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UNITED STATES OF AMERICA

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

JUNE 6, 2018

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dennis Bley, Chairman, presiding.

COMMITTEE MEMBERS:

DENNIS C. BLEY, Chairman

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

HAROLD B. RAY, Member

PETER RICCARDELLA, Member

GORDON R. SKILLMAN, Member

MATTHEW SUNSERI, Member

ACRS CONSULTANT:

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

ALSO PRESENT:

TOM BERGMAN, NuScale

LUIS BETANCOURT, NRO

TIM DRZEWIECKI, NRO

JEFF EHLERS, NuScale

ROBERT FITZPATRICK, NRR

TED HOUGH, NuScale

NADIM KHAN, NRR

SHEILA RAY, NRR

OMID TABATABAI, NRO

DINESH TINEJA, NRO

ANDREA D. VEIL, Executive Director, ACRS

KENT WELTER, NuScale

C-O-N-T-E-N-T-S

P R O C E E D I N G S

8:30 a.m.

CHAIR BLEY: Good morning. The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, a NuScale Subcommittee. I'm Dennis Bley, chairman for today's meeting.

Members in attendance today are Charlie Brown, Mike Corradini -- I don't know if Walt's here or not, maybe not, we expect Walt Kirchner to come in --- Jose March-Leuba, Harold Ray, Joy --- we expect Dr. Joy Rempe, Pete Riccardella, Matt Sunseri, Dick Skillman, and our consultant, Steven Schultz, is with us.

Mike Snodderly is the Designated Federal Official for this meeting. The Subcommittee will review the staff's safety evaluation report with open items of Chapter 8: Electric Power to the NuScale Design Cert Application. Today we have members of the NRC staff and NuScale to brief the Committee.

Before we start and I go into the boilerplate stuff, I'll just comment to the staff. From reading the SER, it really feels like we're premature in this meeting. It is a SER with open items, but all of the most significant open items are

still open. And despite the submittal of responses to the RAIs, there isn't much for us to review and comment on.

I'm hoping that the staff will be able to at least give us a little more background on where they stand and what they expect to come out of their review of the main open item on this issue today. Otherwise, in the future. maybe we ought to think about how our schedule is progressing. It does seem a little premature.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, FACA. That means 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.

That said, we set aside ten minutes for comments from members of the public attending or listening to our meetings. Written comments are also welcome. The ACRS section of the US NRC public website provides our charter, by-laws, letter reports, and transcripts of all Committee meetings including

the slides presented there.

The rules for participation in today's meeting were announced in the Federal Register on June 5th, and I apologize for that. I'm not sure why it was so late.

The meeting was announced as an open/closed meeting which means we may close the meeting after the open portion to discuss proprietary material. And presenters can defer questions that should not be answered in the public session to that time. So we have to leave that up to you if we start straying into proprietary information.

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, will be made available as stated in the Federal Register notice.

Therefore, we request the participants in this meeting use the microphones located throughout the room when addressing the Subcommittee. Participants should first identify themselves and state with sufficient clarity and volume so they can be readily heard.

We have a bridge line established for the public to listen in to the meeting. To minimize

disturbance, the public line will be kept in the listen in only mode. I also request that attendees put their electronic devices on silence. We don't want them going off during the meeting.

We'll now proceed with the meeting. And I'm going to call upon Omid Tabatabai from the NRC staff to make introductory remarks, and then we'll turn it over to the NuScale folks. Omid?

MR. TABATABAI: Good morning. Thank you so much, Dr. Bley, and thank you, the members of the ACRS. As you mentioned, this is a Subcommittee presentation of Chapter 8: Electric Power for NuScale Design Certification Application.

We're excited to present to the Subcommittee members. And the interesting part is that this is the beginning of Phase 3 of the review of NuScale Design Certification Application. And this is the first chapter that comes before the ACRS.

The team from NuScale is going to start the presentation first. And then after that, the NRC staff will make their presentation with respect to the evaluation of information.

Dr. Bley mentioned --- made a comment about this review being premature. And I think, to some degree, we agree with that. And we're hoping

that during our presentation we can provide additional information to the members. With that, I'll turn the microphone back to you.

CHAIR BLEY: Thank you. And I guess I can turn it over to Paul Infanger from NuScale. Paul, go ahead.

MR. INFANGER: Good morning, my name is Paul Infanger and I'm the licensing project manager for Chapter 8. And my background, education, I went to Ohio State University, a bachelor's in physics, master's in nuclear engineering.

And I've been in the nuclear power industry for about 35 years, about 25 years at operating plants and about the last ten years working on new reactors. I was at UniStar for about seven years, and now I've been at NuScale for about three.

So we'll start with the introductions, and then I have a couple of opening remarks about the chapter presentation. Kent?

MR. WELTER: My name is Kent Welter. I'm a chief engineer at NuScale Power. I graduated from Oregon State University with a PhD in nuclear engineering, about ten years at NuScale and about five years at the NRC in New and Advanced Reactors before joining NuScale.

MR. EHLERS: Yes, my name is Jeff Ehlers. I've been at NuScale since January. I've been in the nuclear industry for probably 15 years, mostly spent at Cooper Nuclear Station. I received my degree in electrical engineering from the University of Nebraska. And now I am serving in the role of the electrical engineering supervisor at NuScale.

MR. HOUGH: Good morning, I'm Ted Hough. Good to be here again, see all these faces again from last year. I started my nuclear career back in 1968 when I read a book called Accelerators: Machines of Nuclear Physics. And about a year later the Navy recruiter thought that was pretty nice, so I got in the Nuclear Navy that way.

And over the years, I worked nine different commercial units, and then ended up at Cooper for about 20 years there. That's how I got to know Jeff. And over the years, I got the lead auditor, Level 3 inspector for electrical cert, and a EE degree from the University of Nebraska. And that's my background there.

And I think we can just roll right into the presentation if everybody ---

MR. INFANGER: Yes. I just wanted to say a couple of things about Chapter 8. I think Omid

mentioned, this is the first of the chapters. We've brought a number of topical reports to the ACRS. This is the first of our chapters.

And although there's quite a number of items that are in the open items in the SER, one thing that we'd like to point out is that for the confirmatory items that are mentioned in the SER, those were in Revision I, which was issued after -- was submitted to the NRC after the SER was already in the review cycle. And that's why there's quite a number of confirmatory items. But those have all been --- the responses to all those have been submitted and are on the docket.

And also, for the open items, the largest open item is meeting the topical report for the electrical distribution system for non-safety related power. We have submitted an RAI response on that which has provided how we meet all of the SER conditions.

So that has been submitted. That was submitted in late March which, again, was after the SER was already in the review cycle. So that's why those things are not in the SER. But we are willing to and able to answer questions about those items. We have the appropriate people here.

CHAIR BLEY: Okay, good. Well, two questions, well, two comments. One is thank you for the list of acronyms. I wish I had it when I was reading this stuff, ha, ha.

Number two, have you responded to all the RAIs on this chapter? Or are there still some outstanding that you have not responded to? I know the staff hasn't reviewed them all yet but ---

MR. INFANGER: Yes. We responded to all the Chapter 8 RAIs.

CHAIR BLEY: Okay, thank you.

MR. INFANGER: And with that, Ted, why don't you start the presentation?

MR. HOUGH: All right. We'll just jump right in there. Of course, the abbreviations that the member mentioned there, probably most important is all the system names. After that it's pretty much run of the mill acronyms in the industry. I'll just kind of click through those for you.

And then again, the purpose of the meeting, to provide an overview of our electrical systems and then present some highlights of the systems. And you can see the presentation's kind of organized just like Chapter 8, 8.1 through 8.4 down there, design basis, offsite power, onsite AC and DC,

and then the station blackout.

And then as indicated there, we'll talk about the topical and the road map that'll be provided for that toward the end of the presentation. So there'll be a general flow here.

I just want to give you a little bit of background. The starting point that we had when I first got to NuScale in late 2010, October of 2010, of course, you know, your key basis is nuclear safety and regulatory requirements that everybody has to implement.

And then in March of 2011, the Fukushima event happened. That weighed heavy on our mind, me in particular. That was a significant emotional event for me, I guess you might say. And then what we had to work with was the robust, inherently safe module design that Dr. Reyes put together.

You know, our plant is very simple mechanically. And that was an emphasis that we had all along, make it as simple as possible, don't complicate things. And so my challenge was to put together electrical design that complemented that simplicity.

But at the same time, what I had to look for, I can't just put together 12 independent

distribution systems. That's not economical. But, you know, at the same time, look out for GDC 5, things like that, when we shared electrical systems, you know, so they don't impact economics and viability of the plant.

So that's where we started. And so moving along here, what we have is design basis. We maintained everything, the fail-safe and loss of power, everything, any active components like solenoids. They would de-energize and move to their safety position, depending on what their function is. Breakers would open, for example, reactor trip and pressurizer, heater.

And then once those active components moved to their safety position, via no power, everything from that point on is natural, you know, passive cooling, thermodynamic principles, et cetera. So it's pretty straight forward.

MEMBER SKILLMAN: Ted, let me ask you a question here.

MR. HOUGH: Yes, sir.

MEMBER SKILLMAN: Go back a slide please. On your next to the last bullet, design electrical systems that complement the simplicity, I hear from your background you've obviously dealt with small

plants and likely paralleling diesel engines, paralleling other power supplies.

In this design, you can have 12 independent machines, each of which is parallel to the other --

MR. HOUGH: Yes.

MEMBER SKILLMAN: -- under at least a defined set of conditions, the 11 collapse to an island mode of a selected machine.

I was considering, as I did this review, whether I thought that was simple or not simple, drawing on my background of paralleling multiple diesel engines, finding the oscilloscope, making sure I knew, if I was on lead, when I was going to close the breakers manually. All of that I did manually, you probably did too.

MR. HOUGH: Yes.

MEMBER SKILLMAN: Maybe that's going to be same situation for your operators that might have 12 of these modules coming on one at time on a particular time period, or at least three or four coming on during a particular time period. Speak to that relative the work simplicity.

MR. HOUGH: I think, you know, that's a good point, you know, bringing the units online. Of

course, they'll have to be, you know, brought in parallel online as they come up. Within the island mode factor that you talk about, that is the part of the design that is yet to go in terms of, you know, controls to do that, if it's in the final design phase.

But it's fairly simple in the aspect of when the grid gets --- either it goes away or it gets unstable, disconnect from it. Get away from it. And then we move one unit into isochronous. And the rest of them have full bypass capability, the breakers just open. So the operators have very little to do in that event.

I know you mentioned the island mode there, but that's probably, I would say, I guess in my opinion, the most complicated thing is getting the controls lined up, all the relaying and stuff to make that happen. But that's still yet to go in the design phase.

MEMBER SKILLMAN: Let me just add one more.

MR. HOUGH: Sure.

MEMBER SKILLMAN: So let's say we're on watch, and we've got --- we're a fully mature 12 module plant. And we've got four operating, and we're

bringing two online. What's different here is, when you're paralleling the next two modules, you're not just adding an alternator to pick up load. The instant you connect, you're pumping reactivity to increase power to allow that machine to come out and not only stay synchronized but add to the load capacity.

MR. HOUGH: Yes.

MEMBER SKILLMAN: And so what's really different in this setup is what it takes to, if you will, parallel, assume load, and had enough reactivity that you are actually taking part of the load.

So it's a two-step process, whereas in a diesel or gas turbine, you almost automatically come on up and take load. Here is an action that requires addition of reactivity in addition to paralleling the electrical machine. So how has that been considered in terms of simplicity?

MR. HOUGH: I would say not from an electrical standpoint but, you know, each module is connected to its own turbine, right --

MEMBER SKILLMAN: Yes.

MR. HOUGH: -- independently. So the reactivity controls are ---

MEMBER SKILLMAN: So does it load

automatically and increase reactivity automatically?

MR. HOUGH: Yes. Dr. Welter might be able to follow on there for me ---

MEMBER SKILLMAN: What I'm getting at is the term simplicity. And I'm not challenging that that is accurate. It may be. But I'm imagining a scenario that, at least, I lived through. And it wasn't quite as simple as one might have thought it is.

MR. WELTER: Yes. I don't disagree. I guess what Ted is speaking to a little bit is we're going through a lot of that right now. So we have a crew of about 20 folks going through ISV right now, you know, potential operators of the plant going through all these various scenarios on how to start it up.

CHAIR BLEY: Would you define your acronyms as you use them, please?

MR. WELTER: ISV ---

CHAIR BLEY: You've forgotten what the words mean, ha, ha, ha.

MR. WELTER: Yes, sorry, independent system verification. It's part of our human factors engineering program. So not all of the details on how to do what you're asking have been worked out. But we

have a human factors engineering program, we have people on the simulator right going through a lot of these various scenarios.

MEMBER SKILLMAN: But we're in the conceptual stage, a lot of lessons ahead. You kind of understand exactly where you want to go. There's a lot of work to get there from here.

MR. WELTER: Well, I would say from a design certification perspective, we have the electrical and the systems designed, and the capability of the plant is well understood. And now exactly how you want to operate that is still being worked out, yes, so conceptual, if you will. And that's part of the human ---

MEMBER SKILLMAN: Yes, fair enough. Thank you. Okay.

MR. HOUGH: Okay. So then final bullet there, based on the application of topical, highlights our overall design of AC and DC systems are non-1E. We have the highly reliable DC system we talked about last year with augmented design qualifications and QA provisions.

And that system itself powers up the main control room emergency lighting, your post-accident monitoring type Bravo and Charlie variables. And then

there are no power sources required to perform any safety related functions. And so consequently, the design supports exemption of GDC 17 and 18.

Here's a picture we put together just to give you kind of a big picture overview of how the systems interrelate to one another. At the top, you'll see the grid or what we call the load, fed by the high voltage system, 13.8, electronically designed as a 345 out to the grid. And then EHV supports the medium voltage system at 4160 through unit auxiliary transformers.

And we'll go into a little bit more detail in the next slide here. Then that drops down to a 480 system with low voltage. And the ELV 480 system feeds our DC, both DC systems, the normal DC, the highly reliable DC, and over to the right there in the yellow is the plant lighting system. It also feeds security power down there in the blue box.

And then the backup power system is actually divided into two pieces, one at a 13.8 source that's called the auxiliary AC power supply, and then the backup diesel generators there, at the 480 level, is also part of the backup power supply system. So that's how they all interrelate to one another in a big picture fashion.

And here's where --- I know this is very hard to see. You know, the pictures are in the application and stuff. At the top there, I would like to point out it's a standard breaker and a half scheme. That's what most places use. It doesn't have to be, but that's we put in there.

In the 13.8, there're some interesting aspects of that. Over here at the far left you'll see -- that's the auxiliary power supply unit, an auxiliary AC power supply unit, APS. And it's connected to what appears to be kind of like a swing bus to some of the folks. It might be.

But what that allows us to do, in part of this design, part of my background was maintenance rule coordinator at Cooper for five years. And I was on the Advisory Board. And I've seen a lot of folks struggling with unavailability of maintenance. That's why we end up with A4, five, you know, people trying to do too much online.

We designed this so that you could take out any component of the AC distribution system and stick device protection in there. They disconnect to the breaker safely. And you can see, I could take this generator here, and move it over to this bus.

That main part transformer there was a

component of the AC distribution system. And they still provide 100 percent power. And we put two device protection in there. They disconnect the breaker so it allows safety for the maintenance shops.

And you can see, I can take this generator here, and I can move it over to this bus. That main power transformer there will still put out --- each one is built to handle output of two generators.

And I can move that other generator. You know, I can take this one, put it over here where it normally would be and put two over here. Now I have this bus and this MPT available. These are three phase main power transformers, about 115 MVA each.

So the bus, unless it's the generator itself that goes down on you, I could still put out 100 percent power. And that was also a factor in designing this, because you had to have --- it's not like a normal plant where we're going to take the unit down and, you know, have bus outages and bipower.

What you have here is a plant that's going to operate 24/7 from all the other units that are still online, so even if I take one generator --- reactor off for refuel. So those are kind of the highlights of the 13.8 system.

Now to 4160, you can see it is arranged,

and if you follow it through, you can see there's a ring bus concept built here. And if I have a lockout or anything happened on the UAT, the unit auxiliary transformers there, it'll automatically transfer to an adjacent bus and Ops is selected.

And then moving down to the 480 section down here, you can see --- it's real hard to see there, but each one is a main-tie-main configuration. So I have reliability built in there, that if one of those SSTs, you know, trips, or overloads, or whatever, it can go the other side, to the main-tie-main configuration. So we've built a lot of reliability in there.

And the other factor was, from the control mass type of simplicity, how do I make this system very simple for the operators? Don't add operations for this, you know, because we knew we had this combined control room to deal with. We knew it had to be simple in the first place. So that was another factor we had to consider.

CHAIR BLEY: Ted?

MR. HOUGH: Sir?

CHAIR BLEY: I don't remember if you've done this yet. How are you responding to the open phase situation?

MR. HOUGH: Actually, BTP 8-9, we don't have any motors, anything like that that would be harmed by an open phase condition. And all of our, again, with a zero power need, 8-9 really is a never mind.

CHAIR BLEY: You don't need electric power, but it's darn nice to have. So you're not adding any open phase protection, because you don't need it?

MR. HOUGH: No, that's correct.

CHAIR BLEY: Okay. Your choice, but ---

(Off the record comments)

CHAIR BLEY: Oh, I'm sorry. Go ahead, Jeff.

MR. EHLERS: Yes. This design doesn't have any stand-by AC units. So the open phase issue is where you have a standby transformer that's energized but not loaded. We do not have one of those in our design. So all of our transformers will be loaded and not ready to be transferred to at some type of emergency or a trip condition.

So that's where the open phase causes you a problem. Because once you load that transformer, then that open phase becomes apparent and then causes all your motors, three-phase motors, to be down to two

phases and causes problems.

So the times when we don't have that detection, it's because as soon as we lose a phase due to our design, we're going to know immediately, because we're using those transformers. So in the OE that you're -- the operating experience you're speaking of, that was the problem, was that they had a standby transformer that lost a phase.

And due to the design of those transformers, they have a delta winding on the center of them that allows the voltage to be placed on the third phase, even though it's not connected to anything. It's a phantom voltage. As soon as you load it, it goes away. But again, we don't have that in our design. So therefore, if we lose a phase, we'll know so immediately.

MEMBER BROWN: You said it's a delta output, right?

MR. EHLERS: No, no, no. I'm talking about in the middle of the transformer.

MEMBER BROWN: No, the three phase ---

MR. EHLERS: Yes.

MEMBER BROWN: It's a delta ---

MR. EHLERS: Right.

MEMBER BROWN: -- connected system. And

you can't operate, saying it goes away, that's not the ---

(Simultaneous speaking)

MEMBER BROWN: When it goes down to two phases, you have an open delta, but it can still supply about 60 percent of the load.

MR. EHLERS: Right.

MEMBER BROWN: Roughly.

MR. EHLERS: With some pretty high phase currents.

MEMBER BROWN: Well, there's imbalances. But, I mean, it can ---

MR. EHLERS: Right.

MEMBER BROWN: -- you can supply about 60 percent of the load. So I've got a little bit of a disconnect when you say it goes away.

MR. EHLERS: Well, I mean, the voltage on that third phase is --- the problem with the open phase issue is that, in the sense of transformers not loaded, your voltage indications are going to show there's a voltage on that phase. It's going to show that -- your indication's going to say that phase is energized.

But as soon as you load it, then this voltage on the open phase goes away. And therefore,

you're down to two phases. So that's the problem with the open phase issue, is that on an unloaded transformer there's no way to detect it, or there wasn't any way to detect that open phase until the transformer was actually loaded.

Now, then once you transport --- then once you transfer to that transformer, put load on it, then it became readily apparent that that was already too late. Because you were needing it, and you just cause all your motors, your loads to be operating on two phases instead of three, what they were designed for. Does that make it clear? Did I answer your question?

MEMBER BROWN: A little bit. I just never --- I did an open phase delta connected analysis at one time back in one of my old jobs. I never really thought about it under the zero load condition. So trying to connect that back to saying that all of a sudden the voltage can't be sensed, I mean, I'd have to go back and look at that. It's just been awhile --

MR. EHLERS: Well, it ---

MEMBER BROWN: About 20 years.

MR. EHLERS: Yes. In the operating experience, that was the problem for the two cases this occurred, that have been publicized, is where the phase ---

CHAIR BLEY: Well, that's why it was allowed to exist for the length ---

MR. EHLERS: Yes, because if it --

CHAIR BLEY: -- of time it existed. And I agree with you that it's obvious if you have the transformer loaded. However, you can still get some pretty big phase currents temporarily. And the idea that that can't do any damage, I'm not convinced of that.

MR. EHLERS: Well, I mean ---

CHAIR BLEY: Then again, you know, Ted's right for the details of your response to accident conditions. You don't need it. On the other hand, if it were my plant, I'd think about it long and hard before I didn't worry about that.

MR. EHLERS: I'm just saying, due to all the transformers being loaded, and power flow going through them, an open phase condition would immediately recognized.

CHAIR BLEY: Yes, it would. I agree with you on that.

MR. EHLERS: Yes. Where the open phase detection system is for unloaded transformers.

CHAIR BLEY: I'm not completely sure that under all conditions none of that operating equipment

could be damaged though. That's the other side of it.

MR. EHLERS: Well, yes, I agree with that.

CHAIR BLEY: And I would worry about that.

MR. EHLERS: Yes, I agree with that.

CHAIR BLEY: If it were my own plant.

MR. EHLERS: Yes.

(Simultaneous speaking)

MEMBER SKILLMAN: Where in this diagram is the voltage stepped up to the grid, if this is used, for instance, in grid supply versus a local application where you're not really feeding the grid?

MR. HOUGH: Okay. Right here is the 13.8 bus. That's the main power transformer, 13.8, the 345 going out. And you have a double bus configuration to offsite breakers. Does that answer your question?

MEMBER SKILLMAN: So could you go to island mode? And back into island mode where you're just feeding in-house, could you then have a transformer fault where you did have an open phase that you did not detect?

In other words, could you find yourself in a transient condition going to island mode, separating from the grid, and in that separation end up with the transformer fault that ---

MR. HOUGH: As Jeff indicated, I think ---

MEMBER SKILLMAN: That would disable a phase?

MR. HOUGH: I think I understand the question. The island mode functionality basically disconnects at this point here. And so again, all of these transformers here, all four of the --- or all eight of the main power transformers are normally energized. And you would know whether they were, you know, had a problem or not right away.

And so whatever service unit is designated as the island mode module, you know, it'll pick up the load and just feed it right back through once you're disconnected here from the grid itself. Again, you would know ---

MEMBER SKILLMAN: Okay, thank you.

MR. HOUGH: Okay. Any other questions on this? Hard to read --

MEMBER BROWN: Yes. You mentioned the 4160 was a ring bus, and I --

MR. HOUGH: yes, sir.

MEMBER BROWN: -- I didn't pick that up when I looked at this before.

MR. HOUGH: Okay. You have to kind of trace it through, ha, ha.

MEMBER BROWN: I'm trying to see where it

circles. It's no connection.

MR. HOUGH: There's these ---

MEMBER BROWN: Oh, it's that side as opposed to left or right.

MR. HOUGH: Yes, yes. And then over here too on the outside.

MEMBER BROWN: No, hold it. It still doesn't go back to 4160. So as you come to a 4160 bus, off of the 13.8 kV, just pick one of those.

MR. HOUGH: Yes, go here.

MEMBER BROWN: And then I can go ring bus to the other -- to the left.

MR. HOUGH: Yes.

MEMBER BROWN: Come down, and there's no connection.

MR. HOUGH: Or you can go here.

MEMBER BROWN: I don't see any ring bus connection on 4160. I don't really care ---

MR. HOUGH: Because it's supposed to --

(Simultaneous speaking)

MEMBER BROWN: You just made the comment, and I can't find the line.

MR. HOUGH: Yes. It is there. And these connection points here get you to the other side.

MEMBER BROWN: I'll work on that.

MR. HOUGH: Okay.

MEMBER BROWN: I do not see it.

MR. HOUGH: Okay. It is there. Again, I apologize for the --- it's kind of hard to, on this large picture, or large schematic, the small picture.

All right, the offsite system, again, this would be like 8.2 in the SRP or DSRS, offsite power system is our switchyard and one or more connections to the transmission grid, as you see in there, or a microgrid, or a dedicated service line.

We do have a COLA item included in the DCA for the Applicant to describe their own specific switchyard configuration. And here again, we don't rely on any AC power, either onsite or offsite, to mitigate a design basis event. And a loss of offsite power, as Mr. Skillman refers to, we transition to island mode, and the house load is powered from any one of the designated TGs.

MEMBER SKILLMAN: What is the house load?

MR. HOUGH: It's somewhere right at 30 megawatts, so it's about 50 percent power.

MEMBER BROWN: Is that per module?

MR. HOUGH: No, that's the entire house.

MEMBER BROWN: That's the entire --- if you had 12 modules connected to the house load, is

that a 30 megawatt?

MR. HOUGH: That's correct. But we put it together that way so that, you know, if something happens in the grid, it'd be nice to be the first one back on. So it's an obstacle once the other 11, if they're all aligned, they'll go into a one percent bypass. So the capability is there. And we maintain a whole house load with one unit.

MEMBER SKILLMAN: And that one unit's good for 50 or 60 megawatts electrical? Okay, thank you.

MR. HOUGH: And these are smaller, unlike today's units, you know, they run back to, say, like the Cooper 800-plus. And, you know, when you run back to house load, it's somewhere around 20, 22. That's a long ways for that big turbine to drop. Or, well, ours are small, nimble turbines that very easily accommodate that.

Okay, onsite AC, we kind of went through some of this, but we'll breeze through it here. We specified all standard AC componentry, you know, look out for short circuit readings that didn't buy anything special as far as off the shelf kind of stuff.

And as I noted, we support online maintenance. Any major component, again, can be taken

out without affecting power output unless it's the TG itself.

Those main power transformers take the load of two turbine generators, UATs. Any two of the UATs can power an entire site. As you see in the diagram they do not --- it's real small. There's a 6A slide, 6B slide, so a six-pack. And any two of the UATs can supply that entire load.

Let's see, as we stated there, the 12-module house load, and again, it is our normal source of power, the term preferred power supply really isn't applicable to NuScale design. That's an existing fleet, that's an offsite power source. Not for us. Our 13.8 buses are our supply, our normal load.

And the EMVS is where we have shared loads, shared large loads, that 4160 circ water, site cooling water, chilled water system, any of those big loads that are shared amongst all the units. That's where EMV, that's its role and then, of course, to feed the 480. And the 480, that's where we start breaking it up into module-specific loads. It'll be the main-tie-main configurations, the lower horsepower loads.

The plant lighting system here, PLS, is actually listed as a power source. It is the power

source for us, as well as a main load too. And it provided 480, 277, 208, and 120.

The next onsite AC system is the backup power supply system. And if all eight of the 13.8 buses go dead or, you know, lost for some reason, after a 30-second time delay those units, both the BDGs and the AAPS, will start. And then Ops will manually load them.

CHAIR BLEY: I'm sorry, say that again. I didn't quite follow.

MR. HOUGH: If all eight of the 13.8 buses go away, that's when we will start the BDGs, backup diesel generators, and the auxiliary AC power source. So after a 30-second time delay, Ops can load them as they see fit.

CHAIR BLEY: They don't start automatically?

MR. HOUGH: It starts automatically.

CHAIR BLEY: Yes, that's what I had thought.

MR. HOUGH: Yes.

CHAIR BLEY: Okay.

MR. HOUGH: After a 30-second time delay. And the BDGs, we put them at 480, specifically to power up charger loads. We had a big sit-down with

Operations. And they said, okay, since we don't have any RTNSS loads, let's put our power where we want it.

And we said, okay, where do you want it. And so that's where, you know, control room ventilation, and CVCS pumps, a lot of those loads that Ops wanted for, you know, recovery of the plant, things like that, they said, okay, good. Well, we'll do that. And so the BDGs are, I think the way this calc shows, about 2.4 MVA each. And the AAPS is about 14 MVA units.

MEMBER BROWN: If you lose the power, if you lose whatever you're losing and the backups come on ---

MR. HOUGH: Yes.

MEMBER BROWN: -- multiple backup fuses come on, do they operate independently, or do they automatically synchronize, or anything? I forgot to ask that question.

MR. HOUGH: Yes, that's a good question. But they're manually loaded, so they've got to manually synced to get ---

MEMBER BROWN: Manually synced, okay. So each individual module, BDGs come up and they stick with the ---

MR. HOUGH: Well, there's only two for the

whole site.

MEMBER BROWN: Oh, that's right. Okay, yes.

MEMBER SKILLMAN: Ted ---

MEMBER BROWN: I got it.

MEMBER SKILLMAN: Oh, excuse me. Excuse me.

MEMBER BROWN: No, I'm finished, Dick. I was just re-calibrating.

MEMBER SKILLMAN: I appreciate that you got input from Ops, where do they want power, good place to start.

MR. HOUGH: Yes.

MEMBER SKILLMAN: Was the selection of the loads solely based on Ops preference, or did you inform, did NuScale inform that decision either by items that are deemed critical out of your PRA or out of operating experience?

MR. HOUGH: That's a real good question. And I'd answer it, all of the above. You know, of course Ops has had a main influence for us. But we had, I'd say, 80, 90 percent design. And then we went to Ops and said, okay, look, here's where we stand when I had RTNSS loads. And they never independently, they were going, okay, we got these BDGs, what do we do with them? How do we want to do this?

And so they came to us, and we sort of met

in the middle kind of thing. But, let's see, you have a third element that just slipped my mind here. The use of those were kind of a joint agreement.

MR. WELTER: Yes, so ---

(Off the record comments)

MR. WELTER: Yes, my mic's on. So if PRA was used throughout the conceptual design process for various systems, so the PRA did influence a little back and forth, iterative, on selection of some of these loads.

What you'll find is, in the PRAs, some of the important things from, like, prevention and mitigation of the accident perspective, are the CVCS pumps and the CFDS pumps, and the ability to put water back into the containment or the core.

So you'll see that that's consistent with the PRA, and they did have a number of back and forth during the conceptual design phase on, you know, what do the risk results on the inside look like?

MR. HOUGH: I will add to that, but thank you for the reminder. That was the third item, and it slipped my mind there.

The BDGs, because they're non-safety related, and they don't have to be divisional, we made it so that either one can power up the whole line. So

we increased the size of it.

Because the way it was before, we initially started with a divisional. And then if you lost the division, you're going to lose two. That's two out of four, our MPS -- oh, no, we can't go there. So we said, all right, we'll make it so either one can power the whole plant. And so ---

MR. WELTER: Yes.

MR. HOUGH: -- you played a big role in that.

MR. WELTER: Yes, and I was responsible for the PRA group at that time and, I mean, the PRA practitioners also were nice enough to present alternative designs for your consideration, I think.

MR. HOUGH: Yes.

MR. WELTER: So the PRA would actually suggest you could do away with some of the redundancy and diversity that's in the existing system. But that was provided as input.

MEMBER SKILLMAN: Let me ask this. And this might be the wrong time to ask --- the wrong time for me to ask this. But if you're going to answer it later, that'd be fine.

I read that you're using ELMS, electric load management system, to design this. And if you've been

in a live plant, and you want them to transition from OLMs to ELMS, you recognize that using ELMS is a special database, and it takes specially qualified people to do it. Can you speak to that at this point? ELMS is your electric load management system and most importantly --- excuse me, I mean ETAP.

MR. WELTER: ETAP.

MEMBER SKILLMAN: I'm sorry. There was a transition from ELMS to ETAP.

MR. WELTER: Okay.

MEMBER SKILLMAN: And the ETAP people are like PRA people. It's a different group of electrical people who know how to run that software. And if ETAP's used properly, it will manage your configuration and ensure that the flow and the breaker coordination is what it's supposed to be, if it's done properly.

Is ETAP what you have been using from the outset? Or let me say it differently. Was this a mom and pop design that you kind of forced into ETAP?

MR. HOUGH: We used ETAP from the onset. I went down to --- in California and got trained myself. And the guys, the entire group were all ETAP.

MEMBER SKILLMAN: They're all ETAP qualified, and they've got punch cards, and they're

qualified users?

MR. HOUGH: Yes, sir.

MEMBER SKILLMAN: I'm serious. I mean, it's a ---

MR. HOUGH: Yes it is. It is a complicated program. In fact I made the comment at the ETAP training that, hey, you're doing away with electrical engineers' jobs.

And they said oh, no, no, no. ETAP is just a tool for you. You still have to recognize when this thing's giving you an erroneous answer, obviously.

MEMBER SKILLMAN: So I heard you say you used ETAP right from the beginning.

MR. HOUGH: Yes, sir.

MEMBER SKILLMAN: And the individuals that are using it are qualified individuals?

MR. HOUGH: All have been trained, right.

MEMBER SKILLMAN: Okay, thank you.

MR. HOUGH: Yes.

CHAIR BLEY: Ted --- oh, I'm sorry.

MR. SCHULTZ: Ted, with your response with regard to what the PRA team had offered as options, what was the basis for that, for their discussion associated with other design options?

Were they suggesting that a target value, a

target risk profile could be met with different alternatives? It sounds as if ---

MR. WELTER: Yes. What they were ---

MR. SCHULTZ: -- a more conservative approach was determined by the designers than what the PRA team might have thought was acceptable?

MR. WELTER: Yes. And in summary from a, you know, plant risk perspective, the design is very robust. And you could do away with some of the redundancy that's built in with minimal impact, negligible impact to core damage frequency or large release frequency as an example.

So that was more of an economic suggestion and reliability suggestion. It was just his input. And so, yes, I mean, overall, the PRA team said you can make it less complicated and cheaper, not complicated but just less robust. And the PRA would support that. But the decision was made by the designers to go with this existing design. And it had to do with, well, I'll speak to ---

MR. HOUGH: Yes. And again, the way it was set up before, we really thought everything had to be divisional. But that was, you know, when it was potentially a RTNSS diesel. And it turns out on those loads, there's nothing on there. So they said, geez,

it doesn't have to be divisional.

And we can eliminate a potential two out of four scenarios if we were on the diesels and, you know, we lost one. So you get a two out of four signal, and the MPS would, you know, actuate. But we could eliminate that challenge to the safety systems by making either one of them supply both. So we said, okay, we'll do it. It was a good decision, with observation from PRA.

CHAIR BLEY: Ted?

MR. HOUGH: Yes, sir?

CHAIR BLEY: You talked some about the backup diesel generators.

MR. HOUGH: Yes.

CHAIR BLEY: You also have, I think, just one alternate AC power supply?

MR. HOUGH: Yes, sir, good segue into the next slide, ha, ha, ha.

CHAIR BLEY: You're welcome. Go ahead.

(Laughter)

MR. HOUGH: The AAPS is just a single unit. And it's there to supply permanent non-safety loads, things like your fire protection.

MEMBER CORRADINI: What is it if it's not a diesel generator?

MR. HOUGH: Okay, we had tentatively, because most facilities around the country will use a combustion turbine generator.

MEMBER CORRADINI: Oh.

MR. HOUGH: And we said, okay, you know, but it doesn't have to be. It's just ---

MEMBER CORRADINI: So it's yet to be specified.

MR. HOUGH: We ---

MEMBER CORRADINI: Okay.

MR. HOUGH: -- put it in that way, and have designed around that. But it's conceptual design information where a ---

CHAIR BLEY: But you're thinking it'd be a gas turbine.

MR. HOUGH: Yes. There's some places, like, it was in -- wherever, got a hydro unit or whatever.

MEMBER CORRADINI: The same size as the backup diesel generator?

MR. HOUGH: No. This will be a 14 MVA unit.

MEMBER RICCARDELLA: I'm sorry, would you repeat that please?

MR. HOUGH: The size?

MEMBER RICCARDELLA: Yes.

MR. HOUGH: Fourteen MPA.

MEMBER MARCH-LEUBA: These generators are what size?

MR. HOUGH: 2.4. These are --

(Simultaneous speaking)

MR. HOUGH: -- numbers, what they actually buy could be a 2.5. Well, it's a minimum of that, and needs a calc. And then, again, we put that unit, the 13.8 bus, up there so that Ops could put the power anywhere they wanted it.

And then we have a portable generator connection. Originally, we were going to use it maybe for a flex connection. But they don't need it for that. So it's still there.

CHAIR BLEY: Did you --- when you did that, are you using that standard flex connection terminal set so you can hook up a flex generator if you get one from somebody?

MR. HOUGH: I'm sure I would be, ha, ha, ha.

CHAIR BLEY: You haven't specified though.

MR. HOUGH: No, not yet. Okay, moving on to onsite DC, the most ---

CHAIR BLEY: Does that show up on the one line, the AAP --

MR. HOUGH: I guess.

CHAIR BLEY: No. Your portable generator

connection.

MR. HOUGH: In this diagram here, yes.

CHAIR BLEY: But not on the big one line?

MR. HOUGH: Right there, yes. Not the overall one line, no.

CHAIR BLEY: Okay. That's what I've been looking at. Okay, go ahead.

MR. HOUGH: Yes, this shows a BDG and then a flex connection to that 480 bus that you have there, BDG bus.

Okay, the highly reliable DC system, EDSS, again, that's the one that has the augmented provisions applied to it. The Class 1E isolation, if you think about Reg Guide 175 and 3D-4, you're looking in a reverse manner to what we have. It's usually a 1E power supply being isolated from non-1E loads, et cetera.

In our case, it's a non-1E power supply being isolated from a 1E load down there. And that would be done --- the DC-DC converters, and that'll be, you know, discussed in Chapter 7. That is the power supply from module protection,

and neutron monitoring, et cetera.

The key here is to recognize, you know, they said, oh look, this is a 1E load. It's got to be 1E

power supply. No, it doesn't, because of the stuff we discussed last year at the topical here. It's not essential to achieve the safety-related function. Therefore it can be a non-1E power supply. And that's specifically really the SER that was issued last December.

The system utilizes VRLA batteries, valve-regulated lead acid. The duty cycles in the module-specific subsystem of EDSS, there's two different duty cycles. Again, Alpha, Charlie is Div 1. Bravo, Delta is Div 2. And the Alpha and Delta channel of those are 24 hours. And that's to achieve our ECCS hold mode to hold out ECCS if, you know, if a loss of AC happens, so we can automatically launch ECCS. VHR will go first.

MEMBER MARCH-LEUBA: Hey, Ted?

MR. HOUGH: Sir?

MEMBER MARCH-LEUBA: We have not seen Chapter 15 yet, but that 24 hours would become important, because it goes into ECCS mode automatically. So the question is -- and I assume it's not critical if it's 22 or 26, but about how accurate are we going to be on the timing? It's not going to be 150 hours.

MR. HOUGH: No, no, that's ---

MEMBER MARCH-LEUBA: How do you achieve that?

MR. HOUGH: We've sized the batteries that way. And then there's also a ---

MEMBER MARCH-LEUBA: But aren't the loads going to be variable or not?

MR. HOUGH: I'm sorry?

MEMBER MARCH-LEUBA: You can size the battery, but the load might be case-dependent or won't be?

MR. HOUGH: It will be depending on what vendor we use for the solenoids and things like that. You're right.

MEMBER MARCH-LEUBA: So maybe we'll revisit this on the Chapter 15 uncertainties. We will assume this is covered in 24 hours, but it could be 26.

MR. WELTER: I'm actually going to --- in a station blackout transient ---

MEMBER CORRADINI: You've got a curve.

MR. WELTER: Yes. I'll talk to a sensitivity we did where we looked at with DC power and without, where the ECCS actuated to two hours versus 24 in a few more slides and kind of get a feel for the ---

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. WELTER: -- plant response.

MEMBER CORRADINI: So maybe I'll ask my questions there. But so this is coupled to the timing of this 24-hour changeover? This is coupled to the timing.

MR. WELTER: I mean, the station blackout analysis was run with a 24-hour ECCS --

MEMBER CORRADINI: Clock.

MR. WELTER: -- clock, correct. But we did a sensitivity to that as well.

MEMBER CORRADINI: Thank you.

MR. WELTER: Yes.

CHAIR BLEY: Ted?

MR. HOUGH: Sir?

CHAIR BLEY: You know, a lot of the machinations we've gone through on the topical report and now here are essentially, I think, because there are no VRLA Class 1A batteries around.

Is there any movement in the industry you guys have tracked that were -- I mean, these things are used everywhere. The more you look, the more you find people are using them. Is there any motion to try to get these things classified 1E?

MR. HOUGH: The last input that I had was, you know, from the EPRI folks. And they were actually

looking at more advanced batteries, you know, looking at Type A and things like that, to actually have it ready as a 1E qual, for example, for the AP 1000 when their existing VRLAs become, you know, obsolete or whatever. They're actually kind of leapfrogging over VRLA. And that was the last information I had.

CHAIR BLEY: Of course, going to lithium would raise other issues, but go ahead.

(Laughter)

MR. SCHULTZ: Has EPRI discussed a schedule associated with that?

MR. HOUGH: I'm not aware of it. But it wouldn't be in our timeframe for sure.

(Off the record comments)

MR. HOUGH: So the second to the last bullet ---

CHAIR BLEY: So the answer is kind of no. Nobody's really trying to --

MR. HOUGH: I'm sorry, I didn't --

CHAIR BLEY: -- see VRLAs as 1E batteries. The effort is more looking at something beyond that.

MR. HOUGH: Not that I'm aware of, right. Fortunately, we don't need it.

The Bravo and Charlie channels, those are there to support the PAM functionality from a module-

specific --- get the information from each module. It goes to the control room, and then your EDSS common, they have I and II, feed the displays in the control room for post-accident monitoring. Let's see, so here's ---

MEMBER CORRADINI: So ---

MR. HOUGH: Sure?

MEMBER CORRADINI: No, no. You're on the -- I want you to explain the orange. I'm very confused about how the orange is safety related and what that is, unless that's simply valve actuation at time zero. Is that what the Class 1E box --

MR. HOUGH: The Class 1E box, that represents the 1E load which is MPS, neutron monitoring, et cetera, all right. You know, that's your sense and command. And then the execute device would be your field solenoid or whatever.

MEMBER CORRADINI: Okay. But if I get into an accident in a situation where I demand scram, that's not needed once I scram. But does that also --- that does not power any valve actuation. The valves fail to a safe position?

MR. HOUGH: That's correct. Every execute device we have fails to a safety position without power. And I ---

MEMBER CORRADINI: This is strictly the MPS?

MR. HOUGH: Yes.

MEMBER CORRADINI: Okay.

CHAIR BLEY: But on loss of AC power, you also scram.

MR. HOUGH: Yes.

CHAIR BLEY: Without a signal. I mean, it's just ---

MEMBER CORRADINI: So let me ask the question now, and then Kent will answer in his exam. So if I have a loss of AC power and DC power and all is not what it's supposed to be, and I mistimed the 24-hour changeover --- I can't come up with a better word --- transition, it doesn't matter whether it's a time zero or 24 hours, it's just the most convenient 24 hours?

MR. WELTER: Yes. When we initially, well, from a safety perspective it does not matter. Now there's --- and I can show that with a transient ---

MEMBER CORRADINI: Okay.

MR. WELTER: But the 24-hour time period we established sort of early in the design process with discussion with Ops, and looking at OE, and just --- it's more providing time to recover power before you actually actuate the ECCS and blowing down to

containment. So that's more of an operational coping time period that we want to provide.

MEMBER CORRADINI: So to put it in brutal terms, you induce a LOCA with a 24-hour clock.

MR. WELTER: Well, LOCA is a pipe break. We control, by definition ---

MEMBER CORRADINI: So it's a POCA. It's a planned loss of coolant, POCA.

(Off the record comments)

MR. WELTER: It's a controlled depressurization of the reactor coolant system.

MEMBER CORRADINI: Okay. All right. But whether it's 24, it's a matter of Ops deciding what they thought they needed to try to recover from ---

MR. WELTER: Correct.

MEMBER CORRADINI: Okay.

MR. HOUGH: Questions here then?

MEMBER BROWN: Yes, do you need AC power to do that? I've forgotten some of the stuff.

MR. WELTER: I'm sorry, to do what?

MEMBER BROWN: To execute your ECCS.

MR. WELTER: No. In the beginning of a station blackout, we assume that ---

MEMBER BROWN: You need DC power?

MR. WELTER: The DC power keeps it closed.

And when you lose the DC power at 24 hours, the batteries run out, you remove power from the soleoids, and the ECCS valves open, actuate.

MR. HOUGH: So the answer to the question is either.

MEMBER BROWN: Yes. I'm just trying to, again, I'm trying to calibrate myself, if I lost everything, all the power.

CHAIR BLEY: It's probably more a question --

MEMBER BROWN: AC, DC, and everything else.

MR. WELTER: I'll talk about that a little bit more almost on two more slides.

MEMBER BROWN: Okay. But when you get there ---

(Simultaneous speaking)

CHAIR BLEY: -- station blackout. I'm just thinking if there's no power, that's obviously a super station blackout.

MR. WELTER: Yes. I'll talk just a little bit to that in a couple of slides.

CHAIR BLEY: When you get there, or maybe in Chapter 15, when we lose the batteries, we don't go from full voltage to zero voltage. It degrades, which to me says there's going to be some random sequencing

of how these valves drift from close to open.

Have you thought about that? You know, if you turn off all the DC power, boom, everything works the way you've designed it to work.

MR. INFANGER: The 24 hours is on a timer. It's not just a decay away and then they lose DC power.

CHAIR BLEY: Okay, so the timer ---

MR. INFANGER: The actual timer ---

(Simultaneous speaking)

CHAIR BLEY: -- the timer, these into the batteries.

MR. INFANGER: The batteries are sized to be at least 24 hours. In that 24 hours, you will get a signal that opens all of them and potentially actuates the ECCS.

MR. WELTER: Yes, sorry. I should have clarified that.

MEMBER CORRADINI: So wait a minute.

MEMBER MARCH-LEUBA: This will be an issue with what you were talking about. If your batteries are not large enough, and they only last 23 hours ---

CHAIR BLEY: Yes. Then this becomes a question.

MEMBER MARCH-LEUBA: I would like to have a

voltage monitor isotopes on the batteries.

MEMBER CORRADINI: But get to Dennis' question of the essence. So let's say your design works as planned. But at 22 hours it starts becoming --- it doesn't hit your timer, but it's kind of degrading. What do the valves do? That's what Dennis' question ---

MEMBER BROWN: Do some of them close?

(Simultaneous speaking)

CHAIR BLEY: if, in fact, your batteries, when you get the actual load in the accident and it's ten years into operation, here they're kind of running out of power before you expect it in your design. And now things don't happen all at once like they will in the timer. But you start getting, first one drops out, then another one.

MR. WELTER: I'll have to defer to the electrical systems ---

CHAIR BLEY: You don't see that as a feasible situation?

MR. WELTER: I guess I haven't thought about that at the moment.

CHAIR BLEY: I think it's a good thing to think about.

MR. WELTER: I'd have to talk with the I&C

folks exactly how the system is designed and how losing a little bit of power --- it's my understanding, you know, you're not going to lose a little bit of power and have, like, one ---

CHAIR BLEY: Well, by design you're not.

MR. WELTER: Even by that consideration, but ---

MR. EHLERS: Well, they'll still be doing it just to --- I know you're talking about a theoretical situation, I mean, they're going to still be doing testing of the batteries to make sure their capacity is there to make the 24 hours on a routine basis.

But in this scenario where if, for somewhat of a reason, it didn't make the 24 hours, again, you're only causing an operational issue, not so much a safety one.

MR. WELTER: Yes. I mean, you're generating a signal, right. It's not like they're --- I mean, you're generating a signal to actuate. And so when that signal --- we're not generating partial signals to actuate the ECCS system. They're ---

CHAIR BLEY: Well, you generate a signal to remove all of the power. And the valves pop open.

MR. WELTER: Correct. And if you don't get that signal ---

CHAIR BLEY: If the power degrades ---

MR. WELTER: Then you don't generate a signal.

CHAIR BLEY: -- before you generate a signal ---

MR. WELTER: Then they don't pop up.

CHAIR BLEY: -- at some point, they're going to drift open when they don't have enough power to hold them shut.

MR. HOUGH: I think there's a -- the missing piece here is the instrumentation and control. And correct me if I'm wrong here, but we have something called the equipment interface module. And it doesn't matter whether you remove power, whether you get a logic signal from one state to a zero state, or an operator reaction as a result of the same. The execute device goes to a safety position, okay.

MEMBER BROWN: Say that first part again, something goes to the safe position.

MR. HOUGH: They execute device, the solenoid, or whatever, the breaker will go to a safety position.

CHAIR BLEY: I'll probably save this for when the PRA guys get here eventually, but we've seen real plants where the easy one isn't electrical, it's

air, air pressure doing the same thing as the electrical is doing here.

And if it goes away at once, of course, everything goes to the right position. If it goes away gradually, weird stuff starts happening. A valve over here drifts shut, something over here speeds up, something here happens, and it's not, you know, moving the way you expect.

So I hope the PRA guys have thought about that. You're looking at design. And in design, this can't happen. In the real world, sometimes things happen that are outside of your design basis.

MEMBER MARCH-LEUBA: Let me postulate that.

CHAIR BLEY: But I'll postpone that.

MEMBER MARCH-LEUBA: There was an earthquake that partially grounds to one of your cables.

CHAIR BLEY: There you go. And there's a ---

MEMBER MARCH-LEUBA: So then you have bigger load, and suddenly you only last six hours. Definitely, I would prefer if you have a monitor of the voltage. And do it before the voltage stops, you know, 11 -- yeah.

CHAIR BLEY: It's up to you, Matt.

MEMBER SUNSERI: So I've got a slightly

different question on this topic. In some of the plants that I've been in, from a reliability perspective, we worked hard to eliminate energized -- continuously energized relays and coils from a reliability perspective, especially if they were a single point of vulnerability.

So can you comment on the reliability aspects of having your ECCS valve energized to stay closed for the whole operating cycle?

MR. HOUGH: That is a good point, something we thought about early on. If you wanted to have a zero power plant, that's what you end up with. And an EQ qual for that has to account for that. So it is a consideration here. You're exactly right.

MEMBER KIRCHNER: I'm trying to remember. You presented previously. I think we saw how the valves were, the ECCS valves were --- what's their normal environment? Are they in water or air? I guess they're in air, the actuators?

MR. WELTER: Yes, they're inside the containment, yes.

MEMBER KIRCHNER: So they're in the containment, they're in air.

MR. WELTER: Vacuated containment, minimal air.

MEMBER KIRCHNER: But not accessible?

MR. WELTER: Not during normal operation, correct.

MEMBER KIRCHNER: So I think Matt's point is a good one.

MR. HOUGH: Well, that's the mechanical valve itself.

MR. WELTER: That's the mechanical part.

MR. HOUGH: Tripped solenoids and stuff like that are outside.

MR. WELTER: Yes, that's correct.

MEMBER SUNSERI: So I guess the follow-up question is what's the consequence of a spurious opening of the valve?

CHAIR BLEY: One valve.

MR. INFANGER: Yes. The spurious opening of a single valve is evaluated in 15.6. And essentially, what happens is water starts going into containment. The water level in containment rises. And when you reach the level set point in containment, the rest of the valves open.

MEMBER SUNSERI: So I guess the reactor shuts down and ---

MR. INFANGER: Yes. Containment isolates the reactor, and it trips, and the DHRS actuates.

MEMBER BROWN: How often are the batteries tested? You made the comment about --- I've forgotten who made the comment about they're periodically tested to ensure that their capacity is satisfactory ---

MR. EHLERS: Right.

MEMBER BROWN: -- to handle. And so what's the timeframe between capacity tests?

MR. EHLERS: That's still to be determined. I mean, that's going to follow the vendor guidance when we get the batteries.

MEMBER BROWN: Okay, implementing 1188, 1187?

MR. EHLERS: Typically, it's going to be --

MEMBER BROWN: Are we talking a year, two year --

MR. EHLERS: -- two years, four years.

MEMBER BROWN: -- refueling cycle?

MR. EHLERS: It depends also, typically, on the trend of the capacity, you know, starting ---

MEMBER BROWN: The reason I ask is, relative to Dennis' question about the sequential or the degrading part, is batteries are very unpredictable in terms of their post-tested performance. They're innately good.

I mean, a typical example, I know a buddy of mine came up to visit with me for a week and turned off his car. And half an hour later he went back out to start the car, and it didn't start. The battery was dead. And it did that in a half an hour even though he'd been driving for four hours to get to my house.

So I think it's a good question to ask about the ability to predict the performance of all the batteries, of the number of batteries you've got, and not have some of them do something slightly different than what you --- I'm not saying you're doing it the right way, all I'm bringing out is to amplify Dennis' point.

MR. HOUGH: Those are good points. Let me bring up that we are implementing IEEE 1187, 1188 for the batteries, the monitoring and maintenance of them. And we also have continuous battery monitors installed on the PRA also.

MR. WELTER: I don't know if you can see ---

MEMBER BROWN: Yes, but those --- that's another capacity, that just says that ---

MR. HOUGH: No, that's correct.

MEMBER BROWN: -- you're just putting, well,

you're generating some current at some voltage.

CHAIR BLEY: I think it was Paul earlier who said you are going do deep discharge testing on these routinely. No? I misunderstood what you said.

(Off the record comments)

MEMBER BROWN: There was a periodic test every refueling cycle or something like that, they haven't determined yet. It's a capacity test.

CHAIR BLEY: Well, to me a capacity test sounds like a deep discharge test. You're running it way down. If you're not doing that, then the battery performance gets fuzzier.

MR. INFANGER: Yes. There's actually a standard for the VRLA batteries. And they don't do a deep discharge for them. You do a more shallow discharge, and you trend it on graphs. So it's just a different process. Because you don't want to ---

CHAIR BLEY: No, it's more than a different process, it's not testing what you're worrying about.

MR. INFANGER: If you're at 25 percent discharge, and then you trend that, that has been proven to be accurate for determining that the batteries maintain their capacity.

MR. EHLERS: The key to both technologies that apply to VLAs and to VRLAs is the trending

portion of it. So whatever test you do is to determine the capacity of your current battery and to ascertain the data to do the trend to see how the capacity is degrading over time, so you can make an informed decision of what point you replace that battery.

So that's what he's speaking about, is the actual trend. Whether you do a 25 percent discharge test or you're doing a full deep discharge, which is more common amongst the traditional fleet right now, the purpose of both of those is to get that data for the capacity.

CHAIR BLEY: Yes. And what I'm not fully familiar with is substantial data that confirms that a partial discharge gives you the right trend.

You know, my experience when these started 40, 45 years ago with the phone company who used to do very light testing, and then every time they needed the batteries they didn't work. And they eventually went to deep discharge testing.

But if there's plenty of information to prove that a 25 percent gives you the real trend, and not a pseudo trend, that would help me. And I guess usually the standard doesn't point me to all of that research that proves it's good enough. If you guys

can, that would be interesting certainly.

MR. HOUGH: The Navy uses these, so ---

CHAIR BLEY: Yes, the Navy doesn't share very much.

MR. HOUGH: That's correct.

MEMBER SKILLMAN: The question I would ask is is this system included in your Maintenance Rule, 50.65? I presume that it is. And if it is, then your electrical system is going to be subject to a host of confirmatory tests that it's capable of performing the functional performance requirements for which it is designed.

And it would seem to me that, in that context, you're going to have some form of a discharge test, whether it's via a RLA or a different type battery, to confirm the capacitance is what it is required to be. And you're going to pull batteries, replace cells as needed when those cells don't perform. Is that accurate?

MR. EHLERS: I believe it is.

MEMBER SKILLMAN: I believe it is too. So if that's the case, then whatever that test might be will be the test that is appropriate for that specific battery design. Otherwise, your Maintenance Rule program is not applicable or is not capable of

performing its function. So I think this is going to come out in 50.65 in your Maintenance Rule program.

MR. HOUGH: Yes, it's definitely going to --

-

CHAIR BLEY: I'm partially responsible for us being a little behind. But we're down to the last 20 minutes for you guys. So I'm going to let you run a little freer here toward the end.

MR. HOUGH: All right.

CHAIR BLEY: If we can all do that.

MEMBER BROWN: I'll save my other question until the end then. It's not on this, it's a slightly different question. And they won't be able to answer it. But I just wanted to get it on the ---

CHAIR BLEY: Thanks, Charlie. Get on the record.

MEMBER BROWN: -- I wanted to get it on the table before the meeting was over.

MR. HOUGH: All right, moving on to EES's little brother here, EDNS. These are also VRLA batteries with a 40-minute duty cycle. It originally specifies a 30-minute duty cycle in the URD, the utility requirements document. And we certainly put some margin on there. It's been made in 40 minutes.

And that way, loads as you see here like,

you know, breaker control power, things like that, if we needed it, you know, the AAPS would be up and ready to load within that 30-minute time period. And so it was a ten-minute margin. So again, this is all non-safety loads for investment protection, power generation, TG emergency lube oil pumps, controller drive supply, et cetera.

Moving along here. At this point, I'll turn to my colleague here, Dr. Welter.

MR. WELTER: Thank you, Ted. So I'll give that punch line first here, and then we'll look at the three plots.

So we're looking at station blackout scenario, a 72-hour coping period. And so I'm going to show a single module analysis. But from an initial conditions perspective, it assumes all 12 modules were operating at 100 percent power prior to the event.

Again, the punch line first, all safety functions achieved and maintained for that 72 hours without reliance on AC power or operator action. And those are the safety functions there, the reactor trip, go to passive decay heat removal system, the DHRS, and then eventually the ECCS after the 24-hour time period you talked about.

So the criteria for station blackout coping

period, the core remains cooled, maintained containment integrity without AC power. I don't have the plots, but I'll speak to it. We did do a ---

CHAIR BLEY: Well, before you do that ---

MR. WELTER: Yes.

CHAIR BLEY: -- just a quick question. Your Table A.4-1 on station blackout begins at time zero then gets a high pressure signal at nine seconds and a reactor trip on high pressure. Why don't we have a reactor trip at time zero on loss of power? I thought losing power releases the rod.

MR. WELTER: AC power?

CHAIR BLEY: What kind of power holds the rods up?

MEMBER BROWN: That's your EDN system?

MR. WELTER: Yes. The EDNS is powered by the DC system, so we go back a few slides ---

CHAIR BLEY: We've got 40 minutes there.

MR. WELTER: Yes, you've got 40 minutes on that from --- the batteries provide that.

CHAIR BLEY: So it comes off the batteries.

MR. WELTER: Yes, for 40 minutes.

CHAIR BLEY: I didn't realize that. I thought it came off of AC.

MEMBER MARCH-LEUBA: But your protection

system must still work for 40 minutes?

MR. HOUGH: Module protection?

MEMBER MARCH-LEUBA: The planned protection system.

MR. HOUGH: It's actually 24 hours and 72 hours --

MEMBER MARCH-LEUBA: Class 1E?

MR. HOUGH: -- on protection.

MR. WELTER: On the slide that ---

MEMBER MARCH-LEUBA: Class 1E?

MR. WELTER: Yes. The slide that Ted had shows the EDNS with a different ---

(Off the record comments)

MR. HOUGH: There's EDN, and you can see control rod drives there.

MR. WELTER: You had onsite DC power on the battery duty cycle ---

MR. HOUGH: There's the other one for EDS, for MTS that you're talking about.

MR. WELTER: Oh, sorry, 15.

MEMBER MARCH-LEUBA: Okay. If you lost all of AC power ---

MR. WELTER: Sure.

MEMBER MARCH-LEUBA: -- and now you don't scram, your protection system must work.

MR. WELTER: Correct.

MEMBER MARCH-LEUBA: What powers it?

MR. HOUGH: EDSS is the power supply for the module protection system.

MEMBER MARCH-LEUBA: And that's Class 1E.

CHAIR BLEY: That's the highly reliable ---

MEMBER BROWN: Highly reliable DC power --

CHAIR BLEY: -- DC power system.

(Off the record comments)

MEMBER MARCH-LEUBA: I'm surprised. But it's now creating the plant power?

MR. HOUGH: That's correct. It is the normal supply.

MEMBER MARCH-LEUBA: My understanding was you lose power, your rods drop. And you ---

CHAIR BLEY: That's what I thought I read in this document. But I didn't mark it, so I have to find it.

MEMBER BROWN: The EDNS system is the normal DC power system. And I just went back to Chapter 7, okay.

CHAIR BLEY: That's EDNS. EDSS is the one ---

MEMBER BROWN: EDNS is what supplies the circuit breakers, the reactor trip breakers. It's the

power through the breakers, not the actual trip actuation devices. But that's the power through the breakers.

CHAIR BLEY: Through the breakers.

MEMBER BROWN: Through those control rod mechanisms. I think that's correct. I haven't reviewed all of Chapter 7.

MR. HOUGH: That is correct.

MEMBER BROWN: So according to the schematic, you open these DC breakers via the module --- the plant protection system, or whatever the acronym is. But the actual DC power is supplied through the DC breakers. And if the ---

CHAIR BLEY: And that's off of the normal DC?

MEMBER BROWN: Yes. If, theoretically, your plant protection system would still be energized at this point, although I haven't checked the power sources to that in all cases.

CHAIR BLEY: I misread something on that. It's not real clear.

MEMBER MARCH-LEUBA: The same power that keeps the rods up is the one that powers the protection system?

MR. HOUGH: No.

MEMBER BROWN: No, it's not. That's -- I've told you. I have --

CHAIR BLEY: The normal ones light the rods up.

(Simultaneous speaking)

CHAIR BLEY: The highly reliable system powers the ---

MEMBER MARCH-LEUBA: But none of them are Class 1E?

CHAIR BLEY: No.

MEMBER MARCH-LEUBA: So for 40 minutes, you may or may not have protection if you have a transit?

MR. HOUGH: Oh, no. You have protection.

MEMBER MARCH-LEUBA: Well, you may not have power to the protection system.

MR. HOUGH: That's the EDS highly reliable DC system that provides power to the protection system. And I don't need that system to achieve safety functions.

MEMBER MARCH-LEUBA: Even with the rods out? Your rods are being held by the other batteries.

MR. HOUGH: That's correct.

MEMBER MARCH-LEUBA: You are going to have to run this by me eventually. Because there is something, I mean, what I understood is we don't need

Class 1E power, because if I lose power I scram.

MR. HOUGH: Yes.

MEMBER MARCH-LEUBA: Apparently now, a non-safety grade, highly reliable but not safety grade power holds the rods up.

CHAIR BLEY: Keeps me from shutting down.

MEMBER MARCH-LEUBA: Keeps you from shutting down automatically. And another non-safety grade, highly reliable power is supposed to contain the protection system going.

MEMBER BROWN: The EDSS systems supplies the module systems and the plant protection system. I counted another figure while we're sitting here talking about it. And I'm just looking at Chapter 7 again, Figure 7.0-2 shows the ---

(Simultaneous speaking)

MEMBER BROWN: They call it the highly reliable DC.

CHAIR BLEY: So we're kind of in an odd spot we didn't know we were in here.

MEMBER BROWN: Yes.

CHAIR BLEY: If you lose that, you're going to scram, but if you don't lose that ---

MEMBER BROWN: You don't scram? You don't ---

CHAIR BLEY: You don't scram until you get some signal to scram.

MEMBER KIRCHNER: So I think to maintain religious purity here, they have to scram on loss of power. But they don't.

CHAIR BLEY: Well, if they lose full power, they do.

MR. BERGMAN: If I could interject, Tom Bergman.

CHAIR BLEY: Yes, Tom.

MR. BERGMAN: That is you lose the --- if you maintain the EDSS you could keep the rods out, but you've lost the EDSS which would cause loss of the module protection system and you will trip the plant.

MR. HOUGH: That's correct. That's correct.

CHAIR BLEY: You just used the same acronym twice. You didn't mean to.

MR. BERGMAN: Oh, I'm sorry, they sound very similar.

CHAIR BLEY: If you lose EVMS the rods will fall.

MR. BERGMAN: The common system, which is on the current slide ---

CHAIR BLEY: Yes.

MR. BERGMAN: -- that's the one that keeps

the rods out.

CHAIR BLEY: And if you lose that, the rods will drop.

MR. BERGMAN: Yes.

CHAIR BLEY: Yes.

MR. BERGMAN: If you maintain this one but you lose the EDNS -- no sorry, you had it right -- the EDNS powers the control rods. That would keep them out. But if you lost the power supply to the module protection system, you will trip the plant.

CHAIR BLEY: You'll get a signal to trip the plant.

MR. BERGMAN: Yes. The module protection system controls the Class 1E devices. If you lose that, all the safety systems go to their safe position, regardless of the other power supplies in the plant.

MR. WELTER: Yes, and in Chapter --- not all of the -- at the start of a transient, when you look at it in Chapter 15, you look at loss of power as an initiating event, as an example --- or as a coincident event.

But the module --- not all the safety functions, you know, happen within time zero, right. So we have power to the module protection system to,

you know, monitor the plant. And we have a number of trips that are going to hit depending on the transient.

And so we want power to the MPS for a transient so that MPS can perform its safety functions. Reactor trip is just one of those. We have containment isolation, you know, DHRS, DCCS actuation, so we want highly reliable power to the MPS to protect the plant through the various transients.

But to Tom's point, if you lose that, then it goes to the fail safe position. It's a whole different paradigm.

MR. EHLERS: Yes. Just to be clear ---

MEMBER CORRADINI: Yes, let's be clear, because I thought I understood it now.

MR. EHLERS: The initiator for the plant trip is loss of power to the battery chargers. So once you lose that power, you get a sixty second time delay just to alleviate any momentary lapses, you know, drops or spikes.

MEMBER BROWN: So that's loss of all AC power then.

MR. EHLERS: Right. And so as soon as we lose power to our chargers, to charge the batteries, for better than 60 seconds, we will trip the plant.

CHAIR BLEY: And that's a timer that generates the trip signal?

MR. EHLERS: Yes. Well, it's a --- yes, the voltage signal goes to the MPS.

(Off the record comments)

MEMBER BROWN: So independent of the EDSS and independent of the EDNS, if you lose AC power --

CHAIR BLEY: To the chargers.

MEMBER BROWN: -- the chargers --- yes, thank you --- chargers, there's an independent timer that then says, Kings X, scram the plant. And I don't know where that comes from or how it gets processed. But if you go back and look in Chapter 7, we should be able to see that.

MR. EHLERS: That's in Chapter 7.

MR. WELTER: And as a point, since we do have DC power, we hit that trip point sooner on high pressure before that ---

MEMBER BROWN: You lost me.

(Laughter)

CHAIR BLEY: In the current analysis that he wanted to talk about --

(Simultaneous speaking)

CHAIR BLEY: -- they're going to trip in nine seconds because of --

MR. WELTER: -- in nine seconds, which is within that 60 second window.

MR. BERGMAN: It's hard to envision making it 60 seconds with no AC power and not getting a reactor trip somewhere first.

MEMBER BROWN: Even though there's no "accident" scenario involved.

MR. BERGMAN: Right.

MR. WELTER: If I could go back to the earlier line of questioning ---

MEMBER SUNSERI: Can you get closer to the mic?

MR. BERGMAN: Oh, sorry. The questioning about degraded voltage, that will come up in Chapter 7 which is in August. But it does isolate our degraded voltage.

MEMBER BROWN: I tried to find that, Tom, and was unable to.

(Off mic comments)

(Laughter)

MEMBER BROWN: Is Rev 0 the current revision for Chapter 7? That's all I've got. So we're due to do that in a couple of months.

MR. BERGMAN: I'm assuming we have Rev. 1, Chapter 7.

MR. SNODDERLY: Yes.

MR. BERGMAN: I don't know how many ---

MEMBER BROWN: Mine's 2016. So that's Rev. 0. So I have not seen a Rev. 1 yet.

MR. BERGMAN: We reissued the DCA as Revision 1 in March, mid-March, all the chapters.

MR. SNODDERLY: Yes, this is --- yes.

MR. BERGMAN: I'll certainly be in touch.

MEMBER BROWN: I was unable to find it anywhere.

MR. SNODDERLY: This is Mike Snodderly from the ACRS staff. So as Tom said, Revision 1 came in on March 15th, 2018. And I was going to make a request to the staff. Because also on the public website right now it's still Rev. 0. But, yes, Rev. 1's in, hopefully we can get ---

MEMBER BROWN: That's where I got it.

MR. SNODDERLY: Yes. Hopefully, we can get that up to date. But otherwise, we'll get access for you guys.

MEMBER BROWN: And just to get the proprietary version, not the non-proprietary version that's on the public website. I think it's --- or is it totally non-proprietary?

MR. BERGMAN: Oh, no. The design

certification application is non-proprietary.

MEMBER BROWN: Is totally proprietary?

CHAIR BLEY: Non-proprietary.

MEMBER BROWN: Non-proprietary, okay. Is there any proprietary version of Chapter 7?

MR. BERGMAN: There should not be, no.

MEMBER BROWN: Okay. I'm just trying to clarify.

MR. BERGMAN: Some chapters have security-related information which is redacted but --

MEMBER BROWN: Okay.

MR. BERGMAN: -- will lead us into Chapter 7.

CHAIR BLEY: I want to come back to Jeff just so I understand this. And maybe we'll get to it again in Chapter 7. But this timer that starts when you lose AC power to the battery chargers, I've got two or three things about it. Is it a mechanical timer or a digital timer?

MR. EHLERS: I can't speak to that.

CHAIR BLEY: Is it in the protection system or is it, you know, kind of a separate thing?

MR. EHLERS: It's part of the MPS system.

CHAIR BLEY: It's part of the MPS.

MR. EHLERS: Yes.

CHAIR BLEY: And does it do anything else other than generate a reactor trip signal? We'll want to know all about that come --

MR. EHLERS: Okay.

CHAIR BLEY: -- Chapter 7 time.

MR. WELTER: The next slide. This is a plot of a reactor pressure vessel water level above the top of the active fuel. This is collapsed liquid level. This is a plot generated from NRELAP 5, a NuScale proprietary version of RELAP.

It's a 72-hour time period, so it's a fairly long plot. We kind of already talked about it a little bit, where you lose AC power to the battery chargers. There is a timer. But, you know, you're going to lose your secondary site heat removal, because you're not, you know, providing any power to your feedwater pumps.

And since they are fairly smaller reactors, when you lose that secondary site heat removal, it'll be fairly quick increase in primary system pressure. And you're going to trip the reactor on a high pressure signal within about ten seconds, so fairly quickly.

And then you're also going, on the reactor trip, you're going to get a containment isolation

signal which then you also get a DHRS actuation signal. So within ten seconds of this transient, you've tripped the reactor, you've isolated containment, and then you've transitioned to your passive DHRS system.

CHAIR BLEY: And the containment isolation and DHRS comes off of the reactor trip signal?

MR. WELTER: It's a separate ---

CHAIR BLEY: It's separate.

MR. WELTER: Separate, but the logic is when you get a reactor trip, well, the DHRS is actuated on CNV isolation. So the containment needs to isolate before the DHRS can function.

MEMBER MARCH-LEUBA: I thought DHRS was counting on high pressure or it needs --

(Simultaneous speaking)

MR. WELTER: Yes. Well, the trip signal comes on the high pressure. And then the CNV isolation comes on the reactor trip, and a DHRS actuation comes on the CNV isolation. We don't want to ---

MEMBER MARCH-LEUBA: But I thought the DHRS valves needed high pressure to open. What am I missing?

MR. WELTER: No, I'm just giving the

sequence of the trips. Because we don't want to actuate the DHRS before the reactor's tripped or the containment's isolated. So there's a logic to the trip sequence. They're right after each other. There's not a delay in between them. So we have to make sure there's a logic that happens.

MEMBER BROWN: You said CNV or CNB?

MR. WELTER: CNV containment, I'm sorry.

CHAIR BLEY: That's the vessel containment.

MR. WELTER: Containment vessel, CNV. So reactor trip, CNV isolation, DHRS actuation.

MEMBER KIRCHNER: So this is the result of the decayed ---

MR. WELTER: Yes. Can you go back a slide, please?

MEMBER KIRCHNER: -- system pulling down the pressure.

MR. WELTER: Yes, and slowly over time, right. You're going to be reducing, well, the pressure is --- yes, the pressure goes down pretty quickly on the second slide. I wasn't ready to go to the second slide yet.

So this is just the water level. So it stays pretty high in the reactor coolant system. It's an elevated water level, so you have natural

circulation cooling. And then in 24 hours, you have that ECCS timer. Because we still have DC power in this scenario.

This is a loss of AC with DC power. And then when you get the 24-hour signal, then you have a rapid depressurization at that --- well, actually the depressurization isn't that rapid at that time. You have a rapid loss of inventory as the re-circulation valves and the RVV valves at the top open simultaneously, and the ECCS system actuates.

MEMBER KIRCHNER: So why even actuate the ECCS?

MR. WELTER: It's on a 24-hour timer. So the plant is designed to do that.

MEMBER KIRCHNER: But why actuate it if you don't need it?

MR. WELTER: You would have --- h'mm ---

MEMBER KIRCHNER: You would reduce the pressure. You've got natural circulation cooling. Why breach containment?

(Off the record comments)

MR. WELTER: It's a controlled depressurization. It's --- yes.

CHAIR BLEY: No, I understand that.

MR. WELTER: Yes. No, I understand the

question.

CHAIR BLEY: But it's the ECCS actuation where you've breached containment.

MR. WELTER: Yes. And so this whole timer thing is interesting in terms of how we had it in the design and all and had others add in. It's not a safety feature. And so if we wanted to keep it ---

(Simultaneous speaking)

MR. WELTER: What's that?

MEMBER MARCH-LEUBA: If you lost your feedwater, you don't have any way for heat to go outside. And if your vessel is intact, your thermos bottle prevents you from losing heat. So you need it.

MR. WELTER: We don't need the --- we have the DHRS ---

MEMBER MARCH-LEUBA: The DHRS is still working?

MR. WELTER: -- that will work, yes. Right, that's the first passive safety system. We've designed a system to fail safe on loss of power. And we've designed an ECCS system to fail safe in its fail safe position as it is depressurizing, right? It's opening valves and depressurizing.

And from an operations perspective, you don't want to depressurize that, even though it's fine

from a safety perspective, we want to give the operators time to recover the power so you don't actuate ECCS.

So it's not --- you know, the thing is you could say why not 36 hours, right? Well, the way our system is designed, we'd have to add more batteries, right, because of the way that the system is designed to keep the valves closed from an operational perspective, to give them --- it's an investment protection thing.

So when you're looking at how long to do this, it is -- this timer, it's an economic question. So you can keep it longer, and add more batteries, or this is kind of the spot we pick.

CHAIR BLEY: I'm still --- I'm learning a lot this morning.

MR. WELTER: Yes.

CHAIR BLEY: The 24-hour timer does exactly what?

MR. WELTER: For this, it sends an ECCS actuation signal.

CHAIR BLEY: ECCS actuation.

MR. WELTER: Correct. To de-energize the solenoids to open the five ECCS valves.

MEMBER CORRADINI: So can we just back up?

So this stylized station blackout is a scenario that you have to look at relative to station blackout assumptions. But a more severe one will be that I lost DC at time zero.

MR. WELTER: So we did look at that sensitivity. Well, severe, it's not really more severe from a safety perspective. You'll have a --- if you go to the next slide as an example.

So, you know, DHRS is cooling the system for the first 24 hours, and you see you get almost below 100 PSI in the reactor coolant system before ECCS actuates. So once it actuates, if you go to the next slide, the bump in containment pressure is very small at about 35 PSI.

And if I didn't have DC power, we did a sensitivity case, and we --- now, here's where it gets just a little bit more subtle, is that we have an inadvertent actuation block mechanism on our ECCS valves. So we have another --- and this is a mechanical system that prevents the ECCS valves from opening above a certain pressure or differential.

So if we didn't have DC power, if we didn't have power to the solenoids, and that got removed, and you're at high pressure, at 18.50, you have an IAB mechanism that will block the valves from opening, and

you wouldn't -- until you got down to a range of 800 to 1,000 PSI with those valves actually open.

So if you go back to the previous slide, we did a sensitivity where we opened at the lower range of 800 PSI, and it would open in about two hours. So you would have the start of the transient, loss of all power, everything, super station blackout, and you would come down --- you'd go to DHRS cooling, you would come down and we, for the transient, you would open around 1,000 to 800 PSI.

And then you'd get a little bit more rapid depressurization. The containment pressure would go up to about 200 instead of 35. So you can open it earlier, way earlier, at two hours. You still get the same top of active fuel level, and you have a slightly higher containment pressure.

MEMBER CORRADINI: So what was the containment pressure at two hours?

MR. WELTER: What's that?

MEMBER CORRADINI: What was the containment pressure at two hours?

MR. WELTER: At spike, it gets about 200 PSI.

MEMBER CORRADINI: so the 35 pound spike goes to 200?

MR. WELTER: Yes, yes, yes. Because you're depressurizing at a higher pressure, about 800 versus 100.

So that's the sensitivity. So, you know, and in Chapter 15, we do sensitivities of power/not power. And you'll see similar phenomenon in Chapter 15 analysis when we don't have DC power. So we do that sensitivity to evaluate.

And again, that 24-hour timer is not a safety feature. It's purely for investment protection. But we do evaluate it as, you know, extreme examples of it not working.

And actually, in the PRA there was a question on, you know, the degraded power. And I'm not going to attempt to answer the details on the I&C system. But in the PRA we do look at partial failures of the ECCS system. And you will see that when that chapter comes. So irrespective of it's a mechanical or electrical, we do look at that failure in the PRA.

MEMBER KIRCHNER: What's the containment vessel design pressure?

MR. WELTER: One thousand PSI. It's a stainless steel, well, it's a carbon steel, dual clad, and stainless steel containment vessel.

MR. SCHULTZ: Kent, the partial failure

you're talking about is valves not actuating, or the timing of the event, valve performance ---

MR. WELTER: Right. So when you're looking at ---

MR. SCHULTZ: -- or both of those?

MR. WELTER: Well, yes. The PRA, from a Level 1 perspective, when you're looking at the ECCS system, it's the five valves, right. And we look at combinations of if one of them opens and four of them don't, and two open, and three don't, the top or the bottom. They look at all those various combinations. And there's definitely cases where at least the core damage, you have some open and some don't. So that's on the PRA.

MR. SCHULTZ: Thank you.

MEMBER SUNSERI: If you go back just one slide, so what's the slight decreasing trend? Is that just cooling from the DHS system, or you're not losing any inventory, it's just ---

MR. WELTER: No. It's all bottled up. Yes, you don't start depressurizing and losing inventory until 24 hours. Okay.

MEMBER SKILLMAN: Kent, where else --- you say that the 24-hours is really driven by investment protection and the recognition that you will

conceivably be good 48 or 96 hours, except that does the battery hold, and hence you're increasing the battery capacity that would be required to extend beyond 24?

MR. WELTER: You need more batteries to go beyond 24, yes.

MEMBER SKILLMAN: Is there any other function that shares that same facet in your thinking? In other words, we really could have more margin or have more time. But because of our economic model, this is as far as we're willing to go relative to our battery capacity.

MR. WELTER: That's interesting. I actually, from a safety perspective, want to push it to eight hours. Because when you look at the data, you've got plenty of time within eight hours. So if I was going to start back ten years ago, I would have proposed eight hours instead of 24.

MEMBER SKILLMAN: Except that what you're doing then is you're pitting yourself against your heat generation rate and your decay heat removal capability, right?

MR. WELTER: It doesn't change after eight hours. So if you look there after --- if you see where that dip is, that's way back in the five-hour

period. It's at very low pressure, very low already. I think that 24 hours is quite high, actually, on the high end. And ---

MEMBER SKILLMAN: Okay, so --

(Simultaneous speaking)

MEMBER SKILLMAN: -- so your answer, I would have preferred to have less than 24. But my question is ---

(Simultaneous speaking)

MEMBER SKILLMAN: -- is 24, is that marker 24 spinning up other decisions that we should know about?

MR. WELTER: Well, it sizes the batteries.

MR. HOUGH: Yes, but it was done early on.

MR. WELTER: It was done early on, yes. And it's ---

MR. HOUGH: As Kent says, you know, can see here. You know, less than eight hours, it's almost an equilibrium. And we know where we're at. And then we said, okay, we'll give you a factor of three, give Ops time to do something if they wanted to. So that was ---

MEMBER SKILLMAN: So if you went to 12 you --

(Simultaneous speaking)

MEMBER SKILLMAN: If you went to 12, you conceivably have your battery capacity?

MR. HOUGH: I think you could drop it, yes.

MEMBER SKILLMAN: Just, I mean, that's what we're here to talk about.

MR. WELTER: Yes.

MEMBER SKILLMAN: So the answer could be yes.

MR. HOUGH: Yes.

CHAIR BLEY: Well, for this one particular case.

MEMBER SKILLMAN: For this scenario. Okay, thank you.

MR. HOUGH: I think we're back to almost the last of the slides here. As I noted early on, we're going to talk about the road map.

Late last year, there was discussion on a phone call to staff in looking for, you know, some way to validate incorporation of the topical report, conditions of applicability, and the five conditions of the SER.

And so we received that RAI on January 29th and responded on, as Paul indicated, in late March. And that's Table 839 in the latest revision there. And it provides --- here's an example of that table

right here.

I can't fill out that left-hand column, because that's proprietary information. We'd have to go to a closed session and show you how to put that in. But you can see on the right, it directs the reader to appropriate sections within the DCA to perform the validation of the ---

CHAIR BLEY: And by the way, we have all of those things on the left from the topical report.

MR. HOUGH: That's correct, that's correct. Let's see, and we did make some, you know, conforming changes as a result of doing the road map. You know, for example, Reg. Guide 141 for testing, we added that in so that we could include that in Chapter 14.

And then places where it didn't explicitly say without power, we added that verbiage in there. So it's fairly easy to validate now.

And then, so in conclusion, the distribution system is in support of the use of the topical. There's no power required for any safety related function, or Type A variable, or manual operator action. So everything's non-1E, our backup power sources, the result is that their asset protection and black start, if you want it.

And as I noted earlier, it's designed to

support online maintenance and be a very flexible system. And as a consequence, it supports exemption to GDC 17 and 18.

CHAIR BLEY: I have a separate question on Section 832.1.1, highly reliable, direct, current power system. Your first sentence says, "The EDSS is composed of two DC distribution systems that provide a continuous fault tolerant source." And you don't define fault tolerant there. It means lots of things to lots of people in other applications. What do you mean by fault tolerant?

MR. HOUGH: We just mean we do the FMEA.

CHAIR BLEY: Okay, ha, ha, ha, ha.

MR. HOUGH: We're not adversely affected.

CHAIR BLEY: You think it's pretty reliable, that's what you think, okay.

MR. HOUGH: Yes, sir. Right.

CHAIR BLEY: I want to thank you for a real good discussion. And we'll get on to more of this later perhaps. Before we get there, Charlie, I had one thing.

I want to point out, you know, this is one of the glitches in these design reviews when we go chapter by chapter. There's an awful lot of Chapter 7 that's having us confused because of the

interactions among these things. And we'll hit that more and more. So we'll try to keep track of that and look for things. Charlie?

MEMBER BROWN: My question relates to that little bit of what Dennis said before earlier that we haven't done Chapter 7, and there is some flow back and forth. But with all the energized type stuff, you know, go to the fail safe position, as well as other systems that are not necessarily safety related, has there been a consideration of evaluating "I'm operating normally?"

And you had inadvertent actuation of various parts of the plant. And where is the description of that? I pawed through this thing, the Chapter 8, and tried to go through Chapter 7. I don't know whether --- I haven't done a complete thing on Chapter 7. That was just what I call skating. I mean, there's a number of other components that get power.

The other question was the energizing of electric plant components. I was trying to find out how that gets executed. I couldn't find direct reference in Chapter 7 to control systems that actuate breakers, et cetera, other stuff that may have some impact.

As I go through the plant networks, does it

have a separate --- are they analoged, the old style where you just turn a switch, and a relay opens someplace, or a contacter, or what? There was no description of how, at least that I found in that cursory look.

So that's the question I'll probably be addressing. I don't expect an answer now. It's just something that's going to be on the table when we get to Chapter 7.

CHAIR BLEY: I had the same thing.

MEMBER BROWN: Okay.

CHAIR BLEY: Well, I don't know if it belongs there or here on some of this, but ---

MEMBER BROWN: It's too late here right now.

(Simultaneous speaking)

MEMBER BROWN: Yes. Because they're kind of unrelated since they're not I&C type systems. But do you use main control room stuff through a computing system, the teachable, or whatever you want to call it, if somebody grabbed control of it, could you initiate selected component actuations that would ---

MR. WELTER: Yes.

CHAIR BLEY: I don't think you need to answer this --

MEMBER BROWN: I don't want him to answer it

right now. It's just on the table. That's all.

MR. WELTER: I think you'll see it later.

CHAIR BLEY: Tom, you had something?

MR. BERGMAN: Just to clarify, so yes. Chapter 7, Revision 1 does have changes in response to RAIs in it. That would be the appropriate version to read.

And then Rev. 0 of Chapter 8 has been corrected. Rev. I, there is no flex connection. That was part of our ELAP analysis. So there is no flex connection in Rev. 1.

CHAIR BLEY: Is that the only substantive change?

MR. BERGMAN: Well, no. Rev. 1 captured all the staffs' RAIs that we had ready up to that point.

CHAIR BLEY: Oh, okay. So we got that stuff as responses to the RAIs. It's now in my ---

MR. BERGMAN: But the large open item in Chapter 8, there's an RAI subsequent to the staffs' issuance of that. It was kind of in parallel, but it was already damaged in review that closes most of that.

CHAIR BLEY: Okay. On the large RAI that we're going to hear more from the staff about, are discussions continuing on that? Are you comfortable

with where that's headed, or do you have anything you want to say about that before we hear from the staff?

MR. HOUGH: I just read a lot in developing that table in here --

CHAIR BLEY: Okay. Fair enough. At this time, we're going to recess for a break. We'll come back at 25 minutes until 11:00. We're going to lose three people at noon for an internal meeting. It'd be nice to finish by noon, but if we don't, we can go over a little bit. We'll recess right now until 25 until.

(Whereupon, the above-entitled matter went off the record at 10:16 a.m. and resumed at 10:34 a.m.)

CHAIR BLEY: We are back in session. We look forward to hearing from the staff. And I sincerely hope you're able to go beyond what you gave us in slides today. Omid, I'll turn it over to you.

MR. TABATABAI: Okay. Yes, good morning, everyone. Thank you very much for the opportunity for the staff to present their Safety Evaluation Report with open items with respect to Chapter 8, Electric Power of the NuScale Design Certification Application.

Today, I just want to make sure that we understand, the Chapter 8 that NuScale has presented

to us is not the ordinary ones that we have seen in the past. That's why we have involvement from many other branches, expertise to a new Chapter 8.

It's not quite standalone. We have reviewers, support from Instrumentation and Control, Containment, Ventilation, Mechanical Engineering, Reactor Systems, and Plan Systems, and PRA, who contributed to this review.

I'm Omid Tabatabai, I'm the Chapter PM for Chapter 8. Lead Project Manager for NuScale Design Certification is Greg Cranston. I just wanted to recognize these colleagues of mine who have significantly contributed to this review. And by the way, they are available, they are in the audience, in case there are questions in those areas, they should be able to support us.

Just want to, before we get into the technical presentation of Chapter 8, just as a matter of background, NuScale Power submitted its Rev. 0 of Design Certification Application back in December of 2016.

And then, they submitted a Revision 1 in mid-March 2018. And they're currently working on preparing Revision 2, which includes all of the back and forth RAIs, followup RAIs, and other requests from

the staff to incorporate into the Design Certification Application.

This SER that the staff has prepared is based on Revision 0. I just want to make sure that, although we have more up-to-date information, but the SER does not reflect that, because of the timing, as was mentioned earlier.

Again --

MEMBER CORRADINI: So, just to be clear, so this is Revision 0 that we're going to see the review of.

MR. TABATABAI: Yes.

MEMBER CORRADINI: And Revision 1 is in preparation?

MR. TABATABAI: Revision 2. Revision 1 has --

MEMBER CORRADINI: Revision 2?

MR. TABATABAI: Yes.

MEMBER CORRADINI: But if I go to the NRC website for it, all that's there is Revision 0.

MR. TABATABAI: The whole application?

MEMBER CORRADINI: Yes.

CHAIR BLEY: The public website.

MEMBER CORRADINI: The public website.

MR. TABATABAI: It should be actually

Revision 1, we have --

MEMBER CORRADINI: Really? Okay.

MR. TABATABAI: We have --

MR. SNODDERLY: As of yesterday, it still wasn't up yet.

MR. TABATABAI: Okay.

MR. SNODDERLY: We can make that -- hopefully you guys will get to it.

MR. TABATABAI: I know my project management colleagues, they were working on clearing it for posting it on the website --

MR. SNODDERLY: All right, great.

MEMBER CORRADINI: That's the reason I asked, is that's --

MR. TABATABAI: Right.

MEMBER CORRADINI: -- where I go to check what's publicly available. But that's fine, thank you.

CHAIR BLEY: So, since we've interrupted you here for a second, I'm going to state something I think I noticed here. And whoever is doing Chapter 8.1 can address this, or you might want to, Omid.

When I read Section 8.1 and go through all of the comments through the GDCs and through the other NRC documents and SECYs, it seems there's an awful lot

of things that remain -- I don't think they have an open item number attached to them, but you say you're still evaluating exemptions to GDCs 17, 18, 33, 34, 35, 38, 41, and 44.

Those don't -- well, two of them are part of the giant open item. The rest don't seem to have open items, but it's still ongoing work --

MR. TABATABAI: Right.

CHAIR BLEY: -- that you're --

MR. TABATABAI: That's correct.

CHAIR BLEY: -- involved in. Okay.

MR. TABATABAI: That's correct.

CHAIR BLEY: So, those are not finished yet? There's an awful lot in 8.1 that's --

MR. TABATABAI: That's correct.

CHAIR BLEY: -- still in process?

MR. TABATABAI: Right. I think during the presentation, it was mentioned that the RAI question that we sent for the Topical Report that how NuScale is basically incorporating information in the ECA, that RAI, evaluation of that RAI response is still ongoing, which feeds into those GDCs.

CHAIR BLEY: Okay.

MS. RAY: This is Sheila Ray. If I may add to Omid's response, 8.1 is really meant to be an

introduction and an overview, and it should be pointing to other sections in Chapter 8 where we do make technical evaluations. But, yes, those GDCs are still open and still under review.

CHAIR BLEY: Okay. And they could have RAIs, but they don't as yet? Separate ones?

MS. RAY: Correct.

CHAIR BLEY: Okay.

MR. TABATABAI: For the Chapter 8, specifically, we have issued ten RAIs, which contain about 25 questions. And NuScale has responded to all of the questions.

This SER has two open items and one big, as you mentioned, and the other one relates to the electrical penetration assemblies. And we will address all of the confirmatory items and open items during the Phase 4 of our review.

So, this was my introduction to this, before we get into the technical substance of this presentation. With that, I would like to ask my colleague, Sheila Ray, to continue.

MS. RAY: Thank you. As Omid mentioned, my name is Sheila Ray. I am the Reviewer for 8.1, 8.3-2, and I will be presenting for 8.4, my colleague Fanta Sacko is on business travel, so I will be presenting

on her behalf. So, thank you.

Section 8.1 is the introduction. The electric power system for the NuScale design is comprised of nonsafety-related AC and nonsafety-related DC power systems. The design does not depend on onsite or offsite AC or DC electrical power system, including that from the transmission grid for safe operation.

The NuScale design with non-reliance on electrical power accommodates a site location where offsite transmission grid is not necessarily available. As NuScale mentioned, the normal source of power is one or more of the 12 operating power module main generators.

The staff reviewed the design of the electric power systems necessary for the safe design and operation of the plant or whose failure might adversely affect their safety-related or risk-significant safety functions.

The staff used the DSRS and SRP, as well as the graded review approach for its review.

MEMBER MARCH-LEUBA: Go back to -- stay there. That's an interesting concept that they wouldn't be -- that the plant would be sited in a place where there would be a permanent loss of offsite

power. Is that what we're considering?

MS. RAY: I would not say it's a permanent loss of offsite power, they may not be connected to the bulk power system.

MEMBER MARCH-LEUBA: So, there will be a complete loss of offsite power and they will have their own --

CHAIR BLEY: They won't have any offsite power.

MEMBER MARCH-LEUBA: It's an interesting concept. We need to consider the implications of that, because you can make into an extended period of problems, if you have a common cause failure between the modules.

MS. RAY: I understand your point.

MEMBER MARCH-LEUBA: Yes. So, we need to consider that for the review.

MS. RAY: At this time, since it's nonsafety-related power, and that is really where --

MEMBER MARCH-LEUBA: Okay.

MS. RAY: -- we'll transition perfectly to my next slide. This is where the open item comes in. The major open item, Open Item 8.3-1, is recurring throughout Chapter 8 in that this open item is referenced in all of the sections: Section 8.2 for

offsite power systems, 8.3.1 for onsite AC systems, 8.3-2 for onsite DC systems, as well as 8.4 for station blackout.

MEMBER SKILLMAN: Sheila, as you begin, is this the totality, the exact wording of Open Item 8.3-1 or is this a Cliffs notes version of 8.3-1?

MS. RAY: It would be essentially the Cliffs notes version.

MEMBER SKILLMAN: Okay.

MS. RAY: However, in the SER, we do refer to a specific RAI, and that is RAI 9359.

MEMBER SKILLMAN: No, I go it. Okay, thank you, Sheila. Thank you.

MS. RAY: You're welcome. So, this particular open item is repeated in each section of Chapter 8. And I will discuss the details of this open item up-front, so many of the details will not be repeated later on in the continuous sections.

As previously stated, the NuScale design does not rely on safety-related AC or DC power systems. A Topical Report was submitted on the safety classification of passive nuclear power plant electric systems and the staff approved the Topical Report with five additional conditions.

The open item relates to the exemptions to

GDC 17 and 18, as described in DCA Part 7, regarding the staff verifying that the design does not require safety-related power. In addition, the Chapter 15 review on accident analyses is still ongoing.

Staff issued an RAI regarding how the NuScale design meets these conditions of applicability.

CHAIR BLEY: There are parts of your review of Chapter 8 that cannot complete until the Chapter 15 is done, because it's essentially referred to here in Chapter 8?

MS. RAY: Correct. And it's not just Chapter 15, we have been talking to our friends in Chapter 7 review, PRA, Chapter 6. So, there's a lot of review that will feed into the conclusion of our chapter.

MEMBER MARCH-LEUBA: Going back to my previous comment, if you don't have any grid whatsoever, how do you start the first modules?

MS. RAY: If you remember, NuScale mentioned the backup diesel generators and the AAPS are black-start capabilities.

MEMBER MARCH-LEUBA: Okay. You are considering that, right?

MS. RAY: So, what I -- I think you will get a flavor from our review that many of these things are

still non-safety. As of right now, we still have the open items, so we're not concluding that they should be non-safety or safety-related. So, our review is essentially not fully complete yet, because of this major open item.

MEMBER CORRADINI: What -- then let me ask the question. I guess I took the open item to be that NuScale has yet to document how it meets the limitations and conditions from the Topical Report --

MS. RAY: They have --

MEMBER CORRADINI: -- but it's more than that?

MS. RAY: So, they have provided a response. The staff is still evaluating that response.

MEMBER CORRADINI: Do -- probably, we have it and I don't remember seeing it.

CHAIR BLEY: We got the response.

MEMBER CORRADINI: We got the response? Okay. So, go ahead, I didn't mean to interrupt.

MS. RAY: No problem. So, the responses to RAI 9359, staff is still evaluating. And that includes not just Chapter 8 reviewers, that includes Chapter 15, 6, a lot of the other reviewers. And we'll be evaluating it in Phase 4 of our review. So, staff has issued the RAI and now, we are currently

evaluating the response.

And now, I will --

MEMBER CORRADINI: Well, I don't even --

MS. RAY: Yes?

MEMBER CORRADINI: -- know how to ask my next question, but I'm --

MS. RAY: Sure.

MEMBER CORRADINI: -- struggling to understand this interconnection, because is it the passive nature of the plant that makes this interconnection more complex than a typical active plant? I would think there still -- or is it the fact that they're claiming that there's no need for Class 1E power?

MS. RAY: It is -- correct. It's the second. It's, do they need safety-related power? In order to determine if they need safety-related power, we need to look at how they're safely shutting down and doing accident mitigation. Do they need power for those functions and does it have to be safety-related power?

MEMBER CORRADINI: So, then, let me ask -- oh, okay. All right. I guess my obvious question is, why are we looking at this at all right now, considering that everything else has to be considered before we look at this?

MS. RAY: Does that --

MEMBER CORRADINI: Sorry to ask the question --

MS. RAY: No, it's a great --

MEMBER CORRADINI: -- but I'm struggling.

MS. RAY: -- question. Honestly, the staff asked the same question. It's a scheduling issue.

MEMBER CORRADINI: Okay. So, then, in my role as Chairman, I will say, don't be surprised when we upset your apple cart schedule, because although this is first, somehow in my mind, it's at the end, because everything feeds into it

MS. RAY: I would agree with your assessment.

MEMBER CORRADINI: Okay, fine.

CHAIR BLEY: So, along that line, do we have a -- do you have a likely point in the overall schedule when Chapter 8 will be complete?

MS. RAY: So, we're currently working on our Phase 4 review, and I will leave it to Omid to discuss the schedule date of our Phase 4 review.

CHAIR BLEY: In your talk, are you going to address at all any of the responses from NuScale with regard to the big open item, 3-1?

MS. RAY: I cannot. The staff is still evaluating the response.

CHAIR BLEY: Okay. So, it's wide open?

MS. RAY: It is.

MEMBER BROWN: On other, just to make sure, the Topical Report is still Rev. 1 of 16497?

MS. RAY: I believe so. Yes, that's correct.

MEMBER BROWN: Okay. And that's in the RAI that you, I think you referenced, if I did it correctly, if I can find the right place here, I lost it. There was a RAI, something -- what was --

MS. RAY: 9359?

MEMBER BROWN: 9359, yes, I think -- is that the one we got part of the package, Mike?

MR. SNODDERLY: Yes. But let's make sure we're all on the same page right now. So, the Topical Report, I believe was issued as Rev. 1. And an SE has been issued by you guys approving that Topical, with a set of limitations and conditions.

MS. RAY: Correct.

MR. SNODDERLY: Those limitations and conditions are scheduled to be addressed within the Safety Evaluation for Chapter 8. Which, right now, is -- the Safety Evaluation is on Rev. 0, but you're aware of Rev. 1 and they are working on Rev. 2, which -- I'm sorry, yes, okay.

MS. RAY: Let's -- you're right on the

Topical Report is Rev. 1. We evaluated DCA Rev. 0. In Phase 4, we'll evaluate DCA Rev. 1, as well as the RAI response to the Topical.

MR. SNODDERLY: Okay.

CHAIR BLEY: Okay. And let me ask you one more question about these Revs. When we got the NuScale response to the big RAI, all of the pages are labeled Rev. 2, which is okay, I managed to put them where they belong within the Rev. 0 version of Chapter 8.

My question is, and maybe you don't know the answer to this, were there any substantive changes in whatever was Rev. 1, because the page numbers are certainly very different in the Rev. 2 response to your RAI than they are in Rev. 0?

MS. RAY: I can't answer that --

CHAIR BLEY: Because you haven't --

MS. RAY: -- because we haven't --

CHAIR BLEY: -- looked at Rev. 1?

MS. RAY: Correct.

CHAIR BLEY: But -- I'm a little confused now. You said your next task will be to review Rev. 1 with a response to the RAIs, but I thought it was said earlier that you've received Rev. 2, which includes all of that folded into one.

MS. RAY: No, we've only received DCA Rev. 1.

CHAIR BLEY: And the RAI responses that --

MS. RAY: Correct.

CHAIR BLEY: -- fit into that one?

MS. RAY: Correct.

CHAIR BLEY: Okay. Go ahead.

MEMBER RAY: Well, before she goes ahead, I just want to make a comment, for what it's worth, that in my experience, we as a Committee would not want to finish our review until the staff had finished their review.

MS. RAY: We understand.

MEMBER RAY: Okay.

MS. RAY: We absolutely understand.

MEMBER RAY: And that would include Chapter 8. Okay, thank you.

MEMBER SKILLMAN: Let me add one more, if I may, please. If I read the Safety Evaluation for the Topical Report, that is 0815-16497 Rev. 0, and I compare it with Rev. 1 of that same Topical, Rev. 0 had six conditions, Rev. 1 has five. And the last three are different in Rev. 1.

And it appears as though, some of the word changes are substantive, leading me to believe there was a great deal of deliberation in your Safety

Evaluation of that Topical Report to Rev. 1 that may be influencing what we're talking about here.

What drove the change in the conditions from six to five, because those five conditions plus the other three are really the NRC's backstop for the super wanadine DC system, at least that's the way I interpret the collage of information.

MS. RAY: I understand your question, I may want to defer that to the closed session.

MEMBER SKILLMAN: Yes, ma'am, that would be fine. Thank you.

MR. TABATABAI: And if I may add something? You're right, we had some interactions with NuScale with respect to our conditions of the SER for the Topical Report.

And those issues were discussed among various branches, electrical engineering staff were not involved in that. And that discussions were led by the Reactor Systems Branch and Dr. Drzewiecki here is our expert for that topic. Tim, if you would like to say something now?

DR. DRZEWIECKI: Yes. I can say, in terms of some of the changes in language, there was one condition that was kind of focused on a sequence that had to do with, if you have any kind of AOO, that if

you don't take credit for your DC power system, at some point in time, a few hours into that event, you're going to have a pressure inside of your RCS that is low enough such that you will actuate the ECCS system. Which is not a LOCA, but it's a LOCA-like type of event.

So, one of our conditions was that you would go through and do a PRA-type of an analysis, such that you can show that that is not expected to occur on the frequency of an AOO or during other life of the plant.

Our first version of that language needed to be sharpened a little bit. In fact, if you go back to the record, I believe it was Mr. Skillman -- I'm sorry, not Mr. Skillman, Mr. Stetgar that gave us feedback on that as well. So, we had to sharpen up some of that language. That was a change, that was probably one of the largest changes in the conditions.

Also, our first Rev., the first time we did a review of that SER, we were trying to write it for a general plant. It was not NuScale-specific, it could have been applied to any type of advanced reactor. Coming out of that meeting, it was decided that it should be focused and applied only to the NuScale design. So, that also had an effect.

So, in terms of the precise changes in the

language, I have to go back and see what changed exactly, but that's the context in which those changes were made.

CHAIR BLEY: So, just to get this clear, when we reviewed the Topical with you folks, you had an SER at that time, we made suggestions, other people made comments. You issued a revised SER that had somewhat different language on the conditions?

DR. DRZEWIECKI: Yes.

CHAIR BLEY: Okay. And I guess I never went back and looked at the revised SER, but we had it. We have it, yes.

MEMBER SKILLMAN: And that was very helpful. Thank you.

MEMBER CORRADINI: But just to close the loop, and there were some things we suggested, they politely told us, no.

MR. TABATABAI: Right. As part of the Topical Report, there were some examples to help the staff with their review. And I think Committee recommended to take them out of the SER, any reference to those examples. That was the other changes.

MS. RAY: I'll turn it over to Nadim now.

MR. KHAN: Thank you, Sheila. I am Nadim Khan and I will be discussing Section 8.2, offsite

power system.

The offsite power system for the NuScale Power Plant includes a switchyard and one or more connections to a transmission grid, micro-grid, or dedicated service load. However, the offsite power system is not needed for safe operation, such as the ability to achieve and maintain safe shutdown.

The Applicant has stated that the passive design of NuScale Power Plant does not depend on offsite AC power for safe operation and does not rely on offsite AC power to support safety-related functions.

The Applicant has stated in DCA Part 7 that offsite power is not required. The staff reviewed the offsite power system to ensure that it will perform its design function during all operating and accident conditions.

The review of the offsite power system is awaiting for the completion of Open Item 8.3-1, to address the offsite power system's ability to achieve and maintain safety-related function and safe shutdown.

With that, I will turn it over to Bob.

MR. FITZPATRICK: Thank you. I'm Bob Fitzpatrick and I'm going to discuss Section 8.3.1 of

the SER on onsite AC power systems.

The following nonsafety-related systems are the major constituents of the onsite AC power system: the high voltage system at 13.8 kV, the medium voltage at 4.16 kV, and the low voltage at 480 and below. There are two backup diesel generators at the 480 volt level and one auxiliary AC power source at the 13.8 kV level.

The overall system operation, there are 12 sets of module support systems separated into two six-module sections, north and south, which each section's buses powering multiple module loads. However, no individual loads are shared between the modules.

We had one open item, and that was on electrical penetration assemblies. In Rev. 0 of the FSAR, it's stated that there are no AC circuits that penetrate containment. However, that statement left out, for example, pressurizer heaters.

So, as we looked into this, we issued a couple of RAIs on this issue, and the response to the last RAI did not meet our deadline for Phase 2 SER, but we feel we have a path for resolution that will be addressed in our Phase 4 SER.

There were also a few areas where the staff sought clarity in the FSAR. And for these areas that

needed clarity, the Applicant has successfully responded to our RAIs and these items are now confirmatory, and, again, to be addressed in Phase 4.

An example of the confirmatory items was, we had a question about how many modules could be connected to any of the 13.8 buses. And it sounded, from what we were reading in the FSAR that maybe up to three could be connected to any given bus and we wanted to know if everything was sized accordingly.

And NuScale, in their response to our RAI, they said, no, only two will be on any given bus, and they explained that to us. So, that's an example of just trying to straighten things out and we have an acceptable answer on that.

So, in summary, for the Chapter 8, we had two open items and four clarification items. The open item with respect to GDC 17, the Applicant has documented the disposition for the conditions of applicability, with an answer to our question.

And they've supplied us with two additional tables for Chapter 8 that presents a roadmap as to how to go through that. We have not reviewed that, finished reviewing that yet, so that's still seeing as open, and it will be addressed in Phase 4.

The other open on electrical penetration

assemblies, as discussed on the other slide, the staff feels we have a path to resolution on this. And as stated also before, the confirmatory items will be addressed in our Phase 4 SER.

CHAIR BLEY: Bob, a path to resolution means, you've agreed with them to do something a little different than their response said? Or you think --

MR. FITZPATRICK: No.

CHAIR BLEY: -- their response is resolution?

MR. FITZPATRICK: It's just open, but we feel -- the status of that is actually -- Swagata Som, who retired end of May, was our lead on this item. And so, she briefed me before leaving that it looks good, but --

CHAIR BLEY: Okay.

MR. FITZPATRICK: -- I haven't had time to get to it yet.

CHAIR BLEY: Okay, fair enough.

MR. FITZPATRICK: So, I don't think I'm going to have a problem with it, but that's where it is.

MS. RAY: Bob, if I may add, this is Sheila, we received the last response on the electrical penetrations after we had submitted our SE. So, it's a timing issue as well.

MEMBER KIRCHNER: Bob?

MR. FITZPATRICK: Yes, sir?

MEMBER KIRCHNER: May I ask, GDC 18, this is at risk, I'm doing it from memory, this talks about tests and inspection and includes batteries. Given the role their battery DC system, one would expect that 18 would apply to that, because it's risk-significant, would it not?

MR. FITZPATRICK: No.

MEMBER KIRCHNER: No?

MR. FITZPATRICK: No.

MEMBER KIRCHNER: So, you're just going to go -- your position now is just to do a blanket waiver on 17 and 18?

MR. FITZPATRICK: No, we're evaluating that. Part of -- I think, some clarification, this might help. We reviewed Chapter 8 as if they're going to meet all the requirements.

MEMBER KIRCHNER: Okay.

MR. FITZPATRICK: When we wrote up the SER, we were told we couldn't say it in that -- that's just not the right way to say it. So, we're -- it's an open item. Now, Open Item 8.3.1 --

MEMBER KIRCHNER: Yes.

MR. FITZPATRICK: -- 8.3-1, in terms of Section 8.3.1, there are 15 items in here that would

feed-up to that one open item.

MEMBER KIRCHNER: Right.

MR. FITZPATRICK: And GDC 18, 17, and then, all these other things that you find in the DSRS as --

MEMBER KIRCHNER: Yes.

MR. FITZPATRICK: -- supplemental guidance --

MEMBER KIRCHNER: Right.

MR. FITZPATRICK: -- that they need to meet if they have to meet 17 and they don't have to meet if they don't have to meet 17. So, it looks like a great big, big open item, but in terms of work to solve it, we need the answers from everybody else and we need to wait until the end, everyone else is done with their review.

But the actual solution of that, if everything turns out right, is just some wording changes in the SER. So, it looks like we're very preliminary in coming here, but if things work out, we're not.

MEMBER KIRCHNER: So, just rhetorically, since there are a number of exemption requests to the GDCs, whose principles I would think still apply in some reasonable manner, even if you do come down and say, it's not safety-related, how are you going to approach these? Are you going to put conditions then

on the exemption? Or look for some further PRA-based --

MR. FITZPATRICK: No, actually, we're going to look to, like Reactor Systems, when they finish their review of Chapter 15 and they say, okay, the Chapter 15 analyses work and the analyses didn't require any electrical power, AC or DC, to get there, then we're done.

We don't need to apply any exemptions, they don't need this, it's done another way. So, that --

MEMBER KIRCHNER: So, then, you'll document that --

MR. FITZPATRICK: Right.

MEMBER KIRCHNER: -- accordingly in the SE?

MR. FITZPATRICK: And what we're talking about is any electrical input from GDCs, the 33 and 4 and all that. It's just, if it's not needed, then we just write it off that way. But we don't know that until others finish some really detailed work.

DR. SCHULTZ: So, Bob, originally, you were thinking of saying something like, it meets the intent of the GDC, or something like that, and rather what you want to do is to indicate that the GDC just does not need to apply --

MR. FITZPATRICK: Well, yes --

DR. SCHULTZ: -- to this design?

MR. FITZPATRICK: My draft said, pending resolution of this big issue, that it looks --

DR. SCHULTZ: Of course.

MR. FITZPATRICK: -- acceptable.

DR. SCHULTZ: Yes, right.

MR. FITZPATRICK: And I was told that, that's really not the way we write things, because it's --

DR. SCHULTZ: I understand now.

MR. FITZPATRICK: -- it could be misleading.

DR. SCHULTZ: Yes.

MR. FITZPATRICK: So, apparently, the other way is misleading too, in a way.

DR. SCHULTZ: It has to be turned around.

MR. FITZPATRICK: Right. That's where we are.

CHAIR BLEY: Bob, you reminded me of something I meant to ask right in the beginning. Everybody's -- I'd be interested in anything anyone has to say. This is the first time we've used the DSRS. How is it working? Have you found it needs revision too or is it working out pretty well?

MR. FITZPATRICK: Well, actually, it worked out fairly well. The thing is, when we brought this to ACRS, the DSRS --

CHAIR BLEY: Yes.

MR. FITZPATRICK: -- we said we would leave some of the things about Class 1E in, because we wouldn't know --

CHAIR BLEY: Exactly.

MR. FITZPATRICK: -- so, we did. So, if we had known -- I'll make the same comment I made when we talked about that. If we had known ahead of time that we really wouldn't have a need for Class 1E power, it would have been a more condensed version and less work to go through. But it's just what we came up with.

CHAIR BLEY: Okay. Other than that, though --

MR. FITZPATRICK: Yes.

CHAIR BLEY: -- it's been okay?

MR. FITZPATRICK: It's worked out well.

MS. RAY: This is Sheila Ray. I would add, also at the time of writing of the DSRS, we were not aware of an exemption to GDC 17 and 18. So, when we used DSRS, in my opinion, that was one of the challenges. It does not address review capability with the addition of an exemption, or exemptions.

MEMBER BROWN: I would make one observation. The DSRS -- and I'm segueing back to when we did this review and wrote a letter on it, whatever we did back

two years ago, three years ago, whatever it was.

The fact that you are addressing exemptions or not should not be a reason for not having a general DSRS that applies to SMRs, where you don't delete stuff, you just say, hey, it's now no longer applicable. You do what you're doing now, you address exemptions.

So, you don't want to write a specific that says, oh, you've got these exemptions to all these things, before you know what's going on. You would still have a general DSRS. So, I think you really want to maintain it in a generalized basis, so that you can then adapt it to other SMRs that come on, will have different exemptions potentially.

So, I'm just providing a counterpoint to, we could have had a simpler DSRS. I just think the purpose is to make it so that the Applicant knows what he's supposed to be thinking about, and if there are things that you can exempt or take out, then you do that at the time. That's just an observation.

MR. FITZPATRICK: And with that, I will turn it back to Sheila, for Section 8.3.2.

MEMBER MARCH-LEUBA: I still have a comment. This morning, we were -- I was very confused with the use of timers all over the place, which are used to

turn on and off the electrical systems. I assume you guys didn't review that part. Are we passing it to Reactor Systems for them to consider or how is that handled?

MR. TABATABAI: I think, if I'm not mistaken, we have I&C staff here, if you want to chime in on this timer issue --

MEMBER MARCH-LEUBA: So, somebody --

MR. TABATABAI: -- otherwise, we can get the response --

MEMBER MARCH-LEUBA: My point is --

MR. TABATABAI: -- on that.

MEMBER MARCH-LEUBA: -- somebody needs, from the staff, needs to understand how all those things flow together. Because even the NuScale staff was confused when they were trying to explain it to us. So --

MS. RAY: I think we understand your point, I can definitely say, Chapter 8 did not look at it. However, our friends --

MEMBER MARCH-LEUBA: So, we --

MS. RAY: -- from other chapters might have.

MEMBER MARCH-LEUBA: We should remember, when we look at Chapter 7 and/or 15.

MR. TABATABAI: We took notes of the

discussion on that topic, so we will be --

MR. BETANCOURT: So, this is Luis Betancourt from I&C. We have reviewed that aspect and we're going to be seeing you guys in August, but we took note of that comment and we're going to put that discussion in the presentation.

MEMBER MARCH-LEUBA: Make sure you have a nice flow diagram of how they work.

(Laughter.)

MR. BETANCOURT: Yes, thank you.

MEMBER MARCH-LEUBA: Because I definitely -- and second, maybe while you're there, I don't know if it's still I&C or who, but we talked about if, in case those timers fail or the batteries don't have sufficient power, you're going to have degraded voltage and have actuation of equipment out of order. Whose going to handle that?

MR. BETANCOURT: So, this is Luis Betancourt again. We're going to be talking about that as well.

MEMBER MARCH-LEUBA: Okay.

MR. BETANCOURT: And possibly NPS due to degraded voltage, as well as the 24-hour timers. So, that was part of the Chapter 7 review.

MEMBER MARCH-LEUBA: Somehow, you need to get this report of Reactor Systems to say, what happens if

this valve opens before that valve?

MR. BETANCOURT: Yes.

MEMBER MARCH-LEUBA: You have to have some analysis of some kind.

MR. BETANCOURT: I will leave that to team, but, yes.

MEMBER MARCH-LEUBA: Yes, but make sure you guys interface --

MR. BETANCOURT: Okay. So, then, in that Chapter 7 ACRS presentation, we will discuss that.

MEMBER MARCH-LEUBA: Excellent, thank you.

MS. RAY: Thank you, Luis. I think you can get a flavor of all of the interactions we had in reviewing our chapter. So, Section 8.3.2 is on DC --

MEMBER CORRADINI: Hold on --

MS. RAY: Yes?

MEMBER CORRADINI: Hold on a sec. So, let me observe something, and I could be wrong, but I'm guessing, NuScale is pioneering a path on passive safety systems, with interesting inherent attributes.

I would venture to say, if we ever get past this, to other unusual systems, that the staff is now writing design criteria or alternatives, et cetera, they're going to see the same thing.

Is this method of review logical for these

sorts of systems? Where this sits here and you're doing it by chapter, and yet, this chapter is totally or highly interactive with another one.

You might want to think about this from a process standpoint, because all the advanced systems with all the various funny looking coolants and funny looking designs, all basically have passive system approaches, attributes that are quite similar to NuScale in this regard. So, I'm wondering if this whole process makes sense, from a scheduling and efficiency and effectiveness standpoint.

You might want to look at this now, since it may affect -- it may help you here and it may help you downstream, since I know staff has three or four others that are already starting to interact, but don't have water as the fluid of interest, but has very similar decay heat removal systems, things that don't want to have Class 1E power, that same sort of general attributes. Just a thought.

MS. RAY: Thank you for your comment, we do understand.

MEMBER CORRADINI: I won't forget it, because I'll bring it up again once we see, June 19.

CHAIR BLEY: For people who are wondering, that's the licensing modernization meeting.

MR. TANEJA: I may be speaking -- this is Dinesh Taneja from the I&C Branch. I may be speaking out of line right now, but we already started looking at the usefulness of using the DSRS and the lessons learned from DSRS review and looking at the potential advance reactor designs coming in.

And we have already started working on a strawman of the review standard that should address most of your concerns that you've raised today. So, let's hope that we can come to you in a few months with our idea of what we are thinking and get your feedback at that time.

MS. RAY: Thank you, Dinesh. So, back to onsite DC power systems, Section 8.3.2. As NuScale mentioned, there are several DC systems. The highly reliable DC system is the EDSS.

There's the EDSS-common, that serves common loads, such as the Main Control Room emergency lighting and Post-Accident monitoring. The EDSS-MS serves each module. In addition, the EDNS is also non-Class 1E and serves loads related to power generation.

The NuScale design uses Valve-Regulated Lead Acid batteries.

The staff performed an audit of a NuScale

document, which describes how the NuScale Plant meets the conditions of applicability described in the TR. But specifically, the staff evaluated the design qualification and quality assurance provisions that are applied to the EDSS system.

MEMBER BROWN: Just a little technical question, I guess, but I just thought of it.

MS. RAY: Yes?

MEMBER BROWN: The EDSS, in your first bullet, says you apply this to Main Control emergency lighting, PAM, et cetera, et cetera. So, that is a DC system. Is there -- so, that's battery-powered?

MS. RAY: Correct, that is a DC --

MEMBER BROWN: And I presume, since most of your emergency lighting and other things are AC, that you go from the battery to invertors, you've still got that same routine --

MS. RAY: Right.

MEMBER BROWN: -- there's not some magic --

MS. RAY: Correct.

MEMBER BROWN: -- DC stuff you're going to stick in there?

MS. RAY: Right.

MEMBER BROWN: That's all I wanted to know, I mean, that's --

MS. RAY: And I will just add, we do evaluate lighting in Chapter 9. So, we'll come back to you on lighting.

MEMBER BROWN: Yes, I'm just -- my mind will be basically waiting for the elucidation of these details.

MS. RAY: Excellent.

MEMBER KIRCHNER: I have a related question, if I may?

MEMBER BROWN: Have at it.

MEMBER KIRCHNER: Yes. The plant protection system, I assume is the source of the Post-Accident Monitoring information? Or the module protection system, I think NuScale calls it.

MS. RAY: I'm going to turn to my friend, Luis.

MR. BETANCOURT: This is Luis Betancourt, I&C, again. So, the plant protection system, all it does is basically for common components and it basically does two things: the Control Room habitability and the Control Room integrity.

The module protection system, that's where it's contained -- the wording that, because they use protection system in the plant protection system, many people think that's the actual protection system, as

defined by the GDCs. It's a terminology issue, that's the way the NuScale used that.

MEMBER KIRCHNER: Well, I'm just thinking of things like the neutron detectors for power and such, so you know that you scrammed. Those probably are feeding in through the protection system?

MR. BETANCOURT: Right.

MEMBER KIRCHNER: And then, I would assume, then, they're tapped and used for the -- get my terminology right -- the PAM, the Post-Accident Monitoring --

MR. BETANCOURT: That's correct.

MEMBER KIRCHNER: -- system, right?

MR. BETANCOURT: Yes.

MEMBER KIRCHNER: So, when you have interrelated systems like that, which for its primary function, is a 1E-type system, doesn't the power have to be therefore 1E?

MR. BETANCOURT: No, we were able to discuss that in the last Topical review.

MEMBER KIRCHNER: Yes.

MR. BETANCOURT: So, the conclusion that we made was, if that variable has to be credited for manual action, then that power has to be safety-related. In the case of NuScale, that's still under

review.

Assuming that in the case that there's no amount of credited operator action, per the regulations, that power doesn't have to safety-related. It has to be some of it safety-related and nonsafety-related --

MEMBER KIRCHNER: Yes.

MR. BETANCOURT: -- and that's why we have this highly reliable.

MEMBER KIRCHNER: Well, I guess we'll have to hear more from you in August about these things like these timers that --

MR. BETANCOURT: Yes.

MEMBER KIRCHNER: -- are supposed to function, and if they don't, whose scramming the reactor?

MR. BETANCOURT: Yes. We will discuss that in August.

MEMBER KIRCHNER: Okay, thank you.

CHAIR BLEY: A nice figure to lock all that stuff together would be helpful. I don't know if there is one or not.

MR. BETANCOURT: Say that again?

CHAIR BLEY: A nice figure for your presentation --

MEMBER KIRCHNER: Older people need figures.

(Laughter.)

CHAIR BLEY: I think it would be helpful. There might be one in Chapter 7 already, but --

MR. BETANCOURT: Yes.

CHAIR BLEY: -- I don't know.

MR. BETANCOURT: There are and I have --

CHAIR BLEY: Okay.

MR. BETANCOURT: -- I have to provide that to you.

CHAIR BLEY: All right. I have not looked at 7. Thank you.

MS. RAY: Thank you. Next slide. So, in Section 8.3.2, the open items are related to the classification of the highly reliable DC system and the GDC 17 and 18 exemptions.

The completion of the staff's review of onsite DC power systems is awaiting the completion of the major open item. Next slide.

MEMBER SKILLMAN: Sheila, let me ask this --

MS. RAY: Sure.

MEMBER SKILLMAN: -- I'm in the SER --

MS. RAY: Yes.

MEMBER SKILLMAN: -- for Chapter 8, and I'm on 8-48 to the top of the page.

MS. RAY: Forty?

MEMBER SKILLMAN: 8-48 at the top of the page.

MS. RAY: Yes.

MEMBER SKILLMAN: And the italicized text reads as follows. The EDSS structures, systems, and components are further augmented by applying design qualification and QA provisions typically applied to Class 1E DC power systems, using a graded approach.

So, the short version is, EDSS, it's not 1E, but we're going to apply QA to it so it's somewhat like a 1E system?

MS. RAY: Correct. And --

MEMBER SKILLMAN: Okay.

MS. RAY: -- that's covered in the Topical Report.

MEMBER SKILLMAN: Question is, how do you know where to stop, in terms of applying 18 characteristics of Appendix B? Where do you stop? Do you stop at records retention?

Do you stop at Criterion 3, design control? Do you stop at testing, NTS? How do you choose where to go no further? In other words, what's the boundary for saying, this is enough for this system?

MS. RAY: So, what we evaluated in the DCA

was how they are meeting the TR. And so, we did an audit to look at, how are they meeting those requirements, as stated in the TR?

So, in our review, since the TR is approved by the staff, our review on the NuScale DCA review was, are they meeting the TR? And the audit showed, yes, they are. And we evaluated some documents from NuScale where they're referencing the appropriate standards and what they have stated in the TR.

MEMBER CORRADINI: But I -- that kind of answer tells me that you kind of did it on a case-by-case basis.

MS. RAY: We did it for the EDSS specifically.

MEMBER KIRCHNER: So, if you give them a waiver on 18, on test and inspection, you've got this statement here about this further augmenting the EDSS, why would that not fall into tech specs?

This morning, earlier, surely you heard us talking about battery testing and such, wouldn't that be critical to the reliability of this system for its application?

I'm just trying to followup on Dick's question and push you a little. So, if there's an exemption and then, there's no limits or conditions or

it doesn't have to be covered in tech specs or -- but we're talking about how highly reliable this system is. So, how do you know it's highly reliable?

MS. RAY: And that's where the TR comes in. Based on the provisions in the TR. And those are proprietary in the TR, it is meeting certain standards or meeting certain criteria, in order to establish augmented quality as well as testing requirements.

MEMBER KIRCHNER: Okay. Well, maybe I have to wait for --

MEMBER BROWN: Well, but there's also an RAI still to that TR.

MEMBER KIRCHNER Yes.

MEMBER BROWN: Is that --

MS. RAY: Correct, but --

MEMBER BROWN: -- have you completed that and --

MS. RAY: No.

MEMBER BROWN: So, you're relying on the TR, but you haven't got the TR upgraded or agreed based on the RAI responses?

MS. RAY: We haven't finished the evaluation of the RAI. However, we did perform an audit to look at how specifically the EDSS meets the conditions related to the EDSS.

MEMBER BROWN: In the TR, as initially --

MS. RAY: In the TR.

MEMBER BROWN: -- without the RAI --

MS. RAY: Correct.

MEMBER BROWN: -- clarifications or improvements or revisions?

MS. RAY: Correct. When we --

MEMBER BROWN: And those were deemed sufficient for the EDSS, but not sufficient for other things, because they may not have been resolved yet with the RAI?

MS. RAY: So, the other items are essentially outside the scope of the electrical. They are -- our colleagues in other chapters, on the other conditions.

MEMBER BROWN: Okay.

MS. RAY: So, we have --

MEMBER BROWN: I guess okay.

MS. RAY: You'll hear more about it later, is really -- in other chapters is what I can --

MR. TABATABAI: If I can --

MEMBER BROWN: You're assuming I'll remember it that long.

MS. RAY: I'll make sure you remember.

MR. TABATABAI: If I may add something, Mr. Brown? The RAI is not written for the Topical Report

itself. The Topical Report is done. Topical Report is supposed to be a standalone document.

However, because the Topical Report was referenced or incorporated by reference in Chapter 8, the staff wrote the RAI that how basically the DCA meets the Topical Report. So, just want to make sure we are clear.

MEMBER BROWN: Okay, thank you. I understand now, sort of.

(Laughter.)

MEMBER MARCH-LEUBA: Okay. Changing the topic again, all these highly reliable DC systems, have you considered external hazards, like seismic or more important, flooding? Because this is not light water. All these batteries, if I remember correctly, they're located underground in a basement?

MS. RAY: They're in a seismic Cat I structure.

MEMBER MARCH-LEUBA: Yes, but they're like a wall away from a seven million gallon pool of water and they're in the basement? I mean, are they floodable? Is that part of your consideration?

MEMBER CORRADINI: First of all, if we're getting to things that we've got to go to closed session, you stop us.

MS. RAY: Yes, sir.

MEMBER CORRADINI: Okay.

MS. RAY: We may take that one into closed session.

MEMBER MARCH-LEUBA: Okay, I'll remember.

MS. RAY: Okay. I may not be able to answer it, since that may not have been completely part of the electrical review, we may have to have our colleagues in Structures, I'm not sure if they're here, but --

MEMBER MARCH-LEUBA: Okay.

MS. RAY: -- we will do our best. The last topic to cover, quickly, is station blackout. As I mentioned, the Lead Reviewer is on business travel, so I'll be presenting for her.

The NuScale design does not rely on the use of onsite or offsite AC power for the performance of safety-related functions for any design basis event. And a safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions.

The staff reviewed the SBO-related information provided in the FSAR and the RAI responses against the guidelines of Reg Guide 1.155 and the DSRS.

The staff requested a regulatory audit to seek clarification on NuScale's assumptions and methodology on the SBO Transient Analysis and the SBO sensitivity case. The SBO sensitivity case demonstrates the NuScale design does not rely on DC power from the EDSS to meet the requirements of 10 CFR 50.63.

The staff verified and accepted the methodology assumptions and results of the SBO Transient and sensitivity case, with respect to the electrical.

And in conclusion, there are two items awaiting the completion of Open Item 8.3-1. And the last slide is a summary.

We have two open items, one on the EPAs, electrical penetration assemblies, and the second one related to the exemptions of GDC 17 and 18. And the staff is currently working on the Phase 4 review.

MEMBER CORRADINI: So, can we just go back? I don't understand --

CHAIR BLEY: How far back?

MEMBER CORRADINI: I'm back to Slide 11, that she just -- not that far. So, what is it about 8.4 that is pending? It's really dependent on everything else, assuming everything else -- I'm going to use

Bob's approach.

Assuming everything goes as planned, then the analysis is appropriately using systems to address this sort of station blackout. Is there something particular about station blackout that is an open item or is this just appended onto everything else, because it's using a nonsafety system?

MS. RAY: It is --

MEMBER CORRADINI: It's the latter?

MS. RAY: It's depending on GDC 17 and 18. So, in order to conclude everything is okay with station blackout, if you -- in our DSRS, we do use GDC 17 and 18, in 8.4. So, we cannot make that conclusion --

MEMBER CORRADINI: Oh, okay. I see.

MS. RAY: -- until we complete the open item.

MEMBER CORRADINI: All right. So, it's connected in that regard?

MS. RAY: Correct.

MEMBER CORRADINI: Okay. Thank you.

MS. RAY: And that concludes the staff's presentation.

CHAIR BLEY: Thank you very much. Anything more from the Committee? I'm going to take us, after we collect comments, into the closed session, just in

case. There were a few things that came up and we'll just do that to see.

But before that, I want to make sure the phone line is open and we'll look for comments there. Is there anybody in the room who would like to make a comment? If so, please come to the microphone.

If there's anybody on the phone line who would like to make a comment, please identify yourself and do so. I'm not sure if the phone line is open or not, but we'll keep trying. Anybody there? I don't hear anybody, so I guess we have no comments from there.

At this time, I'd like to go around the table and I'm going to start with Charlie. Any final comments?

MEMBER BROWN: Only to reiterate downstream, evaluating the inadvertent actuation via either internal, because somebody makes a mistake, and/or whether the plant design and architecture is susceptible to external influences?

My quick review was unable to clear that up relative to the electric plant controls, where there seems to be some definition relative to the protection systems and safeguard systems.

CHAIR BLEY: We'll raise that again in

Chapter 7.

MEMBER BROWN: Yes, it's all Chapter 7 stuff. So, then, I couldn't find the connection to the electric plant controls, how they are managed within the overall architecture. So, that's the only comment I would reiterate, to make sure it doesn't get lost.

I'm sorry, I did not have my microphone, did you hear me, young lady? Thank you. Did you all hear me? I figure my voice carries well enough.

CHAIR BLEY: Walt?

MEMBER KIRCHNER: No further comments at this point. Thank you.

CHAIR BLEY: Thank you. Jose?

MEMBER MARCH-LEUBA: No comments.

CHAIR BLEY: Michael?

MEMBER CORRADINI: No further comments.

CHAIR BLEY: Pete?

MEMBER RICCARDELLA: No comments.

CHAIR BLEY: Matt?

MEMBER SUNSERI: No additional comments.

CHAIR BLEY: Dick?

MEMBER SKILLMAN: Yes, sir, one comment. My comment is aimed on the Safety Evaluation, Page 8-9. This is the SER, Chapter 8. At Paragraph 8.1.4.8. Before I make my comment, I would like to make a

statement.

I have a vivid memory of what we went through at TMI when we transitioned to natural circulation. The reason that we maintained pressure up until that time was because we were maintaining NPSH for one reactor coolant pump, and we knew that one pump was a run-out and we needed that NPSH.

Once we stopped that pump, we lost the pressurizer level, stopped the pump, and we had instrumentation that showed us that we went into natural circulation. But we maintained subcooling, because we did not know the condition of the core. Emphasis, did not know the condition of the core.

In another event, Walt and I lived this, we both operated a power reactor in downtown Manhattan. That power reactor was named Savannah. We had a couple of events where we lost pressurizer level.

But our gold standard was to maintain pressurizer pressure, no matter how many pumps we had operating, because we wanted to maintain subcooling on that fuel.

So, to my point, in the Safety Evaluation, the NuScale design does not rely on pressurizer heaters to establish and maintain natural circulation and shutdown conditions. I get it, for what we've

been presented regarding this reactor design.

But from a systems perspective, it seems that this reactor, if you will, is a hybrid. Most of the time, it's a P, pressurized water reactor, but it can go to conditions that are very similar to a B. And when it goes to those conditions, it may have reactivity requirements that depend on subcooling.

And so, I'm going to be very skeptical as we go ahead about the technical accuracy of whether or not pressurizer heaters, and I translate that to be subcooling, is really not needed. Whether it's a 1E power system, whether it's an Evinrude with some kind of an alternator that will make sure subcooling exists.

I've seen the analysis, I understand the explanations we've been given today, but I'm skeptical on the this one point. And to me, this will be the turning point for whether you need a 1E system or not. Do you really not need subcooling driven by pressurizer heaters when this plant has gone into a quasi-PWR/BWR mode? Thank you.

CHAIR BLEY: Thanks, Dick. Harold?

MEMBER RAY: Just to say again, although our review is independent of the staff, it does include review of the staff's conclusions and I look forward

to being able to do that when the time is appropriate.

CHAIR BLEY: And our consultant, Dr. Schultz?

DR. SCHULTZ: My comments are two, and one is just a recognition, both in the presentation by NuScale and then, by the staff, it's very clear that what -- one of the things that's ongoing here is that the reviews, although they're presented sequentially, we are beginning with Chapter 8, you've got, as you said at the beginning of your presentation, a dozen staff members from different areas within the organization working together to perform the review.

And the material that the Committee is wrestling with today is a lot, to a great extent, associated with trying to knit those pieces together. As is the staff. So, that's one side of the comment.

The other is, looking at this from a different angle, as the material is presented, one of the things that is difficult in the situation where we've got a major, a major open item, as we go through it section by section, piece by piece, the conclusion by the staff is all affected by that.

But I think, in fact, there is a gradation of to what extent that review is in fact completed. But they all seem to be tied together by one final comment saying, well, we'll just have to wait and see

if that is resolved.

More information about the level of conclusion that in fact has been reached to this point in the review would be helpful, because we are going through an iterative process here.

CHAIR BLEY: Thanks, Steve. I want to thank NuScale and the Staff for very good discussions today, that's added some clarity.

We're on the schedule to write an interim letter. If we write an interim letter on this chapter, it won't say more than, we look forward to seeing your SER when it has content.

MEMBER CORRADINI: There is, in past letters such as this, a conclusion that there's a myriad of system interactions that may alter our conclusions.

CHAIR BLEY: And that's reasonable too. For me, I --

MEMBER CORRADINI: That's the only that I --

CHAIR BLEY: -- we have no conclusion thus far, other than we don't see any showstoppers, I think. And I guess, you do want a letter? Yay or nay?

MR. TABATABAI: Yes. Actually, I just wanted to mention that we are scheduled to present to the full Committee on July 11. So, we took notes of some

comments and questions that you had and hopefully, by then, at least if we are not giving you the full conclusion, because the reviews are still ongoing, as you've heard, so to whatever extent we can, we can come back to the Committee and --

CHAIR BLEY: Yes, for us to write a letter, you're going to have to come back.

MR. TABATABAI: Yes.

CHAIR BLEY: If you can emphasize anything that answers any of the questions, that will be very good. I suspect the letter won't say much more than I just said, although we might add something. And I understand you want it, so we will help you out and do one, if it helps.

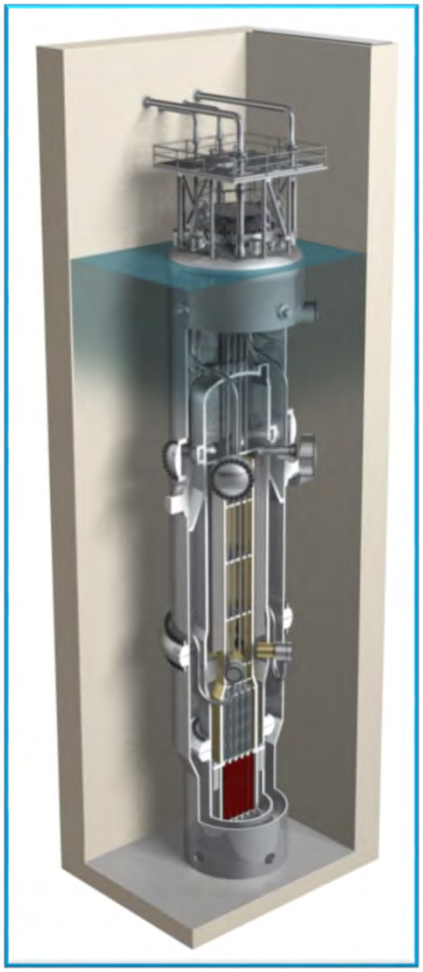
But I guess that's it. Anything else from any of the members?

MEMBER CORRADINI: You want to go to the closed session?

CHAIR BLEY: I do. At this time, we need to clear the room, turn off the phone lines, and we're going off the public record and onto a closed record.

(Whereupon, the above-entitled matter went into closed session at 11:37 a.m.)

ACRS Presentation
Chapter 8 Overview



Ted Hough
Electrical Design

Kent Welter
Nuclear Safety

Jeff Ehlers
Electrical Design

Paul Infanger
Licensing

June 6, 2018

PM-0618-60190-NP
Revision: 0

Abbreviations

- AAPS – alternate AC power supply
- AC – alternating current
- BDG – backup diesel generator
- BPSS – backup power supply system
- CFDS – containment flooding and drain system
- COA – condition of applicability
- CHWS – chilled water system
- CNV – containment vessel
- CVCS – chemical and volume control system
- CW – circulating water
- DC – direct current
- DCA – design certification application
- ECCS – emergency core cooling system
- EDNS – normal DC power system
- EDSS – highly reliable DC power system
- EHVS – electrical high voltage system

Abbreviations

- ELVS – electrical low voltage system
- EMVS – electrical medium voltage system
- FSAR – final safety analysis report
- HP – horsepower
- LTR – licensing topical report
- MCR – main control room
- MCS – module control system
- MPS – module protection system
- MPT – main power transformer
- MS – module specific
- NMS – neutron monitoring system
- OPS – operations
- PAM – post accident monitoring
- PCS – plant control system
- PLS – plant lighting system
- PPS – plant protection system
- PZR – pressurizer

Abbreviations

- RAI – request for additional information
- RG – regulatory guide
- RT – reactor trip
- SBO – station blackout
- SDIS – safety display and indication system
- SER – safety evaluation report
- SPS – security power system
- SST – station service transformers
- TG – turbine generator
- UAT – unit auxiliary transformer
- VRLA – valve regulated lead acid

Purpose

- Provide an overview and highlights of the electrical systems pertinent to Chapter 8 of the NuScale DCA
  - design basis
  - off-site power
  - on-site power (AC)
  - on-site power (DC)
  - station blackout
  - FSAR Table 8.3-9
    - TR-0815-16497 “Conditions of Applicability”
    - TR-0815-16497 “NRC additional conditions”

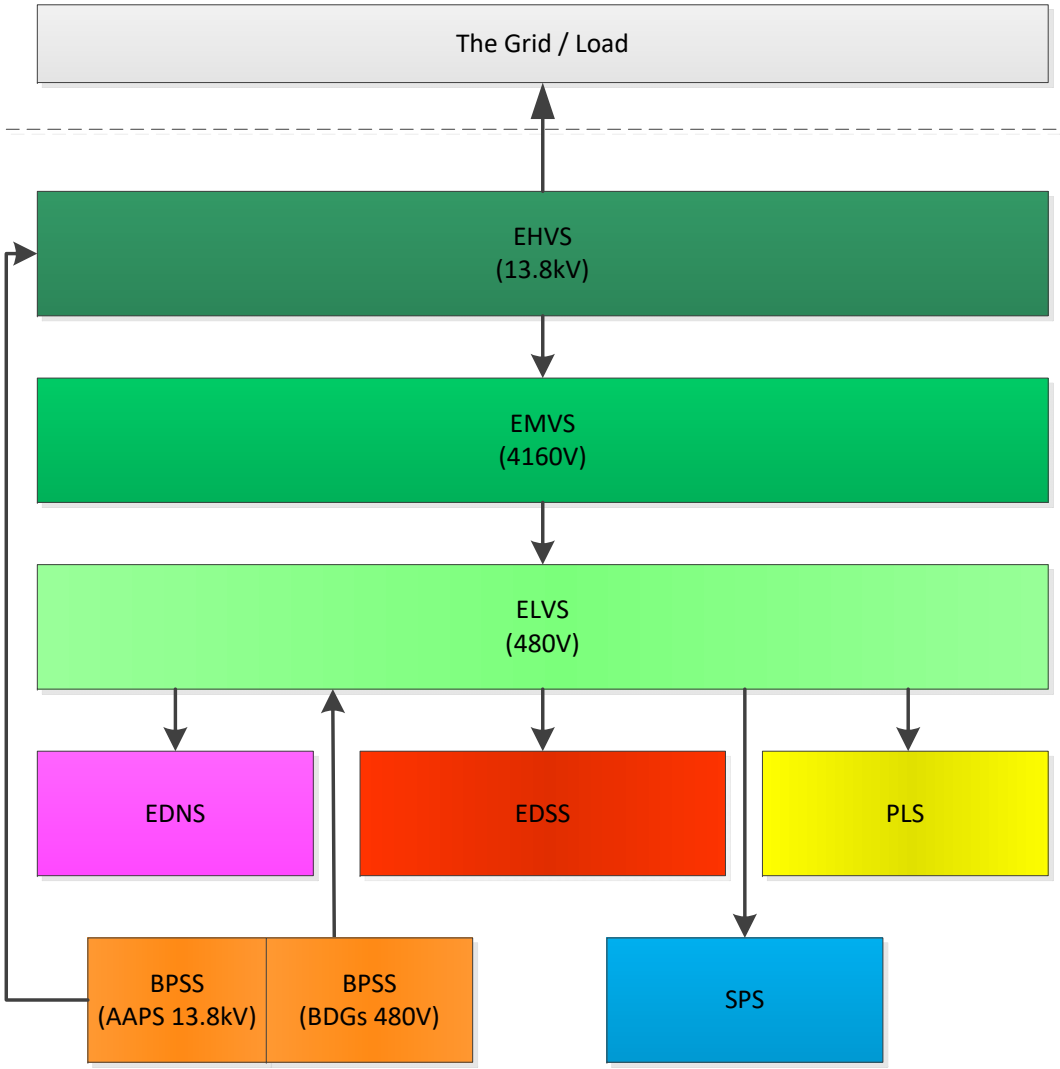
Starting Point

- **Key influences in the overall electrical design**
  - nuclear safety and regulatory requirements
  - Fukushima electrical insights/dependence on power
  - the robust, inherently safe module concept
  - our plant mechanical design emphasizes simplicity
  - design electrical systems that compliment the simplicity
  - 12X factor, electrical impact regarding viability and economics

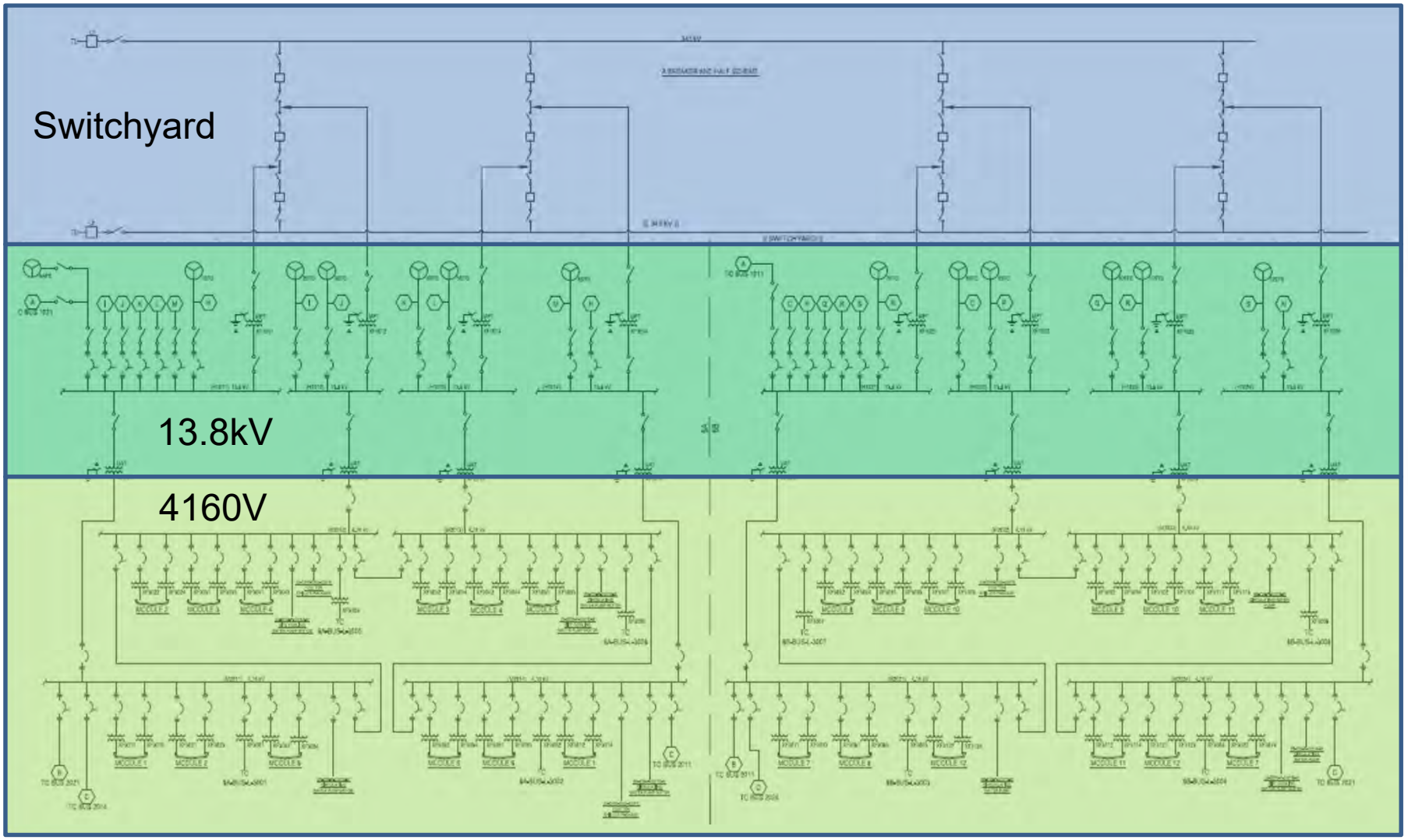
Design Basis

- Safety-related components “fail-safe” on a loss of electrical power
  - solenoids (de-energized) – valves close/open depending on function
  - breakers (RT + PZR) – open
- Safety-related systems rely on natural passive mechanisms based on fundamental physical and thermodynamic principles
- Based upon the application of Safety Classification of Passive Nuclear Power Plant Electrical Systems, TR-0815-16497, the following are key electrical design features:
  - AC and DC electrical distribution systems are classified as non-Class 1E
  - highly reliable DC power system (EDSS) has augmented design, qualification, and QA provisions
  - MCR emergency lighting and PAM B&C variables powered by EDSS
  - power sources are not required to support safety-related functions
  - design supports exemption to GDC 17 and 18

Overall Electrical Design



Overall Single-Line Drawing



Off-Site Power System

- The off-site power system includes the switchyard and one or more connections to a transmission grid, micro-grid, or dedicated service load.
  - COLA Item (8.2-1) to describe the site-specific switchyard layout and design including off-site power connections
- The passive design of the NuScale power plant does not rely on AC power and does not require an off-site power system to mitigate design-basis events.
- On a loss of off-site power the plant is designed to transition to “island mode” with house load powered from the designated TG unit.

On-Site AC Power

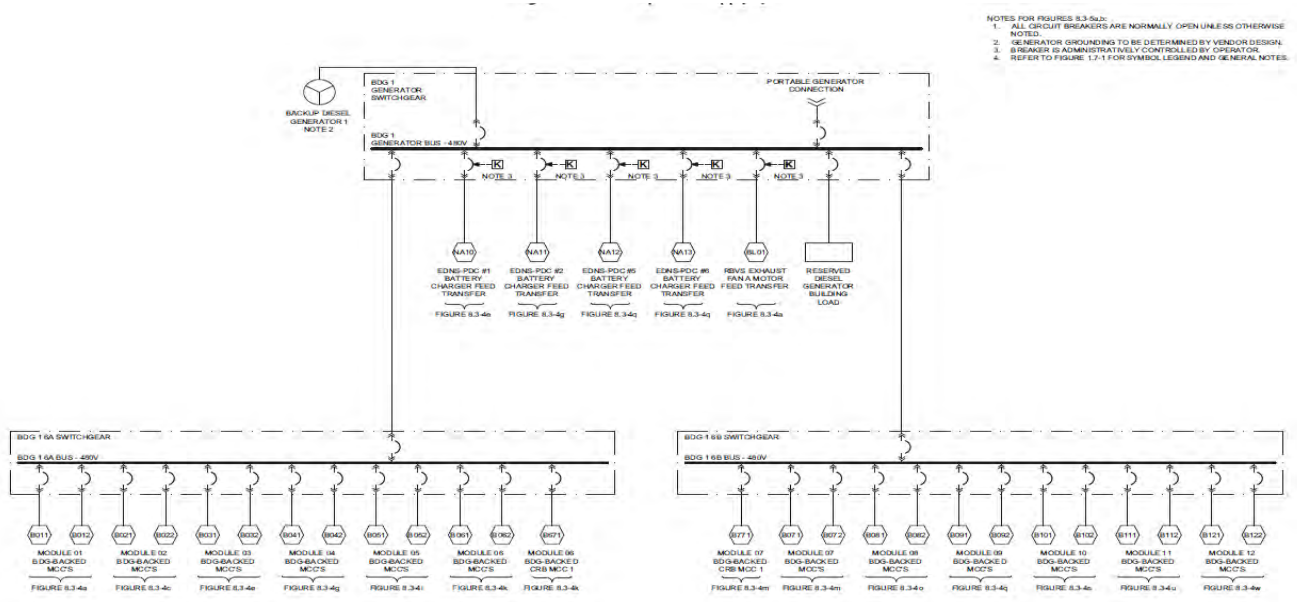
- Use of standardized industrial AC electrical distribution equipment
- Support online electrical bus outages with multiple modules in service (e.g., transformer capacities, short circuit ratings, etc.)
- Electrical distribution levels
  - EHVS – 13.8kV (main generators, MPTs, buses)
    - one generator can power entire 12-module house load
    - normal AC power source to on-site loads
  - EMVS – 4160V (UATs, buses)
    - supports large shared plant loads (CW, SCW, CHWS)

On-Site AC Power

- ELVS – 480V (SSTs, buses)
  - station service transformers (main-tie-main configuration)
    - module-specific and lower HP shared loads
- PLS – 480V, 277V, 208V, and 120V
  - plant lighting loads and misc. power panel loads
- BPSS
  - auto start on loss of all AC to 13.8kV buses (30-second time delay), manually loaded
    - backup diesel generators (BDGs – 480V)
      - support selected plant loads (battery chargers, control room ventilation, CVCS pumps, CFDS pumps)

On-Site AC Power

- BPSS
  - auxiliary AC power source (AAPS – 13.8kV)
    - support permanent nonsafety loads when normal AC not available
    - 13.8kV so OPS can distribute power as needed
  - portable generator connection (480V)



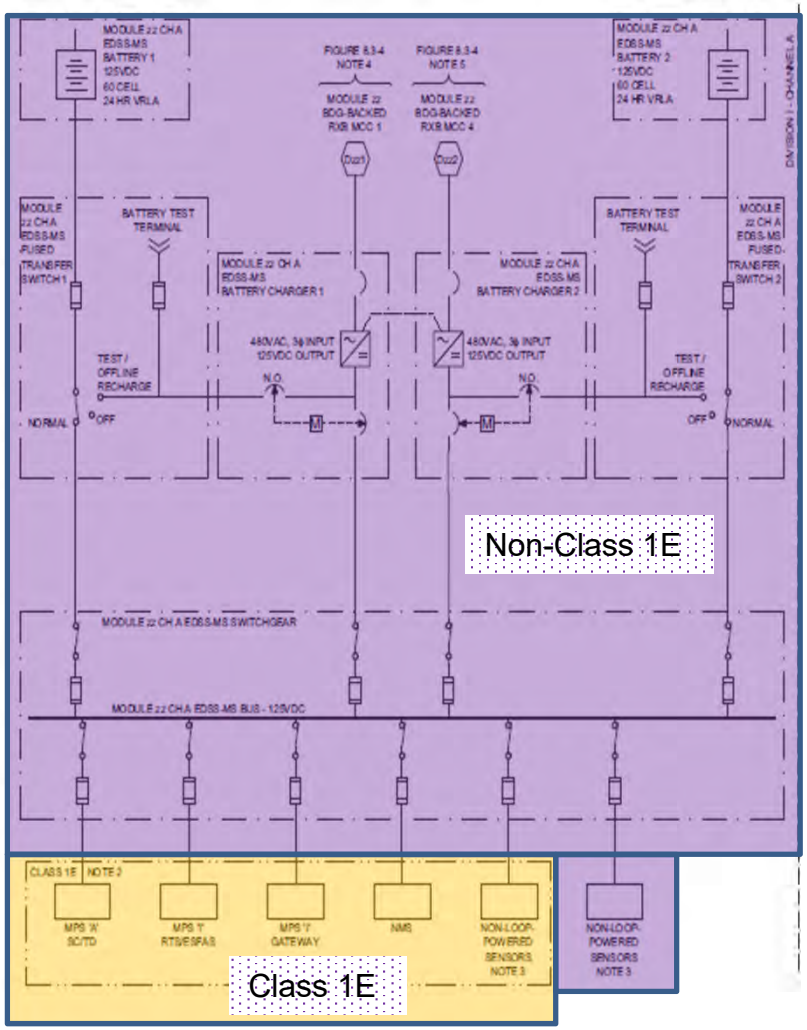
On-Site DC Power

- EDSS (highly reliable DC power system)
  - augmented design requirements
  - augmented QA requirements
  - Class 1E isolation – performed by the MPS and NMS power supply components (i.e., DC-DC converters)
  - VRLA batteries
  - battery duty cycle
    - EDSS MS Channel A & D – 24 hours (ECCS Hold Mode)
    - EDSS MS Channel B & C – 72 hours (PAM Support)
    - EDSS-C Division I & II – 72 hours (PAM Support)

On-Site DC Power

- EDSS – 125V
  - EDSS-MS (module specific)
    - not shared per RG 1.81
    - power to MPS and NMS
    - 4-channel system to support 4-channel MPS and NMS
  - EDSS-C (common)
    - shared common loads (PPS, MCR emergency lights, SDIS)
    - two divisions

EDSS-MS Channel A



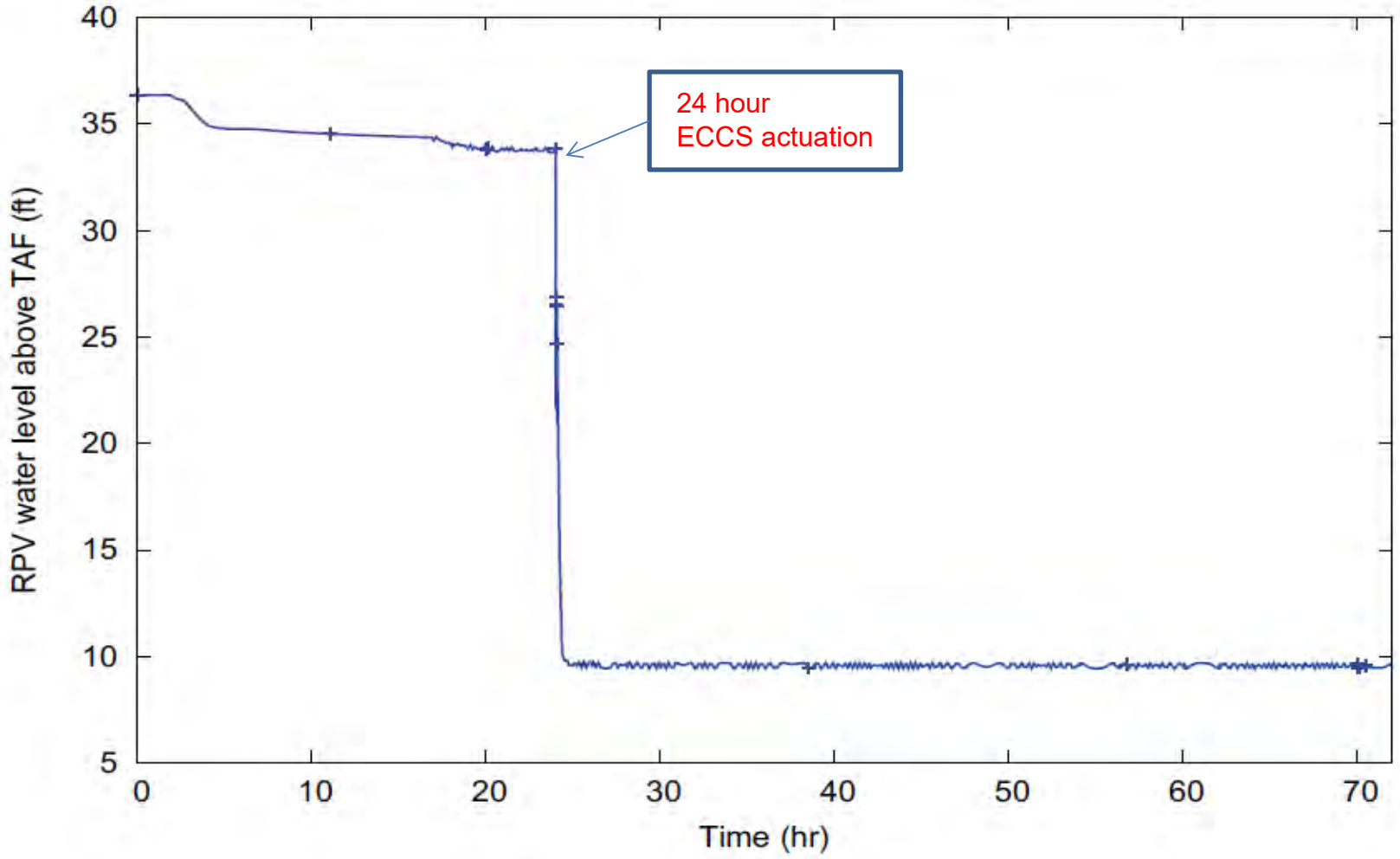
On-Site DC Power

- EDNS – 250 VDC,125 VDC, and 208 VAC
  - VRLA batteries and 40-minute battery duty cycle
  - supports nonsafety loads/functions related to investment protection and power generation, for example:
    - nonsafety I&C (PCS and MCS)
    - control rod drive power supply
    - electrical distribution control power
    - TG emergency lube oil pumps

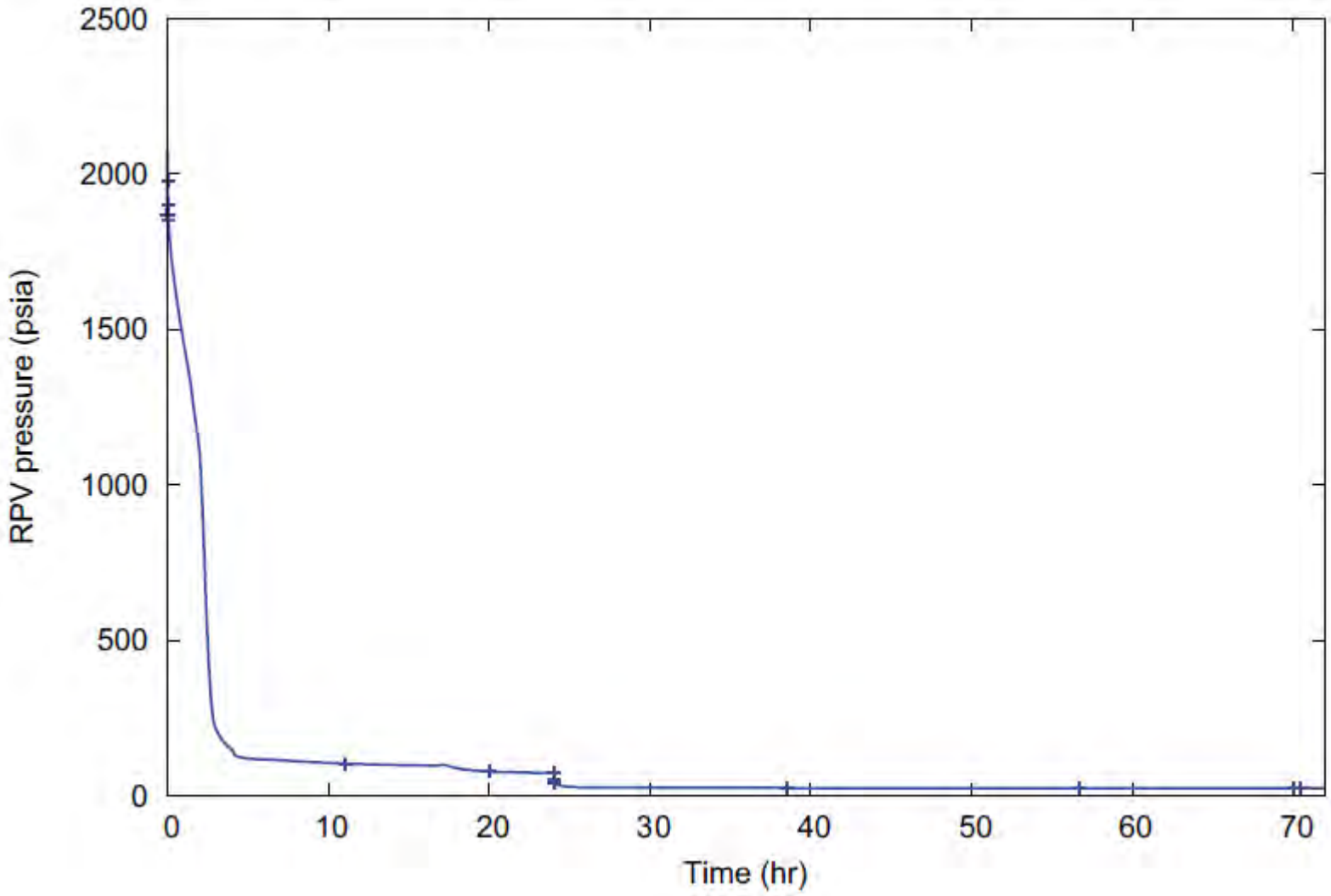
Station Blackout

- Passive plant design coping duration (SECY-94-084 and SECY-95-132)
  - station blackout (72 hour coping duration)
  - SBO analysis includes all 12 modules operating at 100% prior to the event
  - all safety functions achieved and maintained for 72 hours without reliance on AC power or operator action (reactor trip, decay heat removal system, emergency core cooling system)
  - core cooling and containment integrity maintained without AC power
  - sensitivity case demonstrates core cooling and containment integrity maintained without DC power as well
  - EDSS available to support PAM

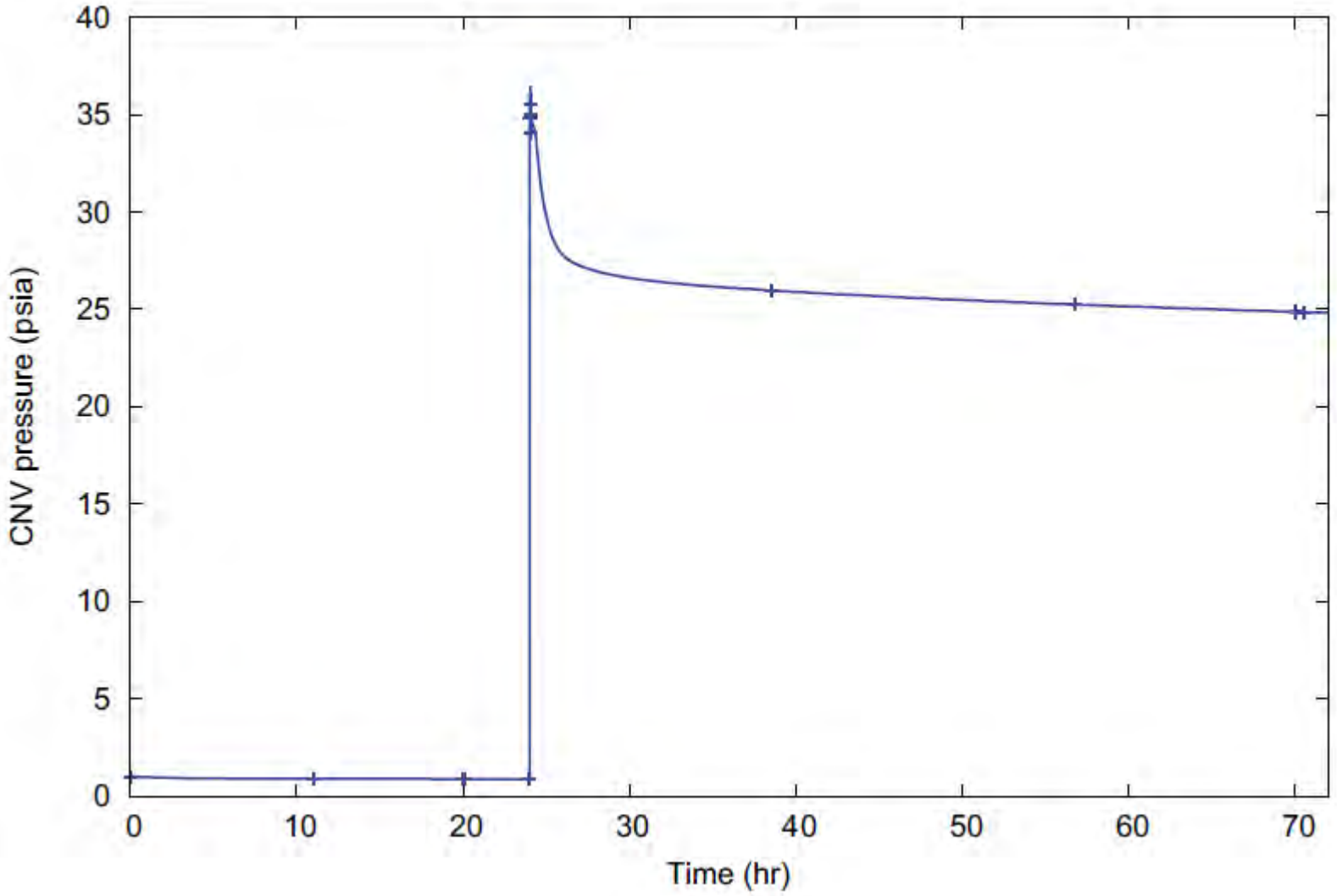
Station Blackout (RPV Level)



Station Blackout (RPV Pressure)



Station Blackout (CNV Pressure)



Electrical Topical Report Evaluation

- NuScale received NRC eRAI No. 9359 on 1/29/18 requesting the addition of a table to the FSAR providing a cross reference for the “conditions of applicability” provided in the LTR and the “five conditions” identified in the associated SER
- NuScale responded to the RAI on 3/27/18 with the addition of Table 8.3-9 (addresses COAs and SER conditions) and Table 8.3-10 (addresses augmented design provisions), which provide the required FSAR cross references for the LTR and associated SER
  - as a result of the FSAR cross reference evaluation, numerous conforming changes were made to the Tier 2 FSAR to enhance validation

Table 8.3-9 FSAR Cross Reference

Table 8.3-9: FSAR Cross Reference for the Conditions of Applicability and NRC SER Limitations and Conditions for TR-0815-16497-P-A

Table 3-1 Section I Condition Number	FSAR Sections that Demonstrate Condition is Satisfied
1.	Design Basis Event Assumptions • 15.0.0.6.4 and 15.0.4 (72 hour stabilized condition DBE end state without operator actions required) • 15.0.0.6.5 (DBE analysis includes loss of electrical power) • 8.4.2 (SBO Loss of AC and DC power for 72 hour duration)
1.a.	• 3.9.4 (CRDS does not rely on electrical power) • 8.4.2 (SBO reactor trip)
1.b.	• 4.3.1.5 (Shutdown capability does not rely on electrical power) • 15.6 (Decrease in inventory event analyses do not rely on electrical power or credit active injection sources) • 8.4.2 (SBO does not rely on electrical power for shutdown or inventory control)
1.c.	• 5.4.3.1 (DHRS function does not rely on electrical power) • 6.3.1 (ECCS function does not rely on electrical power) • 15.0.0.6.3 (DBE analysis does not credit electrical power for DHRS or ECCS functions) • Table 15.0-2, Table 15.0-3, Table 15.0-4 (Fuel and core acceptance criteria confirm core cooling) • 8.4.2 (SBO core cooling relies on DHRS and ECCS)
1.d.	• 6.2.4.2.1 (CNV isolation function does not rely on electrical power) • 8.4.3 (SBO containment integrity does not rely on electrical power)
1.e.	• 6.2.1, 6.2.2, and 6.2.5.1. (Passive CNTS and UHS design does not include active ESF heat removal and combustible gas control systems) • Table 15.0-2 (DBE thermal hydraulic acceptance criteria confirm containment peak pressure margin) • 8.4.3 (No credit for active ESF heat removal for containment integrity in SBO analysis)
1.f.	• 6.5.3 (Active fission product removal systems are not required) • Table 15.0-12 (DBA radiological consequences show guidelines maintained)
1.g.	• 5.2.2. 1 (Overpressure protection system does not rely on electrical power) • 8.4.2 (SBO RPV pressure margin) • Table 15.0-2 (DBE thermal hydraulic analyses confirm margin to RCS pressure acceptance criteria)

Conclusion

- The electrical distribution system supports the application of Safety Classification of Passive Nuclear Power Plant Electrical Systems,TR-0815-16497
- The electrical distribution system is not required to support any safety-related function or manual operator action (no RG 1.97 Type A variables), and thus is classified as non-Class 1E
- Backup power sources (BDGs, AAPS) are available for asset protection, designated plant loads, and black start
- The electrical distribution system has flexibility to support bus outages with multiple modules in service
- The design supports exemption to GDC 17 and 18

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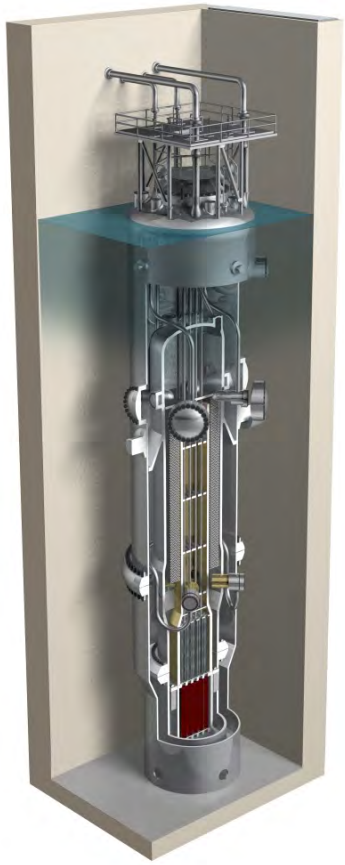

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Presentation to the ACRS Subcommittee

NuScale Power, LLC

NuScale Design Certification Application Review

Safety Evaluation with Open Items: Chapter 8

ELECTRIC POWER

June 06, 2018

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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Robert Fitzpatrick	Clinton Ashley	Jeffrey Schmidt
Fanta Sacko	Thomas Scarbrough	Raul Hernandez

- **Project Managers**
  - Lead Project Manager - Gregory Cranston
  - Chapter 8 Project Manager - Omid Tabatabai

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Overview of Chapter 8 Review

- NuScale submitted its DCA, Rev 0, in December 2016, and a Rev 1, on March 15, 2018. The staff's SER is based on the review of Rev 0 of the DCA.
- Today's presentation is the first ACRS briefing by the NRC Staff in support of the NuScale DCA review.
- Issued a total of 10 RAIs with 25 Questions. All RAIs have been responded.
- The staff's SER with Open Items contains two open items and will be discussed in the subsequent slides.
- Open and Confirmatory Items will be closed in Phase 4 of the Review.

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Technical Topics

- NuScale Design:
  - The electric power system for NuScale design is comprised of non-safety related AC (or ac)(alternating current) and non-safety related DC (or dc) (direct current) power system.
  - This design does not depend on onsite or offsite AC or DC electrical power system, including that from the transmission grid for safe operation.
  - The NuScale Power Plant design with non-reliance on electrical power accommodates a site location where an offsite transmission grid is not available.
  - The normal source of power is one or more of the twelve (12) operating power module main generators.

- Staff's review:
  - The staff reviewed the design of the electric power systems necessary for safe design and operation of the plant, or whose failure might adversely affect their safety-related or risk-significant safety functions.
  - The staff reviewed the design of the electric power systems in accordance with the applicable DSRS or SRP and consistent with the graded review approach.

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Open Item 8.3-1

- FSAR, Tier 2, Section 8.3 and DCA Part 7 state that the design does not rely on safety-related AC or DC power systems
  - This position is supported by the application of the evaluation methodology described in NuScale topical report (TR)-0815-16497, "Safety Classification of Passive Nuclear Power Plant Electrical Systems."
- The open item relates to the exemptions to GDC 17 and 18 regarding the staff verifying that the design does not require safety-related power.
- Furthermore, the staff's evaluation of accident analyses are in Chapter 15 which has not been completed to demonstrate that
  1) fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and
  2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.
- Staff issued a safety evaluation approving TR-0815-16497 with five additional conditions.
- The NuScale DCA did not directly address the conditions of applicability and the five additional conditions.
- NRC staff issued RAI 9359, Question 1-1, to address the conditions of applicability and the additional conditions associated with TR-0815-16497.
- Staff is evaluating the RAI response.

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Technical Topics

- NuScale Design:
  - The Offsite Power System includes the switchyard and one or more connections to a transmission grid, micro-grid, or dedicated service load.
  - The passive design of NuScale Power Plant does not depend on offsite AC power for safe operation and does not rely on offsite AC power to support safety-related function.
  - The applicant stated in DCA Part 7 that offsite power is not required.

- Staff's review:
  - The staff reviewed the offsite power system to ensure that it will perform its design function during all operating and accident conditions.

Open Items

- The completion of the review for the offsite power system is awaiting for the completion of OPEN ITEM 8.3-1

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Technical Topics

The following nonsafety-related systems are the major constituents of the onsite AC power system:

- Electrical High Voltage System (EHVS) (13.8 kV)
- Electrical Medium Voltage System (EMVS) (4.16 kV)
- Electrical Low Voltage System (ELVS) (480 Volts and 120 Volts)
- Backup diesel generators (BDGs) (480 volts)
- Auxiliary ac power source (AAPS) (13.8 kV)

The review focused on the following:

- Overall system operation
- Electrical penetration assemblies (EPAs)
- A few areas where the staff sought clarity in the FSAR

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Open Items

There are two open items associated with onsite AC power systems:

- Open Item with respect to GDC 17 and 18 (Open Item 8.3-1)

  The applicant is to document in the DCA the disposition of the conditions of applicability and the additional conditions imposed by the staff review associated with TR-0815-16497

  This relates not only to the Applicant's request for exemptions to GDC 17 and 18 but also their associated guidance documents from the DSRS

- Open item with respect to EPAs

  The staff has a path to resolution for this item

- The confirmatory items will be addressed in our phase 4 SER

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Technical Topics

- The onsite DC power systems include the non-Class 1E EDSS and the non-Class 1E EDNS.
  - The EDSS-common (EDSS-C) plant subsystem serves plant common loads that have functions that are not specific to any single NuScale Power Module (NPM). These plant common loads include Main Control Room (MCR) emergency lighting and Post-Accident Monitoring (PAM) information displayed in the MCR.
  - The EDSS-module-specific (EDSS-MS) plant subsystem consists of up to 12 separate and independent DC electrical power supply systems, one for each NPM.
  - The EDNS is shared between the NPMs and provides both DC power and AC power (through inverters) to non-safety related loads that support functions related to investment protection and power generation.

- The NuScale design utilizes Valve-Regulated Lead Acid batteries in the DC systems.

- The objective of the staff review is to determine that the onsite direct current (DC) power system satisfies the requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 2, 4, 5, 17, and 18 and will perform its design function during all plant operating and accident conditions.

Technical Topics

Section 8.3.2 – Onsite DC Power Systems

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Open Item

- The open items in this section are related to the classification of the highly reliable dc system (EDSS), and GDC 17 and 18 exemptions.
- The applicant stated in DCA Part 7 that onsite power is not required for the mitigation of design basis events.
- The completion of the staff's review of onsite dc power systems is awaiting the completion of OPEN ITEM 8.3-1

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Technical Topics

- NuScale Design:
  - The NuScale Power Module (NPM) design does not rely on the use of onsite or offsite AC power for the performance of safety-related functions for any design basis event.
  - A safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions.

- Staff's review:
  - The staff reviewed the information pertaining to SBO in the FSAR to determine whether the design is capable of withstanding and recovering from a complete loss of ac electric power for a minimum of 72 hours.
  - Staff performed an audit of the methodology and assumptions of the SBO Transient Analysis and SBO sensitivity case.

- The completion of the staff's review of station blackout is awaiting the completion of OPEN ITEM 8.3-1

Summary

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- Two Open Items:
  - Electrical Penetration Assemblies
  - Relating to the exemptions to GDC 17 and 18, regarding the staff verifying that the design does not require safety-related power.

- Staff's review:
  - Currently working on Phase 4 review.