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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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725TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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TUESDAY

MAY 6, 2025

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The Advisory Committee met via Video Teleconference, at 1:00 p.m. EDT, 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

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VESNA B. DIMITRIJEVIC*

CRAIG D. HARRINGTON

ROBERT P. MARTIN

SCOTT P. PALMTAG

THOMAS E. ROBERTS

MATTHEW W. SUNSERI

ACRS CONSULTANT:
DENNIS BLEY

DESIGNATED FEDERAL OFFICIAL:
MIKE SNODDERLY

ALSO PRESENT:
MAHMOUD "MJ" JARDENEH, NRC
STACY JOSEPH, NRC
RICKY VIVANCO, NRC
LARRY BURKHART, NRC
SANDRA WALKER, NRC
GETACHEW TESFAYE, NRC

*Present via telephone

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

1:00 p.m.

CHAIR KIRCHNER: Okay. The meeting will now come to order. Good afternoon. This is the first day of the 725th 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 Balinger, Vicki Bier, Greg Halnon, Robert Martin, Scott Palmtag, Dave Petti, Thomas Roberts, Craig Harrington, and Matt Sunseri. ACRS member in attendance virtually via Teams is Vesna Dimitrijevic. Our consultant participating today virtually is Dennis Bley. If I've missed anyone, please speak up.

Mike Snodderly of the ARCS staff is the Designated Federal Officer for this morning's -- this afternoon's Full Committee meeting. No Member conflicts of interest were identified, and I know 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 its regulations. Per these regulations and the Committee's Bylaws, the ACRS speaks only through its published letter reports. Therefore, all Member comments 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 -- pardon me -- are located on the NRC public website and can be easily found by typing "About Us ACRS" in the search field on NRC's home page.

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. For this Full Committee Meeting, we have received written statements from an organization called C-10, who are going to make a presentation during the Seabrook session. That would be tomorrow afternoon. Other written statements may be forwarded to today's Designated Federal Officer, and we have also set aside time during 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 identity 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're participating via 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, we ask that you 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 since the ceiling microphones are "live."

For the presenters, your table microphones are very uni-directional, and you'll need to speak directly into the front of the microphone to be heard online and also for the benefit of our court reporter. 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.

And during this afternoon's meeting, we are going to take up the NuScale Standard Design Approval Application and related topics. 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 then will be limited to NRC staff and its consultants, NuScale, 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 the meeting.

And with that, I actually will turn to myself as the Subcommittee Chair for the NuScale Design-Centered Review. And today we are going to hear from the staff on some updates on the completion of their review and SERs, and then from there, we're going to read in a draft letter report on the SDAA application.

So with that, I'm going to turn to Getachew Tesfaye, who is joining us remotely for opening comments. Go ahead, Getachew.

MEMBER SUNSERI: He's on mute.

CHAIR KIRCHNER: Yeah. You need to unmute yourself. Getachew, your microphone is off.

MEMBER ROBERTS: His microphone is open, but we can't hear him.

CHAIR KIRCHNER: Getachew, we still cannot hear you. Are you sure your microphone is unmuted?

MEMBER HALNON: MJ, you want to -- probably need to log off and log back in.

MR. JARDENEH: I can go ahead, Chair.

CHAIR KIRCHNER: Yes. MJ, could you then take over?

MR. JARDENEH: Yeah. Good afternoon, Chair Kirchner and subcommittee members.

CHAIR KIRCHNER: Identify yourself for the court reporter.

MR. JARDENEH: Okay. Good afternoon. My name is Mahmoud Jardeneh, and I am the branch chief for the New Reactor Licensing Branch, responsible for the NuScale Centered Design Approval Review. Thank you, Chair Kirchner and members of the committee for the opportunity to give an update on the NRC staff's review, the staff's safety evaluation with the NuScale's Standard Design Approval Application (SDAA).

Since our last presentation to the ACRS subcommittee on April 1st, 2025, NuScale has submitted a revision to the SDAA on April 9th, 2025. This can be found under ADAMS package number ML25099A236. NRC Staff has confirmed that the revision has incorporated all docketed information that were the basis for the staff's safety evaluation presented to the ACRS through April 1, 2025, and identified as confirmatory.

As a result of SDAA, chapter safety evaluations have been updated and the final safety evaluation is based on the reading to the SDAA. The only other significant change in those updates, Chapter 15 and Chapter 8 regarding EDAS.

Stacy Joseph and Ricky Vivanco will now summarize those changes. Thank you.

CHAIR KIRCHNER: Go ahead, Stacy.

MS. JOSEPH: All right. Good afternoon. My name is Stacy Joseph, and I'm a senior project manager in the Office of Nuclear Reactor Regulation, and I'm the PM for Chapter 15 of the NuScale SDAA.

As MJ mentioned, Ricky and I are here to inform the ACRS of the material changes to Chapters 15 and 18 safety evaluations since the last time we presented these chapters to the members. Chapter 15 safety evaluation was updated to explain the basis for why EDAS is not needed to maintain safe shutdown condition prescribed in the definition of safety-related. NuScale classified the EDAS as a non-safety-related system, and the staff assessed whether EDAS meets the definition of safety-related in 10 CFR 50.2.

The staff notes that while the specified acceptable fuel design limits, or SAFDLs, are not explicitly referenced in the 10 CF 50.2 definition of safety-related SSCs, nor are they a direct indication of fuel clad damage. They are typically used as the measure to demonstrate that the safe shutdown criterion in the definition of safety-related is met through sufficient decay heat removal and containment of radioactive materials during and following anticipated operational occurrences, or AOOs.

Demonstration of the safe shutdown criterion ensures that the fuel clad damage is unlikely to occur as a result of an AOO and the safety-related SSCs are sufficient to protect this fission product barrier. Accordingly, the staff reviewed and audited engineering documentation to confirm that the fuel fission product barrier would remain intact in the case of EDAS failure during an AOO.

NuScale performed minimum critical heat flux ratio and peak clad temperature analysis of a spectrum of state-points for an ECCS blowdown, which is representative of a loss of EDAS at a combination of powers, pressures, and temperatures. The analysis concluded that the clad temperature increase does occur but lasts for less than ten seconds before returning to temperatures less than the initial value. This analysis was presented by NuScale to the ACRS during the Chapter 15 Subcommittee meeting.

In addition, staff audited NuScale sensitivity calculations of peak containment pressure resulting from various non-LOCA events with subsequent loss of EDAS. Limiting results from these studies indicate that peak containment pressure remains below containment design pressure. Therefore, the staff found that EDAS does not meet the definition of safety-related because it is not needed for ensuring a safe shutdown condition of the reactor.

Specifically, the staff found that there is reasonable assurance that the reactor will shut down, decay heat will be removed, and fuel and containment integrity will be maintained without reliance on EDAS. The staff conclusion regarding the reliance on EDAS to meet the Chapter 15 safety analysis acceptance criteria of assuming minimal critical heat flux ratio is maintained above critical heat flux limit remains the same.

Based on its role to protect the SAFDLs as required by multiple GDCs, the staff considers EDAS to be a non-safety-related SSC that performs an important to safety function. SSCs that are relied on to satisfy the GDCs are subject to the quality assurance requirements of GDC 1, Quality Standards and Records. GDC 1 specifies that programmatic quality standards for SSCs important to safety provide adequate assurance that these SSCs will satisfactorily perform their safety functions specified in the GDCs.

Accordingly, EDAS conforms to consensus standards and augmented quality attributes to ensure the quality of the system is commensurate with the importance of its safety functions. Based on the design augmented standards and controls assigned to the EDAS, as documented in the FSAR, the staff finds that there is reasonable assurance the system will function as designed.

I'll now turn it over to Ricky Vivanco, who will discuss the conforming changes made to Chapter 8 related to EDAS.

MR. VIVANCO: Good morning. My name is Ricky Vivanco. I'm a project manager in the Office of Nuclear Reactor Regulation and a PM for Chapter 8 of the NuScale SDAA.

In alignment with Chapter 15, Chapter 8 was updated to refer to the basis and conclusion in Chapter 15 regarding the safety classification of EDAS. The status basis for requesting exemptions to GDC 17 and 18 and the rest of chapter conform to the staff's consideration of EDAS to be a non-safety-related SSC that performs an important safety function. No additional exemptions were generated, and overall, the staff's conclusions in Chapter 8 are unchanged.

CHAIR KIRCHNER: Is that it, Stacy, for your presentation?

MS. JOSEPH: Yes, that concludes the staff's presentation.

CHAIR KIRCHNER: We'll take a opportunity here to have members ask questions of the staff if they wish.

MEMBER ROBERTS: Bob and I may have similar questions. The terminology non-safety-related SSC that's important to safety, what exactly does that mean in terms of the term important to safety, which is its own classification in 10 CFR 50? Are you saying that these SSCs are important to safety, or are they SSCs important to safety function which is somehow different from that?

We saw a draft of the Chapter 8 revised chapter. It was a little bit unclear because the first page basically said EDAS was not important to safety, and the second page says important to safety function. So that kind of mystified a couple of us. If you could clarify what the safety is regarding there. Appreciate it.

MR. VIVANCO: So the draft that was sent to the Committee was based off of the -- I'm sorry, it was a draft that hadn't been finalized with OGC's comments yet. And in finalizing that and the results of the NCP process being completed and carried forth, that was just a carryover from a previous revision. So since the NCP was completed and the staff's considerations were finalized, that paragraph did no longer fit the staff's conclusions, so it was removed.

MEMBER ROBERTS: Okay. Yeah. Thank you. That was very helpful.

Also, the last paragraph of the draft said that the decision on the recommended exemptions the GDCs have attained and a bunch of other GDCs will be deferred to the COL. Can you explain what the logic is to that?

MR. VIVANCO: Yes. So exemptions can only be granted as part of licensing actions. With the issuance of the SDAA, there is no license to issue, so the language was chosen carefully to reflect that no exemptions were authorized or granted as part of the safety evaluation. And the COL was referring the SDAA as long as the basis and parameters were the same for each requested exemption is at that point when the COL license is issued that an exemption will be granted.

MEMBER ROBERTS: Okay. There were a lot of exemptions. I don't remember how many, but are they all be revised with that kind of language change?

MR. VIVANCO: That's correct.

MEMBER ROBERTS: Okay. Thank you.

MR. SNODDERLY: Excuse me, Chair Kirchner. This is --

CHAIR KIRCHNER: Yes.

MR. SNODDERLY: -- Mike Snodderly. For the record and for interested members of the public, the draft markups of Chapter 8 and 15 that the staff shared with the ACRS will be included as part of the transcript.

CHAIR KIRCHNER: Thank you.

MEMBER MARTIN: As Tom noted, we had identified that inconsistency maybe that sounds like from Ricky you have resolved. That was my main concern, but I had no further question or comment on the EDAS question.

CHAIR KIRCHNER: Members? Okay. Well, then thank you very much, Stacy and Ricky. We'll go to letter report.

Before I start, I thought I'd just make some general comments. First, going to thank both the applicant and the staff, and again, noting that these are the comments of one member and not a position of the Committee, but as the lead for this review, it was a very complete application that was submitted by the applicant. Having lead the review of the design certification, they, in my opinion, addressed in the US460 design, they made several improvements.

I tried to reflect those in the text of the letter in the background discussion, improvements that addressed concerns that were identified during the design certification review. And I think they did a very complete job in addressing those issues that had been identified now. That was over four years ago.

So with that, we tried to capture that for the members. In this write-up, I tried to capture most of the significant changes. I did not capture all the design changes. But those that address concerns and issues from the design certification review and also highlight those changes that they made as they upgraded the power for their small modular reactor design.

So with that, I would like to just go ahead and read the letter in the record and go from there. And I'll note that as I do this, there's more in the letter than I think we need to include, and I would hope during our deliberations we could perhaps review and revise this, shorten the length of the letter so that it becomes a record of our review and advice to the commission and it's -- how should I say it? -- a little more concise and succinct in terms of our conclusions and recommendations.

So with that, I'll go ahead and read this in. And I'll note, too, that we have comments, factual corrections that we'll incorporate from NuScale during the line by line, but they do not substantively change the final conclusions and recommendations of the letter report.

So with that, "Subject: Report on the Safety Aspects of the NuScale US460 Small Modular Reactor Standard Design Approval Application. "Dear Chairman Wright, during the 725th meeting of the Advisory Committee on Reactor Safeguards, May 6 through 9, 2025, we completed our review of the NuScale Power, LLC, NuScale, or applicant, NuScale US460 Plant Standard Design Approval Application (SDAA) for its uprated small modular reactor and the NRC staff's associated advanced safety evaluation report with SER with no open items.

"This letter report fulfills the requirement of Title 10 of the Code of Federal Regulations, 10 CFR Section 52.141, that the ACRS shall report on those portions of the application which concern safety.

"During our review, had the benefit of interactions with representatives of the NRC staff --" excuse me "-- and the applicant. We also had the benefit of the documents referenced. Appendix I lists the chronology of NuScale Subcommittee and Full Committee meetings and their subjects, and Appendix II contains the list of our memoranda on advanced SER chapter reviews as approved by the committee.

"Conclusions and Recommendations. The NuScale small modular reactor described in the SDAA is a natural-circulation pressurized water reactor that incorporates unique design and passive safety features providing enhanced margins of safety and long coping times without operator intervention. There is reasonable assurance that it can be constructed and operated without undue risk to the health and safety of the public.

"Two, the NRC staff's SER for the NuScale US460 SDAA should be issued. Three, a standard design approval for the NuScale US460 application should be issued. Four, the NuScale SDAA is a complete well-documented application backed by validated methodologies and extensive experimental testing. With the completion of inspections, tests, analyses, and acceptance criteria (ITAAC), we expect that a license based on this comprehensively reviewed SDAA should lead to an expedited review.

"Background. The NuScale US460 Standard Design Approval Application. The NuScale US460 SDAA is a power uprate of the individual modules of its US600 design certification application, DCA, and consists of up to six NuScale Power Modules, (NPMs), and a single reactor building (RXB).

"The NPMs are largely immersed in a large pool of borated water in the RXB, which also serves as the ultimate heat sink (UHS). Each NPM is a small, integrated, natural-circulation pressurized water reactor (PWR) composed of a reactor core and riser, a pressurizer, and two helical-tube steam generators within a reactor pressure vessel, which is housed inside a high-strength, closely fitting containment vessel. This highly integrated design eliminates large-diameter piping to connect to steam generators and the pressurize to the reactor vessel. The modularized system can then be moved within the reactor building and disassembled for refueling.

"Reactor core consists of approximately half-length commercial PWR 17 x 17 fuel assemblies, 37, and control rod assembly 16, surrounded by a stainless-steel reflector and is cooled by natural circulation of borated, light-water primary coolant. Nominal operating conditions, power peaking, and fuel burnup and below those of the current pressurized water reactor operating fleet. Each NPM is rated at 250 --" there's a typo there "-- MWt versus 160 MWt for the US600 DCA with an output of approximately 77 MWe.

"With the power rate uprate, the nominal operating pressure of the reactor was raised to 2000 psia, and this led to several other design changes, notably the reactor pressure vessel and containment vessel design pressures and associated materials selection.

"Other unique safety features include two independent passively actuated natural-circulation decay heat removal systems (DHRS), each connecting one of the steam generators to the heat exchanger immersed in the reactor pool, and passively actuated emergency core cooling system (ECCS) valves that allow depressurization of a primary system to the containment and core cooling by recirculation of the primary coolant from containment to the primary system. The sizing of the RPV and the CNV are such that the retained reactor coolant inventory is sufficient to maintain a collapsed liquid level above the height of the core fuel rods for postulated accident scenarios.

"Both systems provide diverse, passive means of rejecting stored energy and decay heat by means of boiling condensation from the reactor system to the RXB pool. To address boron dilution concerns associated with long-term cooling by DHRS and ECCS operation identified during the DCA review, NuScale added additional holes and slots to the NPM-20 core riser barrel to promote boron mixing. Combined, the DHRS and the ECCRS functional design provides for a long coping time, 72 hours, without the need for safety-related electric power or operator intervention.

"Additional US460 design changes from the DCA include manufacturing the lower reactor pressure vessel (RPV) shell of austenitic stainless steel rather than the low alloy steel as planned for the DCA and is used within the legacy pressurized water reactor fleet. This change in material provides technical justification to support exemptions from the requirements in 10 CFR 50.60 on fracture toughness and material surveillance program requirements for a reactor coolant pressure boundary and 10 CFR 50.61, protection against pressurized thermal shock events.

"The NPM design incorporates several notable containment design improvements relative to the DCA. The upper containment vessel and a portion of the lower vessel below the main flange will be manufactured as martensitic stainless steel (F6NM), and the lower section of the CNV of austenitic stainless steel (FKM-19)." There's a mistake there in the nomenclature.

"Higher strength allows increased design pressure, 1200 psi, and temperature, 600 degrees Fahrenheit, resulting in improved containment response design margins to the spectrum of primary and secondary mass and energy releases.

"Venturis were added to the chemical and volume control system (CVCS) inlet and discharged lines to mitigate inventory loss in event of an unisolable break. The NPM containment isolation valve design configuration has also been modified to include a containment isolation test fixture to better support periodic CIV local leak rate testing. Venturis were also added to the ECCS valves to restrict blowdown flows upon failure or inadvertent opening, reducing pressure and thermal loads upon the containment.

"The reactor building pool level band has been lowered in the US460 design to better match the passive heat transfer rate from the CNV to the pool with the decay heat load and better control the rate of condensation-driven depressurization. Additionally, NuScale added in the US460 design a supplemental boron dispenser system (ESB) and a passive autocatalytic --" catalytic, sorry "-- recombiner power system in the containment of each NPM to address safety concerns raised during the DCA review. More details and discussion below.

"ACRS Review Approach. Like the NRC staff, we conducted a delta review of the NuScale SDAA, focusing first on safety aspects of the module power uprate and major supporting design changes since the DCA application and review. In particular, we examined design changes that affect the primary safety functions of reactivity control, decay heat removal, and confinement of radionuclides, and changes to structures, systems, and components (SSCs) that implement those safety functions.

"We also reviewed key supporting documentation including new, revised, or supplemental topical reports and new technical reports that amended the final safety analysis report (FSAR) chapters. The final document of record was Revision 2, the NuScale US460 Plant SDA AFSAR. To expedite our review, we implemented the approach for completing our previous review of the DCA by assigning members to review individual chapters of the FSAR and the associated chapter draft SER, renew safety-significant items, impacts of the power uprate or significant design deltas. Individual members then reported back with summaries for presentation to the Committee as a whole for deliberation and approval.

"These chapter reviews included the cross-cutting areas identified from our DCA review, emergency core cooling system (ECCS) and ECCS valve performance, helical-tube steam generator design, density wave oscillations and tube integrity, boron dilution and potential return to criticality, source term (post-accident containment atmosphere sampling) and probabilistic risk assessment (PRA).

"The staff implemented a high-impact technical issues approach to working with the applicant to focus completion of their review. This complemented our approach and provided timely information to address outstanding safety-significant technical issues.

"Discussion. The following sections discuss safety and technical issues, observations, and results from our review.

"ECCS and ECCS valve performance. The passive ECCS system includes four valves with independent hydraulic actuation systems. When actuated, ECCS vents steam through two reactor vent valves (RVVs) mounted on the top of the reactor pressure vessel to the containment immersed in the reactor pool. The steam condenses and accumulates in the lower CNV and is then returned through the two reactor recirculation valves (RRVs) to the downcomer region of the reactor pressure vessel.

"The ECCS does not provide additional coolant to this system, but instead the vessel sizes, RPV, reactor vessel and containment vessel, are designed to retain sufficient inventory in the reactor vessel to keep the core covered during all postulated events.

"Notably, the DCA design included three RVVs and two RRVs with an inadvertent actuation block valve in the hydraulic control system for each ECCS valve. The NPM-20 design employs only two RVVS and the IAB valves have been removed from their control system. The setpoint for a timer actuation of the ECCS after loss of all site power or reactor trip was changed to eight hours from 24 hours. The applicant's accident analyses appropriately reflect the changes made to the ECCS for the US460 design, including the removal of the RVV IAB valves, a lower differential pressure-based actuation, and changed setpoint logic based on riser level sensors.

"These changes simplify the ECCS actuation scheme, improve reliability, and result in more rapid system response following a LOCA initiation. The NuScale evaluation model uses conservative initial conditions to bound primary system depressurization and inventory retention and the staff's confirmatory TRACE analyses verified that the applicant's models conservatively predict the timing of ECCS valve opening reactor vessel level and containment pressure response.

"The Committee finds that the analytical treatment of the ECCS performance including bounding assumptions on valve stroke times and initial RCS inventory supports the conclusion that the system will perform its safety functions to support its licensing basis.

"Eliminating these IABs has been beneficial overall, but it does increase the potential for inadvertent operation of an RVV. The safety analysis address inadvertent initiation of ECCS by opening both RVVs and hence bound actuation of one RVV from steady-state plant conditions.

"The applicant assumes inadvertent RVV actuation during an unrelated transient is sufficiently unlikely that it does not need to be considered in the safety analysis. Nevertheless, the applicant identified a scenario where if an RVV were to actuate during an unrelated transient that increases temperature and power, minimal critical heat flux ratio (MCHFR), thermal limits would be exceeded by a small amount for a short period of time.

"The applicant's analyses demonstrate that despite the MCHFR limit exceedance, steel clad temperatures would be significantly below limits because the collapsed liquid level remains above the fuel height, and the consequences of such a highly unlikely event would be acceptable.

"One potential cause for inadvertent actuation of an RVV is the failure of the non-safety augmented direct current power system (EDAS) removing power to the solenoid trip valves for both RVVs. While this system is designated as non-safety-related, it has significant redundancy and includes quality augmentations that approach those included in the safety-related system. The NRC staff evaluated this system and deemed it sufficiently reliable to support

NuScale's analysis assumptions."

And the next section, I think -- let me read it. I think we'll wind up eliminating this. "At the time this letter report was written, NRC staff management was evaluating a staff non-concurrence that disagreed with the approach used to document acceptance of this system. We take no position on the non-concurrence. We agree with both the NRC staff management and the non-concurring staff that the EDAS design combined with the applicant's assessment that the consequence of the untimely loss of EDAS would be acceptable, even if it were to occur, is sufficiently reliable to support approval of the SDAA.

"In the final design certification application letter, the Committee also noted that the performance of the unique ECCS valve systems as an important risk contributor to the DRA. The Committee letter stated NuScale will perform extensive qualification testing to provide confidence in the ability of the valves to maintain their required performance after extended periods in an operational environment and concluded these additional actions should address the underlying safety concerns. For the SDAA review, residual committee concerns regarding reliable valve operation opening on demand are considered resolved.

"Helical-tube steam generator design. NuScale has continued to evolve their understanding of density wave oscillation (DWO) and its potential impact on the operation of the helical-tube steam generators.

"Testing and analysis. Making two adjustments reflected in the US460 design. The DCA steam generator inlet flow restrictors (IFR) design has been simplified with an IFR installed directly at each steam generator tube inlet instead of a support plate with individual IFRs for each tube attached.

"These will impose a suitable pressure drop for avoiding DWO within a normal operational power range. DWO conditions may still be encountered during startup, low power, and other transient operations resulting in a slow accumulation of steam generator tube damage. Rather than demonstrate the attesting that DWO conditions challenging to system components and operations could be avoided, a DWO management strategy has been adopted for the US460 design. NuScale defines an approach temperature as the difference between the reactor coolant system T-hot and the main steam outlet temperature, which is directly correlated to DWO margin and established an approach temperature limit curve below with which DWO onset could occur.

"Under the DWO management strategy, a cumulative time in conditions favorable to DWO is tracked against the technical specific limit in combination with steam generator tube inspections to ensure that the steam generator remains well-removed from unacceptable DWO-related damage accumulation.

"The applicant's accident analyses further address low stability concerns associated with the helical-tube steam generators, particularly under natural-circulation conditions following transients or during long-term cooling. NuScale's evaluation model incorporates a conservative bias on DHRS heat transfer performance and applies operational limits to identify and minimize operation near conditions where DWOs might occur.

"The staff's review confirmed that the modeling approach includes appropriate conservatism and that operational constraints, including approached temperature limits, provide further margin against instability. The Committee knows that the evaluation model supported by confirmatory analyses demonstrates that the system's stability is maintained under design basis conditions and that the steam generator design supports reliable passive heat removal throughout the event spectrum evaluated in Chapter 15.

"Boron dilution and return to critically. To deal with the potential criticality issues identified in the DCA associated with boron redistribution dilution and stratification, NuScale incorporated additional features in the NPM-20 design, including lower, midplane, and near-top riser hols and slots and ESB boron baskets within the containment. By enhancing, mixing, and mitigating stratification that could otherwise lead to localized deboration, the design changes maintain the core in a subcritical state in event of a small break LOCA DHRS actuation and after ECCS actuation and into extended passive cooling.

"The Committee reviewed NuScale's methodology to evaluate ECCS and the DHRS extended passive cooling function and the effectiveness of these measures in its accident analyses as presented in Chapter 15 of the FSAR. In its methodology, NuScale used the following figures of merit (FOM) to assess performance: subcriticality, coolable geometry (boron concentration below the solubility limit for precipitation) and collapsed liquid level above the top of the active fuel.

"The extended passive cooling GR and analyzed it and showed that coolable geometry is retained and the collapsed liquid level remains above the active fuel pipe. And the Committee agrees with these conclusions."

"However, the ability to remain subcritical after ECCS actuation depends on the behavior of several core parameters of core reactivity. These include the following: initial concentration of boron present in the RCS coolant, which increases in the core region due to constant boiling; uncertainty in boron concentration return through the RRVs from containment due to concentration stratification that boron added from the ESB dissolver baskets; core cooling down substantially over a 72-hour period, which adds positive reactivity; xenon peaking, then decay until 72 hours. The xenon is almost gone while samarium is increasing over the same period, and all control rods except the highest worth rod are considered inserted.

"It should be noted that some of these parameters that are considered beneficial to core cooling, such as lowered decay heat and lowered coolant temperatures, make it more difficult to remain subcritical.

"For the NPM, the most limiting criticality conditions occur at the end of cycle (EOC). It's when the RCS boron concentration at the core is near zero. NuScale's evaluation model conservatively applies cold water temperatures, worst-case control rod configurations, and low initial boron concentration to bound the minimum shutdown margin throughout this period.

"From all the cases analyzed, the core remains subcritical, but the margin to criticality can be relatively small. The smallest margin to criticality shown was 28 parts per million boron. This margin to criticality is within the predicted boron concentration uncertainty usually presumed in pressurized water reactors, 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 their methodology that increase the margin to criticality, such as the use of conservative temperatures in the analysis.

"The NRC staff also ran computational fluid dynamic (CFD) calculations that show there is additional conservatism in the NuScale boron tracking model. In their analyses, the CFD calculations added approximately 180 ppm to the shutdown margin. With these conservatisms, it is shown that the core remains subcritical after an ECCS actuation.

"The Committee finds that the modeling assumptions are appropriately conservative. At our request, the staff indicated that future technical specifications would ensure that the boron concentration requirements necessary to preserve this margin are maintained across below cores.

"Source term, post-accident combustible gas monitoring. In our DCA review, we were concerned that the proposed post-accident combustible gas monitoring system would risk bypass of containment by opening a substantial sized line, yet not provide a representative sample of the containment atmosphere. Therefore, we agree that it should not receive finality and NuScale design certification.

"This issue has been addressed in the NuScale SDAA design by including a passive autocatalytic recombiner in each NPM to control combustible gas concentrations as per 10 CFR 50.44. The part is designed to keep the oxygen levels below four percent, preventing combustion and ensuring an inert containment atmosphere. This change supports an

NPM-20 exemption request from 10 CFR 50.34(f)(2)(xvii)(C) for combustible gas monitoring. Additionally, the applicant has proposed GDC 41 to meet the combustible gas control intent of GDC 41. The draft SER approves these exemptions.

"Probabilistic risk assessment (PRA) and anticipated transients without scram (ATWS). The NuScale US460 design-specific PRA has been comprehensive in scope and in the level of detail. The scope includes Level 1 and Level 2 PRA for internal and external initiating events for both full power and lower power shutdown conditions. PRA was performed was performed for a single module and used to develop quantitative or qualitative risk insights for multiple modules.

"Self-assessment of the PRA was performed to evaluate components with industry standards. The Committee review focused on the design changes and their impact on the differences in the risk profile between US600 DCA and the US460 SDAA. Design changes most relevant to the core damage frequency or changes to ECCS, including reducing the number of RVVs from three to two, the addition of an eight-hour actuation timer, and the addition of redundant solenoid trip valves on RRVs and RVVS.

"These changes result in a small reduction in ECCS reliability and consequently in a small increase in the CDF. The most noticeable difference between the US600 DCA and US460 SDAA risk profile is the significant reduction in the large release frequency (LRF). Design changes most relevant to the LRF are removal of the inadvertent actuation blocks on the reactor vent valves, addition of low reactor pressure vessel riser level ECCS actuation signal, and the addition of Venturi flow restrictors to CVCS injection and discharge lines to limit maximum brake flow.

"By a fast reduction in system pressure to atmosphere, these changes limit coolant loss from brakes outside of containment with failed containment isolation and allow the event mitigation without a need for operator action or inventory makeup. This eliminates the main contributors to the DCA LRF and results in the SDAA LRF to be practically negligible.

"Another design change with possible impact on the PRA results is the addition of a digital reactor building crane control system, which would reduce the potential for operator errors during crane operation. Due to the lack of final design details and shutdown plans and procedures, it's premature to analyze impacts of this design change.

"The Committee is in full agreement with the staff findings that the PRA is of sufficient technical adequacy to support the SDAA and that the Commission's CDF and LRF goals have been met with high margin. This being said, in order to facilitate realism in the PRA inputs to plant operational requirements and programs, we believe that a few improvements should be considered for future PRA developments. Some of these are summarized below.

"The additional SSCs for human actions could be discovered relative as measured to the plant-specific CDF/LRF. Risk importance measures are also used, and other importance-related questions are considered. For example, an SSC failure would increase CDF two orders of magnitude should be considered in the importance ranking, even though an underlying absolute delta CDF is less than a selected value.

Second bullet: "To evaluate realistic uncertainty in the results, the underlying mean values for the risk measures, the ECCS with high risk importances should receive a detailed evaluation on certainties and the applied data common cause assumptions and passive heat transfer failure likelihood. In order to justify that point estimate and mean values are identical, correlated SSCs and factors like common cause factors treated as dependent should be evaluated to assure their completeness.

Third bullet: "Sensitivities are mostly calculated for single factors. The combination of sensitivities are not considered. The overall results could be very sensitive to underestimating multiple factors. For example, it could provide a valuable insight to combine sensitivity to the steam generator tube rupture, initiating frequency with the sensitivity to assumptions of single tube rupture on the single steam generator.

"As opposite to above, a few sensitivities are calculated as big lumps by sensitivities, all common cause failures, or all human error probabilities (HEPs). It would be more valuable to know sensitivities to different common cause groups, like ECCS or DHRS, or to specific HEPs. The current SDAA PRA model does not include sequences related to concerns about the potential for boron dilution and return to criticality during ECCS operation, particularly following a LOCA or other events involving RCS depressurization and inventory redistribution.

Finally, this is an insert. "While in change from the previous US600 design, one aspect of the approach used to meet the intent of the ATWS requirements is worthy of note. Specifically, the ATWS discussions in the FSAR do not cite the analyses that the applicant performed which demonstrate that the consequences of an ATWS event would be acceptable. Instead, the FSAR states that the diversity within the module protection system (MPS) is sufficient to meet the intent of the ATWS requirements.

"It is unclear to us whether the diversity within the MPS would be sufficient if the consequences of an ATWS event had been more severe. For example, the assessment and diversity within the system covers only the digital portions of the MPS and does not address other aspects of design or operation, such as use of a common supply chain, potential maintenance errors, potential effects of a common environment, et cetera.

"We agree that the applicant continues to meet the intent of the ATWS regulations based on a combination of acceptable consequences and significant diversity within the digital portions of the system. However, for future applications citing NuScale as a precedent, we use caution accepting diversity within the MPS is sufficient to meet the intent of the ATWS requirements if the consequences of an ATWS event are more severe.

"As stated in our design certification letter, the PRA should be updated at the COL stage to appropriately reflect the risk of boron dilution events, including associated operator actions. Risk insights would be better supported when the design is completed and the COL items are addressed, ITAAC items are closed, and the plant-specific PRA are completed before fuel load, including a human reliability analysis based on natural plant procedures and experience gained during operator training and plant simulator exercises.

"Subject to the above notes, we conclude that the results of NuScale's full-scope PRA for the internal and external events indicate that the NuScale US460 design will meet the Commission's goals for CDF and LRF with significant margin.

"Summary. The NuScale's small modulator reactor described in the SDAA is a natural-circulation pressurized water reactor that incorporates the unique design and passive safety features, providing enhanced margins of safety and long coping times without operator intervention. There is reasonable assurance that in can be constructed and operated without undue risk to the health and safety of the public. The NRC staff's final SER for the NuScale US460 SDAA should be issued. A standard design approval for NuScale US460 application should be issued.

"NuScale SDAA is a complete, well-documented application backed by validated methodologies and extensive experimental testing. With the completion of ITAAC, we expect that a license application based on this comprehensively reviewed SDAA should be to an expedited review. And we are not requesting a formal response from the staff to this letter. Sincerely."

Thank you.

MEMBER HALNON: So take a break?

CHAIR KIRCHNER: Take a break.

(Laughter.)

CHAIR KIRCHNER: Or a drink of water. Just an observation, and it's at least painfully apparent to me reading the letter, it's too long and, in my opinion, can be significantly condensed and still transmit the message, at least in this member's opinion. I can be incorporated in the conclusions and recommendations.

I thank those who gave me input, and with that, I think we should take high-level comments from members first and proceed from there.

MEMBER PETTI: Well, I have one or two. I have about five or six.

CHAIR KIRCHNER: And I note one thing, too, also. We have input from NuScale, and we can capture that in the line by line, number of corrections.

MEMBER PETTI: The first yellow section on EDAS, I think we have to shorten it based on what we heard today, something that I think we could do before we get to line by line. We have the sentences in there from the previous review about testing, that they have completed the testing and we don't have to -- I don't want to throw it all away. I want to keep that because I think --

CHAIR KIRCHNER: Right.

MEMBER PETTI: -- that that's important.

In the source term, there's a sentence in there about the exemption has been approved, but I gather it really hasn't.

CHAIR KIRCHNER: It hasn't.

MEMBER PETTI: Can't do that, so we got to get rid of that. I thought I saw some edits from Tom that really reduced the whole ATWS section, so I think that is worthwhile considering.

And the PRA section, it seems like we picked up stuff from the previous letter that you have it highlighted in yellow. I think it --

(Simultaneous speaking.)

MEMBER ROBERTS: Yeah. That was actually a placeholder.

MEMBER PETTI: -- be consistent with where we are today. Finally, the last sentence before the end of the letter is that they meet CDF and LRF with sufficient margin. I think sufficient is the wrong word. I would say extensive, ample, but it's large margin.

CHAIR KIRCHNER: Yeah. I may not have read it correctly. Significant margin.

MEMBER PETTI: Significant. I think if we attack those brief things, we'll be in better position for going at it line by line. I just note that you used font 14. If you used our font 16 standard, we'd be at over 500 lines. This is a lot.

MEMBER HALNON: You took my last comment.

(Laughter.)

MEMBER HALNON: I agree with Dave. For the court reporter, this is Greg. I don't think that I was in this morning's meeting.

The PRA stuff, it seems like we intertwined some of the generic stuff that we're looking at in a couple weeks or a couple meetings from now. And I think it felt like we were saying that PRA is not quite good enough because we have these generic issues. I think we can mention and draw down and say that we're still looking at some generic issues that may impact the next PRA but not necessarily make it sound like it's not out there, especially since with we kind of embedded a recommendation to better or to make it include other items during operating licensing.

I came away from that listening to the reading of it, and I had not digested it, but reading it made it sound like it was. We've had a couple of licensees or applicants come in with stuff like that.

(Audio interference.)

MEMBER HALNON: We could mention it without going to too much detail. I don't know we could. It probably came from you and Vesna.

MEMBER BIER: Well, it may have come from Vesna. I don't think the wording came from me. I think --

CHAIR KIRCHNER: It came from Vesna.

MEMBER BIER: Okay, thanks. I think

there's two separate issues. The thing about, well, if this thing causes a two order of magnitude increase, it should be considered significant, that one, we may want to table and say, you know, the Committee is looking at how to treat these and may have a recommendation generically in future or something.

The part about, like, mean value versus point estimate and make sure you have the correlations accounted for, that's just a fact. I mean, that's not a Committee opinion really, so I don't mind keeping that in, that the PRA should be careful about addressing this.

MEMBER HALNON: Okay. Yeah, I thought that you were going to talk about those other issues in much more detail.

MEMBER BIER: Yeah.

MEMBER HALNON: -- coming up.

MEMBER SUNSERI: This is Matt. I have a couple of thoughts. They probably aren't all that helpful, but I'm going to say them anyway. I think the letter is too long. I agree with that but maybe for a different reason. There's so much technical detail in it, it reads to me like a safety evaluation report, like the SER that the staff does. Got a section by section breakdown.

And to me, while it's technically accurate, it seems to me it dilutes our kind of review that is supposed to be at the key issues, like ample margin on a PRA. Minimal operator actions, good use of passive features to maintain safety, these are the things that make NuScale different from the other things we use. And to me, it just gets all lost in all the technical breakdown.

To me, it's not a matter of just going into each one of these paragraphs and condensing them and taking out half of the technical detail, but --

MEMBER PETTI: You're basically arguing whether we need the subsections at all.

MEMBER HARRINGTON: You might be able to take that whole discussion section, make it an appendix or something, and just have a five-page letter just going over the, you know, passive safety features, minimal operator actions, big PRA margin, you know, the four or five key things. I don't know.

MEMBER PETTI: One of the design choices they made that you now see, as safety analysis reflects, and that's what you're kind of saying is you missed that. And we'll work it into the introduction and background, but I appreciate your perspective.

MEMBER SUNSERI: It's just one perspective.

MEMBER BIER: Yeah. I kind of agree with Matt. I mean, I wouldn't even describe it as a high-level comment, maybe a zeroth order comment. As I was listening, when we got to the discussion, I thought the discussion was going to be a reflection of what had come before. And instead, the discussion went kind of on and on and launched into all these topics that had not really been highlighted earlier in the letter.

And so I don't know whether it makes sense to move the whole discussion to an appendix or whether we have to kind of be selective and maybe pick a few parts that we think are important enough to keep in the body of the letter.

MEMBER PETTI: So I think the real question is we all wanted to tie it back to the previous review and show how each of our previous issues had been closed out, and that's why I think it is what it is. Should that be the objective of the letter, I guess, is really what I'm hearing.

MEMBER HARRINGTON: Well, I mean, you won't get me arguing against closing the loop. I like closing the loop. We're on the record, and so we got to close the loop.

I mean, this is like a new design, though, right? We want to say for this reactor as is being designed, these are the key reasons why we think it's safe or that we see as safe, whatever. And the rest of it is just technical detail. That's a superficial comment. The technical detail is important. That's why we're here, right? But, you know, it's not key, the essential points that we want to make. We can close the loop whether patching it or appendix. I don't know how to do it. I'm just kind of thinking out loud here.

MEMBER HALNON: This is Greg. When you say closing a loop, it sounded like we had some unfinished safety questions from the DCA. The DCA is issued. We concluded it was safe to issue. Therefore, there shouldn't be any loop closure. It should be --

CHAIR KIRCHNER: The staff had carveouts and we identified, I would say, just concerns is maybe a better way to put it. Just, you know, for background, it's probably useful because we have so many news members to just revisit what happened.

We were proceeding almost at lockstep with the staff as it went through its first review of the

DC application, and that was chapter by chapter, and we were kind of locked in to SER chapter by chapter. And we made a decision after that first pass through. The staff was issuing SER chapters with open items, and then the process they were using, they were going to revisit each chapter and close out the open items to get a finished product.

We decided not to do that. That's when we adopted the approach of saying, "What are the safety-significant issues in this review that the Committee should concern itself with and devote time to?" And those were items identified with EECS valve performance, steam generator tube integrity, boron dilution, this matter of how in the DCA they were proposing to do post-accident containment atmosphere sampling. And then the overall PRA results.

So those were the five focus areas we identified, and when we did our second pass, we did look at the chapters for closing out of open items, but we focused most of our attention on those five technical areas, so to speak. And some of them were -- open is not the right way to describe it, but from the DCA, there were concerns identified.

So there was the mention of carveouts, so there were a few areas, including the steam generator and its integrity, that were carveouts in the DCA review by the staff where the staff and the applicant agreed that further effort was needed. For example, one was ECCS valve testing. So by and large, that's been completed. There were some changes in the valve designs. You heard about the IABs being taken off to the valves.

So they've done that testing. They've done further testing on the steam generator since the DCA, and then they obviously made several important design changes to address the issue of boron distribution and potential dilution in a number of the transient scenarios, small break and cooldown ECCS actuation.

So the message I was trying to convey was that significant important design changes were made by the applicant, not by us, but the applicant deserves the credit for taking initiative and completing those testing programs that they had committed to, as well as making a number of design changes that improved the performance and took questions off the table, if you will, from the DCA review to where we are now.

So I tried to approach the letter from that perspective and address in the background -- and the reason I put most of the design changes in the background, again, is these are changes that the applicant made, improvements and design choices. They were not the Committee's choices. The applicant deserves the credit for implementing those and completing the testing and such. They changed their approach on the steam generator. They changed the design as well on the inlet flow restrictors and such.

So I was trying in the letter to capture the significant deltas in the design changes from the DCA, credit the applicant where due, and then try and close the loop in terms of what does this mean in terms of improving the safety of the design? And I think these, putting aside the PRA results changing, their changing, we're up there with vary significant margin to the Commission's safety goals as far as the PRA results.

So we can get into the weeds on the PRA, but the bottom line is that they have demonstrated significant margin to the safety goals. I was putting more of my thought and attention and words -- too many words, I think -- into how they implemented design changes and how that improved the overall design of the plant.

So in that sense, I was closing the loop on where we had left off on the DCA where there were

--

MEMBER PETTI: Walt, it's only 150 lines before you get to discussion.

CHAIR KIRCHNER: Yeah.

MEMBER PETTI: So I don't think that background -- that's all right where you talk about it. It's really, I think, the discussion is what is almost 300 lines. Twice as long as the background.

And maybe the answer is moving it to an appendix, but it has a lot of --

(Simultaneous speaking.)

CHAIR KIRCHNER: Well, most of this material came from our chapter memos.

MEMBER PETTI: Memos.

CHAIR KIRCHNER: So it's there, and some of them might have additional information that we've received in the last week. Might warrant being revised and updated to capture that information.

My own sense is, again, I took your input, so each of these sections under discussion could be, perhaps, condensed if not made much more succinct. This is what changed, and this is the impact primarily in terms of the safety analysis results.

MEMBER HALNON: Sorry. Sandra, if you just go up to 163 real quick, and I'll just give you an example of what at least I perceive as being able to do.

So 163 starts the ECCS valve performance. That first gives you background, what it is, how it works, what it does. That second paragraph -- go up to 174 -- that paragraph is really all that's required. I don't even know if you need to go as far down as TRACE and all that stuff. When you get down to that point where it said, "The applicant's accident analyses appropriately --" this is 180, "-- appropriately reflect the changes made to the ECCS 460 design," what more do we need to say?

In my mind, it could be --

CHAIR KIRCHNER: You could collapse it.

MEMBER HALNON: You could collapse it down and start with the end of line conclusion of what do you need to make that conclusion clearer. And then the rest of the stuff, if you want to put it -- that probably in the DCA application. I just don't know if we need to do a tutorial on how the systems work in order to be able to say the conclusion. I'm not suggesting we edit it right now. It was just an example.

The portion of the tube steam generator tube design, we have flow restrictors were installed.

I mean, what's the delta? The flow restrictors being pushed the temperature curve, whatever you call that. And then the accident analysis further addresses the stability.

MEMBER PETTI: The boron section is very long. There is a lot going on.

MEMBER HALNON: Yeah. So I think there's a lot of information that's -- I don't want to say redundant, but maybe is --

CHAIR KIRCHNER: Extracurricular.

MEMBER HALNON: -- low-level of detail not necessary to support the conclusion.

CHAIR KIRCHNER: Let me go around the table and get input. I'll start with Craig. Craig, you looked at the ECCS containment, their systems. The ECCS valve performance, what would you consider the key takeaway or message that we want to convey here?

MEMBER HARRINGTON: To me, the big piece there is the closing the loop part to the DCA. There's a connection from that to PRA issues as well. To Greg's point, when we started talking about this, I looked at that section, and the first paragraph is just something that, yeah, it explains how the system works, but we really didn't do that in this letter.

I don't think we do.

So kind of agree with Greg's comment about that, that much of the rest of this could go away. We might want to keep some form or fashion something about the greater likelihood of an RVV actuation with the removal of the IABs and how that ties in with PRA, but that may not be all that critical, and it certainly doesn't go with closing the loop to the DCA. Yeah, a lot of that could come out.

Same with the steam generator part. Maybe we can just succinctly state that these were made to better manage that issue, the DWO issue, and --

MEMBER BALLINGER: Yep.

CHAIR KIRCHNER: What do you think, Ron, on the steam generator?

MEMBER BALLINGER: I was wondering that there are two sets of things that happened between the DCA and the SDAA, and that is issues related to safety, the boron dilution, da-da-da, those resulted in changes of the design. But there's another set of changes to the design that were simply made to go from X power to Y power.

MEMBER HARRINGTON: Yeah.

MEMBER BALLINGER: And I don't think we need to say anything about that. I would focus on the first set.

MEMBER HARRINGTON: Maybe a statement that that was done.

MEMBER BALLINGER: Yeah, yeah. But you could shorten it up. And that should be reflected in the conclusions and recommendations, which they're not. I mean, they're way general. It's a great thing, we should do it, and all that stuff, but we really went round and round and round, and the staff went round and round and round on some of the issues with the DCA.

I don't know. I just wondering whether we can shorten it up quite a bit by focusing on the issues that were brought out in the original design, which they addressed.

MEMBER BIER: Yeah. I think I would agree with that. I mean, certain things like including the Venturis, it gives a very concrete idea of that the changes to improve safety were significant, they were just causing it occur, you know, pencil whipping or whatever, and the power issue is not really directly related to safety other than, yes, they appear to have done it correctly or whatever.

MEMBER BALLINGER: I mean, the materials changes were because they needed to go from one power to another.

MEMBER ROBERTS: The EDAS issue was documented in two relatively long paragraphs because it took months to get to a conclusion, which I think we heard a conclusion this afternoon. I'm not entirely sure that the non-concurrence has been fully resolved, but it sounds like there's a resolution that, at least to me, makes perfect sense. For us to spend a lot of time on something that's not really a safety issue, it took us a better part of a year to get to that conclusion, it maybe doesn't warrant any mention in the letter at all.

MEMBER BALLINGER: That discussion might result in a precedent being set.

(Simultaneous speaking.)

MEMBER ROBERTS: Yeah. I don't know. The non-safety with important safety --

(Simultaneous speaking.)

MEMBER BALLINGER: Yeah.

MEMBER ROBERTS: -- or whatever. I don't know if that's something that's a precedent or just part of engineering.

MEMBER PETTI: May I ask on a question on the PRA? Is this the first application that we've seen, the PRA was quote, used, in the design process.

Did AP1000 use a PRA in the design process?

MEMBER DIMITRIJEVIC: Well, everyone did.

MEMBER PETTI: No. I mean the legacy fleet. The legacy fleet doesn't. I'm talking about the new ones. They have to do. Is this the first one? I'm not --

MEMBER DIMITRIJEVIC: I don't know in the new process, Dave, but everybody uses PRA to extend advanced reactors in the design. I would not any say this was extensively the other issues, the things which brought some of those changes, because those scenarios didn't exist in PRA and they still don't, you know, boron dilution and that. And in general, issues did not come from PRA, so I mean, you know.

But on that perspective, there is nothing really, you know, special here compared with, you know, my other experience with advanced reactors. My main goal in the PRA, so they have low numbers, right? We should always be uncomfortable with low numbers because they cannot be realistic. They are often not realistic. I don't want to say they cannot be realistic. There is a lot of things that I'm not really totally 100 percent comfortable, and that's because I have not looked in thermal hydraulic analysis behind that.

The thing is, like, for example, this plant cannot have LOCA site containment, which is, you know, unheard in the industry because it depressurize fast enough. What does it mean fast enough? What has to be done to that to be succeed? The things like that stay in the air, but for example, steam generator tube rupture is not suddenly -- I apologize for NuScale. I know it's a failure. But it's I'm so used to the steam generator tube rupture.

So in general, the tube failure is not really important so much because it does not lead to, you know, the loss of coolant outside of containment because it depressurize fast enough, it basically is no event.

So there is a lot of assumptions made here. My main point in the PRA was this is very big PRA, a lot of details, but somehow, in the end all of these should fit together. They miss a lot of points that will leave anybody who reviews that PRA, who has a lot of experience, slightly uncomfortable.

What made me uncomfortable is that, for example, you know, ECCS valves, those are like the most dominant thing in the risk. Those are new valves. We have to assume their failure rates because there is no industry data on them, and we can still assume common cause factors for them.

So now we assume -- I don't really know because that's a multi-factor, and I did not look in details, but I have a feeling approximately seven out of 100 failures between those valves will be from common cause. And I have a feeling that that's really optimistic. If these valves fail, there is a high chance that they will fail from common cause. These make them fail in these situations.

So there is a lot of assumptions we should make because it's a new plant and we have so many new design features, which should be kept in mind. With data sensitivity, they say all common cause factors increase to 95, so we don't really know is it from failure, is it from common cause factors, is it decay heat removal system?

I am very interested in importance of decay heat removal system, which through all this discussion I could not really figure out, because obviously, decay heat removal system was very important to prevent a LOCA outside containment. And I had a feeling was important also to prevent these boron events, but that prevented that, you know, that things like the looking at this make us thinking that this thing said okay.

But if you just change a little in the sensitive places, you just take a little bit, suddenly, you can be ten to minus seven. And then suddenly not everybody will say, "No, that's still good. It means the goal." But they will not say, "Oh, okay. Now we don't have to worry about anything," because it's not true. You should have important assumptions. You cannot say, "Oh, you know, in ten to minus nine, nothing is important." That's not the good engineering.

You should really look in detail. So when I was writing, and I wrote only two pages, I really didn't really, you know -- I tried to keep that as small as possible. I wasn't writing to the -- I don't even know who we writing. I was writing for the future people when they completing these things, saying, "Hey, look at the sensitivity combinations." Don't say something is sensitive to something and then don't have that considering the uncertainty approach, and make sure that this is true that no human actions are important and not any other system are important even they are providing certain defense.

My letter was for the future NuScale analysts. It wasn't just for Commission to say that we agree with this SER because I don't think there is the doubts we are here. We are going to prove it in this meeting.

Also, when come on the length of the letter, okay, we decide in some moment in one thing the shorter letters are better because they get to the end or that it's easier for us to write them or something, you know. If we have to say something, I think that the letter limits should be the issue. If we are repeating some things which are known, we definitely should cut on those. That's my --

MEMBER HALNON: The issue was not the length; it was the dilution of the important points, not necessarily the length. It could be a thousand-page letter as long as the important points are hit, not put in with a bunch of other stuff.

MEMBER DIMITRIJEVIC: All right.

MEMBER HALNON: I agree with you, though. You don't strive for shortness. That's not the way. It's clarity and completeness is the goal.

MEMBER DIMITRIJEVIC: All right. Maybe then we should in this big picture decide what are our important points and make that those are made.

MEMBER HALNON: Yeah. I think we're probably dancing around that exact point. I did have one question though for you. Help me understand the difference between a very important portion of the PRA and very important to safety when we're dealing with very low numbers. Is there a difference there?

I realize you cut the grass, there's always going to be one blade that's higher than the rest. That's the most important. You got to go back and get that. But when it's way far from the safety goal or whatever threshold you want to call it, is there a difference between very important versus very important to safety?

MEMBER BIER: Let me try and respond to that, and it may not be the same as Vesna's response.

MEMBER HALNON: She'll correct you.

(Laughter.)

MEMBER BIER: Yeah. She'll say. Yeah. But I mean, I think part of it is it kind of relates in a way to what Vesna was talking about of what's good engineering practice, because if the total risk is extremely small, it may be that those few tallest blades of grass are not significant from a public health and safety point of view.

But I think as a risk manager or a plant manager or whatever, you still want to know which things should I be the most concerned about, which things should I be looking out for or tracking over time or investing in. And it kind of answers that question of, yeah, your plant looks very safe from what we can see now, but that doesn't mean, like, okay, you're done. Hands off, walk away, and don't look at it again.

So that would be part of my answer, but Vesna, I'm curious to hear what you would say.

MEMBER DIMITRIJEVIC: I mean, you know, the reason, you know, safety and non-safety and important, not important, I don't really know that safety was. I was listening carefully to many things through my Committee meeting to figure out exactly how the safety versus non-safety is determined. That's not PRA. PRA is an important, not important because that safety, you know, you don't write. Either you satisfy whatever deterministic requirements to be categorized as safety or non-safety.

Now, important for safety, it comes from how much it contributes to the risk. And so it could be, you know, like for example. I'm not sure how this works in the practice, but we don't really have too many safety system. That mean this plant can operate without all of those system for very long time because work with the tech specs, you know, charging on the other parts which are non-safety, you know, the DC power or something like that.

So it basically, this plant will be totally fine without non-safety system. When it comes to the --

MEMBER HALNON: I wasn't talking about classification. I was staying strictly in PRA space. Important versus important --

MEMBER DIMITRIJEVIC: All right. Well, the report tells you including plants if it contributes to the half of the percent to the risk, then it's important, and if it is remove, it will increase risk twice is important. Here, those things are changed, so if it contributes 50 percent to this, it's important.

And it is dependent on how much contributes to the risk and how much will risk increase if it fails or if it's not in operate.

MEMBER HALNON: I guess the question was more if you start with a threshold like this and adequate safety sign, and you're decades and decades below that in your numbers, why can't we let it stay decades and decades below that, say, that's okay space, as long as --

MEMBER DIMITRIJEVIC: You know, Greg, nobody uses these things. I mean, it's not really that the design plant. This 10 CFR 50.59, it's, you know, forbidden and unfortunately not used. This plant has nothing important other than ECCS and, you know, ultimate heat sinks and reactor vessel and containment which every plant is important.

So it's not that this importance has any meaning in the plan design. I mean, you know.

(Simultaneous speaking.)

MEMBER HALNON: Yeah. I understand good engineering practice, at least judgment and looking at things like that, knowing what's the most important. But you connect that up with having to put words on a paper that translate into a supply chain, a cost, and a program, and everything else down the road, and you have to assess, at least in my mind, the cost of that versus the ability to say you're way below the line from the standpoint.

And we shouldn't have to worry about it because we designed this plant with such safety margin that it did that so we don't have to worry. We design everything such that we worry about everything. We're never going to get there.

I guess that's the discussion down the road, I guess, when you got to get to the PRA discussion. You know, mathematically, I get it.

Conceptually, I get it. Practically, it doesn't work. So it's just me.

MEMBER DIMITRIJEVIC: Okay. Well, there's one other thing which I just want to tell you that you should keep in mind. Safety, non-safety, this is where your price gets it. Important and not important, that doesn't really put price to the level safety but the sort of dedicated application which nobody really is used so far in this industry, and nobody really knows what price of that is.

So I don't think the PRA in this plant definitely didn't contribute for anything because anything is important. Anything is not important, but eventually will contribute to something which will be between safety classification and non-safety classification sort of dedicated probably tasks to show the reliability and things like that.

MEMBER HALNON: Well, I get the insights from PRAs are important, but we're either going to use them or we're not. And in this situation, I would say that I didn't even need a PRA. I could have told you the ECCS is probably the most important piece. I could have told you from a deterministic perspective that EDAS is an important system, but it doesn't have to be safety-related. I could have told you all that stuff, and we don't even need to spend the money on a PRA. Well, to just do the PRA, then suddenly say it doesn't matter what it says, I think this is important. Main insights.

MEMBER DIMITRIJEVIC: I did not hear you, Greg. What system you were talking about?

MEMBER HALNON: Well, I could have told you without the PRA that the ECCS system is in just about every nuclear plant, if not all of them, are one of the most important systems. So I --

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: Well, PRA must have done --

MEMBER HALNON: I didn't need the PRA to tell me.

MEMBER DIMITRIJEVIC: Yeah. Very good. So let's cancel Chapter 19. I mean, if PRA was done to tell you what system is important, I mean, Chapter 19 is a part of FSER. What in the 53 to be done without PRA?

MEMBER HALNON: Without PRA? I don't know if I'd need Chapter 19 if we did the PRA. Oh, never mind. Let's move on. Again, we're philosophically talking at this point. Trying to get through this. Trying to give Walt time to read and make decisions.

(Laughter.)

MEMBER ROBERTS: And Greg, I have maybe a slightly different answer to what you asked and Vicki or Vesna. So when I look at the ATWS risk, they have covered it with a reliable protective system and a plant that can withstand the loss and scram. Each of those is robust. How robust are each of those?

If you look at the design of the protective system, it's a single platform, which is very well designed by a single designer subject to whatever common cause failures you can dream up for a common platform. Not all of those have been covered by the design because it's probably also covered by the design.

So you have an estimate of what the failure rate might be. You might estimate ten to the minus eight and that wouldn't be a believable number. You might estimate ten to the minus five. That might be a believable number. I don't know. But there's some scenarios that are going to cause a common cause failure of a single platform, whereas the NRC table but the conclusion 40 years ago that you can't ever count on a common platform. You have to have a second platform unless the plant could withstand the event.

Well, in this case, the plant could

withstand the event, so the fact that there is a highly reliable platform is, you know, basically gravy. So you could do the analysis and say, well, if I'm wrong there, no big deal, that the plant is a plant. Great, good performance.

If you had a different plant where you had your ten to the minus eight model protective system, but the plant, if it failed, you would go to a catastrophic state so now you have ten to the minus eight as your CDF or your LRF, whatever parameter, you might think that's great. That's well under the goals. But if you're wrong about the protective system reliability, you know, that caused quite a different area.

So that's where if you were looking at these relative statistics, then that will give you some insights. And yeah, if I'm wrong, you know, I'm in a place I don't want to be, so maybe I'll go redesign something else in the plant.

MR. HANLON: It sounds all great until you start actually drawing out what ten to the minus eight looks like, ten to the minus five. I mean, there's lots of zeros there.

MEMBER ROBERTS: Yep.

MR. HANLON: And if you can't believe that there's seven zeros, that's too many, I can't believe that. Five zeros, I can believe. I don't get it. From an operator perspective, my mind doesn't go there. Mathematically, I get it, but practically, it doesn't make any difference.

MEMBER ROBERTS: Right. And historically, the deterministic requirement is you have a protective system that's diverse in totality, a diverse system, or a plant that can withstand it. Here there's kind of a middle ground.

MEMBER HALNON: Well, I just have to --

MEMBER ROBERTS: And a middle ground may be perfectly reasonable, particularly since this middle ground is a pretty strong case.

MEMBER HALNON: I'm just asking if something comes out ten to the minus eight, just leave it and move on. If it's ten to the minus five, let's leave it and move on. But don't sit there and say it's ten to the minus five in this case, and I believe it, and ten to the minus eight, but I don't believe it, so do it anyway. It doesn't make any sense to me. Either we're going to do it and believe the PRA. It's low-risk, lots of margin, let's move on. Or we're going to --

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: Okay. I not feeling great, so I shouldn't defend the PRA, but, you know, this is a very specific plant. It's a passive plant, and it has features which we are not familiar with. I can give you many an examples in the current fleet where there is no way that people could predict what is the safe system, you know, most important system, you know. Like, nobody will say the Seabrook most important system is service motor or component cooling, which are not even safety systems.

So the thing is that PRA brought some new insights discovering these hidden, you know, dependencies. Everybody says these generators are important, but nobody says service motor is important because it cools them or the service motor cools the ECCS in Seabrook, which is important for the still LOCAs. Things like that are discovered in the complex system through the PRA models. I just saying they're not really used as much in risk informed application, and that's a pity.

Here this is very specific plant relying on the passive features, and there is, you know, not too much to say. However, those passive features are new. We don't have experience. We don't have a failure data. We have to learn about that.

MEMBER MARTIN: I can't help but think, you know, our jobs should be easier than what we're talking about because we're beginning with a design that was already approved. Now, some of the things that we're critiquing, you know, really go back before that, correct?

And then maybe to your point in the letter, our methodology, the delta, if we just kind of proceed through the deltas and, like, for PRA, are we more reliable? You know, those kind of questions that were before us as what NuScale has shown us the last two years was just, you know, farther away from, you know, the threshold they had before in a good sense, you know. When it comes to a common A, the power uprate, you know, Ron, like I said, we don't need to have a lot of that stuff in there.

They provided more evidence on, you know, at least in Chapter 15, in deterministic sense that, you know, we can say, well, that wasn't there before, but now it's now there. And, you know, we like that. I think focusing on the deltas gets us through the letter, and maybe in that sense, we could filter out that it wasn't as important and bring it down by 30 percent, 25, 30 percent. I think our target is a specific number of lines.

MEMBER PETTI: But again, to what end?

MEMBER SUNSERI: I think the delta review is a good way to get through the material. But from our perspective, making a safety statement about this particular plant, I think it has to be comprehensive. I think, you know, Dave or Greg or whoever is saying, we should come out strong on the four or five things, whatever they are, three, and make this plant safe, passive designs and all that stuff.

Sure, the passive cooling only works if the ECCS valves couple the system, so that's something that needs to happen, but, you know, the fact that we learned that through a delta review doesn't take away from the fact that that is part of the big picture, right?

I go back to my original statement. I just lose the big picture the way the letter is constructed. We had something up front that said, "Here's why this plant is safe," and then the rest of the letter supported those four things and then there's technical detail that's important to have but not directly related, put it an appendix or knock out it or whatever we want to do. But, you know, I feel strongly that our letter has to have a big impact on why this is safe for all the right reasons, and then the supporting stuff comes in.

MEMBER PETTI: I would just note I was struck, now having looked at TerraPower, little bit of Terrestrial, knowing what the gas reactor guys are going to do, looking at this, there's a lot of commonality in design space to reduce risk. It's passive, no operator action. You're going to see a lot of them coming. No need for power for safety functions to be actuated.

We're going to see this over and again, so we shouldn't be surprised when the PRA says numbers that are really low. They are designing using the PRA to make sure the number stays, in their mind, very low, whatever you want to quantify it. But that's what they're doing, and coupling it with the inherent characteristics of each technology, which can be a little bit different in passive design.

MEMBER HALNON: And my point, Dave, is that we just got to believe it and move on. If we don't believe it and move on, I mean maybe we find stuff that's --

MEMBER PETTI: Yeah. NuScale spent two billion dollars to get here from what I'm told. If that ain't enough, we ought to go home.

(Laughter.)

MEMBER PETTI: You know? Because, A, I don't think any of the others are going to spend that type of money, you know. It's about as good as you can do from the engineering perspective, if not a little bit more than maybe is good enough.

And my go is this didn't all happen by accident. They made design choices. Design is everything here in terms of the leverage, and that's what you want to highlight, I think, is to say, look, there are important things that were done, whether it be the SDAA or not, that in part the safety attributes that Matt says we want on.

You can take out the paragraph on the source term and the post-accident monitoring because I don't think it even needs to rise to our letter. It's a design change they made. I don't think it gets there.

CHAIR KIRCHNER: It's a very good design change.

MEMBER PETTI: It is. I mean, it is, but in terms of the ones that -- if we're going to talk about any specific things.

CHAIR KIRCHNER: I don't want to harp on it, but I will because it's an excellent design change because prior to, they would have opened up containment and risk, not only bypassing containment, but exposing operators in the course of trying to take a sample for post-accident atmosphere assessment. By putting the combiner in, you don't open it up. I mean, really, it's a major. And it's passive.

MEMBER HALNON: In that kind of situation, there's probably a couple of those.

(Simultaneous speaking.)

MEMBER PETTI: But then everybody has to go back and write their section in seven lines.

MEMBER HALNON: Yeah. Well, no, you just go at the end and say --

MEMBER PETTI: You know, it's short and sweet.

MEMBER HALNON: -- "In other notable improvements in a design for risk reduction are --" bullet, bullet, bullet, bullet. You don't have to explain what they all are. I mean, I realize these letters got to stand on their own, but they don't.

MEMBER PETTI: Never. You have to go back and you have to --

(Simultaneous speaking.)

CHAIR KIRCHNER: And we're going to have the chapter memos in the --

MEMBER PETTI: Absolutely.

CHAIR KIRCHNER: -- back, so we could put those bullets in --

MEMBER PETTI: And say, "See chapter --" Yes.

I'm the only who sound like a contrarian, because I tend to agree with you, but we do not know anything about the SCDA, the certifying design? We wouldn't even talking about this thing because it was just another -- I mean, this was the only plant we saw. We wouldn't even be writing about this.

CHAIR KIRCHNER: No, I hear you. If we didn't see the DCA, we just saw this, then --

(Simultaneous speaking.)

MEMBER SUNSERI: Some of the DCA was -- the carveout of the part is -- I don't want to get too nuanced here -- but, you know, some of it was because they weren't complete with their design yet. Some of it was they weren't complete enough to know that there were problems with their design. So I mean, you know, not all carveouts were equally made, I guess.

And so, you know, whether or not one needs to be referenced back in this letter to say they've addressed the point or not, now I'm talking myself out of it. There's some tying back to the original letter, but anyway.

MEMBER MARTIN: Several of the carveouts, I mean, they really were truly for the COLA, right? I mean, they tended to get resolved this second go-round. So to focus on carveouts, per se, obviously, would be appropriate by just going back to the safety questions and the DWOs probably should be on the list and the boron dilution, sure criticality on the list.

You know, if you don't keep on talking about PRA and maybe move into the PRA discussion really focused on design improvements that were made with insights from PRA, that might knock out ECC performance and ATWS and maybe even the source term section. They could have bullets or something like that that kind of condense the content there all under the heading of, you know, reliability improvements gained by PRA insights. I don't know. I'm obviously spitballing.

And then, you know, retain most of the sections on DWO. And ATWS can be condensed as kind of Tom had mentioned earlier. What else do we have in there?

CHAIR KIRCHNER: So the boron dilution one definitely --

(Simultaneous speaking.)

MEMBER MARTIN: Of course, yeah. That can probably more or less stay like it is. It's not going to get through our line by lines unscathed, of course, but --

MEMBER PETTI: It really needs to be condensed. The problem is that some of it just to set it up takes a lot of time because these are subtleties here from a hydraulic space to get you to understand it.

MR. SNODDERLY: Well, and as, of course, we've all noted, we have the memos. The challenge for the final letter is you obviously don't want to repeat what's in the memos, but there are certainly some cross-cutting issues that the final letter can kind of pull all together and integrate.

And I think that's what I kind of see you did, Walt, for both the issues try to bring in where, you know, Chapter 8, 15, and 19, you know, that always tries to get in there. Or 5 and 15 with DWO, you know, those sort of things. I think when you originally outlined the letter, you identified not just one person necessarily for sections, sometimes you had teams that were contributing from their perspectives of their particular chapters.

MEMBER SUNSERI: So in order to move

forward, can we maybe take like five minutes to go around and just list from each member's perspective what are the key safety things that they see at this plant, use of passive designs, no need for off-site electrical power. I mean, everybody has probably got their one thing or something that they like. And then we can agree on the list of back out from -- or, you know, make sure that the letter supports that. I don't know.

MEMBER PETTI: We've already said that in the previous letter.

MEMBER SUNSERI: This is like starting over. This is a SDAA of a new plant, okay? Nobody is going to say when they build this plant, "Oh, by the way, there's a certified design out there." They're going to reference this one. Has to stand alone, stand on its own.

MEMBER PETTI: So Matt, I had eight design and operational features. NuScale ensures its safety through several key design and operational features: passive heat removal, passive ECCS, reduced stored energy, low source term, supplemental boron system, containment bypass minimization, no operator actions required, and no safety-related --

(Audio interference.)

CHAIR KIRCHNER: Great list. Well, obviously I had the list in front of me, and I thank you, Dave. Yeah. And I tried to make sure in the background section that I kept each bullet rather than just putting them in as a list.

MEMBER PETTI: And then I put a sentence after each one to explain what it is.

MEMBER DIMITRIJEVIC: Dave, why did you identify this boron thing as a safety part? Supplemental boron.

MEMBER PETTI: Minimized the potential for return to power through the emergency boron system.

MEMBER DIMITRIJEVIC: I mean, that's in every plant, you know. And the other thing, did you put the pool?

MEMBER PETTI: Yes. That's in one of the others. Yeah, it's in the passive heat removal.

CHAIR KIRCHNER: Passive heat removal.

MEMBER PETTI: "Utilized a large pool as its ultimate heat sink for passive heat removal through redundant decay heat removal systems." "ECCS," I said, "uses highly reliable independent hydraulic actuation systems on four valves to condense steam on the containment vessel surface, maintain sufficient inventory to keep the core covered during all postulated events."

I was just trying to think at a high level what are the takeaways. Restored energy was really to address ATWS.

MEMBER HALNON: If he started a discussion with that paragraph on those, whatever, and then finished with some notable deltas between DCA and SDAA, and then ended it with -- that's really long at that point -- to support the safety. It's all in here.

MEMBER SUNSERI: Yeah. You could look at, you know, salvaging a lot of stuff where you need to. Is there some place very prominent what we feel the safety case is and what we agree?

CHAIR KIRCHNER: Anyone else? Well, then --

MEMBER BALLINGER: You know, I think Dave's got a great -- that's a great list. We could probably make this letter very short, putting that list in their right up front, adding a few words in the discussion about each topic, and then include a discussion that address the issues that were brought up in the earlier design that we brought up in a previous letter.

And that satisfies both the safety that

you're talking about, and it suggests or demonstrates that the issues that were brought up for the earlier design have been addressed. Those are the key things, are they not?

CHAIR KIRCHNER: Probably, but I would modify that a little bit. I don't think we have to go back and look at everything in the previous letter, only the things that would be relevant to this particular design.

MEMBER BALLINGER: Right. Yeah. Yeah.

MEMBER SUNSERI: So, you know, the steam generator flow vibration, that's a big deal, all right. That was a --

MEMBER BALLINGER: But they had flow restrictors in the original design.

MEMBER SUNSERI: Yeah.

MEMBER PETTI: It's different though.

MEMBER SUNSERI: That was --

MEMBER BALLINGER: But they were different, but they were still flow restrictors.

MEMBER PETTI: Yes.

MEMBER HARRINGTON: The difference is interesting and it's useful, but it's not determinative for this design. It's just different.

MEMBER BALLINGER: Well, it is to the

extent that they understand the DWO much better, and the flow restrictors in that design was to deal with the DWO, right?

CHAIR KIRCHNER: On both designs, the --

(Simultaneous speaking.)

MEMBER BALLINGER: Yeah, both of them, but I think they did more analysis.

CHAIR KIRCHNER: Well, this is a much simplified and improved design because -- well, we don't have to rehash the old design, but that had significant --

(Simultaneous speaking.)

MR. BALLINGTON: But the DWO, well, the sentence in there about the restrictors new design or whatever that addresses DWO, that's one of your -- on the list of things.

CHAIR KIRCHNER: Okay. Well, I think it's coming up to break time, and I would propose that take a break. I will reach out to a few individuals offline, and I'll go away and take what I've heard and reformat the letter accordingly, and probably shorten it considerably at the same time, and try and turn something around and provide it for your consideration, if not this evening, tomorrow.

Let's look ahead to the rest of our agenda and just discuss how we use our time accordingly. We had budgeted this afternoon for the NuScale letter report. Bear with me and I'll get the agenda. We are scheduled to take up first thing tomorrow the TerraPower Topical Report on source term. Dave has cautioned me that that's a long letter also. And we've got the morning budgeted for that.

We have the afternoon for the Seabrook. I sense from looking at the source term draft letter report that we will take that whole time and then some.

What's your sense, Greg -- Looking ahead to tomorrow afternoon, we have the Seabrook and the ASR topic on our agenda. What's your sense of agenda timing schedule?

MEMBER HALNON: I think that we'll be done well before 3:00 o'clock. I think it'll be more maybe a couple hours, given the fact that we have a presentation by C-10 and there's no presentations after that. It's just us discussing what our next steps would be based on the information we received. So I think we'll be done by the first break.

CHAIR KIRCHNER: Okay. So then we could come back, if we're ready, to either continue the source term letter -- that might be the right thing to do.

And Thursday morning, we have P and P for starting off the morning. Let me turn to Larry Burkhart who leads this. Larry, what's your sense for the agenda --

(Simultaneous speaking.)

MR. BURKHART: It's fairly short, so I would be surprised if we went more than two hours for the P and P. Probably less.

CHAIR KIRCHNER: Okay. So that leaves us Thursday morning and the latter of Thursday morning if we're efficient on P and P, and then Thursday afternoon and Friday is set aside right now for letter reports.

MEMBER PETTI: So Walt, do we have all the NuScale letters done? So we don't have to review any?

CHAIR KIRCHNER: No. One, four, eight, 15. They're all in the P and P folder and NuScale letter.

MEMBER PETTI: You're saying that probably is Thursday.

CHAIR KIRCHNER: That's Thursday. But we're not going to go -- oh, we could do it now.

MR. BURKHART: Depends when you want to do them. If you wanted to do them now, we could.

MEMBER PETTI: After break.

CHAIR KIRCHNER: We could do them now.

MR. SNODDERLY: 8 and 15 are ready. One hasn't been reviewed by NuScale, but I'm pretty confident there's not proprietary information and NuScale could, you know, if they see something, they can let us know. We should have NuScale's comments on four tomorrow, so I think four would be better off done Thursday. Fifteen and eight are ready to go. You could knock out one of those two.

CHAIR KIRCHNER: Come and --

MR. BURKHART: Four didn't even have a proprietary version.

MEMBER MARTIN: I'm happy to read them in. I mean everyone's going to fall asleep by the time we get to the end if I read it in.

MEMBER PETTI: I'm just trying to take stuff off.

MEMBER MARTIN: Absolutely.

(Simultaneous speaking.)

MEMBER PALMTAG: You have a lot of good stuff in there that was in the XPC topical report, and there were some questions about where that goes. It wasn't quite in 15, and if we take it out of the final letter, where could we put that? I mean, it was kind of a last minute.

MEMBER MARTIN: Nothing says we can't put it in 15.

CHAIR KIRCHNER: We could put it in 15.

MEMBER PALMTAG: I wanted to capture that somewhere because it was a last minute thing. We didn't really know where to put it. I'm kind of worried that if we take it out of here, we're losing it.

(Simultaneous speaking.)

MEMBER HALNON: Take a break. You come back. Might as well just make it longer. I mean, it's not going to get shorter.

MEMBER SUNSERI: These memos don't have to be to the same level of scrutiny either.

MEMBER HALNON: Exactly.

MEMBER SUNSERI: Just cut the paragraph and paste it in there.

MEMBER BIER: I liked Greg's idea about that instead of rewriting everything that was already in the chapter memos, maybe we should just make the appendix be the chapter memos and then highlight key points from each. Yeah.

CHAIR KIRCHNER: We will do that. They are all referenced in this letter.

MEMBER BIER: Yeah, because then it significantly reduces the amount of editing we have to do, I think.

CHAIR KIRCHNER: Okay. So 15 and 8 after the break? All right. Can we be ready to do that, Mike?

MR. SNODDERLY: Yeah. Yeah.

CHAIR KIRCHNER: Yeah. That's do that, then. All right. I think it --

(Simultaneous speaking.)

MEMBER PALMTAG: Four is very short, and there was no proprietary version of Chapter 4, right?

MR. SNODDERLY: I agree with Scott. I still think we start with 15 and 8, we get those done, and then do four.

MEMBER HALNON: You could read the Chapter 4 memo right now.

MR. CUMMINGS: I will check to see if we've reviewed that for proprietary information.

MR. HANLON: We're just worried about proprietary information and accuracy.

MR. CUMMINGS: Yeah. We're reviewing it now for proprietary information. This is Kris Cummings, NuScale.

CHAIR KIRCHNER: Yes. We can always do

our part just to --

(Simultaneous speaking.)

MEMBER HALNON: By the end of the afternoon, I think we'll have it.

MR. BIER: Yeah.

MR. SNODDERLY: They said tomorrow. Why don't we get through 15 and 8, see where we're at. But I'm with Scott. I'm pretty comfortable that there's not anything proprietary --

(Simultaneous speaking.)

MEMBER PALMTAG: It's already 3:15, so there's not a whole lot of time.

CHAIR KIRCHNER: So what time is it now?

(Simultaneous speaking.)

MR. BURKHART: So Chairman --

MEMBER ROBERTS: It's 3:15.

MR. BURKHART: -- before you break -- this is Larry Burkhart from the ACRS staff -- we have had the court reporter on, so yes, I recommended we leave him go, and he can come back tomorrow morning at 8:30.

CHAIR KIRCHNER: Okay. Did you get that? We'll let the court reporter go, and please be back with us tomorrow morning at 8:30.

(Whereupon, the above-entitled matter went off the record at 3:14 p.m.)

From Section 8.1.2:

NuScale stated, in SDAA Part 7, “Exemptions”, Section 4, that it requests an exemption from GDC 17 because the design contains no safety-related functions that rely on electric power. NuScale stated that the design of the NuScale Power Plant provides passive safety systems and features to accomplish plant safety-related functions without reliance on electric power, and that the design, therefore, meets the underlying intent of GDC 17 without the need for the electric power systems specified in GDC 17. NuScale further stated that it requests an exemption from the GDC 18 requirements for inspection and testing of electric power systems and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44 to address conforming changes and that the underlying intent of these requirements, to ensure sufficient electric power is available to accomplish the safety functions of the respective systems, is met without reliance on electric power.

In its request for an exemption, NuScale stated that it seeks an exemption because its design does not rely on “safety-related” SSCs. However, the GDCs at issue (GDCs 17, 18, 33, 34, 38, 41, and 44) pertain to SSCs that are “important to safety,” not “safety-related” SSCs. Nonetheless, notwithstanding NuScale’s focus on safety-related SSCs, the NRC staff finds that the request need not address SSCs that are “important to safety,” in that there are no “important to safety” electrical systems in NuScale’s design (i.e. all electrical systems are non-safety related and are not important to safety) because they are not needed to “provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public.” NuScale and the NRC staff considered all power systems for the NuScale design, both onsite and offsite. NuScale designated all onsite and offsite electrical systems as non-safety related and determined that there are no other electrical systems that should be classified as important to safety. The NRC staff conducted an audit of the electrical systems in NuScale’s design. Based on its review and audit, the staff concurs that none of the electrical systems in NuScale’s design are important to safety.

For offsite power, FSAR Section 8.2 states that the passive design of the plant does not rely on AC power and does not require an offsite power system to perform safety-related or risk-significant functions. SER Section 8.2 contains the staff’s evaluation of offsite power. SER Section 15.0.0.6.2 states that offsite power is not credited to mitigate Chapter 15 events. Therefore, the staff finds that offsite power is not needed for accident mitigation or safe shutdown and thereby is nonsafety related.

For the onsite AC systems, FSAR Section 8.3 states that the onsite power systems include AC power systems, and the plant safety-related functions are achieved and maintained without reliance on onsite AC electric power. Further, the applicant stated that the onsite power systems do not perform any risk-significant functions. SER Section 8.3.1 contains the staff’s evaluation of the onsite AC systems. SER Section 15.0.0.6.2 states that the normal AC power systems are not safety related and are not credited to mitigate Chapter 15 events. Therefore, the staff finds that the onsite AC systems are not needed for accident mitigation or safe shutdown and thereby are nonsafety related.

For the onsite DC systems, in SER Section 8.3.2, the staff used a risk-informed, graded approach to evaluate the quality aspects of the augmented DC power system (EDAS). In SER Section 8.3.2, the staff finds that the EDAS is nonsafety related with augmented quality and is acceptable. Chapter 19 discusses the availability controls related to the EDAS. The staff finds that the augmented quality and availability controls for the DC systems are acceptable. EDAS, with the augmented quality and availability controls, supports a finding that the SDA provides reasonable assurance of adequate protection of public health and safety. The staff considers EDAS to be a non-safety-related or non-Class 1E SSC that performs an important to safety function, based on its role to protect specified acceptable fuel design limits, as discussed in SER Section 15.0.0.6.2, and there is reasonable assurance the system will function as designed. Therefore, using risk-informed decision-making and a graded approach, the staff finds the onsite DC systems, including the EDAS, are not safety related and have augmented provisions.

Therefore, the staff finds that the NuScale US460 design meets the underlying intent of GDC 17. NuScale further requested an exemption from the GDC 18 requirements for inspection and testing of electric power systems and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, to address conforming changes. It also noted that the underlying intent of these requirements, to ensure sufficient electric power is available to accomplish the safety functions of the respective systems, is met without reliance on electric power.

Based on the non-Class 1E classification of the onsite and offsite electric power systems, and on the analysis described in Section 8.1.3 to support the staff's findings regarding the criteria in 10 CFR 50.12, "Specific exemptions," the staff finds that the application of these regulations to the NuScale SMR design would not serve the underlying purpose of the rule from which an exemption is being sought or would not be necessary to achieve the underlying purpose of the rule. Accordingly, the staff finds that the requested exemption from GDC 17, GDC 18, and the electric power provisions of GDC 33, 34, 35, 38, 41, and 44, if shown to be applicable and properly supported in a request for exemption by a COL applicant that references the SDA, would be justified and could be issued to the COL applicant for the reasons provided in NuScale's SDAA, provided there are no changes to the design that are material to the bases for the exemption. Where there are changes to the design material to the bases for the exemption, the COL applicant that references the SDA would be required to provide an adequate basis for the exemption.

15.0.0.6.2 Availability of Power

Normal alternating current (AC) power systems are not safety-related and not credited to mitigate Chapter 15 events. The normal AC power systems consist of the following:

EHVS (high-voltage (13.8-kilovolt (kV)) AC electrical system and switchyard)

EMVS (medium-voltage (4.16-kV) AC electrical distribution system)

ELVS (low-voltage (480-volt (V) and 120-V) AC electrical distribution system)

The onsite DC power systems are not safety-related and are stated to not be credited to mitigate Chapter 15 events in most cases, as described further below. The DC power systems consist of the following:

EDAS (augmented DC power system to supply essential loads) and

EDNS (normal DC power system to supply nonessential loads).

The loss of normal AC power causes the MPS to initiate a reactor trip, actuate the DHRS, and close the containment isolation valves (CIVs). The loss of normal AC power also causes the loss of the EDAS chargers causing the EDAS to rely on backup batteries. If the augmented DC power system (EDAS) supply to the MPS or the ECCS and DHRS valves is lost, the ECCS valves open. Alternatively, at 8 hours after a loss of normal AC power to the EDAS battery chargers, the MPS actuates the ECCS valves causing them to open. If the 8-hour ECCS actuation is manually bypassed during the first 8 hours, the MPS load sheds the ECCS valves at 24 hours, causing them to open. When the EDAS supply is lost or shed or ECCS is actuated, RCS coolant is immediately discharged into containment through the RVVs, and subsequently through the RRVs when the IAB valve operating pressure threshold is reached.

As no power systems in the design are designated as safety-related, several loss of power scenarios are evaluated to ensure that the FSAR Chapter 15 acceptance criteria are met. The applicant evaluated the following loss of power scenarios:

- Loss of normal AC either at the time of the initiating event or at the time of the turbine trip (TT). After 24 hours, the ECCS valves move to their fail-safe open position.

- Loss of normal DC power (EDNS) and normal AC. Power to the reactor trip breakers is provided via the EDNS, so this scenario is the same as a loss of normal AC with the addition of reactor trip at the time power is lost.

- Loss of the augmented DC power system (EDAS), EDNS, and normal AC at the time of the initiating event. This scenario results in a reactor trip, actuation of DHRS, and closure of CIVs. The RVVs move to their fail-safe open position when power is lost, and the RRVs move to their fail-safe open position when RCS pressure drops below the IAB valve operating pressure threshold.

Also evaluated are the scenarios in which power, AC or DC, remains, if the consequences of the event are more limiting.

The FSAR does not evaluate scenarios where EDAS is lost subsequent to an initiating event (after time zero) during the event progression. For AOO events where the system energy increases over either a short or extended period of time, a loss of EDAS can result in more severe consequences in terms of fuel and containment figures of merit than a loss of EDAS at the time of the initiating event. In these cases, staff determined that the EDAS system is relied on in the safety analysis to mitigate the consequences of the progression of those AOOs by maintaining the ECCS valves closed, thus enabling the ability to achieve safe shutdown of the module (i.e., the safety analysis assumes EDAS functions to maintain the ECCS valves in the closed position and an intact RCPB to allow the DHRS to remove decay heat). Examples of events where EDAS is assumed to remain functional during the entire design-basis period and perform these mitigating functions, includes, but is not limited to, decrease in feedwater temperature (FSAR Section 15.1.1), increase in feedwater flow (FSAR Section 15.1.2), increase in steam flow (FSAR Section 15.1.3), steam pipe failures (FSAR Section 15.1.5), and uncontrolled rod withdrawal at power (FSAR Section 15.4.2). Therefore, the staff concludes that the EDAS is needed to meet the Chapter 15 safety analysis acceptance criteria prescribed in Table 15.0-2 for ensuring the SAFDLs are met by assuring MCHFR is maintained above the CHF analysis limit. The staff notes that failure to meet the SAFDLs, as required by 10 CFR 50, Appenidx A, is not necessarily indicative of a failure to maintain the fuel fission product barrier nor considered a safety-related function. design-specific considerations.

EDAS is classified in the FSAR as a non-safety-related system. Based on the assumed functionality of the system in the safety analysis transients characterized above, the staff assessed whether EDAS meets the definition of safety-related in 10 CFR 50.2. An SSC that is relied on to remain functional during and following a design basis event to assure the capability to maintain a safe shutdown condition is defined as a safety-related SSC. SECY-94-084 defines a safe shutdown condition to be a condition where the reactor is shutdown, decay heat is being removed, and containment of radioactive material is provided. While the SAFDLs are not explicitly referenced in the 10 CFR 50.2 definition of safety-related SSCs, nor are a direct indication of fuel clad damage, they are typically used as the measure to demonstrate safe shutdown through sufficient decay heat removal and containment of radioactive materials during and following AOOs. Demonstration of the safe shutdown criterion ensures that fuel clad damage is unlikely to occur as a result of an AOO and the safety-related SSCs are sufficient to protect this fission product barrier. Accordingly, the staff reviewed and audited engineering documentation to confirm that the fuel fission product barrier would remain intact in the case of EDAS failure during an AOO. The applicant stated that a loss of EDAS is not expected to occur during the life of a module and the staff did not validate this assertion. Nonetheless, NuScale performed MCHFR and peak clad temperature (PCT) analysis of a spectrum of state-points for an ECCS blowdown, which is representative of a loss of EDAS, at a combination of powers, pressures, and temperatures (ML23304A367). This analysis demonstrates that a failure of EDAS at high power, pressure and temperature results [[ ]]. The report concludes that the clad temperature excursion lasts for less than 10 seconds before returning to temperatures less than the initial value; and after this excursion, the transient behaves similarly to the longer-term transient; decreased core power and continuous liquid coverage ensure margin to CHF is maintained over the long-term; and no loss of coolable geometry is anticipated due to low PCT compared to the 2200°F limit. While the staff did not review or approve the post-CHF models utilized in the calculations performed by NuScale, and while other fuel failure mechanisms besides CHF were not explicitly evaluated, these results still provide useful insights into the applicability of EDAS to the safety-related criterion (i.e., whether EDAS is needed to ensure the fuel fission product barrier remains intact). In addition, the staff audited (ML24211A089) NuScale sensitivity calculations of peak containment pressure resulting from various non-LOCA events with subsequent loss of EDAS. The limiting results from these studies indicate a peak containment pressure of [[ ]] which is below containment design pressure. Therefore, based on the above, the staff finds that EDAS does not meet the definition of safety-related because it is not needed for ensuring a safe shutdown condition of the reactor. Specifically, the staff finds that there is reasonable assurance that the reactor will shutdown, decay heat will be removed, and fuel and containment integrity will be maintained without reliance on EDAS.

As noted above, EDAS is relied on in the safety analysis for ensuring the SAFDLs are met by demonstrating MCHFR is maintained above the CHF analysis limit. Based on its role to protect the SAFDLS, as required by multiple GDCs including GDCs 10 and 34 which are evaluated within this Section of the SER, the staff considers EDAS to be a non-safety-related SSC that performs an important to safety function. SSCs that are relied on to satisfy the GDCs are subject to the quality assurance requirements of GDC 1, “Quality standards and records.” GDC 1 specifies that programmatic quality standards for SSCs important to safety provide adequate assurance that these SSCs will satisfactorily perform their safety functions specified in the GDCs. Accordingly, EDAS conforms to consensus standards and augmented quality attributes to ensure the quality of the system is commensurate with the importance of its safety functions. Based on the design, augmented standards, and controls assigned to the EDAS, as documented in the FSAR, the staff finds that there is reasonable assurance the system will function as designed. See Chapter 8 and Chapter 16 of this SER for the staff’s detailed review of the EDAS design, augmented quality attributes, and controls. The staff review of the EDAS modeling in the probabilistic risk assessment is in Section 19.1 of this SER.