Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards

Docket Number: (n/a)

Location: teleconference

Date: Wednesday, April 2, 2025

Work Order No.: NRC-0290 Pages 1-151

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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724TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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WEDNESDAY

APRIL 2, 2025

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The Advisory Committee met via teleconference at 8:30 a.m., Walter L. Kirchner, Chair, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chair

GREGORY H. HALNON, Vice Chair

DAVID A. PETTI, Member-at-Large

RONALD G. BALLINGER, Member

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member

CRAIG A. HARRINGTON, Member

ROBERT P. MARTIN, Member

SCOTT P. PALMTAG, Member

THOMAS E. ROBERTS, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIALS:

MICHAEL SNODDERLY

CHRISTOPHER BROWN

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P-R-O-C-E-E-D-I-N-G-S

(8:30 a.m.)

CHAIR KIRCHNER: The meeting will now come to order. This is the first day of the 724th meeting of the Advisory Committee on Reactor Safeguards, ACRS. I'm Walt Kirchner, Chairman of the ACRS. ACRS members in attendance in person are Ron Ballinger, Greg Halnon, Robert Martin, Scott Palmtag, Dave Petti, Thomas Roberts, Craig Harrington, and Vicki Bier. ACRS members in attendance virtually via teams are Vesna Dimitrijevic and Matt Sunseri. Our consultants participating today virtually are Stephen Schultz and Dennis Bley, and if I've missed anyone, consultants, or members, please speak up now.

Mike Snodderly of the ACRS staff is the designated Federal Officer for this morning's full committee meeting. No member conflicts of interest were identified, and I note that we have a quorum.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, or FACA. The NRC implements FACA in accordance with our regulations. Per these regulations and the Committee's bylaws, the ACRS speaks only through its published letter reports. All member comments, therefore, should be regarded as only the individual opinion of

that member and not a Committee position.

All relevant information related to ACRS activities, such as letters, rules for meeting participation, and transcripts, are located on the NRC public website and can be readily found by typing about us ACRS in the search field on NRC's homepage.

The ACRS, consistent with the Agency's value of public transparency and regulation of nuclear facilities, provides opportunity for public input and comment during our proceedings. We have received no written statements or requests to make an oral statement from the public. Written statements may be forwarded to today's designated Federal Officer, and we have also set aside time at the end of this meeting for public comments.

A transcript of the meeting is being kept and will be posted on our website. When addressing the Committee, the participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. If you are not speaking, please mute your computer on Teams, and if you are participating by phone, press star 6 to mute your phone and star 5 to raise your hand on Teams. The Teams chat feature will not be available for use during the meeting.

For everyone in the room, please put your electronic devices in silent mode and mute your laptop microphone and speakers. In addition, please keep sidebar discussions in the room to a minimum because the ceiling microphones are live. For the presenters, your table microphones are unidirectional, and you'll need to speak directly into the front of the microphone to be heard online.

Finally, if you have any feedback for the ACRS about today's meeting, we encourage you to fill out the public meeting feedback form on the NRC's website.

During today's meeting, the Committee will consider the following topics: The NuScale standard design approval application, including NuScale topical reports on extended passive cooling and reactivity control methodology and the non-LOCA methodology TR.

As stated in the agenda, portions of this meeting may be closed to protect sensitive information as required by FACA and the Government in the Sunshine Act. Attendance during the closed portion of the meetings -- closed portions of the meetings will be limited to the NRC staff and its consultants, NuScale, and those individuals and organizations who have entered into an appropriate confidentiality agreement.

And we will confirm that only eligible individuals are in the closed portion of that meeting.

And with that, I, as the subcommittee chair for NuScale, we're going to depart a little bit from the schedule I just mentioned to take up a topic that we had requested NuScale address, and that is the ECCS valve testing program.

And so, Mike, with that, do we have a question-and-answer approach or are we going to have to have a presentation?

MR. SNODDERLY: The NuScale staff that will help in with Member Harrington's questions are online.

CHAIR KIRCHNER: Okay. Which ones?

MR. SNODDERLY: And then the staff also had some information.

So I guess, Member Harrington, did you want to make a statement, I guess, what you were looking for or -- but we have the staff available to respond to questions concerning future plans for the qual.

MEMBER HARRINGTON: This is Member Harrington. On the Chapter 6 letters, in preparing that after our review meeting a month ago or whenever it was, now I looked back at the final DCA letter, and

there were several topics from Chapter 6 in the DCA that merited particular attention by the committee at the time. I was not a part of the Committee at the time, so some of this is secondhand in that regard, for me at least.

But one of the topics that was raised and carried through to the final letter was in regard to the operability of the ECCS valves after sitting in the operating environment of the containment reactor vessel for the entire operating cycle, basically, and whether the presence of boron or any other issues might degrade the performance of the valve, basically cause it to not open.

And the Committee position expressed in that letter was that there was qualification program plan. Qualification testing was specifically called out in the letter that they felt would adequately address that but also included a couple of comments in that final letter in regard to topics that ought to be addressed in that testing.

And so, the questions that I raised at that point were kind of where are we now? What testing was done? What information do we have now to close out that issue more completely maybe than was done in the DCA? Basically, what is the status now?

So that's, I guess, maybe a useful setup to those questions, and I'd be interested in hearing from NuScale in regard to that topic.

MR. BECK: Hey, Member Harrington, this is Tyler Beck from NuScale and also have Dan Lassiter on the phone.

Dan, I know you were having issues getting in the meeting, so I just want to confirm. Did you -- are you in the meeting?

MR. LASSITER: This is Dan Lassiter. Can you hear me?

MR. BECK: Yeah.

MR. LASSITER: Okay.

PARTICIPANT: Yes.

MR. LASSITER: Yep, but I did only catch the last portion of the question. So, either if Tyler can start, it could be restated shortly. That would be appreciated.

MR. BECK: Yeah. So Dan, the question is getting back to the DCA letter and discussion of testing, and you know, addressing concerns related to potential for something like boric acid buildup during the longer-term period.

And so, to start addressing this question -- and Dan, feel free to chime in if you have

something else to say or Augie's there as well -- we performed two test programs, representative and prototypic valve testing thus far, to confirm the ability and demonstrate the ability of the ECCS valves and their functionality.

In addition to those test programs, we include the ECCS valves in the scope of ASME QME-1 testing and then environmental qualification as well. So you have those additional pieces to qualification of the valves. And then, when the valves are in service, you have in service testing during every outage. And then lastly, there is a boric acid control program included for the -- right now in the scope of a COL item. But all of those components play into ensuring that the valves won't have some type of issue related to boric acid preventing their functionality.

MR. LASSITER: Yeah, this is Dan Lassiter, NuScale Design Engineering. I'll maybe just be a little more detailed in the scope of what Tyler just mentioned there.

In the DCA review, we did a test program with the NRC, reviewing that program to support their review. And we did use boric acid solution within the valve components to demonstrate that in an actuation,

in the flashing and things like that, boron wouldn't precipitate out and affect valve function. But that's a short-term functional test.

The long-term effects of boric acid or boron solution are addressed by the qualification program. There's the QME-1 portion, which is functional testing. That's not really long-term effects. The long-term effects are really addressed by the environmental qualification portion. And so, that has not been carried out yet. But there are requirements in qualification program to address any long-term degradation mechanisms that could affect safety function of the valve. And so, those will be required to be addressed either by test or analysis or justification in the qualification program.

And as Tyler mentioned, there's also, you know, programs during plant operation to ensure functionality of the valves. There's the IST program. These are exercised every outage during the shutdown process. The ECCS valves are, as well as the boric acid inspection program, which is, as you mentioned, a COL item, to develop that program. So we believe that those programs, as well as the functional testing and qualification, address the effects of boron or boric acid solution, you know, in and around the ECCS

valves in the short term and also in the long term.

MEMBER HARRINGTON: Have you looked at any -- I guess for me, in trying to pick up that concern from the Committee several years ago, the area that I'd be concerned about is small ports in tight clearance areas that something might fake out, precipitate out on, and challenge the valve. And really, in the end, the challenge is could there be a common mode failure that could affect multiple valves? Have you looked at other operating experience? I'm not sure there's other valves in the current fleet that really sit in that same kind of environment as warm as these would be.

MR. LASSITER: I mean, there's pilot-operated safety valves which are similar in design and function and in some similar environment. I guess some of them are maybe more in the steam space than the liquid space, but we have operating experience of similar valves either that NuScale has collected information, or the valve vendor provides their -- valve supplier/designer supplies their, you know, their expertise and operating experience.

You know, I think it's difficult to definitively answer the concern today because it has to be addressed through the qualification program,

which is not complete yet but will be prior to operation. So I really have to lean on the fact that any long-term degradation mechanism, you know, with respect to valve safety function, is required to be addressed, including chemistry and buildup of boron precipitate in the environmental qualification program. So that's the primary, primary mechanism.

MEMBER HARRINGTON: Well then, let me just ask this, in the logical extreme, which maybe is not logical in this case, but if there was a common mode failure, what happens if none of this ECCS valves open?

MR. BECK: Probably -- this is Tyler Beck. Probably would be a question for either our PRA or safety analysis folks, but I would imagine we would get to a point where the reactor safety valves would lift, and I'm not sure the event sequence after that.

MEMBER HARRINGTON: Yes, that's what I would expect. Yeah.

MR. LASSITER: There's also a feature in the ECCS valves described in Chapter 6. I don't want to be too detailed here. The -- if the actuator does not actuate, the valve is still open, once the RPV, the reactor vessel is depressurized due to an internal spring inside the valve. So and that's reflected in

the PRA models and is a significant feature.

So that's a portion of the answer to your question, but that is getting into a hypothetical scenario. I think PRA would be best suited to answer that question.

CHAIR KIRCHNER: This is Walt Kirchner. Don't you -- you have to set these valves each time with CVS, CVCS pressure. So, in effect, you will have to exercise them each time or you won't be able to start up that module because you're going -- if they were not seated properly, you're not going to be able to pull a vacuum in the containment.

MR. LASSITER: Yep, that's exactly correct, yeah. They're exercised and open during the shutdown process, and then they're reset and closed during the startup process.

CHAIR KIRCHNER: So there'll be a functionality test with each outage for refueling.

MEMBER HARRINGTON: I guess for those of you that were here when the letter was written, does that keep that issue in a comfortable place?

CHAIR KIRCHNER: Well, at the time there was a commitment, and I believe some of this valve, the ECCS valve testing program was executed, and it sounds like now they're continuing the qualification

program. So that was one of those concerns that was flagged in that letter we were coming out of the DCA.

But the fact that they have to actuate they have to actually seat those valves each time is probably a good test of whether the ports have that buildup of boric acid or of any kind of blockage that would impair their operability. And if they don't get a good seating of the valve, then they're not going to have a leak tight system and be able to pull a vacuum on the containment. So there is in effect a retest of each of the valves with each outage cycle.

MEMBER BALLINGER: Yeah.

CHAIR KIRCHNER: Go ahead, Ron.

MEMBER BALLINGER: This is Ron Ballinger. I think I'm the one that brought that up in the original DCA because I had a lot of experience with on the BWR side, solenoid-operated and pilot-operated relief valves that have a habit of not lifting within specification. So there was an operability issues that I was worried about, and I think what they've said since they -- it has to be operable, and they have to test it prior -- at the end of each outage, right?

CHAIR KIRCHNER: Right.

MEMBER BALLINGER: That's the same thing

that they have to do on the BWR side, or they -- these are safety valves.

CHAIR KIRCHNER: Dennis, you also contributed to that part of the review for the DCA. Do you have any comments on this or questions?

DR. BLEY: Sorry. I had trouble getting my microphone. Nothing further than you folks have already talked about. I don't completely remember the discussions back then, but no, nothing more to add.

CHAIR KIRCHNER: Okay. All right. So does the staff have anything to add at this point?

(Simultaneous speaking.)

PARTICIPANT: Tom Scarbrough is supposed -- Tom Scarbrough our next -- he just walked in.

CHAIR KIRCHNER: Tom, when you sign in, the floor is yours.

(Laughter.)

CHAIR KIRCHNER: Time to get prepared. Oh, by the way. Okay, we'll put you on the spot if you just stand right there.

MR. SCARBROUGH: Sure.

CHAIR KIRCHNER: Yeah, that's the microphone.

MR. SCARBROUGH: Okay.

CHAIR KIRCHNER: So we're just having a

discussion about the ECCS valves and qualification program. Can you give us kind of an update of where the staff review is on the valve test program?

MR. SCARBROUGH: Right, sure. I'll be glad to. Where we are, the DCA, we went through a very elaborate review of the 50.43(e) testing program, including capability, boron, boric acid solution, and all that. We went through and wrote a very long audit report that described all of that and what type of testing they did. And then at the conclusion, we said that all these lessons learned will need to be incorporated into the QME-1 qualification program. And that was very, very specified.

Now, working with the SDA, we had discussions with them, and they did a series of tests of temperatures, and they found a lot of interesting things that they're going to address as part of the QME-1 qualification.

Now for the boron, they were able to make a reasonable argument that from a 50.43(e) test perspective, they did not need to do the boric acid testing that they did before because nothing really changed significantly in the dimensions of the -- of those valves. So we allowed them to do that.

So we completed the 50.43(e) review for

the SDA for the ECCS valves. And we summarize the reports. The reports were all proprietary, but we summarized them in the SER, you know, the non-proprietary version of what we looked at. And they went through all types of things: CB testing, XT testing. They did a number of different type things to demonstrate capability of the valves from a 50.43(e) perspective. And so, we completed that. We wrote the safety evaluation and made a finding that from a 50.43(e) perspective, they had justified it.

They didn't do the boric acid testing for this one, but the other parts we thought were reasonable, and we thought we could take lessons learned from the DCA testing to complete that portion.

Now the next step will be the qualification scheme. We want qualification testing. And in the ITAAC, there's a specification that, a design commitment that they qualify the valves for all design basis conditions. And so, that would include the whole gamut of testing, you know, in terms of the IEBs, the RDVs, RRVs, all that will have to be tested for the qualifications testing.

And so, they haven't relayed to us. I've heard that they're thinking about it. They're planning. They're doing the testing plans that they

would -- I think they would like to probably talk to us sometime, so we can give some feedback to them. And so, when they're ready, we'll be ready to talk to them about what their plans are for full-scale QME-1 qualification test. But we're not there yet.

Well, when we did the testing for the DCA 50.43(e), they came in early. We looked at their test plans. We gave them some feedback. They made some adjustments, and we were able to proceed with the 50.43(e) testing for the DCA. It all went very smoothly. So we're hoping the same thing will happen for the QME-1 qualification testing for either the DCA or the SDA whenever they're ready.

So that's sort of where we are. We're sort of in the process of just waiting for them to be ready to talk to us, and we'll be glad to talk to them whenever. So that's where we are. They have – they've completed 50.43(e) testing satisfactorily. We described that in SER. The next step will be for them to come in and start talking about what their plans are for QME-1 qualification testing. That's sort of where we are.

CHAIR KIRCHNER: Okay. Thank you.

MR. SCARBROUGH: Okay. Sure. The other thing I was going to mention, yesterday, we talked a

lot about 50.69, and Getachew pointed out to me that the DCA is not allowed to use 50.69 because it's a design certification, but the SDA, they could. So, if NuScale wanted to, they could come in under 50.69. I just wanted to clarify that. Okay. Great. All right. Thank you.

CHAIR KIRCHNER: Thank you.

MR. SCARBROUGH: Thank you.

CHAIR KIRCHNER: Okay.

MEMBER DIMITRIJEVIC: Walt?

CHAIR KIRCHNER: Yes. Go ahead, Vesna.

MEMBER DIMITRIJEVIC: Hi. Good morning. In the PRA, you know, the concerns we also -- that was one of the -- it was a number one consideration which says that I was looking for this letter that further examination of the design of emergency core cooling system valves and associated PRA model is needed to help to build confidence that plant risk is accurately represented.

And this, in the PRA, we always express concerns that the failure rates, the common cause assumptions, and you know that the other underlying conditions are realistically represent because those are the most and the only important components in the -- from the PRA perspective, cooling perspective.

So I just wanted to add that that thing you know was left open in the reconciliation saying the ECCS valve performance work will say the, you know, the -- you know, is waiting for the development. So, you know, it was left open and that's with now discussion means in the in DCA -- PRA letter. Okay.

CHAIR KIRCHNER: Okay. Thank you.

Matt, go ahead.

MEMBER SUNSERI: Yes. Good morning. Hey, so I've been listening to the conversation. I've been thinking back on our meetings when we discussed these valves before, and what I'm hearing is a pretty robust program for establishing functionality of the valves, qualification of the valves. I did check tech specs. There are going to be periodic surveillance testings of the valve at the end of cycle, in between cycles. So I don't know why we would be concerned about this. It's not like they're going to be in a environment that is unfamiliar or unchallenged in the history of pressurized water reactors. So I wouldn't have any concern.

CHAIR KIRCHNER: Good. Thank you.

Okay. I think we can move on. Great. Okay. So, with that, we're going to turn to Member Martin, and he'll give us his assessment on the loss

of -- non-loss-of-coolant analysis methodology TR. Okay.

MEMBER MARTIN: Thanks, Walt. To kind of just familiarize us with the -- the agenda title is the next couple hours or more we're going to talk about the topical reports. One is the, of course, the one I'm about to read in at the moment is Scott's on extended passive cooling and reactivity control.

We had our meetings last month. I have prepared a summary report, and that's all -- you see it here on the screen here for all of us to see as I read through it. I don't know if we're going to do an editing. We've passed it around a little bit here among committee, but I'm going to read it in, and I'll pass it off to the -- our transcribe guy. What's the right word for that?

PARTICIPANT: Court reporter.

MEMBER MARTIN: Thank you. So that he'll have it so --

(Simultaneous speaking.)

MEMBER PETTI: Can you make it bigger? Can someone --

(Simultaneous speaking.)

MEMBER MARTIN: Yeah, I think -- who has it? Sandra has it. I'm going to read my copy which

I think is the same copy.

MEMBER PETTI: Yeah, that's better. Thank you.

MEMBER MARTIN: Okay. It's just we also have it in our P&P for later. Anyway, I'll begin now.

Member Martin reviewed NuScale's Topical Report TR-0516-49416 Non-Loss-of-Coolant Accident Analysis Methodology Revision 4 -- and I will not provide the ADAMS number -- describing the non-LOCA evaluation model (EM) for design-basis transient analyses and the 250-Megawatt thermal NuScale Power Module (NPM-20). The Committee reviewed a previous version of this TR in 2020 for use with the 160-Megawatt thermal NPM-160, providing a letter at that time. Revision 4 updates the model to support the upgraded US460 design.

On March 4, 2025, NuScale and NRC staff presented the revised TR and supporting analyses to the Committee. The non-LOCA EM follows established regulatory guidance, including RG 1.203 and the NuScale Design-Specific Review Standard, and retains key elements of the previously approved methodology, including event classification, system response analyses, and demonstration of fuel and radiological safety criteria without operator action for 72 hours.

The applicant affirmed that the methodology identifies limiting single failures, accounts for the potential negative influence of non-safety system actions and includes bounding assumptions as appropriate.

The NRC staff's review concluded that the revised evaluation model supports a finding of reasonable assurance of safety, subject to ten Limitations and Conditions, i.e. L&Cs. Most L&Cs are consistent with those applied in previous approved methodology; however, several were updated to reflect changes in the NPM-20 design and modeling tools. Among these, L&C No. 4 -- requiring evaluation of biases on decay heat removal system heat transfer and non-LOCA analyses -- was a focal point of discussion during the Subcommittee meeting. The staff cited concerns related to scaling and modeling uncertainty as justification for evaluation of biases, despite NuScale's presentation of test data and analyses intended to support the adequacy of the realistic DHRS model.

The Committee concludes that the revised non-LOCA EM remains technically sound and sufficiently conservative for evaluating the NPM-20's response to design-basis transients. This conclusion is supported primarily by its continuity with an already approved

methodology and a reaffirmed focus on dominant phenomena and critical figures of merit. In addition, the Committee has no objection to the staff issuing their safety evaluation report; however, Martin recommends removal of L&C No. 4. The continued evaluation of biases on DHRS heat transfer is unwarranted as the underlying uncertainty relates to standard design considerations, not unmodeled phenomena or scaling distortions. The steam generator -- DHRS configuration reflects well-understood industrial heat exchange principles, where sufficiently sized heat transfer surface area ensures heat rejection with minimum sensitivity to uncertainty. Given NuScale's new test results and modeling that shows the system maintains ample margin to avoid overpressure, biases needlessly double-count conservatism (in both design and analysis) and undermines the credibility of NuScale's validated approach.

It is recommended that this writeup serves as the record of Subcommittee meeting and that an ACRS letter report not be prepared.

So could be some discussion here related to my conclusion on L&C No. 4. So I spent a little time kind of -- you know, actually, I prepared a lump

parameter model kind of looking at basic heat transfer performance and looked at some of the codes standards that apply in this particular case. Frankly, you know, with normal design practices there's going to be very little sensitivity to the uncertainties that we're talking about unless you really hit it really hard to the point where you basically distort it from reality. I do find that it's important that NuScale did do those tests and did show really level of sensitivity -- and we're talking about sensitivity related to pressure in this particular case.

So that's primarily the basis of my conclusion that the L&C is really unnecessary and that design -- standard design practices would otherwise account for the uncertainty that they're concerned with.

CHAIR KIRCHNER: So Bob, yeah, we have two issues here, just so that everyone appreciates what's going on.

We've adopted a practice of late to unless we think there are significant issues with material that we're reviewing -- and this isn't NuScale specific -- across the board, we've been adopting a practice of using summary reports. Those are recorded as part of the meeting minutes and are available to

the public and also provided to the Commission. This is in the interest of efficiency of operation of the Committee so that we reserve the bulk of our time to focus on safety significant matters.

The process issue here is that we have a recommendation from one of our members. It happens to be Bob this time, but we've had this in the past. So we need to look at how do we capture this and how if we're elevating it and we're not writing a letter report, how do we disposition something like this? Or is it just something that is a note to the staff that we have a concern, but it doesn't rise to the level of a letter report and such? So there's the process part here and then there's the technical part.

MEMBER MARTIN: So, obviously --

CHAIR KIRCHNER: Let's start with the technical part, and then we'll go to the process part.

MEMBER MARTIN: Okay. I was going to go the other way but, again, I've kind of laid out -- I mean, I could pull up my plot if you like.

But you know, there are, you know, standards that are to get applied in the design process. It's, you know, heat exchangers is not an unfamiliar type application, basically a boiler condenser kind of environment where the only thing

that really matters is surface area, total surface area. You know, this is undergraduate-level type work. I mean, no offense, but this is not hard stuff.

And you incorporate, you know, whether you want to call the factor safety or what have you, you account for, you know, long-term fouling that, you know, results in oversize and you know, to then, you know, back off even further, you end up getting yourself into what might actually be a very steep curve of sensitivity, which is very unrealistic if you over -- if you use the word penalize, but you penalize, basically, the heat transfer in that model, and it very much distorts what's going on. And NuScale did the work.

CHAIR KIRCHNER: Basically, we had boiling on one side and condensation on the other. So we got big heat transfer coefficients.

MEMBER MARTIN: Yeah.

CHAIR KIRCHNER: So this is not like a fouling factor for a conduction heat transfer problem.

MEMBER MARTIN: No, no.

CHAIR KIRCHNER: So are there any scenarios where, for some reason, the function, the timing of the valve in isolation would result in a solid system where you wouldn't have the opportunity

to boil and condense?

MEMBER MARTIN: I don't think we saw that.

CHAIR KIRCHNER: I mean that would be a much bigger decrement on the heat transfer capability than a fouling factor or penalty on anything.

PARTICIPANT: He had that much water. I'm not sure that'd be a concern.

CHAIR KIRCHNER: Yeah.

MEMBER MARTIN: Yeah, that would give you even more margin to think that they were using the figures of merit.

But if, you know, the transition to the process part -- I mean, somewhat, this is water under the bridge, right? I mean, here we are, you know, near the end of the whole process. There's nothing fundamentally wrong with the safety evaluation report. Clearly, NuScale has probably moved on a little bit. But I just thought that, in this case, that by presenting the L&C No. 4, they kind of identified as a safety issue that I don't think is a safety issue.

And I think while we focus on safety issues, it's also important to highlight when maybe it's not a safety issue, that, you know, we should not be, you know, standing behind things that are -- that may be overly conservative in this case, particularly

given the investment that NuScale did into the testing and what have you.

And it's, you know, in today's day and age, I think it's important to just highlight, maybe not overemphasize, but certainly highlight a situation where, you know, maybe we should, you know, acknowledge the efforts of an applicant into trying to resolve an issue and that indeed there are some people here that concur with the effort and that it is adequate and not a safety issue.

I cut you off, David.

MEMBER PETTI: No, no, you, basically, knew exactly where I was going. I agree with you technically, but I worry that buried in the summary is just the wrong thing. It's a recommendation. I think it's an important recommendation in its specificity here. But it's in its -- when you genericize that and think about, you know -- sometimes I read some of the L&Cs, and I'm going, really? You know, the excessiveness, given the data that's behind it, is an important consideration. I just don't know how we -- without writing a letter on it, I don't know how we get it.

MEMBER MARTIN: Well, first I got --

MEMBER PALMTAG: This is Scott. This came

up last meeting. It is kind of a concern of ours. It was kind of a little bit about the timing because we're doing these reviews and the chapter memos. And so, it's my understanding that these summaries, that any conclusions would roll up into the Chapter 15 chapter summary.

MEMBER MARTIN: It was my intent to throw this into the memo.

VICE CHAIR HALNON: So, from a process perspective, there's a couple ways of handling it. But what I would recommend is that you change it from a recommendation to a conclusionary statement saying the Committee feels that this L&C is unnecessary for the following reasons and leave it at that. And then in your Chapter 15 memo, you can make the recommendation to remove it, which will roll up into the NuScale memo.

MEMBER MARTIN: I thought about the word conclusion. I thought, well, maybe that was a litmus for elevating it to a letter.

VICE CHAIR HALNON: Yeah, just a couple things. You don't want to just highlight yourself. Member Martin suggests or recognizes -- this a committee summary. We all really buy into it or not. I think you have general agreement, especially what

they've said relative to the confluence.

This seems like a lot. But if you make it a conclusionary saying that, you know, this is clearly unnecessary for the following reasons. They did a lot of testing. They should be credited for that. Blah, blah, blah. And then make the recommendation appropriately in your 15 letter, and then we all can -- well, as a committee, we'll decide if that goes in the final.

MEMBER MARTIN: Get away from the word recommends to concludes?

VICE CHAIR HALNON: In this.

CHAIR KIRCHNER: I would just put it as --

VICE CHAIR HALNON: Make it a conclusionary statement. You don't say conclude. Oh, just say that -- Sandra, could you put line 34 back up, please, or thereabouts?

So you could say we recommend. You said we not only say we recommend, the Committee considers the L&C No. 4 being unnecessary for -- and then you --

CHAIR KIRCHNER: Just make it an observation statement of fact rather than a buried recommendation.

VICE CHAIR HALNON: That's a conclusionary statement. That's probably the right word for it, but

Walt said it better, just an observation of fact. And the rest of it's fine.

MEMBER PETTI: So I'm worried. I said this last time. This Chapter 15 memo is going to be huge. There's no reason to say we can't just take this on the topical, and make it a memo in and of itself in the back of the package because it's such an important -- I mean, you know, all of these ones, as opposed to just putting it under the chapter, just going to make it really --

(Simultaneous speaking.)

VICE CHAIR HALNON: You can turn this into a memo, actually.

MEMBER MARTIN: And then I'll -- I was going to take my summary report from LOCA, the summary report for this, summary report from Scott, and then and weave the story. I mean. Yes, Mike.

MR. SNODDERLY: So I think this is some good timing though. This will lead well into the outline. But when we go over the final letter outline, there's an appendix that will have all of the review memos. So and you could put in the text, or you know, the body of the final letter some pointer to that, to the Chapter 15 memo or the observation.

So you've got -- but of course, the

topical report will already have been issued probably. You know, again, not all this time is happening right at the same time. For a little while that, you know, took normally to write, the topical would have been issued earlier or, you know, where you could have given this insight. I was just trying to tell you there's opportunities for you to make it to make the public or interested parties well aware of where there's additional information.

CHAIR KIRCHNER: Yes, yeah. Vesna, go ahead.

MEMBER DIMITRIJEVIC: I just want to mention that in the PRA there is a basic event which models the fail of DHRS strain passive heat transfer to reactor pool that has a failure probability of 40 minus 6, and you know, with uncertainty distribution. So I don't really know that how is this estimated, but it could be -- I mean this could be related. This says that following successful actuation of DHRS strain, this event represents a failure of passive heat transfer nature circulation to the OHS over the mission time. So maybe this L&C is connected to estimating this failure probability.

MEMBER MARTIN: That did not come up in our discussion on March 4th or whatever I have on

here. You know, what was presented to us related to scaling distortions and just uncertainties that the staff felt were unquantified.

(Simultaneous speaking.)

VICE CHAIR HALNON: We don't need to make this hard from a process perspective. Dave had a good suggestion, but since we do summaries of TRs in the P&P summary, I would just put -- I mean, if you're willing to turn this into a memo as a standalone, then you can make your recommendation, or if you want to do it in Chapter 15, it's fine. If you do it in your Chapter 15 memo, then just make that an observation.

MEMBER MARTIN: Sure.

VICE CHAIR HALNON: And roll it up. If you want to do a memo on it, then we'll just put the title and CR and say there's a memo written on this. You can write the memo on it. But I would suggest you just roll it up.

MEMBER MARTIN: That's my plan.

VICE CHAIR HALNON: Since you want to weave that story together.

MEMBER MARTIN: Right. And it's -- and the memo is due really soon.

CHAIR KIRCHNER: So are you amenable, Bob, to making this kind of a third-person thing and --

MEMBER MARTIN: Well, I mean, obviously going into this discussion, I have to make it a first-person now that I, you know, it sounds like I have some consensus on the Committee, and I can change it from first to third person.

CHAIR KIRCHNER: And I would put it at the end before you sign off there. It is recommended. We effectively have it there.

VICE CHAIR HALNON: You got what you needed?

MEMBER MARTIN: I think so. I think I have.

VICE CHAIR HALNON: Okay. So we can move on.

MEMBER MARTIN: Should I have this revised for P&P, Larry?

MR. BURKHART: Well --

MEMBER MARTIN: I mean, it won't take. I mean I can have it revised for P&P.

MR. BURKHART: We can do that.

VICE CHAIR HALNON: Yeah, you've got all day to take it.

MR. BURKHART: Revised, yep.

CHAIR KIRCHNER: All day and all night.

(Laughter.)

MEMBER MARTIN: Plenty of time.

CHAIR KIRCHNER: Okay. Thank you. Thank you, Bob. Okay.

With that, we're going to turn to Scott Palmtag who led the review on the ER or extended cooling.

MEMBER PALMTAG: Not used to being longer than Bob. All right. Some of the process issues are going to show up in this one, too.

On March 4th, 2025, the NuScale subcommittee of the ACRS reviewed the NuScale Topical Report (TR) Extended Passive Cooling and Reactivity Control Methodology Revision 0. This TR describes the methodology to evaluate the emergency core cooling system (ECCS) and decay heat removal system (DHRS) extended passive cooling (XPC) function. Report is applicable to both loss-of-coolant accident (LOCA) and non-LOCA design basis events and shows compliance with regulatory requirements 10 CFR 50.46(b)(4) and for long-term cooling, and 10 CFR 50.46(b)(5) for coolable geometry. The report also shows compliance with General Design Criteria (GDC) GDC 26, GDC 27, GDC 34, and GCD 35.

In the XPC LTR, NuScale presents the Figure of Merits (FOM) selected for the XPC evaluation

model. These include (a) subcriticality, (b) coolable geometry, which is boron concentration below solubility limit for precipitation, and (c) collapsed liquid level above the top of the active fuel. The TR shows that coolable geometry is retained and the collapsed liquid level remains above the active fuel height, and the Committee agrees with these conclusions. The Figure of Merit for subcriticality is discussed below.

This TR also successfully addresses a concern previously raised by the ACRS in 2020 and describes additional shutdown control methods that have been added since the US600 design so that an exception to GDC 27 is not required.

Subcritical configurations. The US460 design did not request an exception to GDC 27. Consistent with SECY-18-0099, GD 27 has historically been interpreted as, quote, requiring a reactor to be reliably controlled to achieve and maintain a safe, stable condition, including subcriticality beyond the short term, unquote. The ability to remain subcritical after an ECCS actuation depends on the behavior of several core parameters that affect core reactivity. These include the following.

One, an initial concentration of boron is

present in the coolant at the beginning of the event and will increase or distill in the core region due to coolant boiling during natural circulation.

Two, additional boron is being added from the dissolver baskets present in the containment vessel. This adds negative reactivity.

Three, the core is cooling down substantially over the 72-hour period, which adds positive reactivity.

Four, xenon first peaks, then decays away over the 72-hour period. At 72 hours, the Xenon is almost gone which adds positive reactivity.

Five, all control, rods except the highest-worth rod, are considered inserted, which adds negative reactivity.

Six, samarium is increasing in the core over the 72-hour period. This adds negative reactivity.

It should be noted that some parameters that are considered beneficial to core cooling, such as low temperatures and low decay heat, quote, hence low xenon, make it more difficult to remain subcritical.

The most limiting conditions to remain subcritical occur at the end of cycle, or EOC, when

the RCS boron concentration in the core is near zero. From the cases shown in the TR and in Chapter 15, all analyzed cases remain subcritical critical, but the margin of criticality can be relatively small. The smallest margin to criticality shown is 28 parts per million (ppm) boron. This margin is in criticality is within the predicted boron concentration uncertainty usually observed in pressurized water reactors (PWRs), which is typically 50 to 100 ppm. Cold, off-nominal conditions usually increase the amount of uncertainty. NuScale has indicated that there are many conservatisms built into the analysis that increase the margin to criticality, such as the use of conservative temperatures in the analysis. The NRC staff has also run computational fluid mechanics (CFD) calculations that show that there is additional conservatism in the NuScale boron tracking model.

To provide confidence that the reactor remains subcritical during an ECCS event, NuScale should quantify the conservatisms in their models and show that each core loading pattern remains subcritical during an ECCS event with sufficient margin to account for uncertainties. Historically, a shutdown margin of at least 1 percent has been used to account for uncertainties. A 1 percent shutdown

margin in k-effective corresponds to approximately 100 ppm boron.

Each new core loading pattern should demonstrate this shutdown margin. This can be done by making -- by adding technical specification requirements that are part of the Core Operating Limits Report (COLR). NuScale already has technical requirements to the operation of the Emergency Core Cooling System Supplemental Boron (ESB) so the existing requirements could be reviewed and modified to demonstrate ECCS shutdown margin with uncertainties.

Moving to additional Riser Holes. The TR addresses a concern that the Committee has raised in the past. On July 29th, 2020, the Committee wrote a letter on boron distribution for the US600-certified design. In that letter, the Committee identified a potential issue where, after ECCS actuation, water levels could drop below the riser holes and render them ineffective; thus, coolant in the downcomer would deborate for a range of design basis accidents, including small-break LOCAs. Operator recovery actions would raise the possibility of an influx of deborated water into the core, which may result in recriticality, return to power, and the potential for

core damage. In the latest TR, NuScale addresses these concerns, or this concern, by making a design modification to the US460 that adds additional riser holes at the midplane level of the steam generators that would maintain a flow of borated water to the downcomer, which would prevent this influx of deborated water from occurring. In addition, the US460 design has added boron baskets to the reactor containment to further reduce the risk of risk of recriticality during an ECCS event.

Conclusion. The NuScale Subcommittee of the ACRS has reviewed the NuScale Topical Report. The Subcommittee has the following recommendations and comments.

One, a technical specification limit should be added to show that the reactor core remains subcritical for a period of 72 hours following an ECCS actuation. This requirement should be added to the Core Operating Limit Report and required for each cycle. The subcritical analysis should account for uncertainties during the ECCS event.

Two, NuScale has successfully addressed the concerns raised in the ACRS letter from July 29th, 2020, by adding additional riser holes at the midplane level of the steam generators. Without these riser

holes, there was a concern that an influx of deborated water could enter the core and cause a recriticality. In addition, the US460 design has added boron baskets to the reactor containment to further reduce the risk of recriticality during the ECCS event.

These comments will be deliberated by the ACRS full committee for inclusion in the Chapter 15 review memo.

CHAIR KIRCHNER: Discussion.

MEMBER PETTI: Just a couple things, notes. I saw typos. It's computational fluid dynamics, not mechanics.

MEMBER PALMTAG: It was late.

MEMBER PETTI: Yeah, I think it was. And then, when you talk about the riser holes, it makes it sound like it was something done in the report. In the latest TR, NuScale addressed this concern. Just strike in the latest TR. They changed the design is what -- right? I mean, it has nothing to do with the topic.

And then I just thought that it could be strengthened when you talk about the CFD stuff that the staff did the calculations. Additional conservatism could mean a lot of different things to a lot of people. I would actually put what their peak

number was because it's a significant additional concern. I mean it demonstrates --

CHAIR KIRCHNER: You say on the order of --

MEMBER PETTI: Oh, yeah, right.

CHAIR KIRCHNER: On the order of 100 ppm.

MEMBER PETTI: Well, it was 188 ppm, so I mean that's a significant difference from the 28 ppm.

VICE CHAIR HALNON: So none of these numbers are proprietary. These numbers are not proprietary.

MEMBER PETTI: That's a staff calculation

(Simultaneous speaking.)

VICE CHAIR HALNON: Because the closed session, we went through some of these numbers.

MEMBER PALMTAG: That was one example. I'm just concerned. Was it one example, or is that a typical number?

MEMBER PETTI: Well, let me just tell you my sense. We raised this the last time. The assumption that they used about, you know, two volumes --

MEMBER PALMTAG: And I agree. I just -- I'm trying to quote it. I don't know how to quote a number, or you know, is that a typical number,

average? You know, is that a --

(Simultaneous speaking.)

MEMBER PALMTAG: It's just one number.

MEMBER PETTI: I understand that, but I asked specifically. It is what made the staff decide everything is okay. That's why I asked the question.

MEMBER PALMTAG: So we could say something on the order of 180?

MEMBER PETTI: Yeah, that's on the order of. Yeah, that's fine.

MEMBER BALLINGER: This is Ron Ballinger. We had some discussion last night and this morning, and I sent a little note to Member Palmtag.

I think we're basically comparing apples and oranges here, and we have to be careful about that, in that those, for lack of a better word, the smaller number that which where the pinch point is. That's resulting from almost a stylized calculation, a sense where you build in all kinds of uncertainty. And for that kind of calculation, from my perspective, if they come within 1 ppm, I don't care, because it's a stylized calculation.

On the other hand, the CFD calculation, that's more a best estimate calculation, which is to me more realistic. And as long as they quote

uncertainties on that, then if that defines the margin, then they're good. But the stylized calculation is a little bit -- can be a little bit misleading, especially at the public, when the numbers come out very close to being what the public might say is, well, hell, 20p or 30 or whatever the number is, why not make it 50? Why not make it 100? But it's a stylized calculation. So that's the thing that concerned me. And I think there's an opportunity here to make that kind of a statement as a precedent. See what I'm trying to get at?

I don't know whether that is -- whether you consider the smaller number calculation, for lack of a better word, a stylized calculation. But we do that all the time. And as long as -- if it's a stylized calculation, if you're within 1, you're okay.

MEMBER PALMTAG: I'm not sure what that means. What is stylized? I mean, there should be a calculation and then --

(Simultaneous speaking.)

MEMBER BALLINGER: Remember, I'm a metallurgist, all right?

MEMBER PETTI: Yeah, you're a reactor physicist. So just understand the difference here is like --

MEMBER PALMTAG: I try to understand.

(Simultaneous speaking.)

MEMBER BALLINGER: We do appendix k. All right, 2200. We do a calculation, and it's a stylized calculation. This is how you do it. This is what you do. You come out with a number. If it's less than 2200, you go home free. But a best estimate calculation shows that you've got a thousand degrees of margin. So we ought to think about asking people to quote both. If you're going to do the stylized plus the best estimate, you ought to make sure that people know that it is a stylized calculation and that that number that they came up with using the stylized calculation is wrong. But it's a conservative, stylized calculation.

MEMBER PETTI: Yeah. I think that was --

MEMBER BALLINGER: So I don't know whether this earlier calculation is what we would call, in other words, unenforced. You do it this way and you incorporate this uncertainty in this calculation.

MEMBER PALMTAG: I think I agree with you. What I was trying to say is maybe what I was trying to -- I think what I was trying to say was, you know, instead of saying a stylized calculation, let's actually unroll some of those uncertainties and say,

you know, and say these are the uncertainties. And instead of just saying, oh, we have lots of uncertainty. Right. Oh, I don't know what that -- you know, is that 20? Is that 50? Is that a thousand? I don't know. So I'd like to see some quantification of the uncertainty. So it's kind of stylized.

MEMBER BALLINGER: Yeah. I'm just thinking that we need to make a distinction between -- I'm not -- don't use the word stylized, whatever it is, pounding on the conservatism and the real, the real deal.

MEMBER PALMTAG: Yes.

MEMBER BALLINGER: Because the real deal in this case is large.

MEMBER PALMTAG: I thought that's what I was trying to do, but maybe -

MEMBER BALLINGER: I think you did.

MEMBER PALMTAG: Yeah, okay.

MEMBER BIER: If I can butt in, I want to make one minor point which is I do think we probably need to have a proprietary check even for the results of staff calculations because the inputs to those calculations may be proprietary even if the calculation is not.

VICE CHAIR HALNON: At this point, what's there is too late.

(Simultaneous speaking.)

MEMBER BIER: Oh, okay. Right. Thank you.

MEMBER PALMTAG: Maybe what Dave had said at the end.

(Laughter.)

VICE CHAIR HALNON: The reason I brought it up is that we went through some of these numbers in the closed session.

MEMBER BIER: Okay.

MEMBER PALMTAG: That's a good point, yeah.

CHAIR KIRCHNER: Well, maybe to help the discussion a little. This, what was reviewed here is a methodology that they're going to use for licensing purposes, right? So this is an evaluation methodology. If the staff accepts it, that's not a stylized calculation anymore. It's their EM model for purposes of licensing.

So what staff went on to do is kind of more in the, like you said, best estimate because they used computational fluid dynamics to kind of get an estimate on the recirculation and the downcomer and

what the boron distribution might be and, hence, what boron is going in the RRV. And that gives confidence that they should have sufficient shutdown margin to mean subcriticality.

I think what would have been useful is to, where there are conservatisms in the application of the methodology, to the extent that one could estimate them in terms of PPM equivalent boron, that would -- that might help when we look at the results and see that that pinch point that we talked about looks to be a little tight versus, you know, what typically is used in PWRs to satisfy oneself that you've got sufficient shutdown margin. So maybe we ask for that in the writeup, or it would help in certainly in the public forum of making the safety case.

MEMBER BALLINGER: The one thing that the CFD calculation results didn't include was the uncertainty on those calculations.

CHAIR KIRCHNER: Yeah, that's true.

MEMBER BALLINGER: I mean CFD is a black art as well as metallurgy.

CHAIR KIRCHNER: Yeah.

MEMBER PETTI: Except there is an equation that they had to try to solve.

MEMBER BALLINGER: Say again?

CHAIR KIRCHNER: Have your stokes.

MEMBER PETTI: Solved all of your stokes. Metallurgy is --

(Laughter.)

MEMBER BALLINGER: Yeah, you're right.

MEMBER PALMTAG: Equation with a lot of closures.

MEMBER PETTI: Without closure.

MEMBER BALLINGER: When you have six adjustable parameters, I'm sorry, it's still a black art. I agree.

MEMBER PALMTAG: It's the closures that are black art.

CHAIR KIRCHNER: May I ask a question of NuScale for clarification?

MEMBER PALMTAG: Yes, I'll be -- yeah. Before -- one thing, I'll make a comment. Both of you brought this up. This is the pinch point. That actually gets a little complicated with GDC 27 because that could be considered a short-term return to criticality, which historically has been allowed. I specifically stayed away from the pinch point. I'm personally more concerned about the endpoint of the long-term criticality. But I just wanted to bring that up because I didn't mention pinch point

specifically.

CHAIR KIRCHNER: I just wanted to ask NuScale if someone could answer this. The way the writeup is right now, we talk about holes at the midplane of the riser, but can you address in an open session, can you address how many holes you have in that riser section? I think I don't want to speculate. I think I know the answer, but Megan, perhaps? Or we have reserved the opportunity to go to a closed session this morning if we need it as well.

PARTICIPANT: We'd have to clear the room.

(Simultaneous speaking.)

MS. MCCLOSKEY: Yeah, they --

CHAIR KIRCHNER: If you just stand here, yep, thank you.

MS. MCCLOSKEY: Megan McCloskey, NuScale. And if the if you're saying that the --

CHAIR KIRCHNER: You have holes, more holes than just the midplane.

MS. MCCLOSKEY: Yes. And I think I would clarify that the riser holes in the steam generator region are near and above the midplane. And but the riser holes that are important for the ECCS operation are those in the lower riser region. We've got four of those distributed around the riser.

CHAIR KIRCHNER: Whereas the holes in the midplane were just, I think, the DCA design. So I didn't want to -- can you scroll up, Sandra? Yeah.

So the -- I think, thank you, Megan, first of all. Thank you.

So, since NuScale volunteered that information to clarify things, there are holes down at the lower part of the riser that are pretty important for the ECCS operation and preventing and recirculating boron from the riser.

MEMBER PALMTAG: So, on line 86 I say additional riser holes at the midplane level.

CHAIR KIRCHNER: Yeah, that was the DCA design. This design has holes at the top. So, as soon as the riser is uncovered, they will still have boron circulation into the downcomer as the levels drop. There are holes then at the bottom of the riser that are the really critical ones for the long-term situation.

MEMBER PALMTAG: Take out at the midpoint level?

CHAIR KIRCHNER: Yeah. I think you could just say additional riser holes.

MEMBER PALMTAG: Yeah, okay.

MEMBER PETTI: It's below the midplane

level.

CHAIR KIRCHNER: That's really important in the long term.

MEMBER PETTI: No, he said at, so I think both --

MEMBER PALMTAG: Right. I'll just take that out, so I'll just take out at the midplane.

MR. SNODDERLY: In defense of Member Palmtag, the proprietary feedback that we got from -- we're getting into that area, so I think --

CHAIR KIRCHNER: Yeah. I know, but --

MR. SNODDERLY: So it's better to just keep it generic and just say --

CHAIR KIRCHNER: With NuScale's input though, I think we can just keep it generic.

MEMBER PALMTAG: Yeah, we'd make this --

CHAIR KIRCHNER: Additional riser holes, but the key ones for long-term cooling are going to be those that are lower down.

MR. SNODDERLY: But I think we can make the changes now.

CHAIR KIRCHNER: Yeah.

MR. SNODDERLY: Got NuScale. I'd recommend trying to take --

CHAIR KIRCHNER: Yeah, let's see if we can

fix it now.

MR. SNODDERLY: So, Scott, you can -- you can make -- have -- direct Sandra to make the changes.

MEMBER PALMTAG: Want me to go through all the changes?

MEMBER PETTI: Sure.

MR. SNODDERLY: At least the major ones, you know, while it's fresh in your -- I mean you've got --

CHAIR KIRCHNER: Yeah. Let's do it in real time.

MEMBER PALMTAG: On the first paragraph, last sentence of the first paragraph, I think it was -- I've had G -- there's a GCD in there, should be all GDCs. Subcritical, the numbered values that was one in the coolant, at 33, RCS coolant. Yes. Yeah. Search for CFD, then a mechanic before that. It should be dynamics. Section -- if you go down to section riser holes, line 85 in the latest TR, in the latest design. Dave brought that up. Actually, let's be more specific. In the US460 design, not latest, so just say in the US460 design. Addressed Dave's comment.

MEMBER PETTI: Oh, now you've got it in two places. I'd just get rid of that phrase. Just

say starting --

MEMBER PALMTAG: You should take out in the US460 design.

Line 86, remove at the midplane level additional riser holes, take out of the steam generators, and now I had a spelling mistake on this and influx. Line 87, take out this.

MEMBER HARRINGTON: And Scott, right there, the next line, you've got boron baskets, and you do that again later. I would put ESP. You've already defined that, and it's more specific than just boron baskets.

MEMBER PALMTAG: Line 88, boron, change boron baskets to ECB --

MEMBER PETTI: ESP.

MEMBER PALMTAG: ESP.

CHAIR KIRCHNER: Is that defined above?

MEMBER PALMTAG: Yes. So that should be last paragraph an ESP subscript -- it needs an article or something or the.

MEMBER ROBERTS: We already added this time. Go back up to the second paragraph.

MEMBER PALMTAG: I mean the ESP system or something like that.

MEMBER ROBERTS: Yeah. Line 17, the TR is

methodology, something like calculation using the TR methodology for the beginning of that sentence starting the TR. You know what I'm saying?

MEMBER PALMTAG: Seventeen, it says the TR.

MEMBER ROBERTS: Calculation using the TR methodology.

MEMBER PETTI: Calculations in the chat?

CHAIR KIRCHNER: Calculations show.

MEMBER PALMTAG: Show, yeah, take out the S on shows, shows to show.

CHAIR KIRCHNER: Calculations in 17 show.

MEMBER BIER: Yeah, it should either be calculations show, or calculation shows, so whichever way.

MEMBER PALMTAG: On 17, change calculations to -- or add an S to calculation.

MEMBER PETTI: Scott, in your conclusions, the first conclusion is actually two separate conclusions. I would maybe break them up, the last sentence is the first.

MEMBER PALMTAG: So this is real-time. We could do it. They shouldn't be conclusions. They should just be facts.

MEMBER PETTI: Yeah. I'm not worried

about that. We have a lot of flexibility this stuff. But to me, since it's two separate --

MEMBER PALMTAG: How would you break it into --

MEMBER PETTI: The last sentence, just make it its own item.

MEMBER PALMTAG: Yeah. No, the last sentence, you're actually right. Make that number two, and then --

MEMBER PETTI: I would -- if it were up to me, I would also put the third one first.

MEMBER PALMTAG: Okay. If we do that, we should change the sections text, too. I talked about the --

MEMBER PETTI: Oh, you -- oh then, we made it.

VICE CHAIR HALNON: We need to -- this is letter writing.

MEMBER PALMTAG: Yeah, I know.

MEMBER PETTI: Yeah.

CHAIR KIRCHNER: Yeah.

VICE CHAIR HALNON: And then we're not writing a letter on this. So we need to now take the comments.

CHAIR KIRCHNER: We need to take stock of

where we are.

VICE CHAIR HALNON: Yeah, take your comments and provide them the -- about the Chapter 15 memo, or you convert this into a letter and schedule it appropriately.

CHAIR KIRCHNER: So what -- we are at a juncture where we have now made some significant conclusions, and I think recommendations. So, now, we as a committee need to decide whether we should convert this into a letter.

And this was one of the major concerns coming out of the DCA review. And my sense is that this is worthy of a short letter report at this point.

Just to reflect on the DCA review, we wrote quite a few letter reports at significant junctures in that review. Given the importance of this and the amount of redesign and work that went into this by both the applicant, primarily by the applicant, and then the review by the staff, they have an SER. Are we in a situation here where we ought to recommend that they issue the SER and not delay this for another month or two? So I ask you as a committee to think where we are.

And this goes beyond, and Bob, in the previous memo, pointed out perhaps an undue

conservatism that the staff was adding to an L&C on a TR, but this was a major design issue for the NuScale, you know, TCA, and considerable rework and design has been undertaken by the applicant to address this. And here we have things that, in my opinion, rise above the level of summary report. So should we convert this? What I'm asking you to consider, should we convert this to a short letter report?

MEMBER PETTI: So the thing that that isn't here is that this makes the design safer.

CHAIR KIRCHNER: Yes. Well, and that's --

MEMBER PETTI: I mean, that doesn't jump out at you in the letter, and I --

CHAIR KIRCHNER: And it wouldn't jump out.

MEMBER PETTI: And again, this is -- again, this is not -- this is the methodology of the topical report.

CHAIR KIRCHNER: Yeah.

MEMBER PETTI: And that, you know, first bullet there is much more of a design issue that we would probably say in the final letter.

CHAIR KIRCHNER: We would.

MEMBER PETTI: For sure.

CHAIR KIRCHNER: We would repeat it.

MEMBER PETTI: Right. But I think it's

important. I'm -- yeah, I'm a little worried about sort of the tone, for lack of a better word, but the context, you know, is how do we structure the water limit the way the -

MEMBER PALMTAG: I think we can add a conclusion point that there wasn't an exception taken to GDC 27, which makes it safer design. I think that's -- that'd be an important conclusion.

MEMBER BALLINGER: If we convert this to a letter, it's easy, and we then can just reference the letter in the final, makes that easy as well.

CHAIR KIRCHNER: Any thoughts? Tom?

MEMBER ROBERTS: It seems about worthy of a letter to me. The question is timing that by the time we get this letter out, the NuScale letter might also be out at the same time. In which case, Scott's original idea was to roll these up into the NuScale letter. So I'm not sure how the timing works.

MEMBER BALLINGER: Is it such that this is in good enough shape so that with minor -- we could probably make it as long as we want. But can we just do this letter right now?

MEMBER PETTI: It's on the AWS to be done this meeting.

MEMBER BALLINGER: Yes.

MEMBER HARRINGTON: I'll also note it may not be adequate, but it is also talked about in the Chapter 6 memo but might be between the binders. I don't know. What do you think, Greg, should we --

VICE CHAIR HALNON: So what I would do recommend is that we take what we have here. To Ron's point, let's just turn it into a letter. We'll do that Friday morning and finish it and do the other business that we have to do and just kind of move on in this meeting. But let's make sure Scott has all the comments. We don't need detailed edits now. We could do those on Friday morning. It should not take too long because we've already done some of the edits, and I could -- you, Scott, can just turn it into letter format, and we'll go from there.

I mean because a lot of the letters could be boilerplate like we normally do. It cites a previous letter report already that we need to -- we can reference back to. So you don't have to put a lot of detail in from that other letter report. You just have to summarize what we did.

So, to me, it's 80 percent, if not more, there, and we can still finish it. We got time, and then we've got to at least one maybe difficult letter ahead of us. But other than that, we should be free.

CHAIR KIRCHNER: Yeah, if we can get it done Friday, then we could go ahead. Otherwise, the alternative is we just make it a major part of the final letter in May.

MEMBER PETTI: What I'm worried about because I've now done this two or three times, this is the topical report. What we heard yesterday was Chapter 15. And in my mind, I've got conflating -- I'm conflating them. And frankly, that first bullet is really a design issue that maybe fits better in Chapter 15.

CHAIR KIRCHNER: Oh, that's the problem.

MEMBER PETTI: Yeah, that's the concern. So the scope here, that's, that's more Chapter 15, but like --

CHAIR KIRCHNER: We've got a lot of Chapter 15 and design in this.

MEMBER PETTI: And if you just took that out and saved it for Chapter 15, then you have to ask yourself, do we really need a letter report on the methodology, per se?

VICE CHAIR HALNON: If you reduce this, what we have here, just down to methodology, then you're fine. Just do a paragraph on the summary of the methodology and you can make a point, a point or

two in the Chapter 15 memo saying application of this methodology leads us to some concerns that will be discussed in the Chapter 15 memo. And then you can start putting this detail.

MEMBER PETTI: That may be cleaner and quicker.

VICE CHAIR HALNON: So that, and that works too. I mean, the key is, is that you don't want to -- I mean, this can't -- you can't leave this as a summary. I think we all agree with that, right?

MEMBER PETTI: No, no. I --

VICE CHAIR HALNON: I mean, it's too detailed to leave it the way it is. So we need to take that and stick it into an official memo, so --

MEMBER PETTI: No, no. I'm thinking if you, if you focus it purely on the TR, you take out any of the design stuff, then it would be a summary.

VICE CHAIR HALNON: Yeah, it should be a paragraph. It should be a paragraph or two on the TR itself. But take this concern about the root criticality and stick that in the 15 with the other things that they added. Does that make sense, Scott? Can you reduce this down to just a methodology discussion and then just point to the 15 memo and give that information to Bob?

MEMBER PALMTAG: What do you want to remove? One or two?

MEMBER PETTI: No, we --

MEMBER PALMTAG: Is there any reason to --

MR. SNODDERLY: It may be helpful to go to the final letter outline now. I think that will help inform you, but you won't put it there. And then I can work with Scott to take this back up a level to be just a pure -- the SER should be issued for the topical report. And then you, you know, you can refer to the Chapter 15 memo with the final letter.

We got -- I think it would be valuable for the Committee to take the next two hours to start talking about the final letter and what you want in that and that will help inform you as to what level of detail you want to put in this and whether it should be a letter or something.

MEMBER PETTI: I think the additional riser hole paragraph and the conclusion associated with it is a design issue, the Chapter 15 issue.

MEMBER PALMTAG: So take out the riser --

MEMBER PETTI: Take that, and then it's two pages. It's fine.

MR. BURKHART: Yeah, this is Larry Burkhart. Chairman, if I could ask, if we could give

the staff just a chance to reiterate. I think you're on the right path to reiterate the scope of the topical report versus the SDAA. So, I've got Becky Patton.

MS. PATTON: Sorry, this is Becky Patton. Yeah, the second one also, if it has like a tech spec on a recommendation in it, that one would also be a Chapter 15. Remember there's a section 1505 that implements the XPC methodology that's actually in Chapter 15 and reviews those calculations. So anything that would be some change that should be made, you know, for the SDA would be a recommendation on the SDA itself, in addition to the discussion on holes.

MEMBER PALMTAG: So it sounds like both -- everything needs to be taken out. That's where what's left.

CHAIR KIRCHNER: Well, this is how it often happens with the TRs. They have a lengthy appendix, or I guess as an example calculations --

MEMBER PALMTAG: The last line --

CHAIR KIRCHNER: -- methodology is applied, and it's then incorporated, either the methodology or -- and/or the calculations are --

MEMBER PALMTAG: So if you go down the

last line --

(Simultaneous speaking.)

CHAIR KIRCHNER: -- in 15.

MEMBER PALMTAG: The last line, is there any reason to take anything out, or is this just all going to the 15?

Sandra, you can scroll down the last line. This going to be -- can we just roll this up and leave it and roll it up, or we can take out the riser hole? I'm just -- I'm not sure what you're asking for to take out and leave in.

VICE CHAIR HALNON: I'm thinking, personally, that it's just a short paragraph saying the EM is adequate for consideration. You can find what the right words are, and then take your information in here, both recommendations, and roll it up into the 15 memo.

I'm having trouble making recommendations in a summary, and because it doesn't it just -- it should be a summary. It's just part. It's just saying, hey, we're -- we did it. We're fine with it. The design information in the tech spec recommendations for tech spec needs to go into either the memo and then I think that's that last thing -- actually, we'll deliberate it in final letter, which

goes to the Commission.

So my sense is if you can distill this down to just address the methodology, the TR, and then make the statement saying use of this methodology -- say Chapter 15 or design, however you want to say it. You can point to the Chapter 15 memo saying recommendations contained in Chapter 15. So there's half people can go from the summary to Chapter 15 memo. They can go from the Chapter 15 memo if necessary to find all that. They all stand on their own. That would be my thought.

So this reduces it down to just what the methodology talks about which in my mind was TR application to the TR and how it's used gets into Chapter 15. So all the words are great. It's just not where they park.

Chapter 15 memo, when is that, like next meeting? May? To the May meeting?

CHAIR KIRCHNER: Yeah, it is in the May meeting.

VICE CHAIR HALNON: Okay. So that'll give you some time.

CHAIR KIRCHNER: One for 15 in the May meeting, but you know, by then, we're into the final letter report.

VICE CHAIR HALNON: When is the final letter report due?

CHAIR KIRCHNER: May.

(Simultaneous speaking.)

MEMBER PETTI: I think it's even more than that. As I'm looking through, I see lots of snippets of Chapter 15 in here. I think you're going to have to cut out even more.

MEMBER PALMTAG: No, I agree. I'm just trying to look for some guidance on where the pieces go.

MEMBER PETTI: Again, don't throw this away. This is a good letter for 15 stuff, but I'd keep this summary as short and sweet as you could.

MEMBER PALMTAG: Now, where are we landing on a letter specific related to boron and maybe --

VICE CHAIR HALNON: No, we're landing in the paragraph on the methodology, saying that it's fine. And then take the rest of this Chapter 15 stuff and add it to you, and then you just maintain the two recommendations.

MEMBER ROBERTS: But as for a separate letter just focusing on the big issue, we've moved away from that at this point.

VICE CHAIR HALNON: That's a Chapter 15

still. That's behind us basically.

MEMBER ROBERTS: Sure.

VICE CHAIR HALNON: It's all -- it's not a concern now. It's behind us. We don't want to make --

MEMBER ROBERTS: Okay, but you've got to --

VICE CHAIR HALNON: We don't want to re-adjudicate that whole issue in this letter.

MEMBER ROBERTS: But the tech spec recommendation is new, so we want to make sure we highlight that, and that'll be probably a recommendation in the final a letter if we all agree it's important.

Did that help, Scott? I mean, is it -- you still, like, willing to do over --

(Laughter.)

MEMBER PALMTAG: I'll figure it out, yeah. I think it'll make more sense after we get through today, yeah.

VICE CHAIR HALNON: Yeah, this process is just process. We can talk more later. You got all the substances there. It's just a matter of just only --

MEMBER PETTI: Just focus on the

methodology, not on its application. That makes it really short, I think.

MEMBER ROBERTS: Maybe I'll clarify. We talked about a standalone letter because it's so important. I think we've concluded no, that the standalone letter will be incorporated into the big chapter -- or big NuScale letter. And Bob's Chapter 15 memo will tee up the issues that are currently up on the screen here because they're more Germane to Chapter 15 than they are to the topical report. But the letter will be in the big NuScale letter.

CHAIR KIRCHNER: Right.

MEMBER ROBERTS: Okay. That's my -- thanks.

CHAIR KIRCHNER: Just from a practical standpoint, and we're so close to the end now that we ought to save what Scott has highlighted here and what Bob will address in his Chapter 15 memo, extract that, put it into the final letter.

So, at this point, Scott, I think the consensus is just shorten this, save, don't throw anything away, but save it, and shorten this writeup just to the methodology, if you can find a way to do that. And we'll take that up on P&P. But then we'll take a break here, come back, and discuss an outline

for the final letter report after the break and maybe that will help provide some clarity as to how we're going to pick up these pieces.

MEMBER MARTIN: You say final letter. Final NuScale letter or chapter letter?

CHAIR KIRCHNER: Final NuScale letter, yeah.

MEMBER ROBERTS: Yeah, and Walt, just the details cover for this morning. We also wanted to talk about EDAS just to close the loop between the staff and the applicant after last night. We do that now or after the outline?

MR. SNODDERLY: It's in the outline.

CHAIR KIRCHNER: In the outline. Let's talk about it during the outline.

MEMBER ROBERTS: Okay. Great. Thank you.

CHAIR KIRCHNER: With one caution, we don't have to resolve the staff. We're not going to be an intermediary between the staff and the applicant on EDAS. We will have our own committee opinion on the matter.

VICE CHAIR HALNON: And I just have a few questions that I want to pose to the staff to make sure that we were briefed on or at least some feedback and has to do with some definitions and stuff. So

there's just a -- I just didn't want to -- yesterday, I made the comment because I didn't want to leave it hanging where staff said one thing, management's working on it. NuScale came up and said we totally disagree. You know, not totally, that's probably experience, but we disagree because of this. And we just went on to the next thing. I just wanted to make sure we have some closure on the pressure, at least from a committee perspective.

CHAIR KIRCHNER: We don't want the Committee to be in the middle of a differing press professional --

VICE CHAIR HALNON: Right. Not here --

CHAIR KIRCHNER: We're not here to adjudicate those kind of things. We are here to provide our assessment on EDAS.

MEMBER ROBERTS: Right. To the extent we make sure we understand the argument.

CHAIR KIRCHNER: Right. We have to understand the arguments. Yes. Okay, let's take a break. And my glasses aren't good enough to see what time -- 10:06. Let's come back at 10:20. Okay. We are recessed.

(Whereupon, the above-entitled matter went off the record at 10:06 a.m. and resumed at 10:24

a.m.)

CHAIR KIRCHNER: Okay. Back in session. And we're going to go onto a discussion and we're not going to read this line by line, but what we have is kind of a draft, or what the final letter may look like. And we're, the discussion today should be more about, the content is, not necessarily the conclusion and recommendations.

So, we're not putting out conclusions and recommendations, or rather an outline. We're in discussion about what material we want to incorporate. So, starting at the top, acronyms, to take this back to the US 60 -- 600 design and our letter work back in July of 2020.

Obviously, things that I think we need to highlight again from that exercise, could you scroll down? Thank you. Is that for the DCA what we focused on were five cross-cutting areas. You heard a little bit more again today about ECCS valve performance. The other big issue was, at the time, was the DWO and the helical tube steam generator design.

We were just discussing the Boron dilution, return to criticality issue. I think the source term, seems it has pretty much gone away as an issue because of design changes. And then we

commented on the completeness of the PRA. We also had some other points in there.

My thinking is in Ting this up, we'll quickly summarize where we were coming out of the DCA review, five years ago. And then talk about, scroll down a little further if you would, Sandra. Discuss the -- and scroll down even a little bit further. I, we just had a discussion about ECCS valves.

Okay. So, I'm going to look here also, to making assignments if I could. So, a little bit further up, the other way. So, yes. There are, there it is, okay. So, I would look to Bob and Craig to provide a write-up on the steam generator design and the DWO issue. I don't want to repeat here in real time what the Applicant has done. But I'm looking to you two. We would have a section on that particular matter.

We just were discussing, you can see, we had a conflated discussion in methodology in Chapter 15 on Boron dilution, return to criticality. Section on that, then Dave, oh, sorry. So that would be a combination of Scott and Bob on the Boron dilution and any other highlights that you think are important from the Chapter 15 review.

Then on the source term, they made some

design changes. So, Dave could you, you know, revisit what we did there on source term and the problems that we identified during the DCA review, pretty much had been eliminated. So, just the, an assessment of the design changes and how you see that impacting.

MEMBER PETTI: Well, let me be a negative Nelly here.

CHAIR KIRCHNER: Yeah.

MEMBER PETTI: I don't like this online.

MEMBER BALLINGER: Tell us how you really feel.

(Laughter.)

MEMBER PETTI: Okay. I don't like this online. We did talk.

CHAIR KIRCHNER: Yeah.

MEMBER PETTI: This is so transactional, and it's, oh, that's what we did before and now how, here's what we did now. And here's what we did -- but it misses the big picture. You know when we write, we've written letters for some of the other advanced reactors, we start with a paragraph of what that reactor is and what its characteristics are. No where do we talk about that this is a fully passive plant, and what does that really mean?

I'm thinking about strong positive

statements of the design in that light. I mean these guys are the first ones of, on large LWRs, they are LDR, not LWRs, large LDRs that have taken it all the way. You know, it's not just the marketing which we, you know, we all know about. But they've actually demonstrated some of these important characteristics of how their safety functions are executed, you know, automatically, without reactor, without operator intervention in a completely passive manner.

Similarly, if you look at the PRA, you know, we love to get into all the weeds, but there's a reason why their core damage frequency and their LERF are low. We can argue the absolute magnitude of the numbers, but if you just look, and read, and think about the design. The double valving everywhere, I mean there is also so stuff that reduces the frequency.

That's the type of stuff that I think you'd want to put in the letter to provide confidence to the public about why this design has safety features. Then I have no problem because now there have been a number of specific changes that they've made. And we can go through these and delineate all these changes.

But up front, I think we need something

that really addresses that big picture, you know. If you look at the Kairos letter for instance, that's what we did. And we used the safety functions to kind of generate our thought process. Whether you actually have to do that here or not, but --

CHAIR KIRCHNER: Well, I was thinking more of introducing all these first, with the, not only the deltas in the design, including the power upgrade, but to actually put in a fairly detailed description of the actual safety aspects of the design.

MEMBER PETTI: Okay. So, I mean, I guess it's a question of whether to do it first or last?

CHAIR KIRCHNER: I would do it first.

MEMBER PETTI: Me too, I like to be lead with the --

MEMBER DIMITRIJEVIC: Well, Dave, I mean you talk like we are here advertising agency for public. I mean, that's not, you know, we are sort of like, you know, advisory committee in safety. So, I think where we should concentrate, okay, while this was great, they sit in this big pool and they just have a valves. But that is still things which, you know, should be kept eye on.

And, you know, things we don't have experience with that, and, you know, the new staff.

And then relying on one thing and what can go wrong. I mean why should we write this as, you know, really as advertising.

MEMBER PETTI: It's not --

MEMBER DIMITRIJEVIC: Our job is to find out, I mean to say what we thinking. They're just relying on one thing, is that thing which can go wrong with that. Is there something they missed, is that, are they too optimistic in some areas? You know, that's how I would see this letter.

MEMBER PETTI: My view is that there are times when I sit at this table, and I keep thinking, guys this is a bunch of molecules in a huge pool of water. You seem to have forgotten that. You know, we get down the rabbit holes. And I mean, that's just what we do. But losing the forest through the trees. And it's a balance. I'm not going to argue that it's not.

But these are the first ones that have gone all the way, done all the work. And they're still not there, obviously. You know, we talked about the valve testing and the like, this morning. But there's a significant amount of investment that somehow we should be able to make a statement about, you know, there's a lot behind these. the statements

that are made.

You know, I mean, we said the same thing on SHINE when we got there too, if you remember. We were very complimentary because when they put all the pieces together, it all hung together. And that was a really different system than a reactor, right?

MEMBER PALMTAG: In terms of safety and the like, you've got to remember there's three, at least two or three more LWRs coming through here. So, I do think it's important to emphasis how -- the safety aspects of this and kind of set the bar high, you know, when these other reactors to come through, you know.

MEMBER DIMITRIJEVIC: Well, I mean the advanced reactors before it shows that, you know, 10 to minus 12, you know, this boiling water reactors in the CDF. I mean the question is really though, such small numbers, I mean, you know. I really -- and if we felt like this things, they are sitting in this pool and there's nothing can go wrong, why did we spend the time coming here? Coming and going over and over talking about that? It's not how I, I don't, that's not how I feel.

I mean, that's how, I feel like we should really feel. Depending on one thing, it's our job to

look in everything which can go wrong with that thing, so.

VICE CHAIR HALNON: We have a generic outline, Exhibit 9, in our guidance. And we should follow that. We should discuss what Dave was talking about, the novel aspects of this design as part of it. You know, even if it was just a couple of sentences or a paragraph that's part of the generic outline.

These issues that we have can still be included, it's just a matter of where they are in that outline. So, we should follow through. And I would think that like maybe the staff should be able to take the memos that's been written and just block copies on the text instead of the final recommendations or whatever and plug it into that template basically, the outline. And then we start there and that would be the letter, other than the first part of it. And I was just pulling it up here.

It starts with the background. Section 2 is other novel and unique aspects of this design. And there's some examples there. Relevant previous operating experience, which is basically going to be in the test loops and the other things that they've done, just the highlight there. So, you're not really, you're not advertising it. But you're

acknowledging the experience.

And then you talk about the principle safety functions and that's where some of these things would fall out. And then you can talk about safety. I don't think that's as relevant here because it's not, it's just a light water reactor.

And then in the summary, the key analysis results. So, yea, I think you can take what we've done here and stick it into that outline and have, you know, like 50 percent there.

MEMBER PETTI: I'm more worried about, you know, we've highlighted that outline to the Commissioners, and then if the NuScale letter doesn't look like it, why did you treat them differently? You know, that's the, it's an obvious thing.

CHAIR KIRCHNER: Yes, well that's the other, but there's history and we --

(Simultaneous speaking.)

MEMBER PETTI: I understand that.

CHAIR KIRCHNER: It's open items from the DCA.

MEMBER PETTI: And I definitely wouldn't want to deal with those, you know.

VICE CHAIR HALNON: That's, that's fitting it into the outline.

MEMBER PETTI: Right, I think so, yes.

MR. SNODDERLY: But I think it's important to acknowledge that significant issues existed as a result of the DCA and the carve outs and some other things.

CHAIR KIRCHNER: That's fine.

MR. SNODDERLY: And significant design work, design changes that were made by the Applicant.

MEMBER PETTI: That makes the reactor much --

(Simultaneous speaking.)

VICE CHAIR HALNON: Yes, so, and in Section 2 and 3, it's 2 is the other novel and unique aspects. So, you could say, you know, that one of the unique aspects is that this has been in front of us before and they fixed all the issues. Or you could do it under relevant previous operating experience, which is during the previous DCA review, they solved the issues. So, there's a couple place it could fit and not feel like it's out of place.

Well, I think Walt also didn't get a chance to finish. I think you've got to finish making a number of assignments.

CHAIR KIRCHNER: We did.

VICE CHAIR HALNON: For the areas that we

haven't bought in?

MEMBER PETTI: You need to scroll up a little bit, you forgot ECCS, about performance.

MR. BURKHART: Yes, Chairman, a Member -- so Larry -- has his hand up.

CHAIR KIRCHNER: Yes, Matt, sorry I saw your hand up earlier. Yes, go ahead.

MEMBER SUNSERI: That's okay, Walt, I know. I must agree with Dave in one respect, I mean, we need to step back and think about who our audience is. It's not the general public. I know we write these things so the public can understand them. It's not the EDO. We're writing to the Commission, right? And we're writing to Commission about something that has gone on for a real long time. And it seems to me, it discredits our charter obligation to speak on matters of safety, in an unprescribed manner, all right.

I've heard so many times in the last couple weeks, especially on this NuScale review about how this meets the regulation, or blah, blah, blah, blah. Well, to be honest, we don't care about the regulation, right. That's why the staff is there to ensure the design meets the regulation.

We take a higher road. We look at,

integral effects. We look at big picture. We look at things that are outside the bounds of regulation because that's what Congress wanted us to do. They wanted a second group to do an independent review, to make sure that there's no holes in the regulation that is allowing a safety signet to gain issue, to slip by, it's going to get out into the, you know, be built.

So, to me, our letter, our final letters are too long. They need to be more direct to the point that the design is safe. I don't think we need to go back in a whole chronology of blow-by-blow of what happened over the last, you know, 17 months or however long we've been reviewing this.

And it seems to me, like, that I just lost my point. We need to think about this in the context of the contemporary environment we're in, the ADVANCE Act, you know. There's more reactors coming. You know, we ought to frame this up in a way that says, we've looked at this, we've learned some lessons. It's safe. There's more coming, et cetera, et cetera.

And I think this is where Dave is trying to take us with his remarks. Dave, am I speaking too much for you, or?

MEMBER PETTI: No. I'm with you.

MEMBER SUNSERI: Anyway, that's just my

general input. And I don't have any specific recommendations on how to change this.

CHAIR KIRCHNER: Dave, Members, further input?

(No audible response.)

CHAIR KIRCHNER: So, I obviously have an action. Greg is right, we have a template that we adopted. I'll look at that again and see, with your input, how to structure this. I wasn't of a mind to rehash everything, Matt. I thought a short letter would work. We can put all the background material in appendices. It's there for the public record or anyone who wants to test how thorough we were in terms of our review.

My sense would be along the lines Dave said, a pretty strong set of conclusions and recommendations to the Commission. The Commission is the audience and this sets a precedent in the fact that this is probably, well not probably, this is in my own personal assessment, this a very complete application. We've been through it effectively, twice.

And I don't know that we're going to see this level of detail from the other applicants, to be candid. And so, my own personal assessment is that

NuScale went away from the DCA review, they made significant design changes. They've addressed the issues that were identified.

Vesna, I don't feel like we're showing for NuScale, but by making a positive statement, if we all agree that this design is safe and meets the requirements, that that's where I am right now. And I don't see that's a letter anything like, as long as what we did for the DCA.

MEMBER DIMITRIJEVIC: No, I mean, Walt, that could be true. I just want to say from the point of view, that sitting in big pool of water with, you know, just like for valves to open or rotate. But that was true in the DCA and still we found many concerns. That's no guarantee. I mean, we still have to look into stuff, when we were coming here. And, you know, and that's what we should just like make clear.

That now, that we, I mean I liked Scott's letter this morning very much because, he went all of these modern concerns. And, you know, sometimes you feel like 100 percent they have been addressed. And sometimes you think they have been addressed. I mean, the thing is like, you know, that we -- this is the same design as it was in that, when this, you know,

ECCS, the changes.

So, I mean, you know, we have to look through them, and make conclude that these problems are addressed.

CHAIR KIRCHNER: Are there any --

MEMBER SUNSERI: Walt, this is Matt again. You know, I think you made a comment that I want to just talk about. Is you said something to the effect, that the NuScale brought a complete design and that others --

(Audio interference.)

MEMBER SUNSERI: -- if able.

MEMBER DIMITRIJEVIC: And this a problem.

CHAIR KIRCHNER: And Matt, we lost --

(Audio interference.)

MEMBER SUNSERI: You lost me?

CHAIR KIRCHNER: We lost, we didn't get you comment, Matt.

MEMBER SUNSERI: Can you still hear me?

CHAIR KIRCHNER: Yes, now we hear you.

MEMBER SUNSERI: Okay. Well, I didn't move, so maybe the internet glitched.

CHAIR KIRCHNER: Yeah, it probably blinked.

MEMBER SUNSERI: So, let me just, I'll

just briefly restate. I thought your comments about, you know, the completeness of the review allowing us to do a thorough safety review, was very good. And I would state that in a positive way going forward in knowing that there are more designs coming. You know, we would expect those designs to be complete enough, so that we could do an efficient use of our time and their time.

Something to that nature, because that's not a NuScale specific, but it's a specific comment from our review of the NuScale specific. Once again, we're writing the Commission about safety matters. And if we're talking, if reviewing of future applicants is a safety matter, then we should discuss that lesson in there. End of comment.

CHAIR KIRCHNER: Got it, thank you. Any further input?

(No audible response.)

CHAIR KIRCHNER: Okay. I have an action then to get you an actual detailed outline. And I will reflect as best as I can, the input that I received. And I'll try and get that to you shortly. And then I'll lean -- oh, I was starting to make assignments.

So, Vesna, I need input from you on the

PRA aspect. We certainly want to, that's a touchstone obviously in the application, and in our review.

MEMBER DIMITRIJEVIC: But Mike should have that. I sent it to Mike for his, to hear his opinion on how that would fit. So, I just sent it late last night, so.

CHAIR KIRCHNER: Okay. Thank you.

MEMBER SUNSERI: Thanks, I'll shoot that to the Members at lunchtime.

CHAIR KIRCHNER: Okay.

MEMBER SUNSERI: Walter, did you want to do the ECCS, the ECCS valve performance?

CHAIR KIRCHNER: Well, that would be Craig, yes. And then Tom, your input on the EDAS would be valued. And but that's my sense right now. And I got your message, Dave. And but I see a fairly succinct, I think it's a positive letter. That's where I am, so, if I'm missing something, Members, that you want to highlight, this would be a good time for us to discuss it because again, our target is to have a letter, a complete letter coming out of the May full committee meeting.

MR. SNODDERLY: So, Walt, one thing I would like to ask Dave is, I went back and looked at the Kairos letter. I really liked it and I liked how

the figures of merit were introduced at the beginning. When I tried to do that for the NuScale, I was coming up with the same ones, the same figures of merit, light water reactor. In other words, I think it would help, it would have helped, like what particular figures of merit you wanted to call out. I think you kind of mentioned already the fact it's completely passive design.

MEMBER PETTI: Yes, I mean, I don't think we actually ever said that in the last letter.

(Simultaneous speaking.)

MR. SNODDERLY: We didn't. We did though --

MEMBER PETTI: You know, I mean --

MR. SNODDERLY: The first meeting recommendation though, was, is the natural -- the first recommendation, NuScale, small, SMR is a natural-circulation, pressurized water reactor that incorporates unique design and passive safety features, providing enhanced margins of safety. There is reasonable assurance that it can be constructed and operated without undue risk to the health and safety of the public. So, that was the first. So, you know.

(Simultaneous speaking.)

MR. SNODDERLY: Anyways, I, that was the

challenge I had, I think that maybe it would help avoid my, ability to share those thoughts. I'm like that's the only reason I didn't put it in this version, because I was struggling, but --

CHAIR KIRCHNER: Okay. Members online, being Dennis and Stephen, have you any input you would like to share?

(No audible response.)

CHAIR KIRCHNER: Well, you don't have to do it in real time, but do you have my email address?

DR. SCHULTZ: I've got it Walt, this time.

CHAIR KIRCHNER: Yes.

DR. SCHULTZ: I'll weigh in on a couple topics. Thank you.

CHAIR KIRCHNER: All right. Thank you. All right, I'm not going to drag this out, we've got a large audience.

(Simultaneous speaking.)

MEMBER PETTI: You want to talk about EDAS?

CHAIR KIRCHNER: EDAS is, well.

MEMBER PETTI: I thought we were going to have a discussion.

CHAIR KIRCHNER: Have a discussion.

VICE CHAIR HALNON: Yes, I just want to

summarize where it's going, just to close the loop.

CHAIR KIRCHNER: Okay.

VICE CHAIR HALNON: Okay. So, yesterday we did get into discussion on a differing opinion and that is being processed. And we're not going to get in the middle of that in any way, we will let it be processed. We also affirmed that there was some options to resolve, from a NuScale perspective, one of which was tension exemptions, staff generated exemptions 84. There were some options put on the screen. You could angle for another potential option is 50.69 as another potential option to resolve this.

In addition to that I asked some questions today about the definition of safety-related and how that fits. And I think that's input into the discussion that they're going to be having on the differing opinion aspect. So, from a Committee perspective, we're on a stand-by mode on that.

I believe we should probably get some feedback on it in the future, whether it is closed out. Is that acceptable, Becky, for you all to provide us at least a status, an ongoing status and also resolution, the resolution on what the differing opinion is, is if you'd --- yes, Michelle, you want to say something?

MS. SAMPSON: Sure, sure. So, we can certainly continue to provide an update on the status. And it is possible that we will have resolution before the May meeting. We'll update you and let you know.

VICE CHAIR HALNON: Yes, if you could update us, in May then, that would be great. And the reason this is important is because it's setting a potential precedence going forward. And we just want to make sure that we as a Committee, agree with the resolution of it or if we have additional recommendations or advice that we can get.

So, it's not that, again, we don't want to get in the middle of it, but it's an important a piece of design going forward. We want to make sure that we're moving collectively. So, that's where I see it is. I think the link is link is closed at least for this meeting. And we'll get a future update. Tom did you have something?

MEMBER ROBERTS: Yes, I raised the issue yesterday about other causes for untimely actuation of an RVV. Things like single failure while operating with a, you know, redundant component out of service or inadvertent actuation of ECCS by the operator. At least for the redundancy, the applicant raised the point that their tech specs do require as assessment

of the probability, and the frequency of ECCS actuation all the time, instead of when you remember redundancy. There is a tech spec requirement to go an evaluation based on old topical report that said this evaluation should be at least once in the lifetime of the plant.

And to me, that is an acceptable solution to the question of redundancy. So, even though the redundancy is not managed in the tech specs directly, it is managed indirectly by this analysis requirement. So, that's why I planned to write up that the issue, EDAS is not a complete statement of the problem, but there is, you know, a tech spec that covers other aspects of it.

And in terms of the EDAS, I'd written up back in January, I think it was, an assessment of the redundancy of the EDAS. And the equivalent is being safety related. And at this point, I see there is no change to that. And so, I don't think the staff has agreed either. I think the staff not concurring, as I understand it, is not getting at the design for the intended operation. It's how you documented and how you controlled it. You know, an administrative documents and I don't think that's really something that we need to be that involved with, as long as

there is agreement of the overall design and the intent as to how it is to be operated is, you know, it is clear. And that's where I'm at, and that's what I intended.

VICE CHAIR HALNON: Yes, I think that's right. And I probably should have said that overall from the technical design perspective, it's where it is. It's fine. It's reliable. It's redundant on, in the process piece, how you call it. Then we have ramifications in the commercial aspect of it down the road. But we're not as concerned with that.

However, for future reactors, we're going to have this question come in again. And we need to make sure that we're applying the definitions appropriately, and we understand how they're being applied by the staff.

MEMBER ROBERTS: Right, it's also the question of clearer explanation in the safety analysis documents, what the basis is. And I think that's part of also what the non concurrence is getting at. As long as there's enough there that the applicant can do their intensive repetitive or 59 evaluations in 50 years and understand what the basis is. And what they might be challenging. That's the other aspect of it.

VICE CHAIR HALNON: Yes.

MEMBER ROBERTS: But I think the staff is all over that.

VICE CHAIR HALNON: Okay. That's enough said at this point.

MEMBER ROBERTS: Okay.

VICE CHAIR HALNON: I think we're good and I just want, again, wanted to make sure that we summarized it so we can move forward.

CHAIR KIRCHNER: Okay. If there's no other comments, input, from the Members then we'll take a recess until 1 o'clock --

(Simultaneous speaking.)

VICE CHAIR HALNON: Well, we have P&P Subcommittee --

CHAIR KIRCHNER: -- Eastern.

VICE CHAIR HALNON: P&P Subcommittee meeting.

CHAIR KIRCHNER: And we, yes, we've all waived that lunch time for a P&P Subcommittee meeting, and Members are welcome to attend. And then again --

(Audio Interference)

CHAIR KIRCHNER: And then we'll reconvene --

(Audio Interference)

VICE CHAIR HALNON: Larry Burkhart.

(Laughter.)

VICE CHAIR HALNON: Sorry, I'm watching you.

CHAIR KIRCHNER: We will reconvene at 1 o'clock. We are in recess.

(Whereupon, the above-entitled matter went off the record at 10:56 a.m. and resumed at 1:02 p.m.)

CHAIR KIRCHNER: Good afternoon, the meeting will come to order. This is the afternoon of the first day of the 724th meeting of the Advisory Committee on Reactor Safeguards. I'm Walter Kirchner, Chairman, the ACRS.

The ACRS Members in attendance in person are, Ron Ballinger, Vicki Bier, Craig Harrington, Gregory Halnon, Robert Martin, Scott Palmtag, David Petti, and Thomas Roberts.

Members in attendance virtually via Teams are Vesna Dimitrijevic, and Matt Sunseri. Our consultants participating today virtually are Steve Schultz and Dennis Bley. If I've missed anyone, either Members or consultants, please speak up.

Christopher Brown, of the ACRS staff, is the Designated Federal Officer for this afternoon's full Committee meeting. No Member conflicts of

interest were identified. And I note that we have a quorum.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act or FACA. The NRC implements FACA in accordance with our regulations. Per these regulations, and the Committee's bylaws, the ACRS only speaks through its published letter reports.

Member comments therefore, should be regarded as only the individual opinion of that Member and not a Committee position. All relevant information related to ACRS activities, such as letters, rules for meeting participation, and transcripts are located on the NRC public website and can be easily found by typing about us, ACRS, in the search field on NRC's homepage.

The ACRS, consistent with the Agency's value of public transparency in regulation of nuclear facilities, provides opportunity for public input and comment during our proceedings. We have received no written statements or requests to make an oral statement from the public, however, we've set aside time at the end of this meeting for any comments from the public.

Written statements may be forwarded to

today's Designated Federal Officer. And that's Christopher Brown. A transcript of the meeting is being kept and will be posted on our website. When addressing the Committee, the participant should first identify themselves and state with sufficient clarity and volume, so that they may be readily heard.

If you're not speaking, please mute your computer, on Teams. If you're participating by phone, press *6 to mute your phone, and *5 to raise your hand on Teams. The Teams, Chat feature, will not be available for use during the meeting. For everyone in the room, please put your electronic devices in silent mode and mute your laptop microphone and speakers.

In addition, please keep side bar discussions in the room to a minimum since the ceiling microphones are live.

Presenters, your table microphones are unidirectional. You'll need to speak into the front of the microphone to be heard online. Finally, if you have any feedback for the ACRS about today's meeting, we encourage you to fill out the public meeting feedback form on the NRC's website.

This afternoon, the Committee will consider Terrestrial Energy's Topical Report on Principle Design Criteria as stated in the agenda.

Portions of this meeting may be closed to protect sensitive information as required by FACA and the Government in the Sunshine Act.

Attendance during the closed portion of the meeting will be limited to NRC staff and its consultants, Terrestrial Energy and those individuals and organizations who have entered into an appropriate confidentiality agreement. We will confirm that only eligible individuals are in the closed portion of this meeting.

And with that, I will pass the microphone to Scott Palmtag, who is the Chair of our Terrestrial Energy Design Center Subcommittee. Scott.

MEMBER PALMTAG: Thank you, Chairman. Just go ahead and read the letter and --

CHAIR KIRCHNER: Do you want to summarize at all, what was done at the Subcommittee meeting before we start the letter writing?

MEMBER PALMTAG: We had a Subcommittee meeting on the Terrestrial, TEUSA, Terrestrial pro -- on the design criteria for the Integral Molten Salt Reactor, the IMSR. we heard the presentations from the Terrestrial and from the staff.

CHAIR KIRCHNER: Good, okay.

MEMBER PALMTAG: All right. We have a, I

have a draft letter. I'll go ahead and read it. So, get it a little smaller, so you can see the, all the way across. All right. That's perfect.

"During the 724th meeting of the Advisory Committee on Reactor Safeguards, April 2 to the 4, 2025, we completed our review of, Draft of the Safety Evaluation, Regarding the Principal Design Criteria, Integral Molten Salt Reactor, IMSR, Structures, Systems and Components Topical Report, Revision C and the associated safety evaluation, SE. Our Terrestrial Energy Subcommittee also reviewed this matter on March 20, 2025. During these meetings, we had the benefit of discussions with the Nuclear Regulatory Commission, NRC, staff, and Terrestrial Energy USA, TEUSA."

Scroll down. "We also had the benefit of the referenced documents."

"Conclusions and Recommendations, one, the Principal Design Criteria, PDC, proposed by TEUSA for the IMSR reactor have been developed by adapting Advanced Non-Light-Water Reactor design criteria from NRC guidance, design criteria from a draft American National Standards Institute, ANSI, American Nuclear Society, ANS, standard for MSR design criteria, and consideration of the unique design features of the IMSR."

"Second, considering the lack of recent operating experience with MSR technology, the staff should consider amending the SE limitations and conditions to require the addition of a safe shutdown system for reactivity control, and to require demonstrating the capability to achieve a subcritical condition, in this first of a kind reactor."

"Three, the PDC proposed by TEUSA eliminate several design criteria used in other reactor designs, including those that support defense in depth. Considering the lack of recent operating experience with MSR technology, additional justification needs to be provided for these decisions, as indicated in the draft SE."

"Four, the final IMSR PDC should be made available publicly in a non-proprietary format to adequately inform the public that the reactor is designed and reviewed in a safe manner."

Background Section, "the General Design Criteria, GDC, for Nuclear Power Plants, Appendix A to Title 10 of the Code of Federal Regulations, 10 CFR, Part 50, are the minimum requirements for the PDC for water-cooled nuclear plants to provide reasonable assurance that a facility can be operated without undue risk to the health and safety of the public."

"The GDC were developed to focus attention on the most prominent issues and improve the predictability and efficiency of NRC reviews of licensing applications. Design criteria are established to provide a solid basis for the staff review and ensure that a given facility can be operated safely. They provide assurance that structures, systems, and components, SSCs, important to safety will remain functional during and following identified design basis events."

"Regulatory Guide, RG, 1.232, Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors, provides guidance on how the GDC can be adapted for non-light-water reactor, non-LWR, designs. It includes generic advanced reactor design criteria, technology-specific sodium-cooled fast reactor design criteria, SFR-DC, and modular high temperature gas-cooled reactor design criteria."

"The criteria established in this regulatory guide are based on extensive interactions among NRC, the Department of Energy and experts in the nuclear community in each of the technologies. The regulatory guide notes that applicants may need to develop entirely new PDC to address unique design

features. Early engagement and agreement on plant specific PDC facilitate a more effective design development and regulatory review."

Terrestrial Energy USA is developing the Integral Molten Salt Reactor. The IMSR nuclear power plant site consists of two Reactor Auxiliary Buildings, RAB, and a single Control Building. Each RAB has a single operating IMSR Core-unit. Each Core unit consists of a 442-Megawatt thermal molten salt reactor, MSR."

"RG 1.232 does not include technology specific design criteria for MSRs, so TEUSA has developed the IMSR PDC by adapting the design criteria from other PDC listed in RG 1.232 for advanced technologies. TEUSA has also considered draft guidance from the development of the ANSI/ANS standard for MSRs, ANSI/ANS-20.2-2023, Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt Reactor Nuclear Power Plants." This standard has since been finalized.

"However, ANSI/ANS standard MSR design is based on a functional containment, while the IMSR has a traditional containment. These factors lead to the IMSR having a unique set of PDC."

"Discussion, molten salt reactors are

Gen-IV reactor concepts that have several potential advantages over current light-water reactors in terms of safety and economics. However, the operating experience of MSRs is small and based mostly on the Molten Salt Reactor Experiment, MSRE, that operated at Oak Ridge National Laboratory in the 1960s at a power level of 7.4 Megawatt thermal."

"Lack of recent operating experience and operating experience at higher power levels suggests retaining many of the traditional requirements in the PDCs that the applicant proposed deleting or scaling back. The proposed PDC for reactivity control in the IMSR is novel and does not conform to PDC used in existing power reactors and proposed in other advanced light-water reactors."

"Bullet 1, we acknowledge the strong negative temperature coefficient associated with the design, however it is not unique as other reactors also have this characteristic."

"Second bullet, because of the complexities, uncertainties and time constants associated with the underlying phenomena, inherent negative reactivity feedback has historically been demonstrated in test reactors and prototypes prior to taking credit for this characteristic in power

reactors"

"Examples include negative feedback from rod bowing and growth in fast reactor metallic fuel assemblies in EBR-II and the Fast Flux Test Facility, demonstration of the High Temperature Gas-Cooled Reactor, HTGR, negative temperature coefficient in AVR, HTTR and HTR-10, and confirmation in the Chinese commercial HTR-PM. No such testing exists for this technology as applied in the IMSR."

"Third bullet, while the use of liquid fuel enhances the negative reactivity coefficient, this is offset by uncertainties associated with the first-of-a-kind nature of the facility and unique geometry. It is prudent to use a more traditional approach that has proven to execute the safety function to control reactivity in a reliable manner until sufficient operating experience is gained."

"The ANCI/ANS standard has developed a set of principle design criteria from molten salt reactor designs adapted from these developed for high temperature in gas-cooled reactor. Criteria 20, 26, 28 and 29 relate to reactivity control in such systems."

"They require, (a) a reactor protection system, (b) two independent and diverse means of

shutting down the reactor (required for all reactor systems, (c) systems to limit the amount and rate of reactivity increase to ensure the integrity of the salt boundary and the reactor core, and (d) such systems to be able to execute safety functions with high probability of success in the event of an anticipated operating occurrence."

"These criteria need to be considered in light of the salt fueling system which is essentially a reactivity addition system. There need to be limits on that system in terms of its ability to add reactivity in order to prevent or limit reactivity increases due to inadvertent over-fueling of the reactor."

"Proposed PDC on reactor shutdown included in TEUSA-26 criterion is also novel. One of the fundamental safety functions is the control of fission process, which has traditionally been interpreted as always being able to place the reactor in a subcritical state."

"Relaxing this requirement to only require the reactor to be in a, quote, "safe state", unquote, depends on the definition of a, safe state, and the ability to demonstrate by analytic means that a safe state can be achieved. This demonstration may be

limited by validation of the computer codes used in such a calculation and uncertainties in cross sections and the movement of delayed neutrons associated with the dissolved fuel out of the core used in the feedback analysis."

"In addition, due to the first of a kind nature of this design, there may be unknown scenarios where the, safe state, cannot be obtained. It is therefore prudent to include the traditional requirement that a safety-related shutdown system be available to ensure that the reactor can always be brought to a subcritical state."

"We also note that the design does not implement two independent means of shutdown. The two independent means are imposed as a measure of defense in depth, to assure that reactor shutdown is accomplished with an extremely high degree of reliability. A stronger rationale is needed that addresses the safety philosophy associated with this requirement."

"One feature of molten salt reactors is that gaseous fission products are released from the reactor core and are not contained in fuel rods. In the preliminary IMSR design, the fission product gas is contained in a gas holding tank for the entire life

of the IMSR."

"The source term from this gas holding tank could be significant and the final design should consider the consequences of a tank leak and glitch. It is premature to preclude that a containment atmosphere cleanup system is not necessary until the final design of this system, and consequences of a release, have been completed."

"Finally, the treatment of the IMSR PDC as proprietary is a new approach. While it may be reasonable for the initial PDC to remain proprietary as the reactor design is developed, the PDC are fundamental to reactor safety and should be available to the public. The PDC inform the public that the reactor is designed and reviewed in a safe manner. Hence, the final IMSR PDC should be publicly available.

"Summary, summary will be mainly copied from the app, once we finalize the letter, so -- "

CHAIR KIRCHNER: Thank you, Scott. So, Members, high level comments?

MEMBER SUNSERI: Hey, this is Matt. I have one high-level comment and it regards the rod control system, to shut down the reactor, which it's my understanding they do have one, right? They have

a way for the operator to manually insert the control rods to maintain shutdown from the safe state. Is that correct?

MEMBER PALMTAG: Right. They do have one but it's not safety-grade.

MEMBER SUNSERI: So, a PWR has the same exact feature, the rod control system is not safety related. The reactor protection system is safety related and it opens the reactor trip breaker but all the equipment is non-safety related. So, I don't see what our grievance is with what they're proposing, other than it's not safety related. Neither is the PWRs though.

MEMBER ROBERTS: Hey, Matt, this is Tom. I guess I question that. At least my understanding is the RTVs and all the reactor protection circuitry that drives their under voltage function. are safety related.

CHAIR KIRCHNER: Are safety, yeah --

(Simultaneous speaking.)

MEMBER ROBERTS: And the boundary is, certainly the circuitry that moves the rods tends to not be safety related. But the cords and circuitry that interrupt power to the control rod drives are of safety -- at least in my background.

MEMBER SUNSERI: The control rod drives in the Westinghouse, at least plants I'm familiar with, is all non-safety related. All the control cards, all the circuits. The motorized, motor generator sets everything up to the reactor trip breakers themselves. But the --

MEMBER ROBERTS: Right.

MEMBER SUNSERI: So, the reactor trip breaker is the --

MEMBER ROBERTS: The reactors, but the next trip break will take away power to all those things, you know. And allows the rods to passively drop.

CHAIR KIRCHNER: The protection system itself that actuates, is safety.

MEMBER ROBERTS: Right. All the way through the reactor trip breaker step, to the power that the reactor trip breaker switch is hooked in on is safety. But, you know, if the oscillating power goes away, you scram anyway. So, the scram function is, at least to my understanding, is safety in other plan designs.

I think that's the point that Scott is making here. Is there is no, there's no intent to make the reactor trip system or the, you know,

whatever part of the reactor tool that actually drops the rods to be safety. That right, Scott?

MEMBER PALMTAG: Yes.

MEMBER SUNSERI: That's not what I'm understanding. The way it's reading is, it doesn't read to me that way. I mean, we're saying that the safe state is not, there is not a reactor protection system to achieve the safe state. And we don't have a grievance with that.

Our grievance is, is that once we're in the safe state, how do you shut down the reactor? The Applicant said, well, they have this rod control system that the operator can manually actuate to shut down a reactor. And that's no different than a PWR.

CHAIR KIRCHNER: No it is.

MEMBER SUNSERI: It is not. But I don't understand why you don't under --

(Simultaneous speaking.)

CHAIR KIRCHNER: You have a reactor --

MEMBER SUNSERI: -- an operate --

CHAIR KIRCHNER: -- protection system that actuates that by releasing, you know, the power, and the rods drop because of gravity. That's not -- you have a manual scram on the PWRs but the reactor protection system is a safety-related system.

MEMBER SUNSERI: I'm saying, but, so, you're saying that you have to have a safety-related system to manually open the reactor trip breaker by an operator?

MEMBER PALMTAG: Well, there's two pieces. There's the actual ability to shut down the system, an operator. And then there's a reactor protection system for example, hi flux alarms or some high temperature alarms, or something that would automatically scram the reactor. They have no reactor protection system.

MEMBER SUNSERI: Right. Because their physics demonstrate that they go to the safe state. Right.

MEMBER PALMTAG: Right.

MEMBER SUNSERI: I thought we didn't have, I didn't think we had a grievance with that not being a safety-related function. That we were relying on the physics for that. I thought our grievance was solely with, they didn't have a safety-related record -- rod control system to open the reactor trip breakers.

MEMBER PALMTAG: I think they're both. My understanding is both issues. You have to have a safety system to shut down the reactor. And then is

there apart, automatic protection system? Reading wasn't right, I'm afraid.

(Simultaneous speaking.)

DR. BLEY: This is Dennis and I'm listening to this and I think everybody is talking past each other. What I hear, not saying, is that the mechanical mechanisms, the motors are all in the line of safety related. The place there, I'm not sure of, and I agree with him on that, the place I'm not sure of is the actual latching mechanism, if there's anything safety related about that?

On the other side, the trip breakers and the logic that opens the trip breakers, the reactor protection system, is safety related on a light-water reactor, I mean on PWRs. So, the only question I had sitting there is, is there anything in the mechanical unlatching mechanism, after you kill the power that's safety related? Because I know the motors and that sort of stuff's not.

MEMBER SUNSERI: Well, my experience is the control rod mechanism coils on the reactor vessel head are non-safety related.

CHAIR KIRCHNER: That's correct, Matt. But the protection system that initiates the scram is safety related.

MEMBER SUNSERI: Yes, so let's just divide up the two issues, because we are talking about two separate things. I'm talking about taking the reactor from a safe shutdown state, which they've defined. And then they show they get to with their physics. I'm talking about taking from that to a subcritical shutdown state, using the manually operated rod controls, non-safety related system. That's what I'm talking about. And that does take the reactor to a shutdown state, in my view.

I'm not arguing right now, about whether or not they need a reactor protection system to achieve the safe state. We can have that discussion separately. But what I heard very clearly at the Subcommittee meeting was, because they did not have a safety-related rod-drive system, I'll call it that, that we had a grievance with that. And I just, I'm pushing back on that point.

VICE CHAIR HALNON: I think that -- this is Greg. I've broken it with basically, two questions, right. In my mind, the first question is, if we'd would accept physics in place of the safety-related reactor protection circuit? That's what shuts the reactor down in a pinch in a safe state. And the second question is, going from that

safe state, to a shutdown, is the rod control system that they have adequate, not, safety related or not safety re -- I think it's --

What I think we're mixing up is that we're saying instead of physics, you need a safety-related rod-control system that trips the reactor. I think that's the second question. Is the rod control system for that second diverse means of shutting down the reactor, adequate?

The first question is, do we accept the natural physics of the core in place of a safety-related reactor-protection system?

MEMBER PETTI: And I think the letter says, no. Because it hasn't been demonstrated.

VICE CHAIR HALNON: Right, for lack of operating experience.

MEMBER PETTI: Ron says. I mean, we in a generic sense, we accept this sort of physics in other systems that have that demonstrated. And we comment on that. And in fact, if you go and look at, I think, Reg Guide 1.232 and look at the gas reactor PDC, you are allowed to use the negative temperature coefficient as your secondary means of shutdown. Whereas --

(Simultaneous speaking.)

VICE CHAIR HALNON: Secondary.

MEMBER PETTI: And that's a change from say, 20 years ago. There used to be two shutdown systems, independent and diverse to shut down a gas reactor. Classic rods and they had a separate special system, little balls.

CHAIR KIRCHNER: Yes. Conditions.

MEMBER PETTI: That has moved forward because it's been demonstrated in so many gas reactors. Similarly, fast reactors, that's what I put in. Is an inherent reactivity feedback in the metallic core that's been demonstrated on two metallic reactors.

VICE CHAIR HALNON: The dome.

MEMBER PETTI: So again, I don't have a problem in an, nth of a kind, but for the first of a kind. It seemed like it should be proven to have such a system.

MEMBER PALMTAG: Related to that we have to do, it hasn't been defined what exactly a safe state means.

MEMBER PETTI: Yes.

MEMBER PALMTAG: And what's the power, and that goes back to first of a kind versus Nth of a kind.

CHAIR KIRCHNER: What is a safe state and is it a, is safe, non-critical, sub-critical, or not?

MEMBER PALMTAG: I believe it's not sub-critical in this case. Again --

CHAIR KIRCHNER: It's critical?

MEMBER PALMTAG: For example if you have positive reactivity, you have a negative reactivity coefficient. Fine, it drops the power, but it could drop it to 80 percent. Is that a safe state or not?

VICE CHAIR HALNON: So, that's a third question.

MEMBER PALMTAG: Lesson three.

CHAIR KIRCHNER: Yes.

MEMBER PETTI: Lesson there.

CHAIR KIRCHNER: So, it --

VICE CHAIR HALNON: But, in essence I agree with Matt. The rod control system in this, doesn't need to be safety related. Because it's not entirely --

(Simultaneous speaking.)

CHAIR KIRCHNER: Yes, the rod control system --

VICE CHAIR HALNON: Watch out.

CHAIR KIRCHNER: -- usually is not safety related.

VICE CHAIR HALNON: Right.

CHAIR KIRCHNER: Because in a PWR, you unlatch the rods and they drop by gravity.

VICE CHAIR HALNON: Right. And then anything that causes that unlatching is safety related.

CHAIR KIRCHNER: And everything up to the unlatching is, is a safety --

VICE CHAIR HALNON: That's where these questions just overlap. We're not talking about the thing that scrams reactor or puts it into the safe state. We're talking about a rod control system that's operated by the operators to drive it to -- is that the verse, secondary, if you will, reactivity control to drive to a safe state? Which may be a different safe state.

So, the first question is, do we accept safe state being critical? Second question is, do we accept the physics being the, basically, RPS, reactor protection system? And then the third question is, is the rod control system being used by the operators adequately, adequately classified in design? I think that third question is, yes.

MEMBER ROBERTS: I would change the third question to, does it meet redundant needs to be

provided? I just skimmed through his last letter, I didn't see anything about rod control on there. And I'm not sure where the argument is coming from.

(Simultaneous speaking.)

VICE CHAIR HALNON: I don't think, Matt is there any --

MEMBER ROBERTS: I don't think anybody is claiming they needed a safety related rod control system.

CHAIR KIRCHNER: No.

MEMBER ROBERTS: I think the question, the third question is, is there a need for a redundant means of shutdown?

VICE CHAIR HALNON: Yes, I think Matt was going back to the Subcommittee discussion, rather than what's in the letter, basically, right?

MEMBER ROBERTS: But the manual is saying --

(Simultaneous speaking.)

VICE CHAIR HALNON: Or diverse means.

MEMBER ROBERTS: It could be diverse means.

VICE CHAIR HALNON: Like with GDC 27, could be diverse means, it'll shut it down. So there is two diverse means if you accept the physics part as being

the RPS.

CHAIR KIRCHNER: Maybe for context, you know, list it as Dave was saying, back -- and I can't remember the SECY, I want to say it's 93-087, but don't quote me on that. But when the advanced small, the SMRs were being considered in the late 80s or early 90s, there was a recognition that those non-LWR reactors could not effect a cold shutdown, as was required of the PWR fleet and the PWRs.

For a lot of obvious reasons you don't want to go to cold shutdown in a sodium loop, because it can freeze components and so on and so forth. So, and for the HTGR, if I remember correctly, Dave, the time it would take to cool down an HTGR with a large, large thermal inertia of all the graphite, led to that kind of policy statement in the SECY that bringing it down subcritical, that's important, subcritical but at temperature, would be adequate for those designs.

And I think that, the first order would hold also with this design, because it's a salt system and you don't want to freeze the salt obviously, or the fuel somewhere else in the system. So, there's that regulatory precedent that the expectation would be of those advanced reactor designs at the time, that they would be able to achieve subcritical.

Those, both reactors as Dave said, had strong negative temperature coefficient evac for controlling potential reactivity insertion accidents and other upsets. And that was recognized as well. But they did require them to have a system that could take them subcritical. That's my recollection notes, where the agency was considering the first set of modular non-LWR reactors.

So, the precedent here of going to a safe condition that doesn't include subcritical, is something that merits discussion. What is that definition? And what is acceptable if it's not subcritical?

MEMBER PALMTAG: Yes, that was one of the recommendations.

VICE CHAIR HALNON: In Number 2.

MEMBER SUNSERI: Well, isn't it a matter of timing? I mean, your question Walt, is a good one, but it's timing, it's about timing, right? And just like your discussion about what's cold? And when is it appropriate to be cold? So, but if we're going to accept this Generation IV reactor physics as a safe, you know, to satisfy, you know, simplicity of the design and enhanced safety, all that stuff that we're talking about, we're going to have start switching our

mindset a little bit from, of the past things.

So, in this particular situation, does being safe means that it has to be subcritical within 1.4 seconds like a PWR? Or can it be minutes after the transient has played out, the safe state is achieved. The reactor operator then sees he's got a stable plant, and takes it to shut down by inserting the control rods?

CHAIR KIRCHNER: Yes, but what has not been explored yet, fully, is the range of transient accident upset conditions and reactivity insertion events that you can have with a liquid fueled system.

MEMBER SUNSERI: Yes, but isn't that what these PDC are supposed to confine -- define?

CHAIR KIRCHNER: Well, the problem is the PDCs that were proposed seemed to be silent on the fact that they're using injection of liquid -- I assume it's in a liquid salt mixture, as they hand it to the primary system. So, you have to look at the reactivity insertion accidents.

MEMBER PALMTAG: Yes, but are you, I still would argue this is going back to our earlier discussions on other designs. You know, part of safety, you have to have a safety system that goes subcritical.

The physics will take you -- are negative feedback, but that does, that could be, you know. It doesn't go all the way down to zero. It could still be 80 percent, 60 percent, 40 percent even, if you like. I look at it, you need a way to, you need an off button.

CHAIR KIRCHNER: Yes. The physics could take you to above 100 percent too.

(Simultaneous speaking.)

MEMBER PALMTAG: Yes. But the negative -- yes, well it depends --

CHAIR KIRCHNER: It depends on what's is the transient.

MEMBER PALMTAG: Right. That's right, oh, yes.

CHAIR KIRCHNER: Because if you have an over-cooling transient, you're going to put in a lot of reactivity.

MEMBER PALMTAG: Yes.

CHAIR KIRCHNER: And your question is, you know, can you demonstrate that the feedback is sufficient to offset the reactivity insertion from a -- strong feedback goes both ways.

MEMBER PALMTAG: Right.

CHAIR KIRCHNER: Yes. So, it goes both

ways. Now it's well coupled because it's in the fuel in a liquid form. But I don't know, has the full spectrum of scenarios, and accident initiators been examined?

VICE CHAIR HALNON: Is that a PDC topical report issue or is that an L&P type, you know, licensing based --

(Simultaneous speaking.)

MEMBER PETTI: Well, but if you don't have a PDC, it says, that as the ANS standard says, that you need to have a system to assure, to prevent a limit reactivity increase, to do in -- you know, it says here, it's Item D. "Executes safety functions with high probability of success in the event of an anticipated operating occurrence."

And so, if the fueling is coming in liquid, an over-fueling event might be an AOO. Might be an inadvertent over-fueling event. Well, how do you deal with that? And how do you --

CHAIR KIRCHNER: It's fueling all the time. It's going to be an AOO.

MEMBER PETTI: Yes, an AOO. So, how do you, you know, prevent or limit that? There's not a PDC even there, so there's nothing to check again. That's the concern, is that there needs to be some

sort of a PDC that says, how am I designing against this?

CHAIR KIRCHNER: Reactivity insertion accidents, that's why you have --

(Simultaneous speaking.)

VICE CHAIR HALNON: My point is that --

CHAIR KIRCHNER: -- protection system.

VICE CHAIR HALNON: -- it shouldn't have -- say you do have an over-fueling event or whatever you might call it. The fact that there's not a PDC there doesn't change the fact that you still are postulating an over-fueling event. You've got to see how the system's react to it. PDC will just ensure that it's mitigated.

So, if you don't have a PDC and you postulate that event, then it's just going to play out to be a problem in whatever the end state of an accident is. You might have melting fuel? I don't know, it's already melted --

(Simultaneous speaking.)

MEMBER PETTI: Well, my concern is there were a lot of smart people who developed the ANS standard, molten salt people. I mean, I looked at the list of people. To not adopt it --

VICE CHAIR HALNON: Would be exceptional.

MEMBER PETTI: -- or to take exception to it, requires I think, a very strong rationale. It would be like, you know, you're going to adopt, You know, you're not going to accept the ASME code for something. It's kind of --

VICE CHAIR HALNON: No, I agree. And I had the same problem with the fact that they didn't use ACU as a benchmark against this. Because that was the first one, and the staff reviewed it and then approved their PDC. And none of them are based on the same thing that they're --

MEMBER PETTI: Right. I'm --

VICE CHAIR HALNON: -- on it.

MEMBER PETTI: You know, I don't need details, but, you know, when there's beryllium and lithium in the salt, that's a very different feedback response than when there's not. So, because there's all these different salts, sometimes there's not as much crossover between the designs.

VICE CHAIR HALNON: But it's still fine.

MEMBER BALLINGER: Why do we not just say, that you have to comply with the ANS standard, unless you provide for an exemption or justified exemption? That's two or three sentences.

MEMBER PALMTAG: There's a few reasons for

that, one, that when they developed these PDCs, the ANS standard was still draft. So, this PDC, or the ANS standard has just been finalized. And then there are some differences between the ANS standard. The ANS standard has a functional containment, where they use a real containment. So, there are --

MEMBER PETTI: Yes, but that doesn't affect reactivity. It's quite nice --

MEMBER PALMTAG: No, no.

MEMBER PETTI: -- that they can, they can adopt the ANS standards verbatim is what my point is.

MEMBER BALLINGER: Well, I was going to say, you don't to adopt verbatim, but they ought to be able to say, we're going to adhere to the ANS standard, with the following exception. Now, the fact that it's just initiated, these guys have been doing this for the last 10 years.

MEMBER PALMTAG: Yes. I think Dave did have a conclusion, but Dave's comments are leading to an additional conclusion that would say that in there.

MEMBER BALLINGER: I think I recall that the MSRE their fueling system and their defueling system were very different. You could defuel really fast.

(Simultaneous speaking.)

PARTICIPANT: They had a treatment --

PARTICIPANT: Oh, they had a fish pond.

MEMBER BALLINGER: Yes, yes.

CHAIR KIRCHNER: And then they dropped into a subcritical configuration.

MEMBER BALLINGER: Yes, yes. So, you physically couldn't add too much reactivity, there was a limit. But for defueling, you could just shove the thing down.

MEMBER PALMTAG: Yes, this design does not have a drain plug at all.

MEMBER BALLINGER: Yes, I was surprised that there wasn't some, I call it dump valve, something.

CHAIR KIRCHNER: It's too much inventory to make it practical actually. By the time you got it drained, you've --

MEMBER BALLINGER: Yes.

CHAIR KIRCHNER: -- you would be operating the whole time it was draining, until you got the fuel level, the solution level below the moderator in the fixed, you know, they have a fixed moderator, which is the de facto, the place where you get fission. And you would have to drain it all out to take the moderator out of the equation.

MEMBER PALMTAG: Yes, this system is about 50 times bigger than the MSREs. They do have a tube, I say tube or pipe that goes to the bottom of the tank. And it runs up and then over to another tank. That's how they defuel and as they pressurize it, it's a much slower process than a freeze plug.

VICE CHAIR HALNON: Would it be better than to, an option to just focus in on the deviation from the ANS standard PDCs, and rather than try to suggest a fixed one?

MEMBER BALLINGER: That's what I was trying to say.

MEMBER PETTI: Yes, I mean, the paragraph that's edited in blue, was a late edition and I had trouble figuring out where it best fit. I think it needs to move up. Maybe it's how we start it.

CHAIR KIRCHNER: It's background.

MEMBER BALLINGER: Yes. That's got to, I think that one, you put that right up front.

MEMBER PETTI: This is all of our reactivity control.

MEMBER BALLINGER: But that's the main think.

MEMBER PETTI: Yes, yes, yes.

MEMBER BALLINGER: So, it's not

background, I think it leads into our discussion.

CHAIR KIRCHNER: It seems, I think Greg, teed it up, but I'll try again. There are three issues. Safe -- are we in agreement that a safe condition is not subcritical?

Second, are we in agreement or not, whether a protection system is -- we can piece part -- we take the system apart and decide what's safety related or not. But I don't think that's the real issue here. It's a more fundamental issue.

Do we have such confidence that there's no reactivity insertion kind of event that could occur, that would warrant not having the reactor shutdown protection system? That is truly unprecedented.

MEMBER PETTI: It's just a -- and then for a first of a kind.

CHAIR KIRCHNER: And for a first of a kind. And then the other thing, what was the third one that you --

VICE CHAIR HALNON: It got into the rod control insertion accident, the diverse means and redundancy,

CHAIR KIRCHNER: Yes.

Well, the history of liquid systems with fissile solutions and criticality events is --

MEMBER BALLINGER: There have been some pretty spectacular criticality events.

CHAIR KIRCHNER: Yes, so --

MEMBER PETTI: Some of the most --

MEMBER BALLINGER: Yes, not least of which is pretty recent.

CHAIR KIRCHNER: Our business, I guess, I don't guess, is not to design the system for them. That there are means to control the amounts of fuel that were --

MEMBER BALLINGER: Yes.

CHAIR KIRCHNER: Mechanical means to kind of safeguard against excessive addition to reactivity. But mechanical systems have been known to fail. They can probably limit the amount of available fuel to be added through different safeguards in mechanical systems. But you still have the potential for the reactivity insertion.

MEMBER BALLINGER: It's hard to not try to design the system, because it's probably physically -- it's hard from the negative feedback effect that had been there. It's probably impossible to add enough fuel fast enough to have anything bad happen.

CHAIR KIRCHNER: Should be, but we haven't seen the design.

VICE CHAIR HALNON: So, if you take, take the non-light-water reactor that we have, you take criticality away from the discussion of whether or not, it's safe or not. You would catch people saying a safe state in the reactors, were basically, I can walk away from it, reduce my control in manning to just the bare minimum, just to keep things running. And not have to worry about, in design basis, or on the basis of that, occurring.

MEMBER BALLINGER: That's what NuScale proposed. Long-term cooling, remember, they argued we could have re --

CHAIR KIRCHNER: For 72 hours.

VICE CHAIR HALNON: So, what you've been telling, saying, well in this defined safe state, a licensing based event could still occur? It could cause a problem. And I'm not talking about license, like, you know, I mean like present state and stuff, like that. Even then, external events, a safe state says the reactor is, you don't have to worry about it. You may have --

MEMBER PETTI: It's hot, I mean from a temperature perspective. I mean, you'll never get to, quote, "cold shutdown" in any of these of these systems.

CHAIR KIRCHNER: We hope not, any of these.

MEMBER PETTI: We don't want to.

MEMBER BALLINGER: Let's say that they reduced power to the point where they were just adding heat. In other words, enough heat was being added to keep it from freezing. You know, keep the temperature. Is there some event that could occur if you walked away, that would be a design basis accident?

If you reduced the power level to that point, and you couldn't add any more fuel, would the thing, would the negative temperature coefficient just allow it to just sit there adding heat?

MEMBER PETTI: Over-cooling events --

MEMBER BALLINGER: That's what I was --

MEMBER PETTI: -- haven't been this big. I didn't hear anything about safety systems to prevent freezing. And we didn't even go there because we didn't have a lot of design detail. But you know we've raised that with other salt systems. That over-cooling events --

MEMBER BALLINGER: That's the thing if they're reduced to adding heat. In other words, you've got enough, you're adding enough heat so that

you can't -- is there some event that can occur that would, you know, take it in a different direction? I don't think so.

MEMBER PETTI: Could you get a runaway reactor?

MEMBER BALLINGER: Yes. No, I mean --

PARTICIPANT: Steam tube generator rupture.

MEMBER PETTI: Remember the other designs we've looking at, you have to tie the primary loop and the secondary loop humps together. Otherwise you'll over cool. If the primary trips the secondary has to trip, or you'll over cool. So, there's all sorts of interconnects here in the system that have to be designed in.

MEMBER BALLINGER: So, there is an event.

MEMBER PETTI: I guess, yea.

(Simultaneous speaking.)

MEMBER BALLINGER: We don't know any of the details.

MEMBER PETTI: But it's not -- it's an over-cooling event. It's not a reactivity event.

MEMBER BALLINGER: Over-fueling.

MEMBER PETTI: Well, that's what I'm saying, if you had a system where you -- at that point, where you defined yourself as being safe state,

is there a way to add reactivity?

VICE CHAIR HALNON: And over-cooling is a problem because you have negative NTC.

MEMBER PETTI: Yes. And the over-cooling and over-fueling of the ones that, I tend to think.

VICE CHAIR HALNON: So, the safe state would be to drive the rods in, shutdown the reaction, and have enough heat so you don't rock it up?

MEMBER BALLINGER: But again, like Walt was saying, it's not, we're not here to design the reactor. We just have to tell them that they have to be able to do that, right?

VICE CHAIR HALNON: Well, that's at least in our minds we have to agree, what is the adequately safe state. And if we're saying that being critical at some low power level, that where the physics, is the physics taking care of it at a high power level? Physics take care of it at a low power level. So, what --

MEMBER PALMTAG: I would argue safe state is subcritical. We have to know, to be --

MEMBER BALLINGER: Well, that's for sure a good definition of safe state.

VICE CHAIR HALNON: Yes. So, if you're subcritical, then you have to have some kind of heater

system on salt to --

MEMBER PALMTAG: They do.

VICE CHAIR HALNON: They will, okay.

MEMBER PALMTAG: That's how they have to heat -- they have heat the system up, right. They have to heat --

CHAIR KIRCHNER: Will have to balance their heat losses against the, they could use the KE or have to use --

MEMBER PALMTAG: Oh, when you start the system up, you have to have heaters. There will be heaters.

CHAIR KIRCHNER: Yes. Yes, you'll have heaters.

VICE CHAIR HALNON: Well again, I think rather than redesign the process, don't redesign the reactor for them, but just that they're deviating well thought out, probably the best we have, input in front of us at this point of operating experience. PDCs that he didn't use.

MEMBER BALLINGER: I'd just say, just comply with the ANS standard unless you can show something else. Unless you justify it.

VICE CHAIR HALNON: So, a two-line letter, for the issues.

MEMBER BALLINGER: Yea, well I mean --

MEMBER PETTI: Yes. But I still think there's an important principle here. I don't think you can rely on physics until it's demonstrated.

MEMBER BALLINGER: That's always the case, yes, right.

MEMBER PETTI: That's my bit. I said it, if this was nth of a kind, I would not have that issue. But this is first of a kind. And you have to demonstrate these -- that's why all those damn tests were done back in the day and when we've talked about the role of prototypes and what they do, and why they're so important is that they demonstrated to the NRC at the time.

(Simultaneous speaking.)

MEMBER PETTI: Look, these systems do have these characteristics. We have tested them.

VICE CHAIR HALNON: Well, do you need to have this reactor demonstrate the physics? Or can you do the physics in a test loop of some other type?

MEMBER PETTI: No, I mean --

(Simultaneous speaking.)

VICE CHAIR HALNON: Is it a critical, just -- it's as if --

MEMBER PETTI: yes, I don't think you can

go without thinking those smaller reactors.

VICE CHAIR HALNON: I'm thinking, you know, like the ACU reactors that came online before this one, well before.

MEMBER PETTI: Yes, but it's a different salt.

CHAIR KIRCHNER: Different salt and its size matters.

VICE CHAIR HALNON: You're right, I think the size, we thought we're getting --

MEMBER PETTI: Yes, the size matters. I mean -- and all we're saying is that for this one, you need a protection system. We're not saying this only needs one from then on. But given the scale of the, I mean all the issues that we talked about in the letter, it's just, it's prudent for this first of a kind.

MEMBER PALMTAG: Historically, we scale up, you never go over a factor 10 larger. And they're taking a jump 40 over 70, so I'm, to go to your point and demonstrate this, you usually demonstrate it with the smaller reactor. Let's start with the 40 Megawatt reactor.

MEMBER PETTI: As we've seen in other designs, I mean, because we've seen, a classic

example. It is a configuration and a coolant and moderator, that are unique use together. What they doing? A very small system, work out those kinks, prove things.

MEMBER BALLINGER: This is, I'm probably being a heretic but I would consider this unsafe, unless they did a prototype. Sorry.

MR. BURKHART: Can I just make an observation on this letter. It sounds like you're, there's a letter there from what you all have just said. Pointing up your observations higher, because you're, it does seem like you're trying to fix the problem, rather than identify the problems, right?

MEMBER BALLINGER: That's what I say, just the ANS standard.

MEMBER PALMTAG: I don't think just far from that.

MEMBER BALLINGER: Huh?

MEMBER PALMTAG: I don't think we're far from that.

MEMBER BALLINGER: Yes.

MEMBER PALMTAG: I mean it's --

MEMBER BALLINGER: But it may be that that's like Dave was saying if, that should be a key point, right up front, the key point.

MEMBER PALMTAG: I do have an issue saying, you know, the PDC should have come from the standard, when the standard wasn't finalized yet, right. And they did --

MEMBER BALLINGER: But it is now.

MEMBER PALMTAG: Yes, but and they did.

MEMBER BALLINGER: And they ain't gonna build this for a while.

MEMBER PALMTAG: But they do claim that they made their PDCs based on the draft of the ANS standard. So, I don't think the issue is they didn't follow the standard. I think the issue is that they decided to go against the standard, right.

MEMBER BALLINGER: Well, why don't we, can we just say that we think there's a better standard?

MR. BURKHART: Can I just interject? The NRC has not, from my understanding, endorsed the standard.

MEMBER BALLINGER: It's all right.

MR. BURKHART: Please keep that in mind.

MEMBER PALMTAG: But my understanding is they basically started with the ANS and the proprietary version of 1.232 that we can't say aloud. And then they said, here's the exceptions that we're going to take. And it's the exceptions that we're,

have concerns with. Not that they didn't start with the standard.

MEMBER BALLINGER: The other problem is this went through the Canadian system, right?

MEMBER PALMTAG: Yes.

MEMBER BALLINGER: And they approved it. In whatever the heck they, by whatever --

VICE CHAIR HALNON: It was only their level one --

MEMBER PALMTAG: Level one and level two, which I don't know what that means.

MEMBER BALLINGER: Yes. I don't know what that means either, but somebody said that it was okay.

MEMBER PALMTAG: Yes, but --

MEMBER SUNSERI: It's essentially a construction permit type review.

MEMBER PALMTAG: I don't even know if it was that far.

MEMBER PETTI: Yes, but again, remember CANDUs are a lot positive coefficients that would not be --

CHAIR KIRCHNER: They redesigned it.

MEMBER PETTI: They redesigned them.

CHAIR KIRCHNER: They took that away.

MEMBER PETTI: But at that time.

CHAIR KIRCHNER: Yes.

MEMBER PETTI: Right, that was a big difference of the two, it was two systems, the regulatory systems. So, what I'm -- let's see if I can move this along. Is if we took this paragraph in blue and that became our second paragraph in the discussion.

MEMBER PALMTAG: I think we have this duplicated don't we, to say basically, we don't specifically call out the ANS standard but we have these points.

MEMBER PETTI: Right, yes. But just let me complete the thought. You'd have a paragraph on what the standard is. That was all put in there for the last sentence, which needed a context, which is the fueling system has to have, because it's a reactivity addition system, has to have some sort of controls.

And if that's consistent with the crime, it's the sin. So, what we could do is we could just say, this what the standard is. Then we could talk about reactor control, and we can talk about the fueling system. Then we could talk about reactor shutdown.

MEMBER BALLINGER: It's referencing --

MEMBER PETTI: And I think we can get rid of the paragraph on two independent means because they do have two independent means. We just are not, you know.

MEMBER PALMTAG: We could do that, we could start over. Or we could try to fix this.

MEMBER BALLINGER: Is the reference to the ANS standard one of the results and conclusions, one of the conclusions and recommendations. If it's not, it should be.

PARTICIPANT: Well, again we haven't --

MEMBER PALMTAG: No, but we've said that those, we've made those four recommendations in here, or we've made the recommendations that do agree with the ANS standard. But again, the ANS standard -- well, there's two things. The ANS wasn't completed and second, I mean, Larry brought up a good point that NRC hasn't endorsed that. I don't know if that's, we want to make that a requirement.

VICE CHAIR HALNON: The one you didn't, number three touches on it, but doesn't say ANS. It just says it eliminates several of design criteria, used in other reactor designs.

MEMBER PALMTAG: Yes, that could be easily modified, to put in the ANS.

MEMBER PETTI: Again, I think we've got to get the letter right before, I think the conclusions will fall easily once we get a logic in the letter, the flow of the letter correct.

CHAIR KIRCHNER: Well, just one Member's opinion. I cannot imagine a power reactor out there in the fleet that doesn't have a protection system.

MEMBER PETTI: Duh.

CHAIR KIRCHNER: And I don't know how their condition would go forward with that and gain any public confidence in deployment of these systems. It's humorous almost, on our part, to say that we can look ahead to something that's scaling a factor of 100 in terms of power versus the MSRE reactor, which didn't operate very long by the way.

MEMBER PETTI: And didn't have the power conversion system.

CHAIR KIRCHNER: Right. And it was much smaller in terms of neutronic behavior. Very leaky system. The idea of not having a protection system to sense accident conditions and initiate operations of systems and components important to safety, to me, is just, I don't think --

MEMBER BALLINGER: Unless they had a proto

CHAIR KIRCHNER: -- it's just incredible.

MEMBER BALLINGER: Unless they have a prototype that demonstrates all that.

CHAIR KIRCHNER: Even if you have a prototype, I mean, you're presuming that you now know so much about this reactor, that you're not going to get into a condition where you don't have a reactivity insertion and an over-power or whatever as a result. This, that's a big leap. It's an awfully big leap. It sounds like an experimental reactor to me. Not a power production reactor.

MEMBER BIER: I think I agree with Walt. Many years ago when I an assistant professor, I was arguing that passively safe reactors may need to have some active systems just to guard against, what if we don't understand all the phenomena properly.

And, you know, I think Dave's comment about, okay, once you get to nth of a kind, and you have, you know, some years of operating experience, and various off normal conditions observed. Maybe you can get there. But it's, you know, I don't know the physics to know how well it's understood. But it seems questionable to me that we can know it that well.

CHAIR KIRCHNER: Well, it's right there on line 130. Do they need a protection system or not?

And that would require essentially a safety grid instrumentation and control system to implement it.

VICE CHAIR HALNON: Okay. Well, so first, so rather than we sit here and concentrate on it for a while, if we answer that first question, and Scott's starting to put it out there. Is the safe state, does it have to be subcritical? If the answer to that is yes, then I think the answer to this is, yes.

That you have to have some kind of protection system to shut it down, because then physics will not do it. So, if we accept, just to move it forward, Scott's discussion about we make the statement that a safe state has to be subcritical. One way of getting this, was subcritical is to have a protection system that shuts it down.

MEMBER PALMTAG: So, let me just, number 2, could we look at number 2.

VICE CHAIR HALNON: Right.

MEMBER PETTI: So, I should, Larry just sent us the us the Executive Summary.

MEMBER BALLINGER: Yes, that's pretty darn good.

MEMBER PETTI: Page 2, review.

MEMBER BALLINGER: Yes.

MEMBER PETTI: Number 4, the capability,

and effectiveness of the proposed means of reactor control and shutdown needs to be further demonstrated. Particularly the reliance on the overall negative temperature reactivity coefficient. The negative coefficient will need to be verified for all conditions and circumstances to help support the proposed design for reactor shutdown.

So, that means the same, the same thing, you know.

MEMBER BALLINGER: Ah, look at number 7.

(Pause.)

MEMBER BALLINGER: Here you go.

CHAIR KIRCHNER: Are you referring to the SER?

MEMBER PETTI: No, this is the Canadian. the Canadian, executive --

MEMBER BALLINGER: Because they're basically saying exactly what we're saying in a sentence.

MEMBER PETTI: In a less direct -- in a maybe a more politically correct way than we are. But what I'm worried about is because all of this proprietary. I really think we need to be as direct as we can in our letter. Because it will be the only thing on the record. If you read the staff's SE, you

can't tell what's really going on, because there's so much proprietary stuff.

MEMBER BALLINGER: Yes, we're lucky that Walt wasn't here during the presentation. We would have had to have blood pressure medicines mainlined in him.

CHAIR KIRCHNER: We could have proprietary discussions.

MEMBER BALLINGER: So, what, should I try to drive and see if this helps?

CHAIR KIRCHNER: Let me do a check with my, do we still have the Court Reporter?

VICE CHAIR HALNON: Yes, we should probably cut him loose him, yes.

CHAIR KIRCHNER: We should let the Court Reporter go, because we are now in letter writing --

MR. BURKHART: Although I think what they're capturing is very, very good.

CHAIR KIRCHNER: No, this was intentional that they do capture our conversation.

MR. BURKHART: Okay.

CHAIR KIRCHNER: All right, with that, it's Jim, right?

COURT REPORTER: James.

CHAIR KIRCHNER: James, I think we can

dispense with the transcription for the rest of this afternoon. And we'll need you back tomorrow afternoon at 1:00 p.m. Eastern time. We hear about the ADVANCE Act from Mike King.

Okay, thank you.

(Whereupon, the above-entitled matter went off the record at 2:06 p.m.)