet. How many slides are there and how long were you expecting it to take?

MEMBER MARCH-LEUBA: It's only five

slides. Only five or six slides, right?

MR. BOWMAN: Yes. I don't think there's even 25 in the closed session.

So, the closed session is not on this computer right now?

MEMBER CORRADINI: We're going to have to make sure.

MR. BOWMAN: Okay. Really, the discussion will go into more detail about the Generic Technical Guidelines, is what the closed session discussion is about.

CO-CHAIR BLEY: Maybe that will help us later.

Mike, let's set up for the closed session. We're going to go well beyond where we thought we would in time.

MR. SNODDERLY: Okay. I think that's a good idea.

CO-CHAIR BLEY: And maybe you can talk with the staff and the NuScale folks --

MR. SNODDERLY: Yes.

CO-CHAIR BLEY: -- in between about us hanging around later tonight.

MR. SNODDERLY: Yes. Okay. So, what I'd like to do is to ask Prosanta and Steven Pope to look

around the room, and if you identify anyone that doesn't have a need to know -- all members of the public or anyone from the staff that doesn't have a need to know, I need you to leave the room.

MEMBER MARCH-LEUBA: Are we on the record still? You should close the open session.

(Whereupon, at 11:46 a.m., the foregoing matter recessed from open session and went into closed session until 1:15 p.m.)

CO-CHAIR BLEY: The meeting will come back to order and at this time we'll hear from the staff about Chapter 13.

Prosanta, are you going to start?

MR. CHOWDHURY: Yes. Good afternoon. My name is Prosanta Chowdhury. I'm the project manager for Chapter 13 of the NuScale design certification application review by the staff, by the NRC staff. And with me I have Amanda Marshall for Nuclear Security and Incident Response Office, and also Maurin Scheetz from Nuclear Reactor Regulation Office.

As for my credentials I have been a project manager at NRO since 2008 and I have gone through several projects including an site permit in 2015. I have also been as a PM involved in the review of EPR design certification application in the past.

So as part of my background I have a nuclear engineering master's degree and also a master's degree in electrical engineering. I have in the past worked for the Louisiana State government for 18 years as a radiation protection specialist. I have joined the NRC in 2005.

And Amanda and Maurin will talk about their credentials.

MS. MARSHALL: Yes, good afternoon. My name is Amanda Marshall. As Prosanta said, I work in the Office of Nuclear Security and Incident Response as an emergency preparedness specialist. I reviewed Section 13.3 of the NuScale design certification application. I've been with the NRC for 13 years working in emergency planning for the past 5 or years. And prior to that I was on the security side of NSIR focused on law enforcement response to nuclear power plants.

MS. SCHEETZ: All right. Good afternoon. My name is Maurin Scheetz. I have been with the NRC for the past five years predominantly in operator licensing as an examiner, and I've also done some time in the Office of New Reactors as part of this review. We've since merged back with the Office of Nuclear Reactor Regulation. So five years with the NRC

predominantly in operator licensing.

Before my time at the NRC I did work in re-qualification training at the San Onofre Generating Station. And prior to that I was in the Nuclear Navy as an officer on an aircraft carrier.

So I -- as far as Chapter 13 goes, I looked at the organizational structure, the training and the procedure sections of Chapter 13. So I'm going to roll right into that.

MR. CHOWDHURY: Yes.

MS. SCHEETZ: So next --

MR. CHOWDHURY: One second. So the staff is going to present Chapter 13 to the members of the Committee. And also this is the agenda we have. The staff -- I already introduced the review team. The purpose and scope will be covered, review activities and timeline, focus areas, open items and conclusions.

So as far as project managers go, Greg Cranston is the lead project manager in LB1, Licensing Branch 1 in NRO.

So with that I think we're going to -- overview of Chapter 13 we have these sections that will be covered: 13.1, 13.2, 13.3, 13.4 and 13.5. You already heard 13.6, Security, and we are not presenting that. However, based on a comment from one

of the members is that the staff indeed reviewed 13.6. Staff indeed issued a request for additional information, received responses and disposition responses. Staff also had an audit conducted, a demi -- half-audit conducted back in December 2017.

So with that I'll turn it over to Maurin to cover 13.1 and 13.2.

MS. SCHEETZ: Thank you, Prosanta. Regulations require a COL applicant referencing a standard design to describe their corporate level management and technical support organization and the on-site operating organization. Therefore, we reviewed the application Section 13.1, Organizational Structure, for acceptable COL information items for the COL applicant to provide descriptions of the corporate-level management, technical support organization and on-site operating organization to include a description of the training and qualification requirements for personnel in these organizations.

The staff finds that the three COL items that -- provided in this section of the application addressed the applicable requirements for these descriptions of the COL's organizational structure. That's all I have for this section.

Next slide, please? The COL applicant is also responsible for describing the training programs and to provide a schedule for training plant staff. The staff reviewed the application section 13.2, Training, to verify COL information items exist for descriptions of the training programs for licensed operator initial and re-qualification training and non-licensed operator -- or correction, non-licensed plant staff initial training and periodic retraining.

The staff also verified COL information items include information about the qualifications for non-licensed staff enrolled in these training programs. For example, that would be non-licensed operators, STAs, instrument and control technicians, chemistry technicians, maintenance technicians and other engineering support staff.

The staff finds that the two COL information items provided by the applicant address the training program description requirements and therefore are acceptable.

CO-CHAIR BLEY: You didn't say STA, did you?

MS. SCHEETZ: I did say STA. So --

CO-CHAIR BLEY: They're licensed SROs.

MS. SCHEETZ: Correct. So in the NuScale

model they intend them to be licensed SROs. They don't -- regulations don't require for them to hold an SRO license, though most of the fleet -- or most of the operating plants do that.

CO-CHAIR BLEY: Yes.

MS. SCHEETZ: Yes.

MEMBER SKILLMAN: Maurin, what attention did you give to training of those who will handle the modules?

MS. SCHEETZ: Do you mean fuel handling? Is that what you mean?

MEMBER SKILLMAN: Well, I'm afraid if I say yes to that, it narrows the question I'm really asking.

(Laughter.)

MEMBER SKILLMAN: You know, a fuel assembly weighs as much as a Volkswagen. These are half-size. So they weigh as much as a Fiat. Okay? The modules are 732 tons. This is not a trivial load. Is there any specific attention given to handling those modules, training-wise?

MS. SCHEETZ: So I hear what you're saying. I understand the question. So for our review, because we looked at COL information items, because that's what's required at this stage for the

design certification application, we didn't look at the details of what the training program -- the content of the training program. That would be looked at when the COL application comes in, to look into the actual topics and how it's organized. Is that going to be a licensed operator training program requirement or is that going to fall into a different training program for anomalies and stuff on those.

MEMBER SKILLMAN: Fair enough. Thank you.

MEMBER MARCH-LEUBA: Since we're on the training, you heard us this morning talking about the training, about HSI, human system interface failures due to software or computer hardware. Did you consider any of those in your review?

MS. SCHEETZ: So your question is did we look at where HSI training would come into a training program?

MEMBER MARCH-LEUBA: Yes.

MS. SCHEETZ: Did we review that?

MEMBER MARCH-LEUBA: Assuming that software fails most of the time, maybe once every 100 years, but it does fail.

MS. SCHEETZ: So for this review again we looked at COL information items, so I would expect the NRC staff to review HSI degradations or malfunctions

and how operators in the control room and outside the control room are trained on that in the FSCOLCs.

MEMBER MARCH-LEUBA: And for the record I love HSI approach, I love computer-aided procedures. I -- in the example I gave this morning I love being able to land a 767 without any training. Okay? But the operator must have a healthy respect for failures and there is over-reliance. The computer is telling me there's been an issue. It will be okay. You should always look at the other two. And that's part of training and part of the philosophy of doing things. Thank you.

MS. SCHEETZ: I agree. I totally agree. And I could say that from an operator licensing standpoint in Part 55 we have requirements that would essentially require that kind of training for operator staff. So that's where I would -- from a regulator I would expect to see it in the Part 55 sections.

Any other questions?

(No audible response.)

MS. SCHEETZ: Okay. So now I'm going to pass it to Amanda Marshall.

MS. MARSHALL: Yes, good afternoon. For a design certification review Section 13.3 is intended to address those design features, facilities,

functions and equipment that are technically relevant to the design that are not site-specific and that affect some aspect of emergency planning or the capability of a licensee to cope with plant emergencies.

The applicant may choose the extent to which the application includes EP information to be reviewed as part of the design certification and there's no minimum amount of information that they must include.

NuScale chose to include in the DCA and the staff reviewed emergency planning design information related to a technical support center, emergency response data system, TSC engineering work stations, decontamination facilities, the process sampling system, specifically the post-accident sampling function of which there's an associated open item, and four COL information items related to the operation support center, an emergency operations facility, a comprehensive emergency plan and EP ITAAC, which is actually in Chapter 14.

MEMBER MARCH-LEUBA: So you addressed the emergency procedures, how the evacuation would be done, things like that, but did not address the emergency planning zone, the size of these zones.

MS. MARSHALL: That's correct.

MEMBER MARCH-LEUBA: That's correct?

MS. MARSHALL: That's outside the scope of this particular review.

MEMBER MARCH-LEUBA: Because we keep saying that we really to see the -- how the source terms are calculated.

MEMBER CORRADINI: The source term is going to be used for multiple things, but I think the staff's point is that the emergency planning zone is not part of the DCA.

MS. MARSHALL: That's correct.

MEMBER MARCH-LEUBA: It's not on any DCAs?

MEMBER CORRADINI: Not any DCA. Not just this one. Not any DCA.

MEMBER MARCH-LEUBA: But last -- in December we had some kind of talk about the LPZ, the low population zone. They said at a minimum it has to be the size of the exclusion ridge.

MEMBER CORRADINI: That's for accident -- I'm --

MEMBER MARCH-LEUBA: Okay.

MEMBER CORRADINI: -- not sure exactly what you're talking about, but --

MEMBER MARCH-LEUBA: You did not consider

EPZ as --

(Simultaneous speaking.)

MS. MARSHALL: Yes, that's correct, sir. You may be referring -- there's a few technical reports out as well as an SMR rulemaking, which are a little more focused on the EPZ size.

MEMBER MARCH-LEUBA: Now remind me again; I mean, in the Clinch River Breeder reactor site where we have licensed or have an approval --

MEMBER CORRADINI: That was the ESP that we looked at. That's unrelated to whatever technology is there.

MEMBER MARCH-LEUBA: Correct. The early site permit. But they do have some recommendations from NuScale about the size of their emergency planning zone, if I remember correctly.

MEMBER CORRADINI: Well, they used -- we're a little off topic, but just to be clear, they used four different potential SMRs that would fit, and then when they decided the size of their emergency planning -- when they made the recommendation for the acceptability of the emergency planning zone, they used an 800-megawatt thermal machine --

MEMBER MARCH-LEUBA: Yes.

MEMBER CORRADINI: -- and an associated

scale source term for 800 megawatts.

MEMBER MARCH-LEUBA: Okay. But my impression is that they were using some numbers directly from the NuScale report. That's what I thought they said.

MEMBER CORRADINI: I think not.

MEMBER MARCH-LEUBA: Okay.

MEMBER CORRADINI: I think they scaled everything to a canonical 800-megawatt thermal. Which is in the open session, so we can talk about that?

CO-CHAIR BLEY: Yes.

MEMBER CORRADINI: Okay.

MS. MARSHALL: Okay. NUREG-0800 identifies various emergency planning reviewer interface areas which support the review of Section 13.3 which are not the specific focus of this meeting nor of the staff's evaluation contained in SER Section 13.3.

Primary SER interface areas for EP include: SER Section 6.4, which provides information regarding the protection of main control room personnel during an emergency; SER Section 7.2.13.7, which provides information related to TSC data retrieval capabilities; SER Section 9.3.2, which provides information pertaining to the process

sampling system; SER Section 9.4.1, which provides the staff's determination of the acceptability of the HVAC system that supplies the main control room and the TSC; SER Section 9.5.2, which discusses voice and data communications equipment; SER Section 12.1.2.3, which provides the staff's determination of the acceptability of the on-site decontamination facilities proposed by the applicant; and finally SER Section 15.3, which contains information related to TSC radiological habitability. So as you can see, there's a lot of tentacles to other SER sections.

Next slide, please? This slide identifies that there is one open item associated with Section 13.3 EP review related to the post-accident sampling function of the process sampling system. And the DCA itself, DCA Part 2, Tier 2, Section 9.3.2 states that the function of the process sampling system, or PSS, is to provide the means to obtain representative liquid and gaseous samples from various primary and secondary process streams and components for monitoring and analyzing the chemical and radiochemical conditions. The PSS capability is used during normal plant operations and following accident conditions without the need for a dedicated post-accident sampling system.

As I mentioned earlier, the capability to obtain a post-accident sample is an interface item with Section 9.3.2. And in EP space Planning Standard B-9 of 10 CFR 50.47 requires adequate method systems and equipment for assessing and monitoring actual potential off-site consequences of a radiological emergency condition are in use. And the guidance in NUREG-0654, Evaluation Criteria, (I)(2) identifies a post-accident sampling capability as an acceptable means of meeting this requirement.

As you see on the slide the resolution of this open item is ongoing, and if the process sampling system is determined to be acceptable as a means for obtaining a post-accident sample in accordance with 10 CFR 50.34(f)(2)(D)(ii) and (B)(iii), then this open item will be resolved.

And that's all I have. Oh, excuse me. Except for my conclusion.

With the exception of that open item concerning the capability to obtain a post-accident sample, the staff concluded on the basis of its review that the EP design-related features included in the DCA that the applicant met the applicable regulatory requirements. When the process sampling system review is complete the NRC staff will update its conclusion

to reflect the disposition of this open item.

That's all I have. Thank you.

MR. CHOWDHURY: Section 13.4, Operational Programs. This is a COL item. The COL applicants are required by 10 CFR 52.79 to describe operational programs, but similar requirements do not exist for DCAs.

NuScale did provide COL Item 13.4-1 stating that a COL applicant that references the NuScale design certification will provide site-specific information including an implementation schedule, operation programs -- operational programs.

So the staff has reviewed this COL item and then compared with the Standard Review Plan Section 13.4, Draft Revision 4, September 2018, and find it to be acceptable.

MS. SCHEETZ: Section 13.5 is Plant Procedures. Plant procedures include administrative procedures, operating procedures, emergency operating procedures, as well as maintenance and other procedures for safety-related activities. COL applicants are required to develop these type of procedures that are plant-specific, thus the staff reviewed the COL information items in Application Section 13.5, Plant Procedures, for a COL to provide

procedure description and information about procedure program development and implementation.

CO-CHAIR BLEY: You actually review the procedures or just --

MS. SCHEETZ: Just --

CO-CHAIR BLEY: -- review the plan?

MS. SCHEETZ: We review that the application, the design certification application has COL information items that would then have a description of these --

(Simultaneous speaking.)

CO-CHAIR BLEY: When the COL comes up and they have their procedure, do you review the procedures or just ensure they have procedures?

MS. MARSHALL: The COL applicant review stage, descriptions of the procedures, and then I do think the SRP does into procedure review, especially for --

(Simultaneous speaking.)

CO-CHAIR BLEY: The reason I'm asking is --

MR. CHOWDHURY: Maybe for fuel loading. Maybe.

MS. SCHEETZ: Yes, as part of operational programs for fuel.

CO-CHAIR BLEY: I couldn't hear, Prosanta.

MS. SCHEETZ: I'm saying it may be right before fuel loading that the actual procedures would be looked at, but I'm not sure about that.

CO-CHAIR BLEY: Who would know?

MS. SCHEETZ: It's in our SRP. I thought you --

MR. CHOWDHURY: I don't have --

MS. SCHEETZ: We can get back to you on that.

CO-CHAIR BLEY: I'd like to know. And, I don't know, were you here all morning?

MS. SCHEETZ: I was here all morning.

CO-CHAIR BLEY: NuScale has prepared guidelines that are essentially the emergency procedures that are going to be used and I don't know why you're not looking at those now.

MS. SCHEETZ: So I am, and I'm going to get into that. That's --

CO-CHAIR BLEY: Where? Okay.

MS. SCHEETZ: In this section. So this section has essentially two parts because there are COL information items to actually provide descriptions of these procedures in the implementation program. And we did -- the DC applicant is required to provide

generic technical guidelines which are reviewed at this stage. And so that was part of my review in this section. So I'll get into that.

The seven COL information items provided we found to be acceptable because they addressed the requirements for procedures. And then additionally the staff reviewed the applicant's generic technical guidelines, or GTGs, and those are used by the COL applicant to develop plant-specific technical guidelines that then form the basis for plant-specific emergency operating procedures. The GTGs are the responsibility of the DC applicant and NuScale provided them as part of the application.

As a reminder, a lot of the detail in the 50 --

CO-CHAIR BLEY: I'm sorry. If you reviewed them, do they look like guidelines or do they look like actual procedures that you'll work from?

MS. SCHEETZ: They -- the GTGs themselves is a -- it's a large package of both. I would say you could use those as procedures right now, but they also have a lot of basis information and implementation strategy and other stuff. And they do contain a lot of proprietary information, so I think a lot of the discussion on the GTGs we might have to hold off for

the closed session. I just want to caution that.

CO-CHAIR BLEY: I understand that. So we might revisit this section in the Chapter 18 closed session, if I remember. Go ahead.

MS. SCHEETZ: Yes, I think we can definitely cover -- I'll be here for the closed session for Chapter 18.

CO-CHAIR BLEY: Okay. Good.

MS. SCHEETZ: So, but I'm --

MEMBER MARCH-LEUBA: This morning, I don't know if it was the open or the closed session, I don't remember, but we were shown some graphic diagram of decision making. There are five or six of those and the GTGs, which are basically the procedures, but they're not written as a procedure. It's a graphical procedure. Yes, a flow chart.

CO-CHAIR BLEY: Well, that was in the closed session.

MEMBER MARCH-LEUBA: Oh, was it?

MS. SCHEETZ: Yes.

MEMBER MARCH-LEUBA: Okay. So we didn't --

(Simultaneous speaking.)

CO-CHAIR BLEY: -- closed session.

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: -- that's in it?

CO-CHAIR BLEY: And as I understand it, those are part of the general guideline document you talked about --

MEMBER MARCH-LEUBA: That is correct.

CO-CHAIR BLEY: -- that's now on our SharePoint site.

MEMBER MARCH-LEUBA: That is correct.

CO-CHAIR BLEY: Members can access that.

MEMBER MARCH-LEUBA: And they're actually full PDF. You can blow up those charts and you actually read what it says, whereas the slide we saw this morning you cannot. It's a big chart.

CO-CHAIR BLEY: I'm sorry for the diversion. Go ahead.

MS. SCHEETZ: That's okay. I can speak about the staff's review of the GTGs. So the NuScale GTGs contain generic guidance for procedure writers to develop procedures that will be used by plant operators to ensure plant safety during an accident. The guidance covers the content for emergency operating procedures, severe accident management guidelines, and guidance for extended loss of AC power and loss or large-area events.

The staff evaluated the technical adequacy

of the NuScale GTGs to determine if they are acceptable for use in the development of a COL applicant's plant-specific technical guidelines. In our review the staff focused on three areas: We looked at the design-specific critical safety functions that the applicant identified and described, we looked at what methods the applicant used to identify operator actions, and the operator actions necessary to assess and maintain the critical safety functions including the basis for this information.

Also, as part of this review we looked at the use of type B post-accident monitoring variables in the GTGs. Type B post-accident monitoring variables are defined as variables that provide primary information to control room operators to assess critical safety functions during an accident. The applicant provided a list of the type B post-accident monitoring variables in the application. The staff found some differences between the type B post-accident monitoring variables in the application and those presented in the GTGs for operators to use for assessing the critical safety functions.

In response to requests for additional information about this item, about this inconsistency the applicant informed us that it planned to validate

the GTGs using the Human Factors Engineering Integrated System or ISV testing and validation methods and then make changes to the GTGs.

Therefore, there's one open item in this SER for the applicant to provide updated GTGs as necessary and to resolve the PAM -- post-accident monitoring variable inconsistencies and account for any necessary changes resulting from those validations.

MEMBER CORRADINI: So just to -- in short, when they submit their report for their ISV, whatever that is --

MS. SCHEETZ: Yes.

MEMBER CORRADINI: -- that's what you will review to make sure this open item is satisfied?

MS. MARSHALL: I would expect either if it comes in the Integrated System Validation Report or another way of NuScale informing the staff that they've completed the validation activities of the generic technical guidelines, and then I guess a new revision of the GTGs.

CO-CHAIR BLEY: And --

MS. SCHEETZ: I'm sure NuScale can answer how --

CO-CHAIR BLEY: -- it would be okay if you

gave up using acronyms.

MS. SCHEETZ: Okay. I can, yes.

CO-CHAIR BLEY: GTG is?

MS. SCHEETZ: GTG, PAM. I can use --

CO-CHAIR BLEY: No.

MEMBER CORRADINI: No, I think he wants --

MS. SCHEETZ: Do you want me to --

MEMBER CORRADINI: -- you to say it out loud.

MS. SCHEETZ: Okay.

CO-CHAIR BLEY: Say what the words are.

MS. SCHEETZ: So you want me to say generic technical guidelines?

CO-CHAIR BLEY: I do. Thank you.

MS. SCHEETZ: I will.

(Laughter.)

MR. BOWMAN: Dennis?

MS. SCHEETZ: Doug, did you want to --

MR. BOWMAN: Hey, Dennis? One comment. We will be submitting a revised set of generic technical guidelines once we have completed the work associating with getting -- we have to get the ISV Report done.

CO-CHAIR BLEY: That will be before the design cert is complete?

MR. BOWMAN: Yes.

CO-CHAIR BLEY: Okay. So we'll see you again on this when there are no open items remaining.

MR. BOWMAN: Yes.

MS. SCHEETZ: That's correct.

MEMBER MARCH-LEUBA: And --

MEMBER SKILLMAN: Maurin, what challenge --

CO-CHAIR BLEY: Thanks.

MEMBER SKILLMAN: did you give -- I'm sorry, Jose.

MEMBER MARCH-LEUBA: Oh, no. Go ahead.

MEMBER SKILLMAN: Maurin, what challenge did the staff give to the adequacy of the critical safety function? There are only three and they become the -- they have become the foundation for almost everything. What consideration did the staff give to challenging whether or not something has been orphaned, something has been overlooked?

MS. SCHEETZ: Okay. So we did challenge the applicant on the critical safety functions. There's not -- in the SRP there's not clear, hey, this is how you review critical safety functions. We had to go into a lot of the background information of TMI action plan items and look at where these critical

safety functions came from in the beginning and the background information for them and kind of come up with a plan of what -- how we would do this review.

So the first thing we did was -- you know, what do the other PWRs have for critical safety functions? So we did a comparison of NuScale critical safety functions to traditional -- or large light water reactor critical safety functions for PWR. And when we found -- okay, why don't they have several of those safety functions? Then we issued a request for additional information to NuScale asking about -- asking more information about why these critical safety functions and not these other ones.

So, and NuScale did provide a response which we found acceptable basically explaining that those other safety function -- critical safety functions that we're used to seeing are inherent to the three critical safety functions that they present, which we found acceptable. We agreed with them on that.

MEMBER SKILLMAN: Would you give consideration to taking one more look recognizing that the critical safety functions that have been developed are common for PWRs? And they certainly address fuel in terms of reactivity, decay heat and containment,

but they don't look at the unique features of this plant independent from the fact that there are 12 smaller-sized pressurized water reactors. There are other features of this plant I think that need -- that deserve to be at least challenged in terms of whether those unique features might in fact constitute the basis for an additional or different safety function in addition to the three that are focused on the fuel.

MS. SCHEETZ: I agree. So I can also say that because of -- in part of the Chapter 18 human factors engineering review we've also incorporated -- okay, what are the important human actions? We've looked at that part of the review to understand what is known about the NuScale design at this time and how that factors into plant safety functions, safety functions and critical safety functions. So that is part of the human factors engineering process the staff does, and we'll -- I think we'll get into this in Chapter 18.

We do have some questions on fuel operations for NuScale, and I do believe we have an open item in Chapter 18 reserved for what important human actions might come out of what we know at a later time about fuel handling and module movement. So using the human factors engineering process, that

information would get fed back into the process and the staff would have an opportunity to assess plant safety functions and understand if there is something missing there.

MEMBER SKILLMAN: Thank you.

MEMBER MARCH-LEUBA: Don't go too fast. He stole my time.

NuScale has finally learned how -- they're trying to implement what we've always been saying, that you should have a generic design and then make cookie cutter reactors, make them all the same. And I applaud them for that. This is what everybody has been trying to do, which means that these generic guidelines, the GTGs, are not really generic. They're plant-specific because all plant are the same. And that's what I believe NuScale intends.

So I sense a little gap on the review. You're reviewing the point of view of the operator actions. I missed the Chapter 15 reviewer's reviewing them for technical contents. Is this operator action the appropriate one to do at this condition, or is it a better one, or is it a bad one? And I've reserved some time for the closed session to give you some examples about that.

MS. SCHEETZ: Okay. I can say that as

part of this review we did interface with the Chapter 15 technical reviewers, Chapter 19 technical reviewers, 20 and 21 to understand what operator actions were or were not required and how they -- if they appeared in the generic technical guidelines. So that's -- when I talk about we looked at the methodology that NuScale used to identify operator actions, we looked at across other chapters.

MEMBER MARCH-LEUBA: Before we close open item 13.5-1 -- I will not just review a document that NuScale sent. I would love to see all technical experts from all branches in NRR and NRO get together and look at -- there are not many. There is only five screens with some flow charts. I mean, there aren't that many. And you can review them in an afternoon. If I was the king of the world and I was organizing this, I would make a workshop, internal workshop in NRO, say everybody come here, we're going to go through the procedures for NuScale. Let's see what you think. And that would be very valuable. As I say, I reserve some examples that are proprietary for later on.

MS. SCHEETZ: Okay. Thank you.

CO-CHAIR RAY: Dennis?

CO-CHAIR BLEY: Yes, sir? Go ahead,

Harold.

CO-CHAIR RAY: I understood that you were advised we will revisit this area after the two items are closed in the exchange you had a few minutes ago.

CO-CHAIR BLEY: That's right.

CO-CHAIR RAY: I just wanted us to see if we make note, either our staff or somehow, that will bring it back to our attention so we don't miss that. I think --

MEMBER CORRADINI: Well, we're automatically going to see it, Harold, when they close the open items. We have to make sure we're satisfied with it.

CO-CHAIR BLEY: We'll have an open -- we'll have meetings on I believe each chapter again with no open items.

MEMBER CORRADINI: In Phase 5.

CO-CHAIR BLEY: Phase 5.

CO-CHAIR RAY: I just -- I didn't want it to go past us somehow because we didn't recognize it. That's all.

CO-CHAIR BLEY: We'll have to remember we want to look for it, though. Keep a note.

CO-CHAIR RAY: Help me do that, will you?

CO-CHAIR BLEY: I'm not the right one to

ask.

CO-CHAIR RAY: Well, I'll ask --

MEMBER CORRADINI: I'll -- we'll remember.

CO-CHAIR RAY: Mr. Snodderly can take note of it. That's fine.

CO-CHAIR BLEY: Mike Snodderly's got it.

MEMBER MARCH-LEUBA: We're on Chapter -- Section 13.5. I will address this in the closed session with more detail, but there is a section under reactivity control, 13.5.4.17 -- pardon me, that has all that number -- in which you quote verbatim what NuScale said about the ATWS transit. So have you seen this ATWS transit? Have they documented the ATWS transit? Has the staff seen this document anywhere, because Chapter 15 says we don't need to give you an ATWS result because we're so good that we don't need one.

MS. SCHEETZ: So, no, I have not looked at the specific documentation for ATWS.

MEMBER MARCH-LEUBA: We'll go into a little more detail later on this afternoon, but I am convinced that if you give me the ATWS transit I can make that thing go straight widely on flow, and I will read from NuScale's own report that says so. So I would please ask you to -- even if we don't resolve

it, that don't have that quote on the SER on page 13 of 34.

MS. SCHEETZ: I know what -- yes.

MEMBER MARCH-LEUBA: Because it feels like an implicit approval of what they're saying. And I don't think we have reviewed it aggressively enough.

MS. SCHEETZ: Okay. So what I can say about the generic technical guidelines is that so far we believe that they are logically structured, they appropriately have prioritized safety and defense-in-depth functions, they adequately describe initial and follow-up evaluation when critical safety functions are challenged or not met, they can be practically implemented and they provide adequate design-specific information for a COL applicant to use in the development of plant-specific guidelines, and then the b subsequently emergency operating procedures.

The staff plans to review the results of generic technical guideline validation to understand if operators were successful in using the generic technical guidelines during simulated accident scenarios and to understand what if any changes the applicant has identified for the generic technical guidelines or the application.

MEMBER SKILLMAN: Maurin, I would like to

ask a specific question. This is in the Safety Evaluation, Chapter 13. It is in Section 13.5.4.2.1, 13,5.4.2.1, Critical Safety Functions. And the text is describing the low temperature over-pressurization protection system. And there's one statement here: "The NuScale reactor pressure vessel is designed to withstand the maximum passive system cool-down rate." And you will find that on PDF page 13-29.

And my question is has that -- has the staff verified the accuracy of that statement? And this is important because when the plant goes into ECCS mode, they actually add cool water to the reactor vessel. So I -- the reason I'm raising this is part of the TMI accident was the operators' fear of over-pressurizing. If you talk to those operators, they were afraid of fracturing the reactor coolant system. So I'm really asking have you verified, has staff verified the NuScale statement?

MS. SCHEETZ: So a predecessor did this specific part of the review before I took it over, so I'd have to check with him about who in Chapter 15 you talked about -- he talked to you about this. My understanding was that Chapter 15 was a large interface in this review as far as verifying these requests for additional information responses from the

applicant. So I believe that we have verified that through Chapter 15 and all.

MEMBER SKILLMAN: This is in Chapter 13, the statements in Chapter 13.

MS. SCHEETZ: The Chapter -- the statement is in Chapter 13 because we were explaining about why other critical safety functions didn't need to be specified because they were inherent to the critical safety functions that NuScale had outlined, so this kind of explains that basis for that decision.

MEMBER SKILLMAN: Thank you.

MS. SCHEETZ: That's all I have.

CO-CHAIR BLEY: Yes, we are. That's it. I'm just curious; and I don't know if you can answer this, given that you have reviewed the guidelines at this point, when a COL -- should a COL come forward and they say we have no changes with respect to the design cert, what will you be looking for them to do on this COL item, 13.5-2 through 7? Will you expect anything or will you just say, well, if you use those as your procedures, that's great? We've already --

MS. SCHEETZ: No, I think we would -- I would expect that the staff would do a new review of the design-specific emergency operating procedures, whether or not they --

CO-CHAIR BLEY: Even if they're the same?

MS. SCHEETZ: Even if they're the same, yes.

CO-CHAIR BLEY: Thank you.

MS. SCHEETZ: We would follow our review procedures.

MEMBER MARCH-LEUBA: Yes, but I think it would be more efficient if we do it once instead of every time a new module gets built. I mean, if you have 12 modules, you just pick 12 reviews of the GTGs? I mean, every time you put a new --

CO-CHAIR BLEY: Well, wait.

MEMBER MARCH-LEUBA: -- module into effect, will you expect it to --

CO-CHAIR BLEY: The procedures will not change dependent on whether there's 1, 2, 3 or 12 modules, I don't think.

MEMBER MARCH-LEUBA: They're not going to change with respect to the GTGs that already exist.

CO-CHAIR BLEY: Yes.

MEMBER MARCH-LEUBA: It would be more efficient to do it once and --

(Simultaneous speaking.)

CO-CHAIR BLEY: Well, the way it was just explained it would be done once on the first COLA.

The rest of the COLAs could refer to that one. But I don't know why it couldn't be done now myself, which is why I was asking it, too. I agree with you.

Anything from the Committee?

(No audible response.)

CO-CHAIR BLEY: All right. At this time -- no, we're going to go to Chapter 18, open session.

Thank you so much. The same people will be back for Chapter 18?

MR. CHOWDHURY: Correct.

CO-CHAIR BLEY: Okay. Thanks, Prosanta.

MR. CHOWDHURY: Well, we have more people.

CO-CHAIR BLEY: And more? Okay.

(Laughter.)

CO-CHAIR BLEY: Let's stand them up in the center of this dome.

(Pause.)

CO-CHAIR BLEY: All right. Is there any reason for us to delay or can we go ahead?

Okay. Dough, you're up.

MR. BOWMAN: All right. Good afternoon, everybody. We're going to present on Chapter 18 now.

NuScale recognizes some unique goals in Chapter 18. We went through a little bit of this in Chapter 13. But given the unique nature of the

control room in terms of -- especially U.S. plants, with 12 units being operated from a single control room, this was our vision. We knew -- and the fact that the design was so simple, we knew there were some unique things that we were going to be faced with.

So we set some goals early on. We wanted to integrate human factors engineering into the development, design and evaluation of the plant. And what that really resulted in is deliberate elimination of operator actions in the design-basis. We as operators certainly were staunch advocates of that position. We also wanted to provide an HFE design that facilitated safe and reliable operation, maintenance testing, inspections around the plant. Really what resulted from that was we wanted to allow an operator to be able to quickly assess the status of all 12 units. We're going to show you some examples of the human system interface that we designed to allow that to happen.

And we wanted to provide a state-of-the-art human factors design that satisfied the regulatory requirements, and out of that we really wanted to expand the use of automation. I know we've talked about this extensively in 13. For routine normal tasks to limit operator workload really do the things

that computers are doing now.

So in light of that I'm going to -- this presentation is going to -- I'm not going to walk through every single section of Chapter 18, but I'm going to walk through the areas that we felt were very important to our development, and we're going to talk about how we developed our Concept of Operations, and really that Concept of Operations leads up to the staffing plan validation for the first major event we did in human factors engineering. So we'll discuss that. We'll follow that up with the integrated system validation and how all of those two items flange together. And that's really what this presentation is going to be about.

So we did an extensive operating experience review. It is the first area I'm going to talk about. And we reviewed the operating experience in the following industries: Currently operating nuclear power plants; that was an obvious choice for us, nuclear facilities that do not produce power, non-nuclear power plants, a U.S. military platform. And we also went into the health care industry. We looked at a neonatal care intensive unit where they monitor multiple babies over the course of -- or children as part of that exercise. Electrical distribution and

the airline industry. And our purpose was to review -- was to identify human factors engineering safety issues and incorporate identified positive features in the NuScale plant design.

CO-CHAIR BLEY: When you said "non-nuclear," that could be almost anything in the world. What kind of things are you talking about?

MR. BOWMAN: Well, in this case it was a non-nuclear power plant, right?

CO-CHAIR BLEY: Oh, it was a power plant?

MR. BOWMAN: So we are -- I'm going to talk about the specific -- because that's one very specific -- we --

(Simultaneous speaking.)

CO-CHAIR BLEY: But not chemical processing plants, that kind of stuff?

MR. BOWMAN: I don't believe we did any chemical plants at all.

CO-CHAIR BLEY: Okay. Just curious.

MR. BOWMAN: So the things we were worried about. From the current industry inside of a nuclear -- inside of the current commercial nuclear area we were worried about alarm avalanche. That idea that at the time that an event occurs, especially a reactor trip or a major accident, the operator is inundated

with alarms. And many of these alarms are essentially not applicable to the situation he's looking at. He has to know what alarms are just normal that are going to come into the situation, then he has to look for those alarms that are actually pertinent to his situation.

So we established a tiered alarm system. Now this isn't unusual to use a tiered alarm system. Ours is set up with three levels of alarm notification: alarm, caution and notice. And I will provide you at least some visual examples of how we'd do that, but a brief explanation. Alarm -- go ahead.

CO-CHAIR BLEY: Before you do that, you now have 18 former licensed operators with you. How many did you have back when you were doing this work? Were there operators involved in deciding how these alarms ought to be displayed?

MR. BOWMAN: There's been other people involved despite the ones the we have now. I couldn't tell you exactly how many, but yes, we've had other people who've come and gone out of our project.

CO-CHAIR BLEY: Not just people, but operators?

MR. BOWMAN: Operators, yes. Absolutely.

CO-CHAIR BLEY: Go ahead.

MR. BOWMAN: All right. So a tiered alarm system. The alarm is -- operates as we're all used to. There's a continuous alarm sound and a flashing indication that stays in until you acknowledge the alarm. And we expect those alarms to be used on a very limited basis for those things that actually require an operator to take action in our safety concern.

The caution behaves differently. It comes in. It provides a single tone to the operator and then it stops. There's no continuous alarm function. On the human system interface you can see how many cautions you have in at a given time. There's a yellow icon that shows you how many cautions you have in.

And then the final one is a notice, and the notice is essentially kind of like getting an email. Essentially it's a way for the human system interface to provide the operator with information that's not critical in nature, but he needs to provide the operator that information. There's a lot of alarms today in the industry that are like that that are currently -- they're all one tier and you don't know the difference.

So an example of this would be we do have

an automation that covers -- that monitors all 12 units and looks for whether or not a dilution needs to be performed. And if that automation decides that it's ready for a dilution, it will provide a notice to the operator that it wants to dilute for example Unit 8. Then the operator would go and review that information and decide whether or not he wanted to allow that automation to continue. That's an example of a notice.

CO-CHAIR BLEY: Does a notice tell him why?

MR. BOWMAN: Yes, absolutely. When he brings up that screen, it's going to show him all the parameters on that unit and why it thinks it's time for it to go dilute. And he can review all that and decide if he wants to move on with that or not. And again, a dilution is not a time-critical -- there's nothing critical about the operator performing a dilution. It's a thing to maintain your power is all it really is. So that's one piece of what we did.

Operating multiple units from a single control room. Obviously given the lack of information about that in the industry, we -- especially the American industry, we started looking outside of the American industry. So obviously we started with our

on subject matter experts and they provided us some initial ideas about what our staffing level should be and what our basis should be.

But then we went to Bruce Power, and Bruce Power, the Canadian plants, they operate four units from a single control room. And from this benchmarking trip we took a concept they use where they have a control room supervisor -- although we've kind of talked about him as being in a traditional role, and he does serve that traditional role. He is a bit step-backed in his oversight because he's much more of a resource manager in the control room than he is direct oversight of a reactor operator performing a duty. So we took that idea from Bruce Power.

And also at Bruce Power they'll have operators who are operating at the controls, but they also have additional operators in the control room that are basically resources for those operators at the controls to perform various activities. So we also took that concept, and that's a part of how we got to our operations concept.

Then the other major one was -- we did benchmarking at the T.H. Wharton Gas Turbine Generating Station. So this -- at this plant they have a total of 17 different turbines operating, both

gas generation and steam turbine units, and they both operate in both simple and combined cycle and they're all operated by a single operator in a single control room. So 17 individual units. One operator is monitoring them all. Different designs, different design features, different eras. So there's a wide variety of what he has to take in.

CO-CHAIR BLEY: Were you able to see anything about their operating history and what kind of problems occurred?

MR. BOWMAN: Some. We did use some of it. I didn't personally go on this trip, but I can tell you that for example they had a lot of problems where they didn't understand --

CO-CHAIR BLEY: "They" being the operators?

MR. BOWMAN: The operators at this gas plant didn't understand their I&C system well enough. So they didn't understand the effects of failures. So we within our design certainly looked at that. We provide the operators with backup control stations. We have a procedure built already -- a draft procedure; we don't have real procedures yet for this kind of thing -- a draft procedure that describes what the operator does in various failure states on the I&C

system, depending on which portion of the system is broken or failed. So we've developed some of that work already.

But also the concept of a single operator operating multiple units evolved. So what we wound up with for the three reactor operators that you talked a little bit about earlier is we have RO-1 as described. He is operator at controls for 12 units. He's monitoring 12 units. And he has two other operators that are resources for him to use depending on what's going on, are resources for him to help. And that allows the maximum amount of flexibility with addressing problems as they come up for that crew.

Instead of for example having an operator -- three operators each describing -- covering four units, they can only cover those four units and how much further can they extend their use? For the single operator, he's in passive control, what we term passive control, as the plants are operating in normal conditions.

CO-CHAIR BLEY: Can I ask you a question?

MR. BOWMAN: Sure.

CO-CHAIR BLEY: I had to take -- I saw it there five, six -- four years ago, whenever that was, but I read through the DCD, I read through the SER.

I didn't find anything. I went to the staffing and whatever it is final report. Didn't find anything there except a reference to the Concept of Operations report where I found either specific details or at least close-to-specific details with hints of the rest of what you've described.

I think this material is very important to support your philosophy of how to operate these plants, yet from a regulatory point of view; at least my regulatory point of view, it's in a tertiary document. I don't know why you didn't recommend and the staff didn't say that that document ought to be -- I forget the words they used -- picked up by reference --

MR. BOWMAN: So the --

CO-CHAIR BLEY: -- for the design.

MEMBER SKILLMAN: Incorporated by reference.

CO-CHAIR BLEY: Incorporated by reference.

MEMBER SKILLMAN: IBR.

MR. BOWMAN: So the Concept of Operations is actually required by NUREG-1711 and is submitted and on the docket as part of our application.

MR. TOVAR: There's two different documents that we have: One is the Concept of

Operations, which is a higher-level document that describes at a high level roles and responsibilities and the staffing. We have a Conduct of Operations, which I think your -- is really where your interest lies -- is a much more detailed document that describes the conduct of the operators within the control room, different human error prevention techniques and so forth, what is the requirements for peer checking and so forth. That was not incorporated by reference or docketed. As they are not in commercial plants today it doesn't make sense to have that type of controls on a document like that because that makes it much more difficult for --

MEMBER CORRADINI: Was the overview document explained, the process that we observed back in -- when we were physically there, because you guys took us through at least -- I can't remember who else in the room was there.

CO-CHAIR BLEY: Just me, I think.

MEMBER CORRADINI: No, you and I.

CO-CHAIR BLEY: Of the people who were still on -- were you there, Ron?

MEMBER BALLINGER: Oh, yes, I was there.

CO-CHAIR BLEY: Okay.

MEMBER CORRADINI: That you took us

through the what-ifs about if one plant went to some sort of --

CO-CHAIR BLEY: Well, they actually ran a drill --

(Simultaneous speaking.)

MEMBER CORRADINI: They ran the drill.

CO-CHAIR BLEY: I need to come back. The document I'm looking at is -- wow, that's a different number than -- oh, no. RP0215-10815-P, and it's called Concepts, with an S, of Operations.

MR. BOWMAN: But that does describe the role of --

(Simultaneous speaking.)

CO-CHAIR BLEY: It does.

MR. BOWMAN: Yes.

CO-CHAIR BLEY: It does. And that's the one I was talking about. The other one I haven't seen, so I'm going to have to go look for that.

(Laughter.)

CO-CHAIR BLEY: Conduct of Operations.

MR. BOWMAN: So the Concept of Operations, the document you referenced, is incorporated by reference and was --

(Simultaneous speaking.)

CO-CHAIR BLEY: No, it's not. Nowhere I

saw in either the DCD or the SER. If it is, please show us. Not this instant, but fill us in. That one I would like -- I think that would be a good idea. The Conduct of Operations one, if you can give us a report on that, that would be of interest, because I didn't see that referenced anywhere.

MR. BOWMAN: But to echo Tim's comment, I don't believe the Conduct of Operations is appropriate. I mean, mind you, we're reviewing it, obviously. I don't believe it's appropriate to bring into a DCA application, but --

CO-CHAIR BLEY: Well, that might be. It's the other one that I was --

MR. BOWMAN: Right.

CO-CHAIR BLEY: -- thinking should be.

MR. BOWMAN: Okay.

CO-CHAIR BLEY: Because I didn't see anywhere else where this was addressed.

MR. BOWMAN: Sure.

MR. TOVAR: And I just checked Chapter 18 of the design certification application and it is not referenced directly, but if you --

CO-CHAIR BLEY: Yes.

MR. TOVAR: -- look into --

CO-CHAIR BLEY: It's true.

MR. TOVAR: -- I want to say the Staffing and Qualification Results Summary Report --

CO-CHAIR BLEY: It references it.

MR. TOVAR: -- it will be referenced --

(Simultaneous speaking.)

CO-CHAIR BLEY: That is true. That's why I called it a tertiary --

(Simultaneous speaking.)

MEMBER CORRADINI: That's how he found it.

MR. TOVAR: Right.

CO-CHAIR BLEY: That's how I found it. I didn't --

MR. TOVAR: Okay.

CO-CHAIR BLEY: -- find it until like Friday and didn't get a copy of it to look at until Sunday.

MEMBER SKILLMAN: Doug, let me ask this question: When I look at my RO license and my SRO license, there's a blank. It gives my name and I'm authorized to operate reactor with facility designation, and there's the facility designation. And for both my licenses there's just one reactor. What is the vision that NuScale has and what is the NRC's vision for how your reactor -- how the NuScale reactor operators' licenses will be identified,

because one of the key facets of, at least the licenses that most of us have held, is the issue of accountability. If you are the OAC and you fail to operate in accordance with procedure, you own it.

MR. BOWMAN: So --

MEMBER SKILLMAN: So here you are, an individual perhaps with a license to operate sub 1, sub 2, sub 3, sub 4, sub 5, sub 6, and it's good old sub 7 that goes belly up in the night. You say, well, really, I was just monitoring it. I wasn't operating. He was operating.

MR. BOWMAN: So I'll try to answer that in two parts. So I'll start off with -- both of my licenses have two facilities on them because I was licensed --

(Simultaneous speaking.)

MEMBER SKILLMAN: On both? Okay.

MR. BOWMAN: So we envision that first part of that question to be answered with the docket. I believe we're going to have individual dockets for the units. So therefore, an operator would be licensed on those 12 units.

No. 2, our -- I don't know how far I can go in open session with this one in terms of discretion of --

PARTICIPANT: If it's displayed in a non-proprietary simulator presentation, it's --

(Simultaneous speaking.)

MR. BOWMAN: Yes, we can do that. Okay. We use a concept called passive and active control in the Concept -- in the Conduct of Operations. So if the Operator 1 -- I say one guy is in charge, RO-1, and one person is -- he -- that person is monitoring those 12 units and there's nothing displayed on the HSI. So when somebody wants to go take action on the unit, we go into a mode we call active control.

So if it's going to be RO-1, which on certain cases, limited cases we roll out and take very small actions, he would actually change the HSI to show that he is in active control of that unit. And that's a symbol that -- an icon that shows up. If he were to do a bigger -- a bigger task needed to be done, then for example RO-2 might do it. Well, when RO-2 took over control of that unit, you would put his icon up there and show that he's in control.

So our Concept of Operations; we like to use this term a lot, is baked into our human system interface. We have a very clear set of roles and responsibilities. We know who's in charge of all the units all the time and it's displayed for anybody who

walks into the control room to see.

MEMBER SKILLMAN: Thank you.

MR. BOWMAN: All right. So I'll move onto task analysis. I'm leading up to -- to get back to our summary, I'm leading up to the staffing plan validation. We talked about operating experience and how we developed our Concept of Operations. I'm going to talk about task analysis.

This is really a brief slide, but task analysis was important to us because much like the question about the generic technical guidelines, the task analysis we did for human factors engineering. When you look at it, it looks like a procedure. I mean, that's the way we wound up using it. We developed task analysis to look like procedures.

This was done by our subject matter experts, the 18-plus people, SROs, we've had working on this project for four-plus years. More than that. The five years I've been around. We actually put this task analysis into the database that almost the entire industry uses for training. That allows us to use that task analysis as a training basis, too, in the systematic approach to training. So our intention is to build the entire operations program forward starting with human factors engineering and keep

developing the project as we move on.

Next slide. Treatment of Important Human Actions. So we've talked about this in Chapter 13 a bit, but we have two risk-important human actions. We talked about the other seven actions we identified during GTG -- or generic technical guideline development, but these are the two important ones. And we've discussed them before. We're adding water to the reactor coolant system with a chemical and volume control system and adding water to containment with the containment flood and drain system.

We needed to develop these to know what our staffing plan validation test was going to look like. We had to understand them well. And recognize there are no deterministic important human actions identified in -- by transient max analysis or by the diversity or defense-in-depth coping analysis.

CO-CHAIR BLEY: I don't know quite what that means, but --

MR. BOWMAN: So I'll talk about it by chapter then.

CO-CHAIR BLEY: Okay. That's fine.

MR. BOWMAN: We found our important human actions in Chapter 19 like we discussed. These other two, the major areas were the human factors

engineering regulations tell you to look is in Chapter 7 in your diversity and defense-in-depth analysis, and in Chapter 15 under your accident analysis to look for operator actions.

CO-CHAIR BLEY: And we haven't reviewed that yet. Chapter 15 --

MR. BOWMAN: Seven you've reviewed.

CO-CHAIR BLEY: -- we haven't. Seven we have.

MR. BOWMAN: Yes.

MEMBER SKILLMAN: Doug, isn't that -- that second bullet on that slide, the deterministic important human actions were identified, so on and so forth, based on your critical safety functions. Because the real root of this and of these two highly important actions come out of your critical safety functions. They're driven by the CSFs.

MR. BOWMAN: Well, they're certainly categorized under CSFs and put in that way, but we were always looking for places where people were trying to specify actions for operators. When I went back to that early statement where I said we were a staunch defenders of the position that we didn't want any operators -- operator actions in the design. So Chapter 15 and Chapter 7 we were -- I don't know how

best to put it -- we defended that position strongly.

Any time somebody brought up -- an engineer might bring up a solution to a problem we were having with a design, they might say, yes, we can put an operator action here. It's common in the industry. We came back with, no, we need to come up with a solution that doesn't require an operator action.

MEMBER SKILLMAN: Okay.

CO-CHAIR BLEY: Okay. And this was in Chapter 18 you talk about this for the important actions. Or no, for the deficiencies? You looked for --

MR. BOWMAN: No, no, no. This is back in the design stage.

MEMBER SKILLMAN: This is your overall --

MR. BOWMAN: I'm sorry. I'm going back, way back --

(Simultaneous speaking.)

MEMBER SKILLMAN: Yes, this is your overarching design?

MR. BOWMAN: Right, this is how we -- this is our design philosophy. We were strong about not wanting operator action.

MEMBER SKILLMAN: So I'm going to agree

with you that that is the appropriate overarching design intent, and I think you fulfilled that by and large by being faithful to your CSFs. And I just think there may be one or two more that need to be elevated to CSF category, because I think they are so important that they need attention. So I would suggest that -- generally I agree with you, but I think the lens needs to be opened a little wider.

MR. TOVAR: So I think that we've heard that message very clearly --

MEMBER SKILLMAN: Yes, okay.

MR. TOVAR: -- and we need to go back and make sure that we --

MEMBER SKILLMAN: I'll stop.

MR. TOVAR: -- take a look at that.

MEMBER SKILLMAN: I'll stop. It's just really a chapter 18, but it's also a Chapter 13 issue.

MR. TOVAR: Sure, and I'm not asking --

CO-CHAIR BLEY: Can I put a little onus on you?

MR. TOVAR: Sure.

CO-CHAIR BLEY: Earlier when you followed this line you gave them at least the example of the crane moving loads while the other plants are operating. I didn't hear another one you offered

them. Did you have another one? I don't think so.

MEMBER SKILLMAN: I -- well --

CO-CHAIR BLEY: I think it was just that one.

MEMBER SKILLMAN: Only to the extent that it's woven between Chapter 15 --

CO-CHAIR BLEY: Yes, but if --

MR. TOVAR: -- and 18.

CO-CHAIR BLEY: -- there are two or three more important safety functions --

MEMBER SKILLMAN: No, I --

CO-CHAIR BLEY: -- we know about, we ought to tell them why we think that's --

MEMBER SKILLMAN: I do not have --

CO-CHAIR BLEY: -- I kind of suspect I could throw a couple in, but almost all of them could be reduced to what they have except for the thing you were talking about.

MEMBER SKILLMAN: Yes. No, I don't have one beyond that, Dennis.

CO-CHAIR BLEY: Okay.

MEMBER SKILLMAN: Yes, I agree. I agree.

CO-CHAIR BLEY: I just didn't want to leave them with an assignment that had no answer.

MEMBER SKILLMAN: No, and I'm not trying

to give --

CO-CHAIR BLEY: Not that we can give you assignments --

(Simultaneous speaking.)

MEMBER SKILLMAN: Yes. No, but I'm not trying to give them raspberries, either. I'm not trying to hassle them. I am --

CO-CHAIR BLEY: No, I was just trying to be --

(Simultaneous speaking.)

MEMBER SKILLMAN: Very sensitive to the module and the crane, that coupling. Okay.

MR. BOWMAN: All right. So a little bit of background about the important human actions. We've talked about what they are, but I'm going to tell you when we use them. This is a bit of a simplification, but I'm an operator; I like simpler answers better than more complex ones.

We categorized the important human actions of the three major design -- beyond-design-basis accident events. The first is a containment bypass event, which is -- could either be a LOCA outside of containment, un-isolable in either -- on CVCS, for example, would be a great example, or you could have a steam generator tube failure in combination with an

un-isolable stem break, which would also force you to lose inventory out of the -- outside of the module. That's really what a containment bypass event is. And in that case we need to add water using the CVCS system to the reactor coolant system in order to address that. Again, beyond-design-basis.

The second is a failure of ECCS where either all of the reactor vent valves or all of the reactor re-cert valves fail to open. So this isn't a normal single-failure ECCS failure. This is a -- all three -- there's three vent valves on top of the system that are on top of the reactor coolant system that are part of the ECCS system. All three of those have to fail to open in this case.

MEMBER CORRADINI: And either that or --

(Simultaneous speaking.)

MR. BOWMAN: Or the reactor re-cert valve -- both reactor re-cert valves have to fail. Again, beyond-design-basis failure ECCS.

And the third is a complete failure of the decay heat removal system. That means the whole system, all trains are failed and both reactor safety valves failed to open. In this case you have no way to remove heat. So in that case you actually -- you just use the containment flood system to add water

outside of containment in order to provide a coupling of the reactor coolant system with the open heat sync to cool down the reactor.

So what's important about that --

MEMBER CORRADINI: Sorry, but for all three of these you require -- back to the -- my question about the two actions, either CFDS or CVCS must be actuated to satisfy --

MR. BOWMAN: Right.

MEMBER CORRADINI: -- to get around it?

MR. BOWMAN: I'll go back to that. So when -- and if you would bypass on that, you can actually use either the containment flood action or the CVCS action to address it.

In the ECCS failure the only thing that's successful --

MEMBER CORRADINI: Is CVCS?

MR. BOWMAN: -- is the CVCS. And in the last one I talked about, the failure of decay heat removal and the reactor safety valves, only the containment flood system is accessible.

So both of those important human actions were sampled by the staffing plan validation. I'll talk a little bit more about what staffing plan validation was in a minute.

And then all of the human actions that were performed from the main control room assumed in the PRA were sampled during the integrative system validation. That's the later testing which was completed. We looked at all seven of those actions and did those -- not all seven. We didn't do the local action. All the one from the control room were sampled during the integrated system validation.

CO-CHAIR BLEY: I want to ask you a question because it wasn't transparent to me either in the DCD or in the SER. To me. It might be clear to everyone else. The ISV, the integrated system validation, and the SPV, the staffing plan validation, both seem to be key to many open items that I saw. Can you explain the difference between those two?

MR. BOWMAN: I will get into those in just a minute. Hopefully that will explain your -- answer your question. In fact, we'll talk about it now.

So talking about staffing and qualification --

MEMBER BROWN: If I could interrupt for a second. Go back. Go back a page. You say the IHAs are utilized in three major beyond-design-basis accident conditions, yet in -- and I'm trying to correlate this with some words in Chapter 18 that says

you only have two IHAs.

MR. BOWMAN: Correct.

MEMBER BROWN: Two risk-important. And that is relative to the un-isolate and initiate injection of the inventory of the vessel using CVS -- CVCS system. The second one is to un-isolate and initiate injection of inventory to the containment.

MR. BOWMAN: Correct.

MEMBER BROWN: And yet --

MR. BOWMAN: Two actions will cover these three beyond-design-basis --

MEMBER BROWN: Is that --

MR. BOWMAN: So I'll walk --

MEMBER BROWN: I'm trying to get -- that's what I'm trying to get is what's the --

(Simultaneous speaking.)

MR. BOWMAN: All go through it again. So the containment bypass event can be addressed by either using the -- adding water to the reactor coolant system with CVCS or by using the CFDS. Either one of those will work, because in these cases the ECCS valves are open and your -- the water can come in either from containment or into the reactor coolant system.

In the second case, the ECCS failure, you

have to put water into the reactor coolant system. The containment flood and drain system is not effective in this case to prevent core damage. So you have to put containment -- CVCS into the reactor coolant system to mitigate this event.

And the third one, the complete failure of decay heat removal, basically all of your heat removal systems, you have to put water outside of -- outside of the reactor coolant system in the containment vessel in order to couple the core -- reactor coolant system to the ultimate heat sink to address it.

So there are three events and there are two actions we use to address all of them, just in different combinations depending on the event.

MEMBER BROWN: Okay.

MR. BOWMAN: And then if you go back and look at the GTGs, we have direction that gives the operator which one to use under which event. So although they're not event-based, they are symptom-based.

MEMBER BROWN: Okay. Thanks for the connection.

MR. BOWMAN: Does that --

MEMBER BROWN: Yes. Yes. No, I --

MR. BOWMAN: Okay.

MEMBER BROWN: -- I've been listening. That's what I have read and all of a sudden I -- my -- I had two and just with -- burned it in my brain, which is a very small brain these days.

MR. BOWMAN: All right. So staffing qualification, again our staffing qualification was based on the fact that we have no operator actions required for design-basis events. The HSI provides at-a-glance assessment of the plant conditions and facilitates protection of the creating conditions and one operator can have primary focus on maintaining and monitoring a role during normal, abnormal and emergency conditions. And that's the role described in the Concept of Operations for RO-1.

So the results of SPV, I'll start with. SPV verified that a NuScale plant can be operated --

CO-CHAIR BLEY: Say the words.

MR. BOWMAN: Staffing Plan Validation --

CO-CHAIR BLEY: Thank you.

MR. BOWMAN: -- verified the NuScale plant can be operated safely and reliably from a single control room by a contingent of three reactor operators, three licensed reactor operators and three licensed senior reactor operators. We do have a COL action item that will determine the non-licensed

operator staffing requirement.

CO-CHAIR BLEY: Okay. How are you going at that?

MR. BOWMAN: We did model -- in both staffing plan validation and integrated system validation we modeled four non-licensed operators just to allow those events to go on. We need to do a separate assessment of some kind to determine how many operators that will be, but that is a COL action. I mean, they may ask us to do that for them, but --

CO-CHAIR BLEY: Okay.

MR. BOWMAN: -- that's something the need to determine.

So our staffing plant validation was performed in August of 2016. This -- I'm going to talk about scope. This event, this staffing plan validation consisted of two crews of five NuScale operations staff. This is not a separate group. This is a group of people we pulled from inside of our organization, 10 people total. They were trained to perform the tasks necessary to complete staffing plan validation and they did not know the content or sequence of any of the scenarios.

So the scenario tasks for staffing plan validation were samples from the task analysis, which

is why I talked about it earlier, based on the following attributes: We did task analysis and then we evaluated them using human factors engineering tools. So these are the attributes that we looked for and sampled from. So it would be a high-risk task, high-stress task. You can see the list there.

What we're after is -- a large workload under a high-risk or high-stress condition is what we were looking for when we did the sampling for staffing plan validation.

CO-CHAIR BLEY: Just an aside, because I was a little concerned about the human reliability analysis so far down in the PRA. I'm trying to think of when you did these different things. Did the people doing the human reliability analysis in the PRA have access to the thinking about what's high-stress, all of the items on this list, as they did that work? And if they didn't, I'm wondering if they shouldn't go back and make sure they picked up things that the rest of you thought of.

MR. BOWMAN: I'm not sure if one of our PRA members are the line or not, but my understanding of the HRA was -- consisted of is a very simple model --

CO-CHAIR BLEY: Very simple?

MR. BOWMAN: -- that allows -- that says the first time an action appears in an event tree, there would be a one in a thousand chance the operator would fail. And then it goes down to one in a hundred for two and it progresses down until you always fail them.

CO-CHAIR BLEY: Okay. So I don't -- I didn't need an answer to this, but if somebody from the PRA group is on the line, one day maybe when we come back with no open items, you can tell me how this is going to be done in a less-simplistic way for the final PRA before fuel load. And I hope that won't just be saying that's up to the COL applicant.

Go ahead.

MEMBER SKILLMAN: I've got to --

CO-CHAIR BLEY: It's a separate thing. I don't think we need to talk about it.

MEMBER SKILLMAN: I got to ask this question: High-stress. I operated with a guy who when things were really coming apart at the seams, he was so lazy his automatic watch would stop.

(Laughter.)

MEMBER SKILLMAN: He did not get stressed under any circumstances. And his DNA was just flat-lined. But he was a great operator. He never missed

a beat, but he did not stress.

CO-CHAIR BLEY: You may have worked with a guy like one I worked with. When it was as simplest thing like a startup, he was completely stressed, right?

MEMBER SKILLMAN: But my only point is --

CO-CHAIR BLEY: You have both kinds.

MEMBER SKILLMAN: -- what might be very high-stress for me might be a non-item for Dr. Ballinger. How do you identify what's high-stress?

MR. BOWMAN: Well, for this juncture where we were at in the design, it was the subject matter expert's job to identify if he thought the task was high-risk.

MEMBER SKILLMAN: Fair enough. Okay.

MR. BOWMAN: And that's really what we do.

CO-CHAIR BLEY: Did he do any checking --

MR. BOWMAN: I have a story for you about a person --

(Simultaneous speaking.)

MR. BOWMAN: Yes, we found also during ISV, integrated system validation --

(Simultaneous speaking.)

CO-CHAIR BLEY: Did you see any change to that during your simulator exercises that might say we

didn't think this was high-stress, but everybody's having trouble with it, or vice-versa?

MR. BOWMAN: It was actually probably likely more towards the other -- what -- so what we traditionally felt was high-stress, for example accident mitigation, especially within the design, is essentially not really all that stressful in the NuScale design. Not so much the other way.

I mean, so the tasks that we sampled are fairly obvious to you. Major accidents, beyond-design-basis accidents, fires. And the other side of this is it wasn't just this sampling. They also had to be not -- something you couldn't drop, right? Something you couldn't stop doing. So you have to respond to the fire. I can't stop responding to the fire. A surveillance that's going on I might be able to stop and move onto something else. So that really shouldn't be part of our workload concerns. So we look for fires. Medical conditions. A medical issue in the plant. We sampled that.

CO-CHAIR BLEY: But that shouldn't be part of our workload concern, but when you read lots of incident reports --

MR. BOWMAN: Sure.

CO-CHAIR BLEY: -- people get tied up in

that sort of routine stuff and don't come around in time sometimes.

MR. BOWMAN: I have personal experience, so that was why we --

(Laughter.)

CO-CHAIR BLEY: Don't we all? Okay. So you do have it? Okay.

MR. BOWMAN: Absolutely.

MEMBER CORRADINI: So must to make sure I understand. So you went through all the Chapter 15 accidents at least --

MR. BOWMAN: Yes.

MEMBER CORRADINI: -- and see how they kind of fell out relative to these attributes?

MR. BOWMAN: Correct. And we sampled quite a few Chapter 15 accidents during the staffing plan validation.

MEMBER CORRADINI: Okay. That's fine.

My next question is since this is an area that we've been talking about that I have -- I am learning; I'm not -- I can't criticize or ask questions about that much -- I'm curious about how did you -- for the analysis or -- for the simulation of the Chapter 15 accidents you were using RELAP and NRELAP?

MR. BOWMAN: Correct.

MEMBER CORRADINI: Okay.

MR. BOWMAN: The simulator model, as you -- so this was after you guys visited, so it would have been a more developed version of the same simulator that you guys saw.

MEMBER CORRADINI: Okay. Fine. Thank you.

MR. BOWMAN: Okay. So these tasks, we took the sampling of tasks, we grouped them into three very challenging scenarios and each crew, these two crews performed all three scenarios. So these scenarios -- I would have some examples for you what we put into them, but there was -- if any of you are familiar with the initial license training exam, it would look two or three of them stacked together at times and how much was going on in these scenarios. We intended them to be very challenging high-workload scenarios to prove that the design could be operated with the operators we had.

MEMBER CORRADINI: And so I'm sorry to ask this question. So let me make sure I understand. So you had the dozen units, modules, whatever you call them, and something would happen here and something -- okay. That's what I wanted to check.

MR. BOWMAN: Right. We would have multiple events on multiple units in a single scenario.

MEMBER CORRADINI: Okay.

MR. BOWMAN: Scenarios generally lasted about less than two hours and they would run across -- for example, they might run across a Chapter 15 event and a design-basis event and then maybe a multi-unit event as well.

MEMBER CORRADINI: Thank you.

MR. BOWMAN: So our testing methodology was based on what we anticipated doing for integrated system validation testing, so that meant that we took -- we had observers in the room. We collected their feedback. We collected feedback from the operators themselves. We collected task times, which means if there was a timed task within that evolution, we would take a stopwatch and watch the guy from start to finish and see how long it took him. And our SPV again successfully demonstrated that NuScale design could be safely operated by the proposed staff.

So after SPV we did some more work on human system interface design. Just a little bit of background about it. We have a multi-faceted team, so we -- I talked a lot about the operators we used. We

also have human factors engineers that do work for us, too. So we're -- their input is important, but we are led by the operations group in terms of doing this human factors engineering work. It sounds a little strange, but that's the way we did it.

MEMBER CORRADINI: Doesn't sound strange to me.

MR. BOWMAN: I mean, my background, I don't have any human factors engineering background and I'm in charge of our human factors engineers. But they've been a great resource and they've been a great fantastic input to us.

So we went through and --

MEMBER SKILLMAN: Let me ask this: The two groups of five you chose, two groups of five --

MR. BOWMAN: Yes.

MEMBER SKILLMAN: -- what gives you confidence that those individuals are representative of a future licensee's individuals?

MR. TOVAR: So that wasn't really the intent of the staffing plan validation. That was more the intent of the integrated system validation, which is a more comprehensive test. For this we wanted to show that a crew of competent licensed operators; and that's what they simulated, would be capable of

operating the plant in a very challenging high-workload situation.

MEMBER SKILLMAN: This is kind of a proof of principle as opposed to --

MR. TOVAR: Exactly.

MEMBER SKILLMAN: -- checking out a future licensee? Understand.

MR. TOVAR: Okay.

MR. BOWMAN: Okay. Yes, thanks.

MR. BOWMAN: Okay. So here's an example screen we have up. And this is actually what we termed the process library, so when you ask about your electronic procedures, this is the screen that does our electronic procedures for us.

On the left-hand side you can see a column with a menu list of various procedures that you're allowed to go access. On the very right-hand column you have a progress bar and that progress bar shows you all the active procedures anywhere in all 12 units at any time. So anybody in the control room can access that information on the right-hand bar and tell every activity that's going on in the control room at the time. And he can also go click on it, select it and it will pull up into his process library and he can see live where that person is at.

CO-CHAIR BLEY: Any time they hit a point where they trip the unit and put it in its safe mode, does this disappear or are they still in the middle of those procedures?

MR. BOWMAN: So I show you this as a single example. It would probably be good to have a layout. You've seen the layout. But we have three work stations --

CO-CHAIR BLEY: It's been a long time.

MR. BOWMAN: -- we have three work stations. There's four screens in front of the operator. Each operator is at their work station. There's also a large horseshoe that has all 12 units mimicked up in front of it. So when a unit does for example a reactor trip there's many indications that come in to tell the operator this has happened.

One is there's a large overview screen that provides an indication that the reactor is tripped and whether or not that trip has been successful or not. There's a series of four screens below it in the horseshoe that also come out of sleep mode and wake up and show the status of for example our critical safety functions and -- but there's lots of ways for him to know that has happened. This stays up and available at all times. Or I shouldn't say at

all times, but it doesn't change status because of that --

CO-CHAIR BLEY: Okay.

MR. BOWMAN: -- change in the status of the unit.

MEMBER BROWN: If a screen pops up, how long before it disappears?

MR. BOWMAN: As long as there is an actuated safety function those screens stay up, right?

PARTICIPANT: Right.

MEMBER BROWN: But if something else happens and you need it -- so it disappears and something else comes in in its place?

CO-CHAIR BLEY: Or they stack up?

MR. FLAMAND: So the critical safety function display isn't meant to be moved. It's pretty much got an area so that way the operator always know to go look there. At the work station you're able to maneuver your screens however the user wants them. And so --

MEMBER BROWN: But they don't change without you changing them?

MR. FLAMAND: Not at your work station.

MR. BOWMAN: Correct.

MEMBER BROWN: Let me give you a

frustration. How many times have I been doing something, had to go pull something else up and I have to make it so small I can't read it or you cover up what you're doing, you can't remember what you read on the other page and you're snapping back and forth, and by that time, when you're my age, you've forgotten what you're looking for in the first place.

MEMBER CORRADINI: They're not that --

MEMBER BROWN: Huh?

MEMBER CORRADINI: They're not going through --

(Laughter.)

MR. FLAMAND: That's my answer.

MR. BOWMAN: We've addressed many of those things. For example, the font sizes are limited based on the screen, a human factors engineering principle. You can't actually -- they have to be a certain size to be readable at all times. We don't shrink down into windows for any screens or fall full screen systems, but you can go through and select what screens you want up. And operators, as we went through the integrated system validation, found they wanted certain sequences of screens up, and that's what they like, depending on what work they were doing.

MEMBER CORRADINI: Are some of these back up on paper, pull up paper? I think they asked the same question about --

MR. BOWMAN: Some of the procedures you have paper backup when appropriate.

MEMBER MARCH-LEUBA: Some or all?

MR. BOWMAN: Some. Not all.

CO-CHAIR BLEY: They're --

MR. BOWMAN: You got to --

CO-CHAIR BLEY: The DCA says some.

MR. BOWMAN: Yes, so the -- go ahead.

MR. FLAMAND: I was just going to say one of the things that we showed -- because we did have operators use backup procedure sets. And they were still electronic. They were just on tablets. So then we could have whole sets of procedures on an electronic tablet. And the nice thing about that is then the same feel and look at the operator would see in an interface is what they see on the tablet, same place keeping, same -- so that way it wasn't a jarring. They moved from one --

(Simultaneous speaking.)

MEMBER CORRADINI: -- a three-ring binder is a tablet, an external --

(Simultaneous speaking.)

MR. FLAMAND: Correct. Yes. And now you can have 10 of those and have your entire procedure set.

MEMBER MARCH-LEUBA: The failure that happens here is reproduced on the tablet? That's what you're saying?

MR. FLAMAND: Say that again, please?

MEMBER MARCH-LEUBA: The same failure of your software that is happening on this screen is reproduced on the tablet?

MR. FLAMAND; Well, the tablet is not connected to the HSI. They're separate.

MEMBER MARCH-LEUBA: But it's a logic failure where the programmers messed up?

MR. BOWMAN: Well, we do have --

CO-CHAIR BLEY: I mean, if they have the procedure -- and if it's a procedure, it can be in black and white or it can --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: No, it's a failure to implement it. I mean, it's a quality control --

MR. BOWMAN: But for example -- I'll give you an example: We do have a paper procedure available. The paper procedure is the loss of I&C, because if you lose that, you don't have access to

this. So where appropriate we do have paper backup procedures.

MEMBER MARCH-LEUBA: Why not have them all on paper? It's just been too -- a little obstinate.

MEMBER BROWN: What did you call these? The tablets, whatever the latest winkle is for these little doohickeys?

MR. FLAMAND: Yes.

MEMBER BROWN: You can tell I don't have one. They're not really paper?

MEMBER MARCH-LEUBA: Similar to your phone.

MEMBER BROWN: 2002 cell phone. It works. They're not paper? There's no paper is what you're telling me. They're written in tablets?

MR. BOWMAN: No, no. There is some paper where appropriate.

MEMBER BROWN: Oh, okay. All right.

MR. BOWMAN: For example, the loss of I&C --

MEMBER BROWN: I got lost in that iteration back and forth here with the --

MR. BOWMAN: For example, the loss of I&C procedure is on paper because when you lose I&C, you

don't have access to these procedures in the HSI anymore. So it's then appropriate to have --

MEMBER BROWN: Yes, but you've got the tablet.

MR. BOWMAN: We could use the tablet, but in this case it might be easier just to turn around and grab the paper procedure.

MEMBER BROWN: It's much easier to look at pages than turning back and forth.

CO-CHAIR BLEY: Depends your generation, right?

MR. FLAMAND: Depends on your generation.

CO-CHAIR BLEY: But when you go to the tablet wherein the big board, the normal system it says as the following three functions achieved and it will tell you yes, they are. You don't have that on the tablet, correct? You have to go find it yourself?

MR. FLAMAND: You're not communicating with the HSI, so you --

CO-CHAIR BLEY: At all?

MR. FLAMAND: So for instance; and Doug talked about this earlier, one of the reasons of the STA to go look for things separate was, one, to try to address the issue of a problem on the HSI, a software problem. That's another backup. Another could be if

all the -- if the system's gone, I have a way to still address the critical safety functions manually. And then of course there is a paper version of the critical safety -- of the emergency operating procedures. So that would be one of the few set of paper procedures available.

CO-CHAIR BLEY: in your test programs have you run at least some kind of simulation on every emergency operating procedure?

MR. BOWMAN: We have gone through -- we did not get through every branch in the simulator. We have on tabletops on everything in the emergency ops. Every branch --

CO-CHAIR BLEY: Have you exercised them all? The reason I ask is, out in the operating fleet, we've done a pretty good job of that. Somewhere people have exercised all of them. And then, we came up with the shutdown emergency procedures and thought we were really smart. And I was doing some work with one of the plants that had done that, and we started running events, and procedures had all kinds of dead-ends in them that the guy who wrote them never thought of. If you don't exercise them, you don't know they're going to work, even for the things you've thought of, let alone the things that we talked about.

MR. BOWMAN: So, my background was you had to go through every branch of the procedure to validate it. So, that effort, the open item in Chapter 13 about validation of the GTGs --

CO-CHAIR BLEY: So, you will do that?

MR. BOWMAN: Yes.

MEMBER CORRADINI: What open item is that?

MR. BOWMAN: The Chapter 13 one about the validation of --

MEMBER CORRADINI: The 13.5.1?

MR. BOWMAN: -- the Generic Technical Guidelines. I think it's 13.5.1, yes.

MEMBER CORRADINI: Okay, fine.

MR. BOWMAN: Yes.

MEMBER CORRADINI: All right. Thank you. Thanks.

MR. BOWMAN: That's what we need to do.

CO-CHAIR BLEY: Okay. And that part of testing you have not done?

MR. BOWMAN: We've actually completed it. We just haven't written the report on it yet.

CO-CHAIR BLEY: Oh, okay. So, that's --

MR. BOWMAN: So, in Integrated System Validation, we were able to complete a large majority of that work of getting through the emergency

operating procedures. So, we took credit for that.

CO-CHAIR BLEY: And then, you had a few more?

MR. BOWMAN: We had a few more that we had to clean up.

CO-CHAIR BLEY: Okay.

MR. BOWMAN: Okay. So, human factors verification and validation. This is where we get into that Integrated System Validation. We all talk about Integrated System Validation as V&V, but there's several other elements to V&V and human factors engineering design.

Design verification would be one of those. So, those activities were conducted between August of 2017 and July of 2018. And then, we did actual Integrated System Validation testing performed with the crews from July 23rd, 2018 through September 6th, 2018.

So, we had three crews of operators. They were selected to participate in the training program to qualify them as ISV Certified Training Operators. So, unlike the training we did for staffing plan validation, which was limited, this looked more like a full-blown certification program, five and a half months of training. Both classroom and simulator

training was done for the operators. These people were brought in mostly from outside of our company and were independent from our HSI design group.

MR. FLAMAND: I'd just like to make one point since we're talking about this topic. One of the specific things we were looking for, when we brought this group of people in, is who would be the operators, what would be the dynamics of operators at a future NuScale plant. So, there was a large cross-section of experience, you know, younger experience. And that was on purpose, so that we could get a wide range of who we thought -- you know, they might get a license operator upgrade or you might get someone through the Navy. And we had all of those kind of backgrounds involved.

MR. BOWMAN: Yes, we had people directly from engineering school, directly out of the Navy. Some had been non-licensed operators at other facilities. Some had been licensed operators at other facilities. So, we had a mix of just everybody we thought would be in a program.

MEMBER SKILLMAN: Was there a proportion of those that washed out?

MR. BOWMAN: We did not wash anybody out. We did lose people along the way. They were contract

staff, and in some cases some chose to take other jobs along the way.

MEMBER SKILLMAN: Okay.

MR. TOVAR: I'll correct that. We did --

MR. BOWMAN: Oh, I'm sorry, yes.

MR. TOVAR: We did terminate two individuals, and then, we had additional individuals that left on their own choice.

MEMBER SKILLMAN: Thank you.

MR. TOVAR: Yes.

MR. BOWMAN: So, the overall conclusion of Integrated System Validation testing, although this is staff a draft topic, is that NuScale's control and design staffing plan supports safe operation of a NuScale plant.

So, the V&V RSR is an open item from the Chapter 18 SER. It's more than one open item. It's many open items in Chapter 18.

The V&V RSR, Results Summary Report, will be submitted by the end of March 2019. We completed two trials for 12 scenarios. So, we had three different crews, and we cycled those crews through these two different trials. So, we rotated them through, and all the crews saw some portion of the testing.

During those 24 total scenarios, we collected 8,000 total data points. We created and wrote 32 human engineering discrepancies. We have three categories. We had no Priority 1s, nine Priority 2s, and 23 Priority 3s.

I'll let Ryan talk quickly about priorities.

MR. FLAMAND: Yes, what does that mean to us? A Priority 1 would be a safety-significant-type action. So, if we found something that potentially an important action couldn't be performed, that would probably fall under that priority. Priority 2 is more operation of the plant or operability of equipment. Priority 3 is basically, hey, it doesn't fall into safety, it doesn't really fall into operation of the plant.

So, you can see we had a lot of Priority 3s. Those are things that were typically we saw performance that could be better, but it wouldn't have affected the plant safety or operations.

CO-CHAIR BLEY: So, the HEDs, the human engineering discrepancies, they are things, when you did the testing, you said, "That isn't what we expected," or something like that?

MR. FLAMAND: Right.

CO-CHAIR BLEY: Is that where they came from? I didn't see that well laid out, where they came from.

MR. BOWMAN: And you probably really won't see them until the Results Summary Report come out.

Yes, most of our stuff was, most of the items were gathered as -- would have started out potentially as feedback from the operators or from the observers.

CO-CHAIR BLEY: Okay. So, maybe not the testing itself, but the operator said, "This is something that was" --

MR. BOWMAN: It could have been a testing problem as well.

CO-CHAIR BLEY: Okay.

MR. BOWMAN: But, yes, most of what we wrote up as human engineering discrepancies are: this procedure step doesn't work the way I like it to work.

CO-CHAIR BLEY: Okay. So, they were kind of reports from the people trying to use them?

MR. BOWMAN: Or this human-system interface, I don't like the way this is laid out. I'd rather have it laid out this way.

CO-CHAIR BLEY: Okay. And those, if they were Priority 1s, your goal was to fix them

MR. BOWMAN: We had to fix before we finished the RSR.

CO-CHAIR BLEY: Okay. And fixing was a design change usually or --

MR. BOWMAN: Results Summary Report.

It could be a design change. It could be a procedure change. It could be a human-system interface change.

CO-CHAIR BLEY: Okay. If the procedure wasn't working right, yes. Okay.

MR. BOWMAN: You could have even potentially addressed it as a training item.

CO-CHAIR BLEY: So, when we see -- is it the report on the ISV --

MR. BOWMAN: Yes.

CO-CHAIR BLEY: -- where we'll see these delineated --

MR. BOWMAN: That's correct.

CO-CHAIR BLEY: -- and what you did about them?

MR. BOWMAN: Yes.

CO-CHAIR BLEY: Okay. And that will all be reviewed by the staff by the time we get back together on this. Okay. Thank you.

MEMBER SKILLMAN: Were the HEDs primarily

on the primary side or on the secondary side?

MR. FLAMAND: I don't know if I really categorize them primary or secondary.

MEMBER SKILLMAN: If they were over on the reactor side or over on the steam plant auxiliary side shooting a bogus signal into the primary?

MR. FLAMAND: No, they weren't really -- I wouldn't categorize them quite that way. It was more, a good example might be someone is using a startup procedure. And this is just an example. But they had maybe a wording issue or there was some clarification that the crew got through the scenario, but it just wasn't --

MEMBER SKILLMAN: Crisp?

MR. FLAMAND: -- efficient and crisp and clean. So, it's definitely something we wanted to fix. So, at the end of the day, the crew was able to get through startup, and then, we showed that, but there might be a piece to that that there was discussion on, or whatever.

And so, I do want to say, too, during this testing there is acceptance criteria. So, there's clean acceptance criteria as part of the test, and then, there's what we called performance measures. So, certain things that they would do. Workload is a

performance measure. That could have been a way an HED is generated.

The participants get asked certain questions. They might say, "Hey, my workload is really high, and that might have triggered us." So, maybe we saw nothing, you know, like it didn't really happen. I would say we pretty much saw everything. But, potentially, they could have reported a high workload, which, then, generated us to figure out, okay, why did that happen; where did that come up? Maybe it was because this procedure wasn't written well, and that's how we're going to fix it.

MEMBER SKILLMAN: I asked the question because it's hard to be operating at, say, 85 percent of power unless your secondary plant is absorbing 85 percent power by the reactor. So, sometimes you say the plant is not functioning, and the question is, which part of the plant is not functioning? Is it on the reactor side or condensate feedwater, or, you know, the turbine? What's going on over there? So, it takes the two.

MR. TOVAR: Yes, I think most of the human engineering deficiencies that we saw --

MEMBER SKILLMAN: Over on the primary side probably?

MR. TOVAR: Well, like were related to the human-system interface. Like, for example, the notification system for the alarms, cautions, and notifications. So, that would cross boundaries. If a caution came in and we didn't have an audio sound that was supposed to be there, or it was inconsistent, that may be like a human engineering deficiency, but it would cross boundaries, depending on where the caution came from. But it was part of the human-system interface and not really a plant-generated issue.

MEMBER SKILLMAN: Okay. Thank you.

MR. TOVAR: I did want to just throw out a couple items here. Cleanup. We said NRELAP was used in the simulator. It is actually RELAP. So, I just wanted to do that correction. We used RELAP5-3D, Studsvik S3R, Jay TOP, Merit, and Jay ELECTRIC as our modeling software.

One other thing we talked about was having data lost to the operators and getting confusing. In the Integrated System Validation, we didn't run into that as an issue with the operators losing data. If you had an overhead view of what the operator station looked like, they have four separate computer screens that they can put data on. And so, they became very

proficient at putting data up and accessing the data that they needed.

That was it.

MR. BOWMAN: A point on this slide, the important human actions integrated with some validation were completed with 70 percent margin of the time allowed; i.e., it took us 25 percent of the required time to complete the action on average.

MEMBER CORRADINI: So, these are the seven actions, five --

MR. BOWMAN: Only the two important human actions.

MEMBER CORRADINI: Oh, oh, oh, excuse me. The two that would solve the three -- okay.

MR. BOWMAN: That's correct.

Okay. Design implementation --

MEMBER SKILLMAN: Wait, wait, wait.

MR. BOWMAN: Go ahead.

MEMBER SKILLMAN: When you communicate that, that the operators completed those actions within 25 percent of 100 percent of the time that was necessary or required, is that telling you something about your design other than there's a lot of margin in the time that is allowed for the operator actions? Is that communicating something that needs to be

listened to?

MR. BOWMAN: That's all we're trying to communicate, is the fact that we have lots of time to complete those important human actions as well.

MEMBER SKILLMAN: Okay. Thank you.

CO-CHAIR BLEY: Can you be specific about margin to what? Your expectation or margin to damage or?

MR. BOWMAN: So, our PRA group did analysis for us that shows how long from the time the operator sees the queue to take that action until he needs to be done to be successful.

MEMBER CORRADINI: But I think what he's asking is, what state variable goes awry that creates the end time? In other words, if the time is two minutes, is it to get to, essentially, the fuel design criteria?

MR. BOWMAN: The best thing to do would be to walk you through an example. So, in a bypass LOCA, containment bypass LOCA, you have 90 minutes to get CVCS in service. That starts at a time whenever the operator --

MEMBER CORRADINI: We can do it later.

MR. BOWMAN: We can do it later. Sorry.

CO-CHAIR BLEY: Okay. So, we'll try to

remember that for the closed session.

MR. BOWMAN: We'll answer your question later. I hope this will answer your question.

MEMBER SKILLMAN: You said "minutes," not "seconds," right?

CO-CHAIR BLEY: We'll wait for the closed session.

MR. BOWMAN: I said -- no, I might have said "seconds". I don't know.

(Laughter.)

MEMBER CORRADINI: He didn't say anything.

MEMBER SKILLMAN: He didn't say that.

(Laughter.)

MR. BOWMAN: All right. We're pretty close anyway. So, let's finish this up.

Design implementation. So, this is an activity that happens in the future, right? Design implementation takes the design. Once we're done, we have a DCA-committed design, an approved design, and this will track the changes that are done to the design between what we did and what the COL eventually implements. And there is ITAAC that will confirm that.

So, COL items, there are three COL items in Chapter 18, one for the human performance

monitoring program, which is essentially a program that looks at how the operators are functioning within the HSI and reports on their performance, then takes corrective actions.

Also, one we already discussed about the non-licensed operator staffing.

And then, the training program and procedure development for the COL are addressed in Chapter 13, which we have previously covered.

Open items. So, there are a total of 23 open items in the SER. And as you asked earlier, 19 of those we believe will be closed by the submission of the V&V Results Summary Report. One will be closed when we complete a revision to the Human-System Interface Style Guide after the RSR is completed, the Results Summary Report is completed. One will be closed by the completion of the Chapter 7, 15, and 19 SERs. So, we're tied into those three chapters.

And then, the closure of the remaining two items are actively being pursued between the NRC and NuScale staff. One of them is related to the main control room and human-system interface ITAAC and its method of closure, and the second one is related to the remote shutdown station ITAAC.

And that's all I've got to discuss. Any

other questions?

CO-CHAIR BLEY: Nothing from the Committee?

MEMBER BROWN: Yes.

CO-CHAIR BLEY: Well, talk.

MEMBER BROWN: No, I thought you had something.

CO-CHAIR BLEY: I was going to send us on a break. Are you interfering with our break?

(Laughter.)

MEMBER BROWN: Do you want me to ask my question before the break?

CO-CHAIR BLEY: If you want to ask it.

MEMBER BROWN: Oh, okay. I just wanted to backtrack to the alarm avalanche routine where you talk about your alarms, cautions, and notices. And I went back through Chapter 7, and it talks about they're generated by the MCS and, then, presented to the operators in the main control room and remote shutdown station.

But there's nothing in either of the chapters which talks about how they're aggregated, what alarms. You talked about you all did an analysis of the alarms, but you didn't want -- unimportant alarms, but they're all important -- but critical

alarms to be masked by what I would call the trip-less-important or less-critical alarms. But there's nothing listing it. Who is going to develop that list and where is it? Are they specified now? Are they delineated or required by the DCA? It didn't sound like -- I could find no listing in any chapter of alarm aggregation. I only looked at three, the ones that had instrumentation in them.

MR. BOWMAN: We did do that alarm aggregation for the Integrated System Validation. So, we have those set of alarms that we built for Integrated System Validation, based off of those design documents. You know, what was put as an alarm, what was put as a caution, what was put as a notice within that model, meaning the control --

MEMBER BROWN: But how are they displayed for aggregation purposes? I mean, are the critical alarms displayed so the guy can see them, and the ones that are yellow are on some other panel somewhere where he doesn't have to look at them?

MR. BOWMAN: Every screen, if you look at this, the top of the screen --

MEMBER BROWN: My God, that's terrible.

(Laughter.)

You just lost it right there.

MR. BOWMAN: So, up at the top there's a red stop sign at the top left.

MEMBER BROWN: I can see the little red thing up in the upper right-hand corner.

MR. BOWMAN: Yes, but hold on.

MEMBER BROWN: I got it.

MR. BOWMAN: So, this one is on every screen. This top bar is on every screen. So, no matter what screen you have up, you always have an indication of how many alarms are happening. And again, the alarm --

MEMBER BROWN: That tells you how many?

MR. BOWMAN: That tells you how many also, yes.

CO-CHAIR BLEY: Well, that's very intelligible. I'm not cutting any slack here.

MR. TOVAR: It would be much, much more clear when you get into the actual control room to see this. It's displayed in multiple locations, but it's very clear to the operations individuals how many alarms they have, how many have cleared.

CO-CHAIR BLEY: If you want to talk about this more, let's wait until later.

MEMBER BROWN: This is for the closed session?

CO-CHAIR BLEY: Yes, there's some things I want to tell you, too, in the closed session.

MEMBER MARCH-LEUBA: Give me 20 seconds. I talk very fast.

CO-CHAIR BLEY: We know that.

(Laughter.)

MEMBER MARCH-LEUBA: Is it fair to say that your validation of your human operations is based on this alarm aggregation? And if you change the aggregation, you will have to rerun it?

MR. BOWMAN: We would have to evaluate it. I don't know that we would have to rerun it. It would depend on whether or not it impacted the results of ISV.

MEMBER MARCH-LEUBA: Okay. So, you plan to use it to validate?

MR. BOWMAN: Yes.

MEMBER MARCH-LEUBA: Just as well as you did with the hours?

(Laughter.)

CO-CHAIR BLEY: Okay. At this point --

MEMBER BROWN: Just one observation, so they can think about it while we break.

CO-CHAIR BLEY: You bet.

MEMBER BROWN: It's just, for those of you

who are nuclear operators, we spent a lot of time trying to make sure that there was nothing showing up red that didn't have to be paid attention to immediately. And the warnings were pretty much sublimated. They were kind of -- I won't say "out of mind," but they were out of -- we paid a lot of attention to that. And that's why I asked the question. I just look for some way, a visual way for the operators not to be distracted; that's all.

CO-CHAIR BLEY: We can come back and --

MEMBER BROWN: That's my thought process. That's all I wanted to get across during the break.

CO-CHAIR BLEY: That was a hammer. We're on break until 3:20.

(Whereupon, the foregoing matter went off the record at 3:03 p.m. and went back on the record at 3:21 p.m.)

CO-CHAIR BLEY: This SER feels to me like it's all process, meeting criteria from this NUREG, that NUREG. And it becomes very repetitious. It's really hard to read. And the technical meat is hidden under those things and never gets really brought out.

For example, there's no words that really explain to a reader, or a regulator I would think, how do the minimum staff actually control 12 reactors, and

why does it work? How does it work? Does it really work?

So, we're meeting lots of criteria, but I didn't see anything that really talked to the technical issues. But I look forward to your presentations, and we'll probably have some questions as you go forward.

Prosanta, I'll turn it over to you.

MEMBER SKILLMAN: Dennis?

CO-CHAIR BLEY: Yes?

MEMBER SKILLMAN: Just an issue of admin here. My version of the SE has "Official Use Only - Proprietary Information" at the top of each page. So, I'm wondering what environment we are in in this meeting as we, if you will, dig into this issue. Is this a proprietary session?

MR. SNODDERLY: This is Mike Snodderly from the staff.

So, Dick, that's partly my fault. When the staff first provides us the SE in a timely manner, they also send it to NuScale for them to do their proprietary designation. So, prior to that designation, we call it "proprietary". So, that's why it's labeled the way it is.

What I would suggest is that you proceed

with your question, and then, we'll ask NuScale or the staff to step in if they feel like you're going into an area, and we'll do it during the closed session. Does that sound fair?

CO-CHAIR BLEY: Yes, as long as it's okay with NuScale.

MR. SNODDERLY: Right. That's what I'm saying. I think they'll stop us from saying anything that --

CO-CHAIR BLEY: So, interrupt us if anything --

MR. SNODDERLY: Say, "Let's cover this in a closed session."

CO-CHAIR BLEY: I don't know where you stand on this.

MR. SNODDERLY: That's the version you have. That's the version that you guys --

CO-CHAIR BLEY: And it's proprietary because at this point it hadn't been reviewed to ensure --

MR. SNODDERLY: We're asking you to treat it as such until the staff --

CO-CHAIR BLEY: -- that it's not proprietary?

MR. CHOWDHURY: Wait. Please let me

chime-in here.

Again, let me introduce myself once again. I'm Prosanta Chowdhury. I'm the Project Manager for Chapter 18, the NuScale design certification application review.

And the staff will present the Chapter 18 Safety Evaluation at this meeting. And this is the phase 2 SER with Open Items.

To go back to your initial comment about the voluminous SE, this SE will be streamlined. The staff needed to document. We recognize the issue that you brought up. The staff documented everything that they needed to, so that they can go into the phase with no open items to clean it up. So, in phase 5 you'll see --

CO-CHAIR BLEY: I look forward to phase 5.

MR. CHOWDHURY: Yes. So, I want to clarify that.

Then, regarding the proprietary version, we initially provide any SE to the applicant as proprietary pending their verification of proprietary information and any factual errors. Once we receive confirmation that there is no proprietary, we list it publicly, or if there is proprietary, redact it and release it for the public.

For Chapter 18 SE, a redacted version has been released to the public. So, that portion does not have proprietary marking on any page at all. And both the ML numbers have been provided to ACRS staff.

So, maybe it's the timing issue that you didn't get to have that in your system, but we do have a redacted version for the purpose of this meeting. In the proprietary version, we do have proprietary information bracketed with bold paired brackets. So, please be aware of those.

CO-CHAIR BLEY: And if we should wander into that or ask you questions, please say, "That's proprietary. We can't go into it." But we'll have a closed session at the end --

MR. CHOWDHURY: We will.

CO-CHAIR BLEY: -- to cover both Chapter 13 and 18, if there are additional questions for the staff.

MR. CHOWDHURY: Sure.

CO-CHAIR BLEY: Thanks, Prosanta. Please go ahead.

MR. CHOWDHURY: Sure.

The technical staff we have today is Lauren Nist, next to me. And then, next to her is Dr. Brian Green, and then, Maurin Scheetz, and Dr. Amy

D'Agostino. And the lead Project Manager for this project is Greg Cranston. I wanted to recognize him.

With that, I'll turn it over to Lauren. She will be the key presenter, and then, the others will assist her in fulfilling. And they will provide you their credentials as well as the sections of the application that they have individually reviewed and coordinated.

Lauren?

MS. NIST: Good afternoon. As Prosanta said, I'm Lauren Nist, and I have been at the NRC -- can everyone hear me, by the way, or should I turn this microphone?

CO-CHAIR BLEY: Turn it towards you, please.

MS. NIST: Thank you.

CO-CHAIR BLEY: We have to have a good record.

MS. NIST: Thank you.

So, I've been working here now at the NRC for about four and a half years as a Human Factors Engineering Technical Reviewer and, also, as an Operator Licensing Examiner. Prior to joining the NRC staff, I worked also with Maurin at San Onofre Nuclear Generating Station in license operator requalification

training. And prior to that, I was also in the nuclear Navy, also on a target, the USS Nimitz, for about two and a half years and non-nuclear Navy prior to that on a destroyer.

So, that's my background, and introduce Brian Green.

MR. GREEN: Hi. I'm Brian Green. I've been with the NRC almost nine years now, almost all of it doing human factors work, both in NRO and in NRR. Prior to that, I was at the University of Buffalo where I studied trust in automation and human factors associated with aviation maintenance tasks.

MS. D'AGOSTINO: Hi. I'm Dr. Amy D'Agostino. I've been with the NRC since 2009. So, I'm coming up on 10 years. I work in the Office of Research, but I did a year-long rotation to NRO to help with this review. I'm a Human Factors Analyst. My background is I have my PhD in organizational and human factors psychology from the University of Connecticut.

MS. NIST: So, today we will discuss the purpose and scope of our review, the review activities that we've conducted thus far, the activities that we plan to complete in the near-term, areas of interest specific to our review, the status of the open items

discussed in our Safety Evaluation Report, and our plans for closing them.

Additionally, some of our colleagues who are reviewing Chapter 7, Instrumentation and Controls, of the application shared with us that there were some human factors-related questions that were raised during the Subcommittee meeting back in August. And so, we tried to address those questions in this presentation as well.

Also, before we move on, I'd like --

MEMBER BROWN: Will you highlight those?

MS. NIST: I can do that.

MEMBER BROWN: When you get there.

MS. NIST: Sure.

Before we move on, I'd actually like to address two of the questions that came up in the previous session. So, the first question I'd like to address has to do with the concept of ops, Concept of Operations Technical Report, and clarification of what it means for a document to be incorporated by reference and where you will find that information.

So, the concept of operations document that talks about the roles and responsibilities of the operators, methods of control, that document is incorporated by reference into DCD Tier 2. That means

it is essentially, even though it's in literally a separate paper, it is treated as the DCD Tier 2 --

CO-CHAIR BLEY: Where does it say that? Sometimes I see it spelled out. I didn't see it spelled out for this one.

MS. NIST: You know what is incorporated by reference by looking at Chapter 1. There's a section of Tier 2, Table 1.6-2, which shows you the technical reports that are part of the DCA.

CO-CHAIR BLEY: Thank you.

MS. NIST: And then, the Topical Reports are in Table 1.6-1.

That is different than going to Chapter 18 of the DCD and looking at the individual sections and seeing references listed. Those are just references. That does not mean --

CO-CHAIR BLEY: Yes, but somewhere in Chapter 18 one of the other reports actually is labeled "incorporated by reference".

MS. NIST: Well --

CO-CHAIR BLEY: There you go.

MS. NIST: You have to go to Chapter 1 to see what is actually incorporated and treated as part of the DCD.

The second question --

CO-CHAIR BLEY: And concepts of operations, RP-2015, or whatever it is, is incorporated by reference?

MS. NIST: Yes, sir.

CO-CHAIR BLEY: Okay. That makes me more comfortable.

MR. GREEN: I believe the acronym that's used to describe this document is simply CONOPS, and it's in the functional requirements analysis. There's a reference to the document in there.

CO-CHAIR BLEY: As CONOPS?

MR. GREEN: But it may not have been clear.

CO-CHAIR BLEY: Chapter 13, right, is -- never mind. To me, this is the real concept of operations. It's how you're going to operate the machine --

MR. GREEN: There's an overlap between the two.

CO-CHAIR BLEY: Yes.

MR. GREEN: It makes sense to consider it in both.

CO-CHAIR BLEY: And lack of overlap, too, yes.

Okay. Go ahead.

MS. NIST: And then, the second question

was from the Chapter 13 session that I'm going to let Maurin address, having to do with inspection of operating procedures at a site.

MS. SCHEETZ: So, you asked about when or how does the NRC staff review the plant-specific technical review guidelines and the emergency operating procedures.

So, the plant-specific technical review guidelines are submitted with a COL applicant and they're part of a procedure generation package. Those would be reviewed at the COL application level by the NRC staff using NUREG-0800, the Staff Review Plan.

CO-CHAIR BLEY: So, if another plant comes along, they would reference that COL, yes?

MS. SCHEETZ: If another COL comes along, they could submit their own plant-specific ones or --

CO-CHAIR BLEY: Or they could reference this --

MS. SCHEETZ: But I think the thought that they use NuScale's Generic Technical Guidelines to create their own plant-specific. How plant-specific that is depends on the COL.

And then, the emergency operating procedures are looked at in the NRC's Construction Inspection Program. So, that's during inspection as

we get closer to fuel loading, so that EOPs, emergency operating procedures, are expected to be very mature at that point. And the inspectors will go in using Inspection Procedure 42454, which is Part 52, Emergency Operating Procedures, which has very clear guidance for inspectors to look at the emergency operating procedures.

CO-CHAIR BLEY: Yes, and most of our existing plants, there's a wide range -- well, not a wide range -- there's a lot of differences in specifics, different set points, that sort of thing, as you go through the EOPs from one unit to another of the same general type. But, in most of those cases, they didn't stick to the design cert. They've done other things.

MS. SCHEETZ: I think when you talk about the operating reactors, emergency operating procedures came about at a later time, not --

CO-CHAIR BLEY: I wasn't talking about the operating plants.

MS. SCHEETZ: Okay.

CO-CHAIR BLEY: I was talking about ones that have come forward to get --

MS. SCHEETZ: To get design certifications?

CO-CHAIR BLEY: Yes.

MS. SCHEETZ: I can't answer that. I'm not --

CO-CHAIR BLEY: I told you what.

MS. SCHEETZ: Okay.

CO-CHAIR BLEY: Go ahead.

MS. SCHEETZ: I thought you were asking. I'm sorry.

CO-CHAIR BLEY: So, in this case, people come in and use the actual design, replicate it. And then, one would expect that the procedures won't change very much because the reason they changed in the other cases was because there were design differences actually within the same general design cert.

Go ahead.

MS. SCHEETZ: That's all I have.

CO-CHAIR BLEY: So, when the applicant was up, they talked that they kind of expect all these plants to follow very closely. We see that. It could be that only the -- let me turn my question around.

They have a document that lays out, it has, essentially, a version of the procedures. If a COL comes along and adopts those essentially as is, would you have to review it again or would you just point to the design cert and say that it's a match?

Do you review them to the depth that you could say you've actually reviewed the proposed EOPs?

MS. SCHEETZ: I don't see any way out of not completing the inspection procedure for inspectors to look at the emergency operating procedures. So, my belief is that they would be reviewed by those inspectors at the as-constructed plant.

And in that procedure there's a lot of detail about how many of these procedures were actually table-topped or simulated in the simulator with the COL staff. So, not NuScale doing it as part of a different validation, but the COL at that point doing it.

CO-CHAIR BLEY: So, in the design cert, what we're doing now, you haven't reviewed that document that contains what might be the procedures for the first COL?

MS. SCHEETZ: No. We've looked at what's supposed to be used as generic technical information for a COL to base their emergency operating procedures on.

CO-CHAIR BLEY: I'm not saying this the way I'm trying to. You've reviewed that as generic?

MS. SCHEETZ: Generic.

CO-CHAIR BLEY: If I come in with an

application next year for a COL and say I'm going to use that exactly as written, would there be an additional review?

MS. SCHEETZ: Yes, there would be a review during the construction program.

CO-CHAIR BLEY: Even if they're using the same thing? Is that because you didn't review them at the level one would review it at the COL stage?

MS. SCHEETZ: Yes, I think that they're not going to be called -- I doubt that a COL -- I'm speculating. I doubt that a COL would be operating with generic technical guidelines. They'd be operating with emergency operating procedures, which are required in technical specifications. So, they're going to be looked at through the Technical Specifications Program, and then, the Construction Inspection Program.

MS. NIST: So, if I might add, what has been reviewed for within the scope of the design certification is the design certification element provided a document that can be used as the guidelines for the development of their site-specifics procedures.

When a COL applicant applies, then we have review criteria that we'll be reviewing, in part to

address the COL item provided in Section 13.5. And so, part of our review criteria would be to look and see if certain things have been provided and if they have sufficient process to develop site-specific emergency operating procedures.

Now what we're looking at here is -- correct me if I'm wrong -- adequacy of these guidelines as the basis for the development of the site-specific procedures. So, there would be additional review at the COL stage when the application comes in.

CO-CHAIR BLEY: Okay.

MS. NIST: And then, there's the inspection piece which happens prior to operation after the license is issued.

CO-CHAIR BLEY: I apologize that I haven't read the current document because I didn't know it was there until today. I'll be reading it. But the way it was described is that, although it's guidelines, it's really essentially the procedures they expect a plant would use, and if you adopted it verbatim, I'm wondering why there would be another review. Is that because we didn't review them as if they were operating procedures today? Or is it something else? Does that question make sense to you? If it doesn't

make sense, just say so.

MS. NIST: I think what's confusing is -- so, you're basically asking, why is there a COL item if they're provided procedures, essentially?

CO-CHAIR BLEY: Well, I asked them that earlier. I mean, you heard their answer, I suppose. I don't know if you were here.

MS. NIST: I did hear the answer, and I can tell you, you know, that we've reviewed what's on the docket and what's been provided as generic technical guidelines to meet the scope of the DC review.

CO-CHAIR BLEY: Go ahead. Whoever is next, go ahead.

MS. NIST: That would be me.

(Laughter.)

Next slide, please.

So, the purpose of our human factors engineering review was to determine whether the human factors engineering design of the NuScale standard plant control room supports operators in the safe operation of the plant. Additionally, the Applicant requested that minimum licensed operator staffing requirements specific to the NuScale power plant design be adopted as requirements applicable to

licensees, referencing the NuScale power plant design certification in lieu of those stated in 10 CFR 50.54(m).

To provide a technical justification for its proposed operator staffing requirements, the Applicant conducted a staffing plan validation test, which they discussed previously, using personnel trained on NuScale operations to perform a set of challenging high workload scenarios in the 12-unit main control room simulator.

So, I'd also like to take this opportunity just to remind us that many of the specific details of the staffing plan validation tests were proprietary. And so, if we have a specific discussion about that, we will need to do that in the closed session.

To conduct our review and develop the Safety Evaluation, we reviewed the following parts of the application: we reviewed the application Tier 2, Chapter 18, as well as parts of Chapter 7, 15, and 19 that were related to human factors engineering topics.

Chapter 18 of the DCD also summarizes the numerous human factors engineering technical reports that were included with the application. These reports contain a description of the methods the Applicant used to conduct the various human factors

analyses and summaries of those results; a description of the human-system interfaces, or HSIs, available to the operators; the concepts of operations, which describes the roles and responsibilities of the control room operators and how they will interact with one another and use the HSIs to operate the plant; a description of the methods that the Applicant used to conduct and evaluate the staffing plan validation as well as the results. They also provided a description of the methods that they used to conduct the Integrated System Validation test.

As previously mentioned, the Applicant completed its Integrated System Validation testing in September of 2018, and they have informed us that they will provide us the results of that testing by the end of this March.

Additionally, we reviewed the information in Tier 1, Section 3.15, for human factors engineering, which includes design description as well as an ITAAC for human factors engineering.

Chapter 14 of the Safety Evaluation Report documents our review of the human factors engineering ITAAC. And there is some overlap with Chapter 18.

Our review activities also included several audits. And on the next slide, I'll discuss

in more detail what we did and what we observed and when we did it.

As discussed in the Chapter 18 Safety Evaluation Report, we used the guidance in NUREG-0711, HFE Program Review Model, and NUREG-0700, Human System Interface Design Review Guidelines, to evaluate the Applicant's HFE design and make our findings; in our Safety Evaluation documents, the current status of our review and the conclusions that we've made so far, as well as the open items.

Next slide, please.

So, one of the members asked that I point out a question from the Subcommittee. I think we attempted to address those here on that slide. But one of the questions was whether the staffing plan had been settled in the DCD or if it was a policy issue before the Commission. And the answer is that this particular issue is being addressed as part of this design certification review activity. That is in accordance with, this strategy is in accordance with the plan that was set forth in SECY-11-0098, where we informed the Commission that we would evaluate staffing proposals on a case-by-case basis using some of the guidance that had been developed specifically for that purpose.

CO-CHAIR BLEY: Did they issue an SER on that SECY?

MS. NIST: An SRM?

CO-CHAIR BLEY: Yes. Sorry.

MS. NIST: No, sir. It was an information paper.

CO-CHAIR BLEY: Okay.

MS. NIST: Also, someone had asked whether the design of the human-system interfaces were fixed. And the answer is basically yes, at the end of the design certification review, the HED design for the standard plant will be fixed by NuScale completing the activities related to verification and validation.

CO-CHAIR BLEY: So, when we see the V&V, verification and validation, report, we will see those details of what the panel looks like, how it's used, all the information?

MS. NIST: Well --

CO-CHAIR BLEY: I mean, I think this is important because -- well, you guys had a visit out there, right?

MS. NIST: Yes, at least one.

CO-CHAIR BLEY: Did you watch the simulator?

MS. NIST: Yes, we did.

CO-CHAIR BLEY: Did they run a whole series of things on it?

I'm still stuck with the two things that made that convincing to me, and those are not directly addressed here. One is the way the panel was laid out so that one person could really have an understanding of what was going wrong in particular units, if that started to happen, particular modules, and then, pass it off to others.

The other piece was the ability to easily put it into a safe state, so they didn't have to spend time monitoring it.

There aren't any words about that in the SER that I saw. To me, that's more convincing than saying, "We met all the criteria in NUREG so-and-so and the B&O report." And there's nothing there that tells me that you really paid attention to that.

MS. NIST: So, I think what we can do, because I think that we have that information there, but, unfortunately, like you said earlier, I don't think it's elevated in the document such that it's blinking light, you know, getting your attention, hoping to make a finding. So, we hear your feedback, and we thank you for.

I'll talk about this more at the end, but

we will be -- we need to recognize this is an interim product. And so, our review strategy, as I said a moment ago, we reviewed this guidance. And so, this guidance has a lot of guidance related to the overall HFE process. And so, we can talk about why we felt that it was necessary to review the process activities that ultimately led to the development of the HSI design.

But, having said that, we do realize that we need to, as we get the results, we need to tie that together into a way that ultimately supports our findings. And so, hearing your feedback is valuable to us to make sure that we rely on the information, and not only that we find it compelling from a process standpoint, but our observations, which are documented, maybe not necessarily in the SER, but in some of the audit reports -- and we can go back and look at that.

CO-CHAIR BLEY: Okay. I think that would be useful.

Maybe at some point we'll talk about schedule with the Applicant again. But there's a lot of open items here, but they don't depend on many sources. So, when you get a couple of these sources back, you'll be able to deal with them.

From what we've heard, they've done most of the tests they plan to do. Can you give me a hint of when you expect to hear from them and how long it's going to take you to go through? I think this section will be much more understandable once that work is done. But I am curious, how does the time line up with the time available?

MR. CHOWDHURY: Chapter 18 has identified 23 open items. I think 19 of them are related to the V&V RSR that the Applicant informed us would be submitted by March 31st.

CO-CHAIR BLEY: Okay.

MR. CHOWDHURY: So, here's what happens: it is that two things will happen. One is that we received Revision 2 of the design certification application in October. By that time, the staff had completed writing or drafting the SER. So, this SER is consistent with Revision 1 of the application.

Changes that have been made as a result of NuScale's own initiatives as well as in response to certain RAIs, Requests for Additional Information, those will be incorporated in the next version of the SE.

CO-CHAIR BLEY: Well, Rev. 2 is already posted on the NRC website.

MR. CHOWDHURY: That is correct, Rev. 2 of the application, the SE going into phase 5 --

CO-CHAIR BLEY: Ah, okay.

MR. CHOWDHURY: So, we think between this phase 3 that we are going through now and phase 4 this SE will be updated, revised, streamlined, as I mentioned before. And then, a clean product will be available by the end of the phase 4. I don't have the date right now, but the schedule. You know, we have a schedule of phase 4. I believe that's the end of this year, but I have to make sure that's correct. But, by phase 4, the SE will have no open items and be clean.

CO-CHAIR BLEY: Okay.

MR. CHOWDHURY: So, right now, we know that March 31st, the deadline that the Applicant wants to submit the Results Summary Report, it is important for us to meet the subsequent milestones of our SE.

CO-CHAIR BLEY: Okay.

MR. CHOWDHURY: So, we have not developed internal milestones because we want to make sure that we get that. And also, one RAI response is still pending, the response to RAI 9415. We are expecting it next week, also, or the end of this month. So, based on all of --

CO-CHAIR BLEY: So, it looks to be tracking?

MR. CHOWDHURY: Yes.

CO-CHAIR BLEY: I guess just one more comment on the SER. Since you based it on meeting the criteria in at least two NUREGs and the BNL-NUREG/CR, it's very repetitive. Because lots of those criteria are repetitive, it would be easier for almost anyone to read and understand if you could somehow merge those kind of things that are the same into one place and not repeat them many times.

MS. NIST: Right. So, we realize that, and that is going to be something that we will be paying attention to moving forward.

CO-CHAIR BLEY: What you said earlier, yes.

MS. NIST: I think part of this is an artifact of an intention to be very thorough in this review and be transparent about what we reviewed, why we looked at it. But, certainly, moving forward to the final product, we'll definitely take that into consideration and work for readability of the document.

CO-CHAIR BLEY: Thank you.

Go ahead.

MS. NIST: Okay. I think that actually we can --

MR. CHOWDHURY: Let me make one comment. On this slide, you will see the last bullet. It says, "Phase 4 activities in progress." So, what it means is that the staff has already started reconciling information that came in response to RAIs.

CO-CHAIR BLEY: Okay. And Chapter 10 is on V&V and is really loaded with them, yes.

MR. CHOWDHURY: Okay.

MS. NIST: Now I'd like to discuss the activities that we've completed in the course of our review of --

CO-CHAIR BLEY: I'm sorry?

MEMBER MARCH-LEUBA: Use the microphone.

MS. NIST: Okay. How's that? Okay. Thank you.

So, I'd like to discuss the activities that we've completed and what we're planning to do moving forward. As part of pre-application activities that started around the 2015 timeframe, we reviewed the Applicant's Human Factors engineering Implementation Plan which described their proposed means of conducting human factors analyses, developing the human-system interface design, and validating the

effectiveness of that design.

As part of that, we also reviewed their method for conducting the staffing plan validation, and we observed one of two weeks of the staffing plan validation testing. NuScale is the first applicant to conduct a staffing plan validation, and we're reviewing the staffing plan validation results for the first time.

As we discussed previously, we used two guidance documents to evaluate the Applicant's staffing plan validation methods and results. So, the first was NUREG-1791, Guidance for Assessing Exemption Requests, and the nuclear power plant license operator staffing requirements in 10 CFR 50.549(m). And the second is Attachment B of Chapter 18 of the standard review plan, "Methodology to Assess the Workload of Challenging Operational Conditions in Support of Minimum Staffing Level Reviews".

NUREG-1791 describes a process for systematically reviewing and evaluating alternative staffing plans. This process involves reviewing data and analyses from validation exercises that are performed to demonstrate the effectiveness and safety of a proposed staffing plan.

And Attachment B, Chapter 18, of the

standard review plan is based on the technical report that was prepared by Brookhaven National Laboratory. Its main focus is to provide a methodology for developing a sample of scenarios to be used specifically for this kind of a test to simulate challenging high workload scenarios. Key performance measures for the staffing plan validation include acceptable task performance, operator workload, and situation awareness.

As discussed in Chapter 18 of the Safety Evaluation Report, we concluded that the Applicant's method for performing the validation was consistent with this guidance. And, also, the results of the staffing plan validation shows that, for each of the scenarios, the operators completed all of the tasks within any specified time limits while maintaining workload and situation awareness within acceptable levels.

Additionally, as I mentioned, we went to observe one of the two weeks of testing. And we observed that the operators were able to complete all of the tasks in the scenarios. They maintained adequate situation awareness, and it appeared that their workload was very manageable.

The operators were able to use the

indications provided by the HSI to diagnose the scenario events in a timely manner and take appropriate actions. So, for example, one event resulted in an increase in megawatts and reactor power for one unit. The HSI or the displays and controls for the affected unit showed an increase in megawatts and reactor power. The operators identified the change in these parameters for the affected unit within seconds of the HSI providing the changes. And during this event, the operators also used other indications in the control room to confirm their diagnosis.

So, ultimately, we have concluded that the staffing plan validation results do validate the proposed staffing plan.

Following docketing of the application and the start of our review, we reviewed the Applicant's human factors engineering analyses, as summarized in the application. We also conducted two audits to review the results of those analyses.

Specifically, we reviewed a sample of the Applicant's operating experience review, their task analyses, and their function allocation results. We found that the Applicant completed those analyses that were necessary to identify the inputs to the human-

system interface design, and we found that those analyses were acceptable.

So, we also conducted an audit to review the Integrated System Validation Test Plan. And then, we went out to observe two of the seven weeks of the Integrated System Validation testing. We observed that the preliminary scenario results showed that the pass/fail criteria for the scenarios had been met and issues were being identified and documented for further analysis and evaluation by the Applicant. Issues were identified and documented, but the staff did not observe that there were any apparent significant human performance degradations as a result of the identified issued.

While we were observing the ISV testing, we also assessed a sample of the control room HSIs to confirm that the design complies with certain regulatory requirements for human-system interfaces and, also, that it conformed to their own design-specific human factors engineering design guidelines. For example, we compared a sample of the computer-based procedures to the relevant guidance in NUREG-0700 and found that they conformed to the guidance with a few minor exceptions, and that there was adequate justification for not conforming to all

of the guidelines.

We also observed the operators using the safety display and indication system to complete critical safety function checks following simulated unit trips. And we saw that the crew could complete those checks for all units in the time required by the Applicant's procedure.

Finally, when we receive it, we will review the Applicant's ISV and other validation results and update the Safety Evaluation Report. And in phase 4, we'll also be resolving the open items, which we'll discuss in more detail later.

Next slide, please.

In preparation for review of small modular reactor designs, the staff developed two guidance documents that identified potential human performance issues that were specific to small modular reactors. These were NUREG/CR-7126, Human Performance Issues Related to the Design and Operation of Small Modular Reactors, and NUREG/CR-7202, NRC Reviewer Aid for Evaluating the Human Performance Aspects Related to the Design and Operation of Small Modular Reactors.

Some of the potential human performance issues identified in these NUREGs were relevant to the NuScale design. And so, we considered them during our

review, and I'd like to share a few examples.

First, the design allows for operation of all units from a single-operator workstation. So, we were interested particularly to see what kinds of design features would help to prevent operators from taking actions intended for one unit on a different unit, or otherwise referred to as wrong unit errors.

We observed that the Applicant has used consistent and clear schemes for unit labeling on their displays that are used for monitoring and control. Also, the concept of operations defines the roles and responsibilities of the control room operators. The operators have different responsibilities for the different units, which can also help to prevent operating errors.

Additionally, although the human-systems interfaces at the operator workstations can be used to operate safety-related components, the operator must first deliberately operate the enable non-safety control switch and no automatic or manual safety actuation signals can be present. Operation of the enable non-safety control switch to allow operation of safety-related components from these operator workstations is only necessary under a limited set of conditions. Also, it is an action that is intended to

be controlled by procedures, and because it occurs in the control room within sight of the control room supervisor's workstation, it can also be overseen by the control room supervisor.

Additionally, if an event occurs on a given unit that requires actuation of a protective signal from the module protection system, the module protection system will position the safety equipment as necessary, regardless of the position of the enable non-safety control switch or the component.

Thus, we concluded that the HSI design features, the concept of operations, and the module protection system design features do help to minimize opportunities for, and consequences of, significant wrong unit errors.

We were also interested to see how the crew could manage the operation of up to 12 units from one single control room. For example, if multiple alarms are received at once for one unit, the HSI should help the operators identify the high-priority alarms and determine what actions, if necessary, are needed.

The NuScale Plant Notification System is designed with multiple features that allow operators to identify relatively higher-priority alarms and

determine how to respond. During the ISV audit that we conducted, we observed alarm prioritization, and we did not observe any cascading alarm conditions that impacted operator performance during those scenarios.

Additionally, as was discussed previously --

CO-CHAIR BLEY: Was that because of the nature of the drills you were watching or was it because of some aspect of the design of these modules?

MS. NIST: So both. The design, as Doug mentioned earlier, they've set up a tiered system to help prioritize and display the important alarms and priority to the operators. So, we observed, also, the operators using that system, interacting with that system. Of course, given the scenario, you would expect to have more alarms, depending on how significant the consequences are of that scenario other than others.

But we did, just from a sampling perspective, when we were trying to figure out when we wanted to go observe, we were interested specifically in observing scenarios where there would be relatively more action happening, so that we could observe what to us would be the more significant scenarios to see how operators were interacting with the system.

CO-CHAIR BLEY: I don't know if this kind of information is appropriate for the SER. Is it documented in a trip report or something? I don't see anything referred to. You know, the things you're telling me here are pretty important with the judgment that you're making in the SER.

MS. NIST: Yes, we refer to the audit report for the ISV audit.

CO-CHAIR BLEY: In the SER?

MS. NIST: Yes, we have.

CO-CHAIR BLEY: Which part?

MS. NIST: It would be --

CO-CHAIR BLEY: The staffing part?

MS. NIST: No. It would be in 18.10.

CO-CHAIR BLEY: 10, V&V. Okay.

MS. NIST: Yes. And the staffing plan validation audit also has an audit report that is also referenced in 18.5 of the SER.

Finally, the last point on this slide, speaking to novel HSI design features, we've observed that the Applicant has included novel HSIs in the control room. For example, one of these control room display designs, which is proprietary, is intended to help operators detect changes in unit status. And we were interested to see how operators use this display

during both the staffing plan validation and the Integrated System Validation testing, and whether it was effective. And we observed instances where this particular display was an effective tool to alert the operators promptly to changes in unit status.

Next slide, please.

We've talked to some extent today about this, but, again, there are several open items. The majority of those we expect to be able to close when we get the results of the validation testing.

There's one open item related to adequacy of the scope of the human factors engineering ITAAC, and we are working with NuScale to resolve that issue. There's also an open related to remote shutdown, as it's described in Chapter 7, and we'll be tracking the resolution of that issue to make sure that our SER is consistent with the way that that issue is resolved.

Also, the reviews for Chapter 7, 15, and 19 are happening at the same time as this review. Chapter 7 is much further along. But we will be monitoring the progress of those reviews to make sure that our conclusions are consistent with the conclusions in those Safety Evaluation Reports as they progress as well, since the information in those sections feeds directly into Chapter 18 in some cases.

And then, also, this is more of an administrative item. It's just to ensure that the HFE reports yet to be received are incorporated by reference into Tier 2.

Next slide, please.

So, in conclusion, to speak to what we've been able to determine thus far about the Applicant's HFE design and the proposed staffing plan, there was also the staffing plan validation testing does support the Applicant's proposed staffing plan. And we'll confirm if there were any staffing issues identified during ISV, that they've made any changes to that plan, if they were necessary.

Also, based on our observations of ISV tests, we expect that the ISV results will provide evidence that the HFE design adequately supports personnel in the safe operation of the plant. But, again, we do need to resolve the open items and complete our review of the validation and verification results prior to making our finding, which we will be doing in phase 4.

CO-CHAIR BLEY: I have a minor request. I guess we won't have another break. But, at some point in time, if you can flag to where those audit reports are referenced, it would be helpful.

MS. NIST: Sure.

CO-CHAIR BLEY: The references aren't at the end of every chapter. So, they must be scattered through. That would be helpful.

MS. D'AGOSTINO: The ISV audit is, if you look at page 18-142, the ML number is 1829A, or 298A189.

CO-CHAIR BLEY: There were more, though, right?

MS. D'AGOSTINO: Yes. That was the ISV audit, and there is the June 2018 audit as well.

CO-CHAIR BLEY: Oh, yes. Okay. And they're in ADAMS, so we can find them.

MS. D'AGOSTINO: Yes.

CO-CHAIR BLEY: Okay. Thank you.

MS. D'AGOSTINO: ML 18208A370.

MR. GREEN: Was that the staffing plan validation? I think he was looking for that one as well.

MS. D'AGOSTINO: No, they were just the two ISVs.

MR. GREEN: Okay.

CO-CHAIR BLEY: Thanks, Lauren.

MS. NIST: Sure.

CO-CHAIR BLEY: You don't need to give us

any more.

MS. D'AGOSTINO: Okay.

CO-CHAIR BLEY: We can find them now.

MS. NIST: Thank you. That concludes our prepared remarks.

CO-CHAIR BLEY: On everything?

(Laughter.)

MS. NIST: I wanted to make sure we had plenty of time to address any questions.

CO-CHAIR BLEY: I guess I think I agree with you, a lot of the confusion comes from trying to get everything in here. Some of the judgments are probably laid out in your audit reports. It would be helpful to have some of that up in the SER, so you understand the engineering basis for some of the conclusions. I mean, it felt very checklist-oriented to me. "We met criterion 3. We met criterion 4." I find if the engineering judgments are in there, they're so buried among the other stuff, I couldn't find them or missed them.

MS. NIST: I understand.

CO-CHAIR BLEY: Anything from other members in the open session?

(No audible response.)

Raise your hand if you have questions for

the closed session.

Okay. Were there other things that we flagged for the closed session that you remember?

Okay. Oh, no, it's the open session. So, yes, get the phone line open.

And while we're waiting for the phone line, is there anybody in the room who would like to make a comment? If so, please come to the podium over here and state your name and who you represent, and give us your comment.

Don't be shy.

Okay. Is the phone line open?

If anybody on the public line is there, just say a word or two, so I can see if it's open, if there is anybody. We don't know yet.

PARTICIPANT: NuScale Corvallis is here, just so you know the line is open.

CO-CHAIR BLEY: Okay. So, NuScale's line is open.

MR. SNODDERLY: Yes. Yes, the NuScale line is always open.

CO-CHAIR BLEY: If there's anybody on the public line who would like to make comment, please give us your name and your comment.

(No audible response.)

Going, going. I guess not. Thank you.

MR. SNODDERLY: So, please close that open line. But keep the NuScale line open, but close the public line.

CO-CHAIR BLEY: I'll wait until we finish the closed session --

MR. SNODDERLY: And so, if the NuScale person is on the open line, hold there to make sure it is closed. If not, you'll tell us.

And then, as we go into closed session, I need to ask anyone from the public or from the staff that does not have a need to know to leave.

Prosanta and Steve, if you can help?

Okay. So, I think we're good.

All right. Once we verify the open line is closed, I think, yes, we can go into closed session.

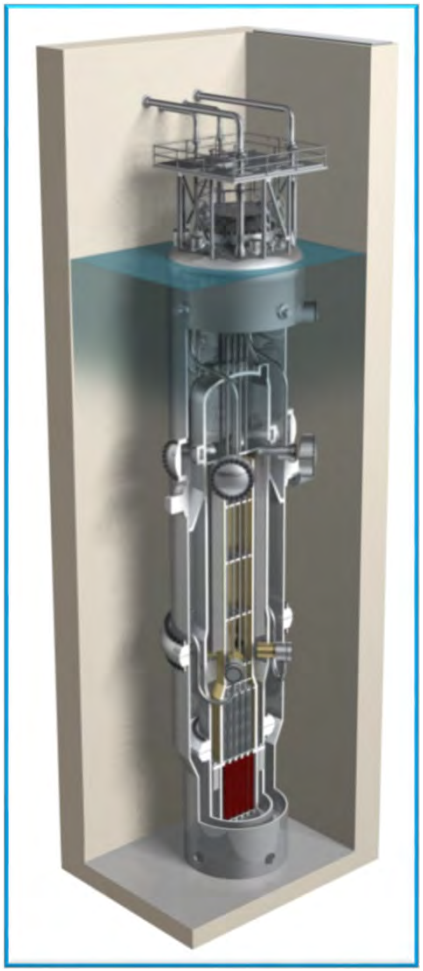
CO-CHAIR BLEY: Okay. So, is the NuScale person who was on the public line still there? If so, say something very loud, so we can hear you.

(No audible response.)

I guess it's closed.

(Whereupon, at 4:09 p.m., the foregoing matter recessed from open session and went into closed session.)

ACRS Presentation
Conduct of Operations
Chapter 13 Overview



January 23, 2019

Doug Bowman

Supervisor Plant Operations

PM-0119-64147
Revision: 0

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Template #: 0000-21727-F01 R4

Introductions

- Doug Bowman- Supervisor Plant Operations
- Ryan Flamand- Senior Reactor Operator 5

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Operations Staff

- 18 previously licensed SROs
- Licenses held at:
  - Byron
  - Columbia
  - DC Cook
  - Limerick
  - Nine Mile Point
  - Palisades
  - HB Robinson
  - Seabrook
- 569 years of nuclear experience
- 16 Navy nuclear veterans

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Conduct of Operations – Chapter 13

Primarily a collection of action items for a Combined Operating License holder to describe the structure of the organizations and programs supporting plant operations, as well as the qualification of the individuals in the organizations.

Security and FFD programs covered separately.

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Organizational structure

Section 13.1 includes COL actions to describe:

- corporate or home office management and technical support organization
- onsite operations organization
- qualification requirements for each management, operating, technical, and maintenance position described in the operating organization

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Training programs

Section 13.2 includes COL actions for a description and schedule for:

- initial license training program for reactor operators and senior reactor operators
- licensed operator requalification program
- initial training, periodic retraining, and qualification(s):
  - non-licensed operators
  - shift supervisors
  - shift technical advisors
  - I&C technicians
  - electrical maintenance personnel
  - mechanical maintenance personnel
  - radiological protection technicians
  - chemistry technicians
  - engineering support personnel

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Emergency Plan

Section 13.3 describes the emergency facilities included in the standard plant design. This includes:

- TSC – including the following associated systems
  - Ventilation systems
  - Communications systems
  - TSC workstations
- Emergency response data systems

This section also includes 3 COL actions that require development of:

1) operations support center
2) emergency offsite facility
3) the overall emergency plan

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Operational programs

Section 13.4 includes COL actions to provide site-specific information, including implementation schedule:

- Pre-service and In-service testing and inspection
- Environmental Qualification
- Fire protection
- Containment leak rate
- Process and Effluent monitoring and sampling
- Radiation protection
- Training
- Process control
- Emergency planning
- Security
- Quality Assurance
- Motor operated valve
- Maintenance Rule
- Initial test

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Plant Procedures

Section 13.5 includes COL actions to provide a description of and a plan for the development, implementation and control of the following procedure areas:

- administrative procedures
- operations and maintenance procedures
- plant radiation protection procedures
- emergency preparedness procedures
- calibration and test procedures
- chemical-radiochemical control procedures
- radioactive waste management procedures
- maintenance and modification procedures
- material control procedures
- plant security procedures

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Plant Procedures – Generic Technical Guidance

Section 13.5 also includes COL actions to ensure that plant specific emergency operating procedures are developed

The staff requested that we provide a set of generic technical guidelines as part of the DCA

Goals for development:

- Symptom based procedure
- Status easily assessed by the operator
- Fully integrated into the HSI
- A single procedure set addresses all post accident actions (covers the legacy emergency operating procedure, severe accident management, LOLA/ELAP/extensive damage mitigation)

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Plant Procedures – Generic Technical Guidance

How did NuScale start development of the GTGs?

Source document	Credited Actions
FSAR Chapter 7 I&C failure defense in depth analysis	0
FSAR Chapter 15 plant design basis response to DBE's	0
FSAR Chapter 18 HFE task analysis and associated reference	0
FSAR Chapter 19 operator actions assumed in beyond-design-basis PRA	7
FSAR Chapter 20 operator actions assumed in beyond-design-basis evaluations	2
FSAR Chapter 21 multi-unit design considerations	0
System requirements and limitations as defined in system description documents	0

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Acronyms

CFDS- containment flooding and drain system

COL- combined license

CVCS- chemical and volume control system

DCA- Design Certification Application

DBE- design basis event

ECCS- emergency core cooling system

ELAP- extended loss of AC power

FFD- fitness-for-duty

FSAR- Final Safety Analysis Report

GTG- Generic Technical Guidelines

HFE- human factors engineering

HSI- human system-interface

I&C- instrumentation and control

IHA- important human action

LOLA- loss of large areas

PRA-probabilistic risk assessment

TSC- technical support center

SRO- Senior Reactor Operator

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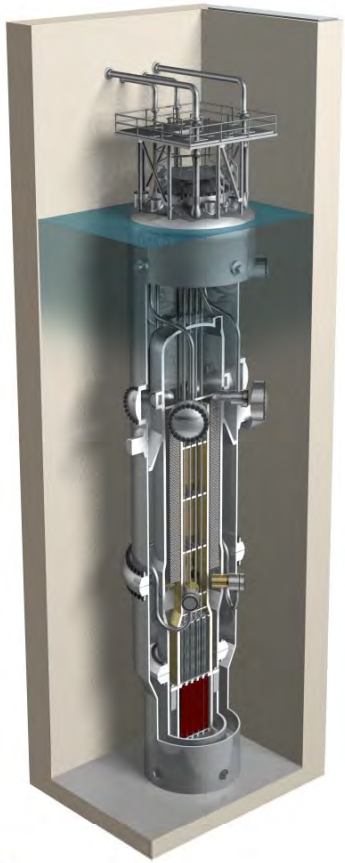

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Safety Evaluation with Open Items: Ch 13, Conduct of Operations

NuScale Design Certification Application Review

ACRS Subcommittee Meeting

January 23, 2019

Agenda

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

- NRC staff review team
- Purpose and scope
- Review activities and timeline
- Focus areas
- Open items
- Conclusion

NRC Staff Review Team

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

- **Technical Staff Presenters**
  - Maurin Scheetz, NRR – DCA Sections 13.1, 13.2, 13.5
  - Amanda Marshall, NSIR – DCA Section 13.3
  - Prosanta Chowdhury, NRO – DCA Section 13.4

- **Project Managers**
  - Greg Cranston – Lead Project Manager
  - Prosanta Chowdhury – Chapter 13 Project Manager

Overview of Chapter 13

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

Section	Description
13.1	**Organizational Structure** – contains COL items which require the COL applicant to develop the management and tech support organizational structure including design, construction, operating, and maintenance responsibilities. This includes the qualification requirements such as education, training, and experience for each position.
13.2	**Training** – contains COL items which require the COL applicant to develop the description and schedule of the training program for licensed reactor operators and non-licensed plant staff.
13.3	**Emergency Planning** – contains a description of design-related emergency planning features, such as the Technical Support Center, as well as COL Items pertaining to emergency planning.
13.4	**Operational Programs** – contains a COL item which requires a COL applicant to provide site-specific information, including implementation schedule, for operational programs.
13.5	**Plant Procedures** – contains COL items which require the COL applicant to describe the admin & operating procedures for all operational modes, and a schedule for preparing the procedures.

Technical Topics
Section 13.1 – Organizational Structure

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

Scope of Review

- The purpose of this section is to provide assurance that the applicant has established acceptable COL Information Items pertaining to the corporate-level management, technical support and onsite operating organizations necessary for the safe design, construction, testing and operation of the nuclear plant, including training and qualification requirements. That is, the COL applicant will have the necessary managerial and technical resources to support the plant staff in construction, operation, maintenance, and in the event of an emergency.

Focus Areas

- Three COL information items are provided, COL 13.1-1 through 13.1-3. Staff found that the COL information items appropriately identified and sufficiently addressed the required information.

Open Items

- None

Conclusion

- The staff has reviewed DCA Part 2, Tier 2, Section 13.1, “Organization Structure,” and determined that the applicant’s approach for COL items describing the corporate-level management and technical support organization, and the onsite operating organization, is acceptable to meet all applicable requirements.

Technical Topics
Section 13.2 – Training

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

Scope of Review

- The purpose of this section is to provide assurance that the applicant has established acceptable COL Information Items pertaining to a description of, and schedule for, (1) the licensed operator training program for reactor operators and senior reactor operators, including the licensed operator requalification program, and (2) the training program for the nonlicensed plant staff.

Focus Areas

- Two COL information items COL 13.2-1 and COL 13.2-2 are provided pertaining to a description and schedule of training programs for licensed and non-licensed staff.

Open Items

- None

Conclusion

- The staff has reviewed DCA Part 2, Tier 2, Section 13.2, “Training,” and determined that applicant’s approach for COL items for training programs is acceptable.

Technical Topics
Section 13.3 – Emergency Planning

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

Scope of Review

- The purpose of this section is to address those design features, facilities, functions, and equipment that are technically relevant to the design, that are not site specific, and that affect some aspect of emergency planning (EP) or the capability of a licensee to cope with plant emergencies. The applicant may choose the extent to which the application includes EP features to be reviewed as part of the design certification.

Focus Areas

- Technical Support Center (TSC)
- Emergency Response Data System
- TSC Engineering Workstations
- Decontamination Facilities
- Process Sampling System (Post-Accident Sampling function)
- Operations Support Center (COL Item 13.3-1)
- Emergency Operations Facility (COL Item 13.3-2)
- Emergency Plan (COL Item 13.3-3)
- EP ITAAC (COL Item 14.3-1)

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

Open Items

- **Open Item 13.3-1 – Process Sampling System**
  - DCA Part 2, Tier 2, Section, 9.3.2, states that "[t]he function of the process sampling system (PSS) is to provide the means to obtain representative liquid and gaseous samples from various primary and secondary process streams and components for monitoring and analyzing the chemical and radiochemical conditions. The PSS capability is used during normal plant operations and following accident conditions without the need for a dedicated post-accident sampling system."
  - The capability to obtain a post-accident sample is an interface item between SRP Section 9.3.2, "Process Sampling Systems," and SRP Section 13.3.
  - Resolution is ongoing: If the process sampling system is determined to be acceptable as a means for obtaining a post-accident sample in accordance with 10 CFR 50.34(f)(2)(vii) and (viii), then this open item will be resolved.

Conclusion

- With the exception of Open Item 13.3-1, the staff concludes, on the basis of its review of the EP design-related features included in the DCA, that the applicant has met the applicable regulatory requirements.

Technical Topics
Section 13.4 – Operational Programs

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Protecting People and the Environment

Scope of Review

- COL applicants are required by 10 CFR 52.79 to describe operational programs, but similar requirements do not exist for DCAs. Staff evaluated this section using Draft Revision 4 of SRP 13.4, which was published in September 2018, to ensure COL Information Item(s) include necessary requirements for COL applicants consistent with the SRP.

Focus Areas

- The applicant provided COL Item 13.4-1 stating that a COL applicant that references the NuScale Power Plant design certification will provide site-specific information, including implementation schedule, for operational programs.

Open Items

- None

Conclusion

- The staff has reviewed DCA Part 2 Tier 2, Section 13.4, “Operational Programs,” and determined that the COL Information Item is acceptable because the applicant appropriately directs the COL applicant to develop operational programs, consistent with the list in SRP Section 13.4, draft Rev. 4.

Technical Topics
Section 13.5 – Plant Procedures

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Protecting People and the Environment

Scope of Review

- The purpose of this section is to for the NRC staff to review the acceptability of COL information items for descriptions of plant procedures and the establishment of a program for development and implementation of plant procedures. The staff also reviewed the technical adequacy of the NuScale Generic Technical Guidelines (GTGs) for use as a basis for development of COL applicant Plant Specific Technical Guidelines (P-STGs).

Focus Areas

- Seven COL information items are provided, COL 13.5-1 through 13.5-5, 13.5-7, and 13.5-8 for plant procedures.
- The GTG review focused on (1) the three CSFs defined for the NuScale power plant, (2) the methodology used to identify operator actions, and (3) the CSF flowchart logic and operator actions necessary to assess and maintain the CSFs, including the bases.

Open Items

- The staff is unable to conclude that the NuScale GTGs are acceptable for use as a basis for the development of COL applicant P-STGs. This is contingent upon the achievement of satisfactory results from ISV testing and validation activities and the subsequent incorporation of any necessary changes to the GTGs and the associated PAM variables. This is being tracked as **Open Item 13.5-1**.

Conclusion

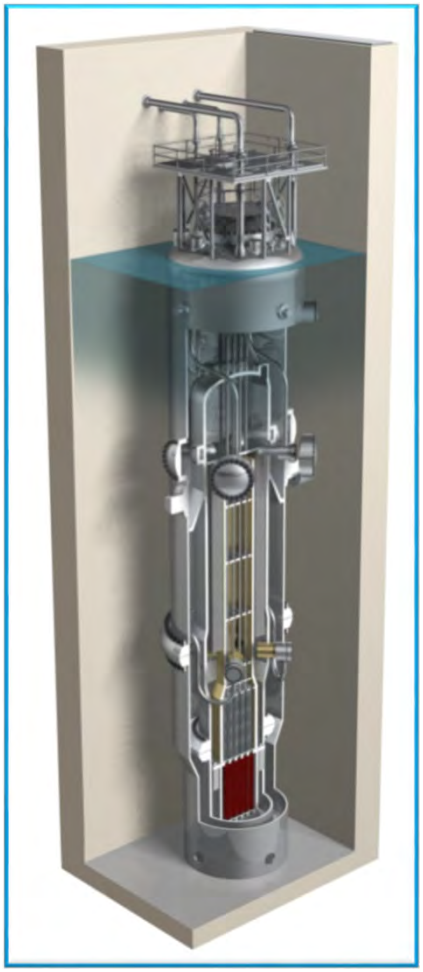
- The staff has reviewed DCA Part 2, Tier 2, Section 13.5, “Plant Procedures,” and determined that the COL Information Items the applicant provided are appropriate and acceptable. The staff will make a conclusion on the GTGs at a later time.

Acronyms

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

COL: Combined License
CSF: Critical Safety Function
DCA: Design Certification Application
EP: Emergency Planning
GTG: Generic Technical Guidelines
ISV: Integrated System Validation
ITAAC: inspections, tests, analyses, and acceptance criteria
OER: operating experience review
NRO: US NRC Office of New Reactors
NRR: US NRC Office of Nuclear Reactor Regulation
NSIR: US Office of Nuclear Security and Incident Response
PAM: Post Accident Monitoring
PSS: Process Sampling System
RES: US NRC Office of Research
TSC: Technical Support Center

ACRS Presentation
Human Factor Engineering
Chapter 18 Overview



January 23, 2019

Doug Bowman

Supervisor Plant Operations

PM-0119-64207
Revision: 0

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Template #: 0000-21727-F01 R4

Human Factors Engineering – NuScale goals

1. Integrate HFE into the development, design, and evaluation of the plant
   - Eliminate operator actions in the design basis
2. Provide an HFE design that facilitates the safe, efficient and reliable operation, maintenance, testing, inspection, and surveillance of the plant
   - Ensure an operator is able to quickly assess the status off all 12 units
3. Provide a state-of-the-art human factors design that satisfies regulatory requirements
   - Expand the use of automation for routine normal tasks to limit operator workload

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Operating Experience Review

- NuScale performed an extensive review of operating experience in the following industries and facilities:
  - Currently operating nuclear power plants
  - Nuclear facilities that do not produce power
  - Nonnuclear power plants
  - A U.S. military platform
  - The heath care, electrical distribution, airline industry
- The purpose of the review was to identify HFE-related safety issues and incorporate identified positive features in the NuScale plant design.

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Operating Experience Summary

Current Industry concerns and benefits:

- Alarm avalanche in the control room and the need to prioritize and control them.
  - Tiered alarm system – Alarm, Caution and Notice
- Operating multiple units from a single control room
  - SMEs with commercial plant experience from various disciplines at NuScale provided input to the initial staffing levels and bases.
  - Benchmarking at Bruce Power displayed the operation of four reactors in the same control room.
    - From this benchmarking trip, the concept of the control room supervisor as a resource manager and providing additional operators as a resource to the at the controls operator evolved.
  - Benchmarking at T. H. Wharton Gas Turbine generating station (a total of 17 gas and steam turbine units operating in both simple and combined cycle) operated by a single operator from a single control room.
    - From this benchmarking trip, the concept of a single operator in control of multiple units evolved.
    - Providing the operators with back up control stations and a thorough understanding of various I&C system failures and effects was important.

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Task Analysis

- Performed by SMEs – former commercial licensed operators.
- Provided the foundation for all procedures developed for SPV testing required to operate the plant.
- TA was the cornerstone for cognitive and performance based operator training that is required for S&Q.
- TA was essential to the HSI development and the V&V process.
- Used a software database that the nuclear industry currently uses to manage operator training programs.

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Treatment of Important Human Actions Results

Important Human Actions:

- The NuScale plant identified two risk-important human actions:
    1) Add water to the Reactor Coolant system with the Chemical and Volume Control system
    2) Add water to Containment with the Containment flood and drain system
- No deterministic-important human actions were identified by transient and accident analysis or by diversity and defense-in-depth coping analysis.

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Treatment of Important Human Actions Results

- The IHAs are utilized in three major beyond design basis accident conditions:
  - Containment Bypass event
  - ECCS failure of either all Reactor Vent valves or all Reactor recirc valves to open
  - Complete failure of the decay heat removal system and both reactor safety valves
- Both important human actions were sampled during staffing plan validation
- All human actions performed from the MCR assumed in the PRA were sampled during ISV

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Staffing and Qualifications Summary

- S&Q activities were based on the following NuScale design attributes:
  - no operator actions are required for design basis events.
  - the HSI design provides ‘at-a-glance’ assessment of plant conditions and facilitates early detection of degrading conditions.
  - one operator can have primary focus of maintaining a monitoring role during normal, abnormal, and emergency conditions.
- SPV verified that a NuScale power plant can be operated safely and reliably from a single control room by a contingent of:
  - three licensed reactor operators
  - three licensed senior reactor operators
- Non-Licensed operators
  - COL will address the staffing and qualifications of non-licensed operators.

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Staffing Plan Validation

- Performed August 2016
- Consisted of two crews of five NuScale Operations staff
  - Trained to perform the tasks necessary to accomplish the validation
  - Did not know the content or sequence of the scenarios

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Staffing Plan Validation

Scenario Tasks were sampled from the task analysis based on the following attributes:

- High risk
- High stress
- High consequence of inaccurate performance
- High cognitive or physical work load
- Requires communication outside of operations
- Abnormal, transient or severe conditions
- High time pressure
- Also sampled tasks with a high frequency (once a day or more)

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Staffing Plan Validation

- These tasks were grouped into three very challenging scenarios and each crew performed all three scenarios
- Testing methodology was based on NuScale's anticipated ISV testing methodology
- Observer and operator feedback was collected
- Task times were collected for those tasks that had time limits
- SPV successfully demonstrated that the NuScale design could be safely operated by the proposed staff.

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Human-System Interface Design Summary

- NuScale's integrated HSI design was developed by a multi-faceted HSI design team that brought unique skills and knowledge to the effort.
- FRA/FA, TIHA and TA results, tabletop activities helped the team develop the layout and construct the MCR simulator.

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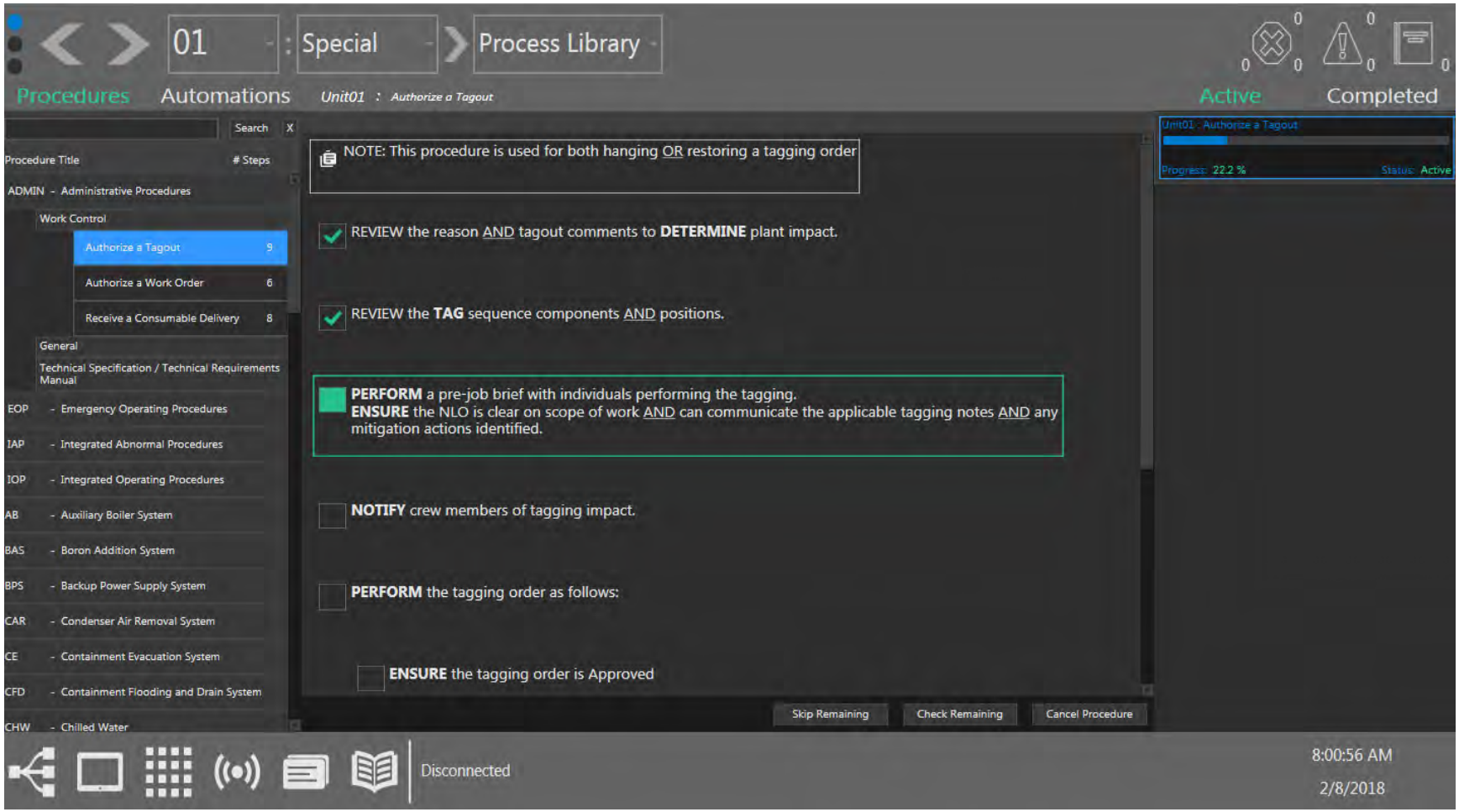
Human-System Interface Design Summary



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Human Factors Verification and Validation Summary

- Design verification activities were conducted between August 23, 2017 through July 23, 2018
- The NuScale ISV testing was performed from July 23, 2018 through September 6, 2018.
- Three crews of operators were selected to participate in a training program to qualify them as ISV-certified operators.
- This training primarily focused on technical design knowledge, but also stressed the importance of providing feedback during the ISV testing period.
- The overall conclusion of the testing is that the NuScale control room design and staffing plan support safe operation of the NuScale plant.

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Human Factors Verification and Validation Summary

- V&V RSR is an open item for the Chapter 18 SER.
- V&V RSR will be submitted by the end of March 2019
- Completed 2 trials for all 12 scenarios

  ~8000 total data points captured
- 32 HEDs
  - no Priority 1
  - 9 Priority 2
  - 23 Priority 3
- IHA actions completed with 72% margin of the time allowed

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Design Implementation Summary

- Completion of design implementation activities is tracked and confirmed by an ITAAC.
- This ensures that the as-built design conforms to the verified and validated design resulting from the HFE design process.
- After completion of start-up testing and provisional turn over, a licensee institutes a HPM program to evaluate impacts on human performance going forward.

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COL items

- A COL applicant that references the NuScale Power Plant design certification will provide a description of the HPM program in accordance with applicable NUREG-0711 or equivalent criteria.
- A COL applicant that references the NuScale Power Plant design certification will address the S&Q of non-licensed operators.
- The training program and procedure development for the COL are addressed in Chapter 13.

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Open items

- Total of 23 open items in the SER
- 19 will be closed by the V&V RSR
- 1 will be closed by completion of revision to HSI Style Guide
- 1 will be closed by completion of the Chapter 7, 15 and 19 SERs

Closure of the remaining 2 items are being actively being pursued between the NRC and NuScale staff

- RAI 9415 - MCR and HSI ITAAC and its method of closure
- RAI 9612 Remote Shutdown Station ITAAC

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Acronyms

- COL- combined license
- ECCS- emergency core cooling system
- FA- functional analysis
- FRA- functional requirements analysis
- HED- human engineering discrepancies
- HFE- human factors engineering
- HPM- human performance monitoring
- HSI- human system-interface
- I&C- instrument and controls
- IHA- important human action
- ISV- integrated system validation
- ITAAC- Inspections, Test, Analyses, and Acceptance Criteria
- MCR- main control room
- PRA- probabilistic risk assessment
- RSR- results summary report
- SER- safety evaluation report
- SME- subject matter expert
- SPV- staffing plan validation
- S&Q- staffing and qualification
- TA- task analysis
- TIHA- treatment of important human actions
- V&V- verification and validation

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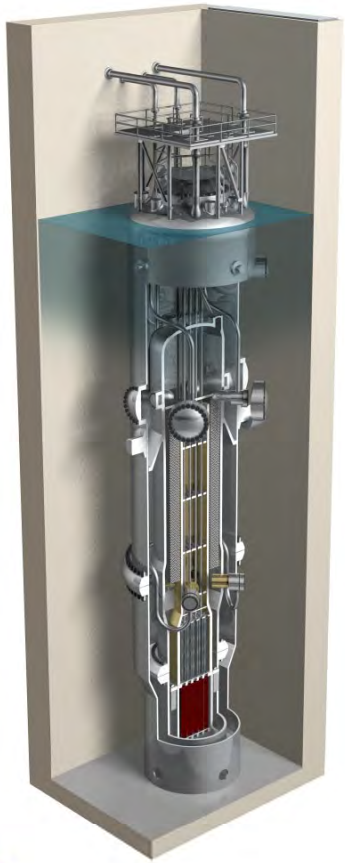

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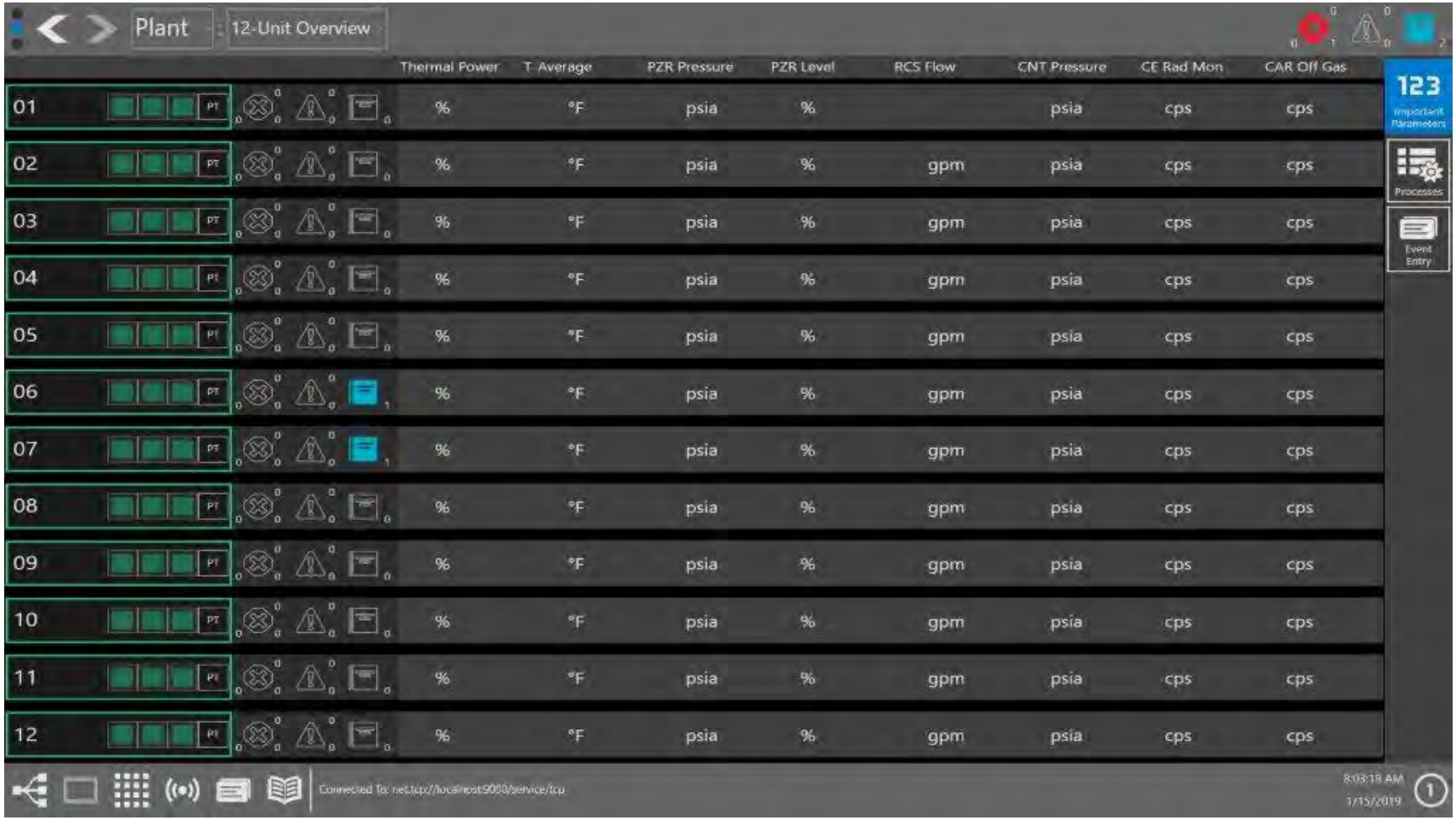

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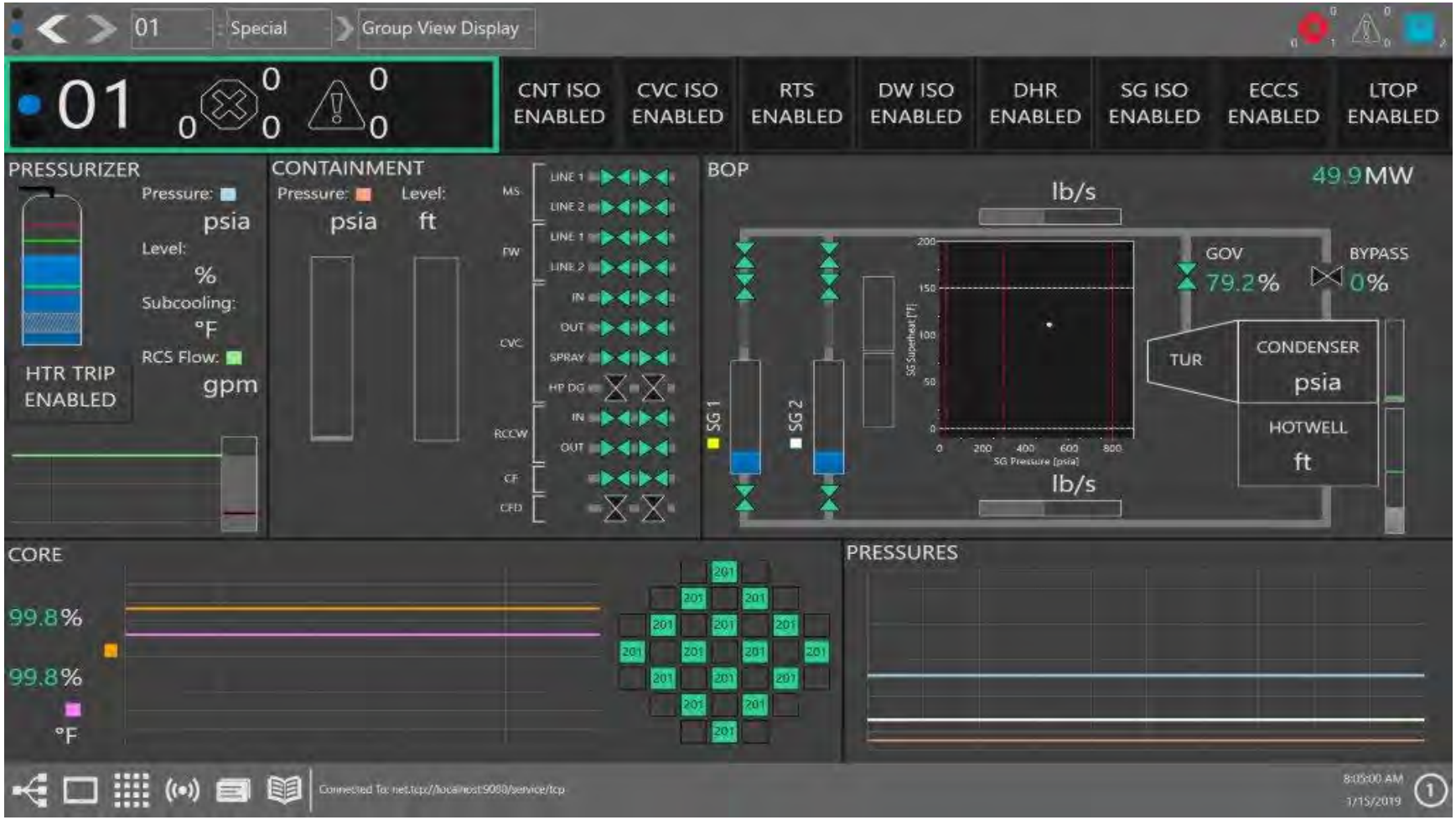

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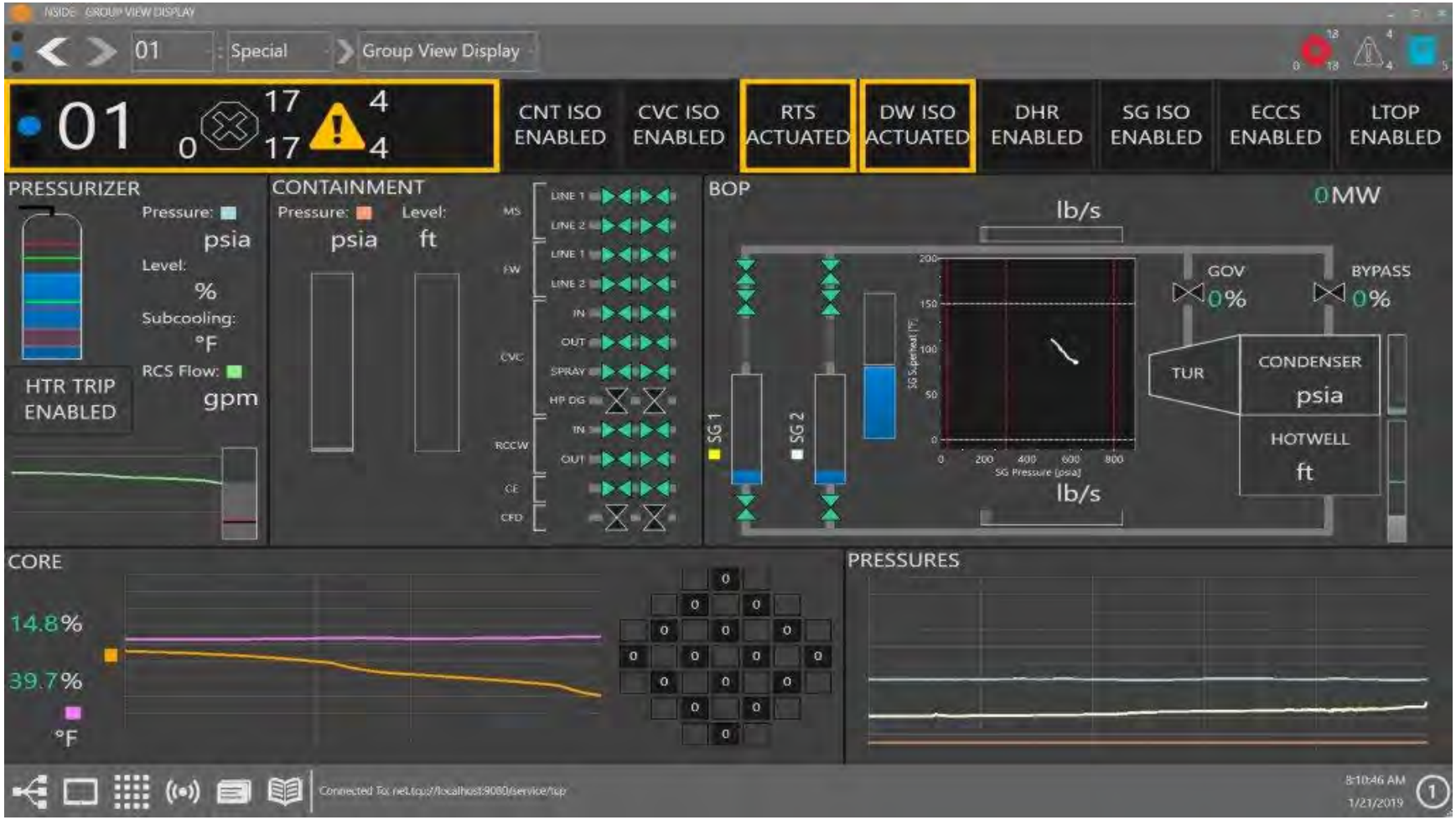

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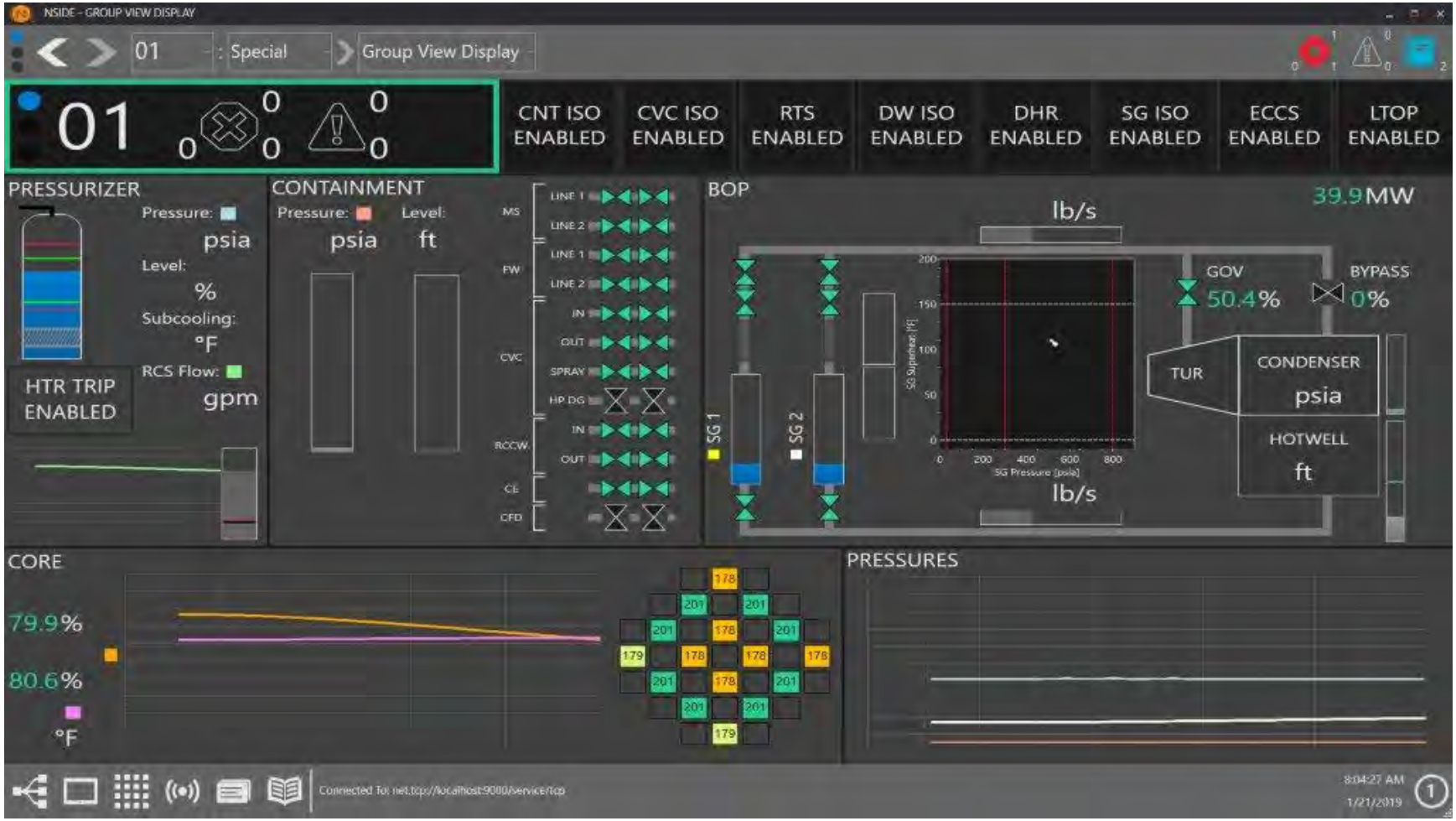

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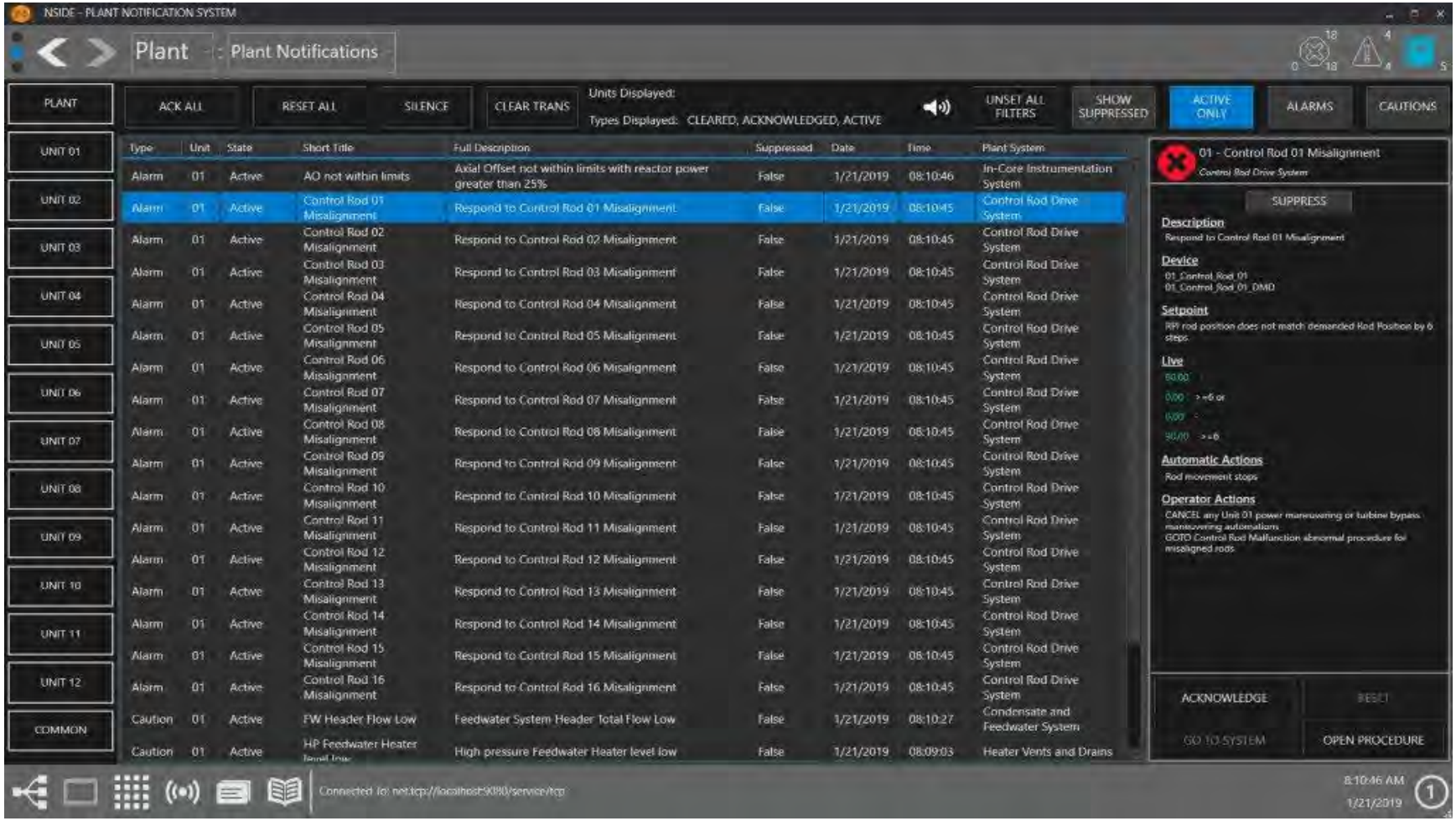

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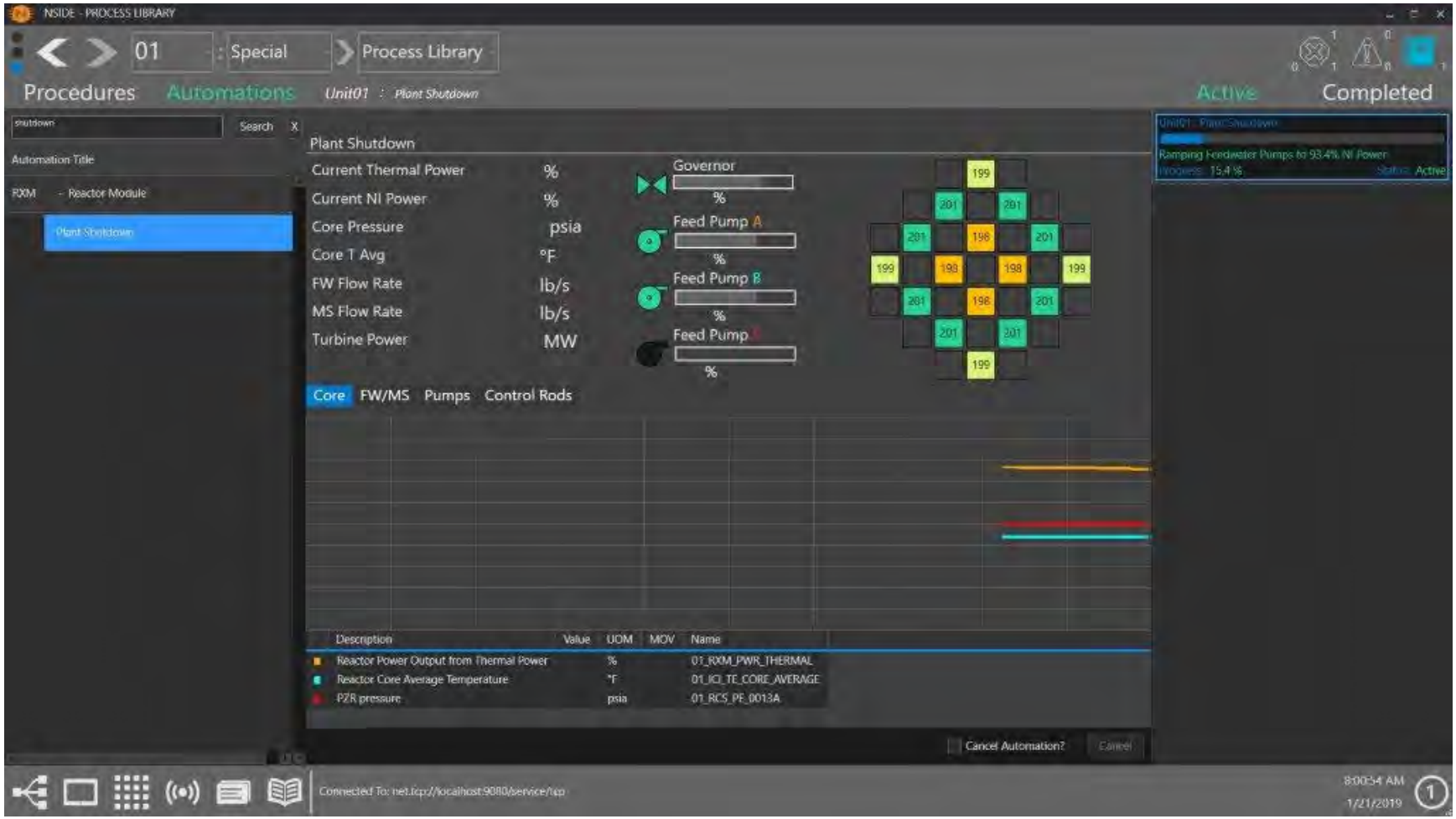

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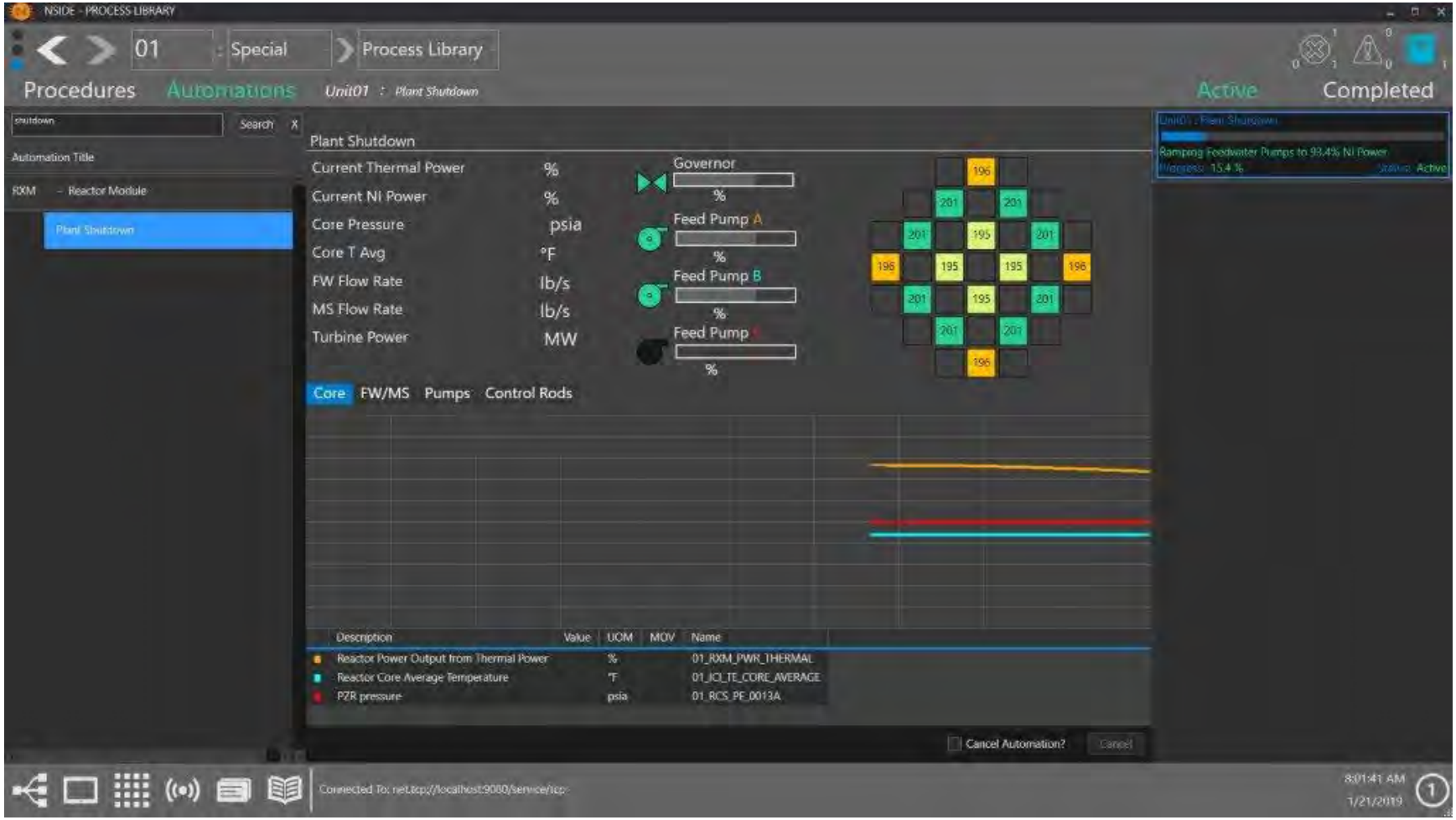

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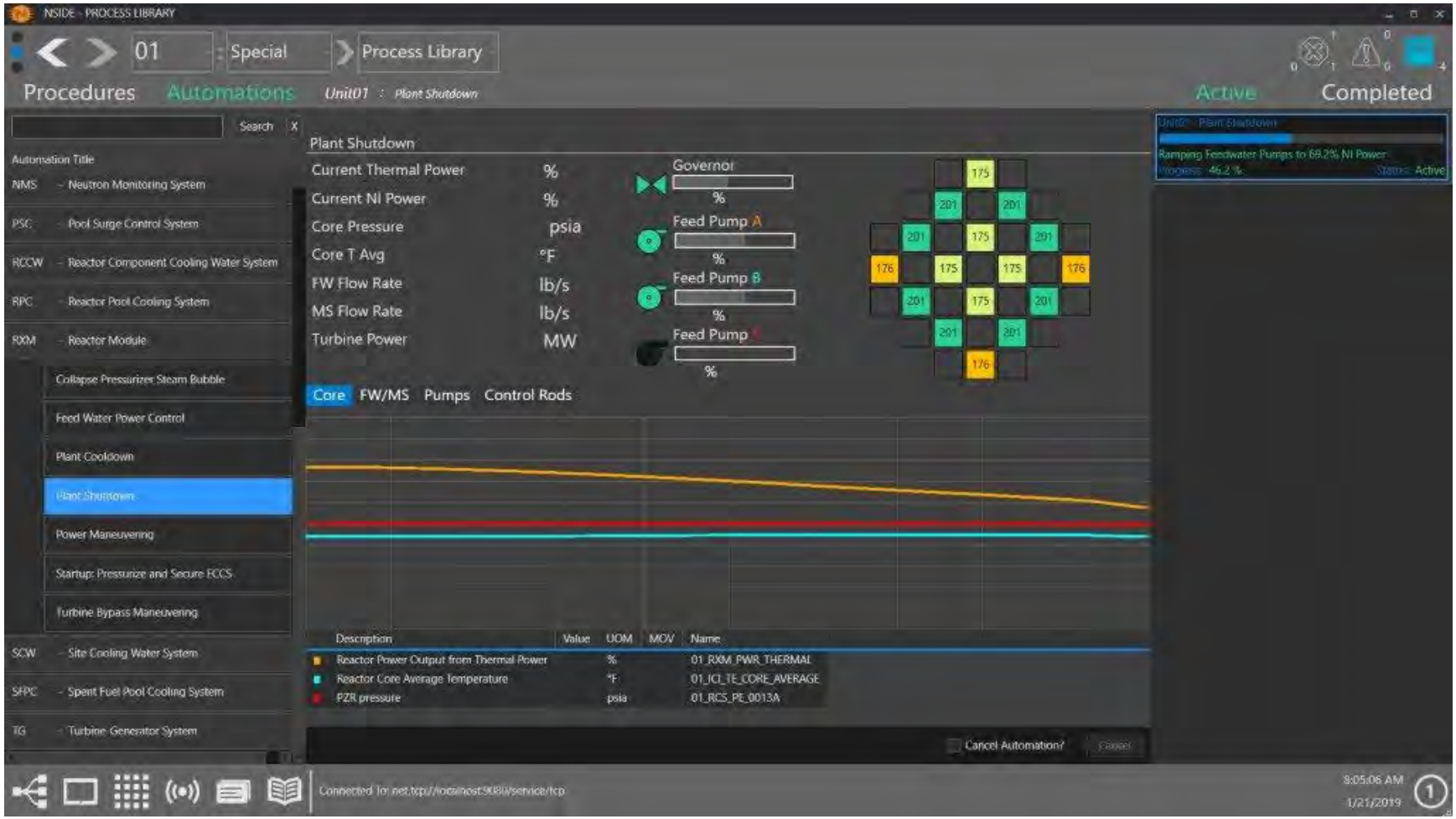

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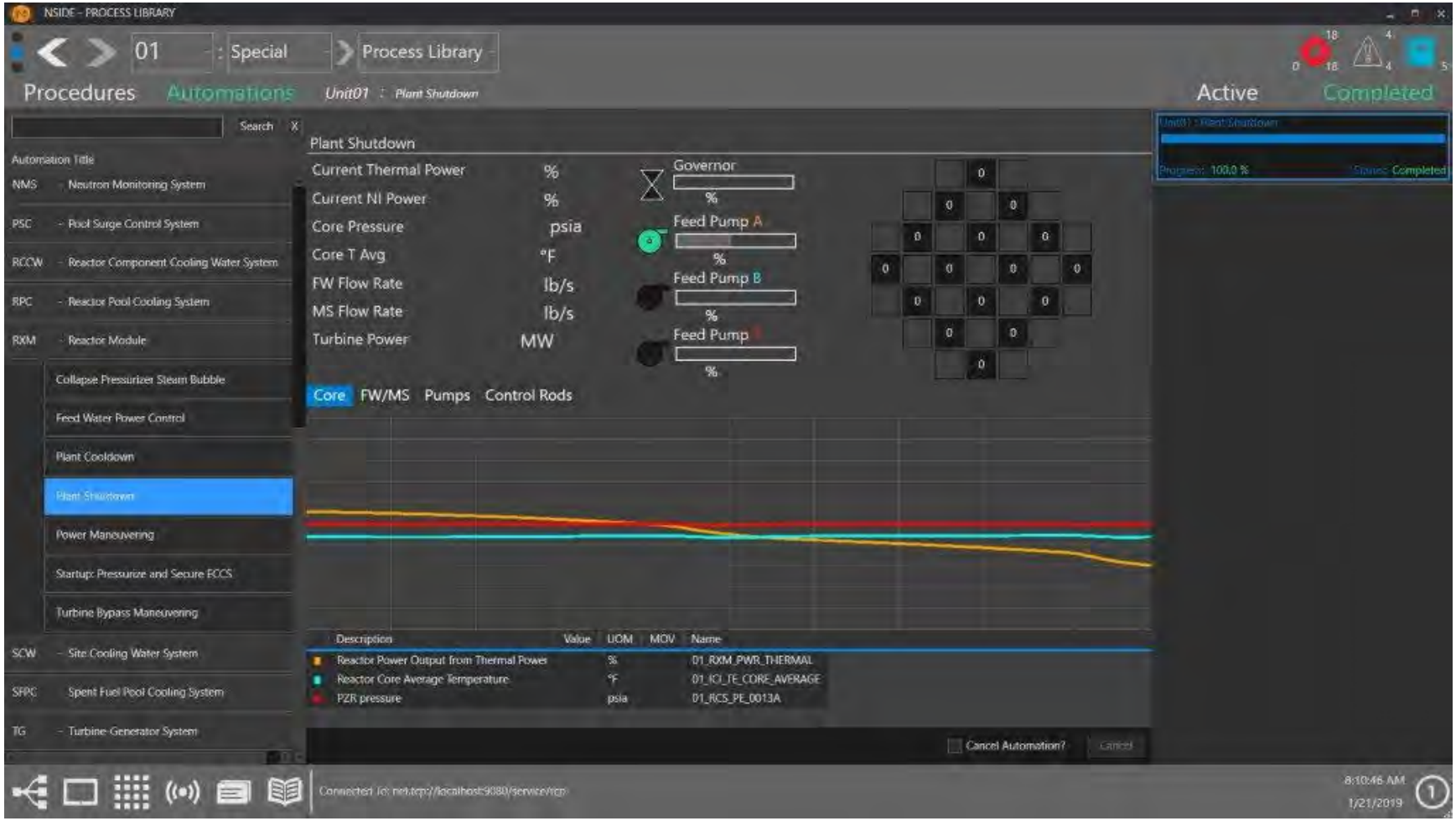

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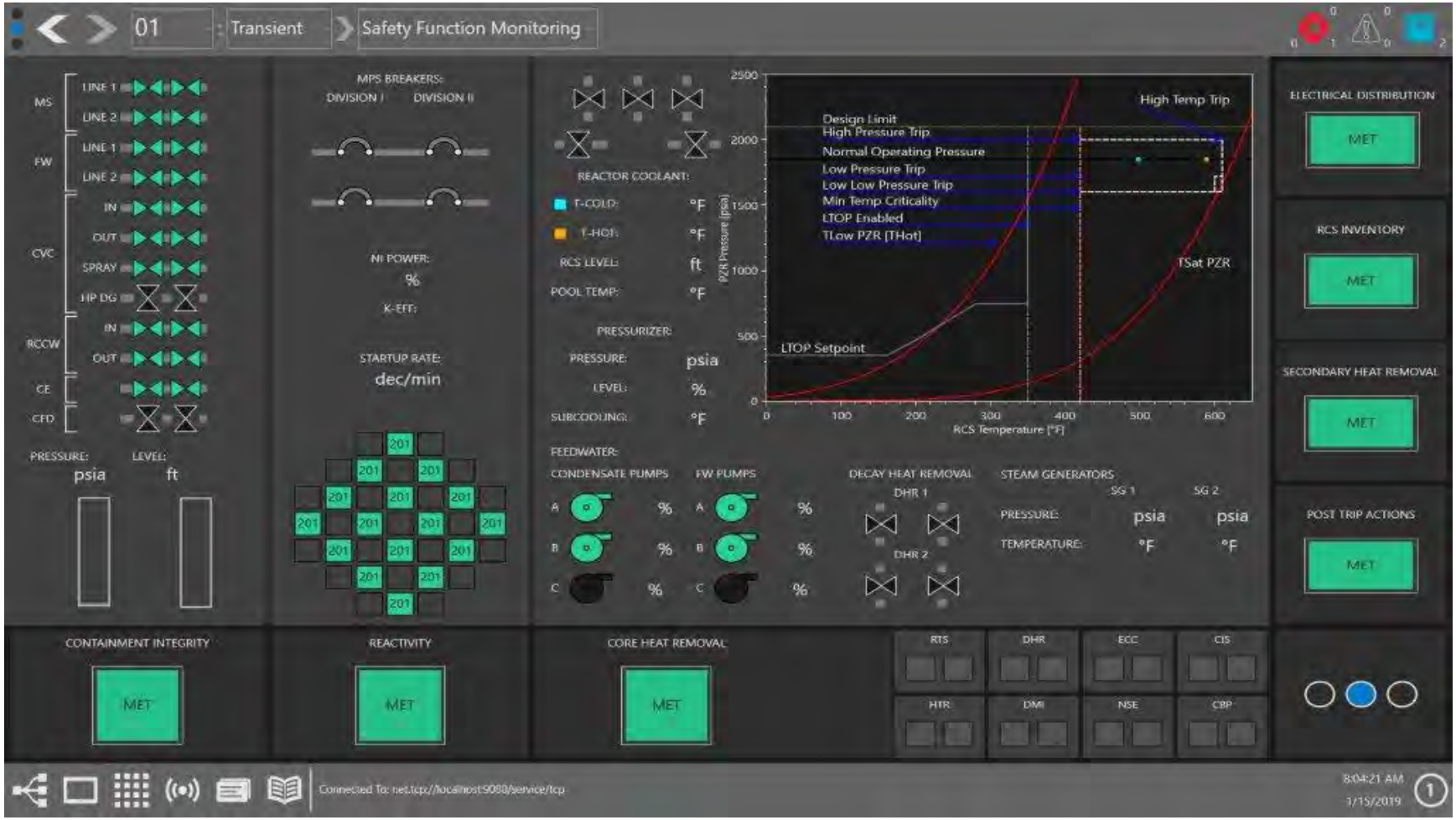

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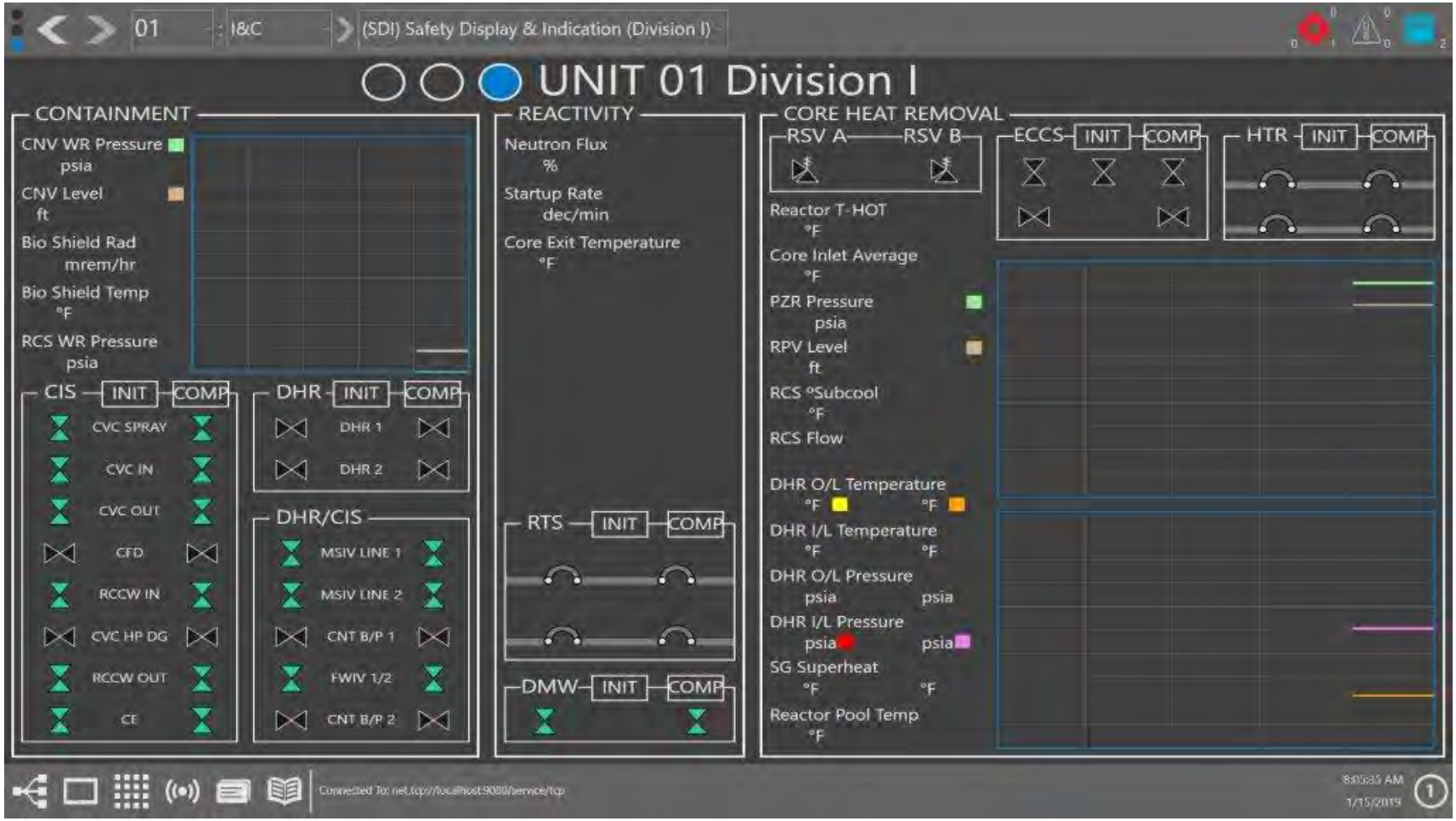

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Safety Evaluation with Open Items: Ch 18, Human Factors Engineering

NuScale Design Certification Application Review

ACRS Subcommittee Meeting

January 23, 2019

NRC Staff Review Team

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

- **Technical Staff**
  - Dr. Amy D'Agostino, RES
  - Dr. Brian Green, NRR
  - Lauren Nist, NRR
  - Maurin Scheetz, NRR

- **Project Managers**
  - Greg Cranston – Lead Project Manager
  - Prosanta Chowdhury – Chapter 18 Project Manager

Agenda

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

- Purpose and scope
- Review activities and timeline
- Areas of interest
- Open items
- Conclusion

Purpose and Scope

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

- Purpose
  - Verify that the HFE design of the NuScale Standard Plant control room supports operators in the safe operation of the plant
  - Verify there is sufficient technical justification for a new, design-specific staffing regulation
- Scope
  - DCA Part 2, Tier 2, Ch 18 as well as parts of Ch 7, 15, and 19
  - HFE technical reports
    - Methods used to conduct HFE analyses and the results
    - Description of the HSI design and the concept of operations
    - SPV methods and results
    - ISV methods (**note**: ISV results will be submitted no later than March 2019)
  - DCA Part 2, Tier 1, Section 3.15
  - Audits of HFE analyses, SPV testing, and ISV testing

Review Activities and Timeline

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- Pre-application activities (complete)
  - Reviewed HFE IPs
  - Conducted audit of SPV methods and SPV test
- Phase 1 and 2 activities (complete)
  - Reviewed and conducted audit of results of HFE analyses
  - Reviewed and conducted audit of ISV methods, ISV testing, and HSIs
- Phase 4 activities (in progress)
  - Review the applicant's V&V results and resolve open items

Areas of Interest

U.S.NRC
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- Potential human performance issues specific to SMRs are identified in NUREG/CR-7126 and NUREG/CR-7202
- The staff considered the effects of the following on human performance and safe plant operation:
  - Multi-unit operation from a single operator workstation and from a single control room
  - Relatively higher amount of automation
  - Novel HSI design features

Open Items

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- The Phase 2 SER contains 23 open items for the following topics:
  - Review of the applicant's V&V results (19 open items)
  - Scope of the HFE ITAAC and documentation of the HFE activities to be performed by the licensee (1 open item)
  - Evaluate whether changes to Ch 7 related to remote shutdown affect Ch 18 and verify accuracy of the SER (1 open item)
  - Confirm conclusions in SER Chapters 7, 15 and 19 about the treatment of important human actions are consistent with those in Ch 18 (1 open item)
  - Ensure that HFE reports are incorporated by reference into Tier 2 (1 open item)

Conclusion

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- The results of the SPV testing support the applicant's proposed staffing plan. The staff will confirm the ISV results also support the staffing plan or that any changes have been made if needed.

- Based on the staff's observations of the ISV test, the staff expects that the ISV results will provide evidence that the HFE design adequately supports plant personnel in safely operating the plant.

- The open items identified in the safety evaluation need to be resolved for the staff to find that the HFE design complies with all NRC requirements related to HFE and thus that the HFE design supports personnel in the safe operation of the plant.

Acronyms

U.S.NRC
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FA: function allocation
FRA: functional requirements analysis
HFE: human factors engineering
HSI: human-system interface
IP: implementation plan
ISV: integrated system validation
ITAAC: inspections, tests, analyses, and acceptance criteria
OER: operating experience review
NRR: US NRC Office of Nuclear Reactor Regulation
RES: US NRC Office of Research
RSR: results summary report
SER: safety evaluation report
SPV: staffing plan validation
TA: task analysis
V&V: verification and validation