

**Official Transcript of Proceedings**  
**NUCLEAR REGULATORY COMMISSION**

Title: Advisory Committee on Reactor Safeguards

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Thursday, September 6, 2018

Work Order No.: NRC-3880

Pages 1-129

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UNITED STATES NUCLEAR REGULATORY COMMISSION'S  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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656TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THURSDAY

SEPTEMBER 6, 2018

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Advisory Committee met at the Nuclear  
Regulatory Commission, Two White Flint North, Room  
T2B3, 11545 Rockville Pike, at 8:30 a.m., Michael L.  
Corradini, Chairman, presiding.

## 1 COMMITTEE MEMBERS:

2 MICHAEL L. CORRADINI, Chairman  
3 PETER RICCARDELLA, Vice Chairman  
4 MATTHEW SUNSERI, Member-at-Large  
5 RONALD G. BALLINGER, Member  
6 DENNIS C. BLEY, Member\*  
7 CHARLES H. BROWN, JR. Member  
8 MARGARET SZE-TAI Y. CHU, Member  
9 VESNA B. DIMITRIJEVIC, Member  
10 WALTER L. KIRCHNER, Member  
11 JOSE MARCH-LEUBA, Member  
12 HAROLD B. RAY , Member  
13 JOY L. REMPE, Member  
14 GORDON R. SKILLMAN, Member

15

## 16 DESIGNATED FEDERAL OFFICIAL:

17 MICHAEL SNODDERLY

18

19

20 \*Present via telephone

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

(8:30 a.m.)

1  
2  
3 CHAIRMAN CORRADINI: I'm sorry we had the  
4 microphones on mute. NuScale, are you there and Matt  
5 Thomas? Is there anyone on the phone line?

6 MR. LIGENFELTER: Andy Ligenfelter's here  
7 from NuScale.

8 CHAIRMAN CORRADINI: Fantastic. Anybody  
9 else?

10 MR. GAMBLE: Robert Gamble is here as  
11 well.

12 CHAIRMAN CORRADINI: Anybody else? Okay.  
13 Thanks. So, I think the best thing to do is, we're  
14 going to put you guys on mute. And if you need to  
15 speak, then maybe perhaps you could text Paul.

16 And then, Paul can let me know and we'll  
17 take you off mute and -- unless, otherwise, if a  
18 question comes up and we think we need you, then we'll  
19 ask you guys. Does that sound reasonable?

20 MR. LIGENFELTER: Sounds good.

21 CHAIRMAN CORRADINI: Okay. Thanks. The  
22 meeting will now come to order. This is the first day  
23 of the 656th meeting of the Advisory Committee on  
24 Reactor Safeguards. In today's meetings, the  
25 Committee will consider the following, the NuScale

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1 Topical Report on Subchannel Analysis Methodology and  
2 the NuScale Design Certification Application for  
3 Chapter 7, Instrumentation and Control and Chapter 8,  
4 on electrical systems and then, preparation of ACRS  
5 reports.

6 The ACRS was established by statute and is  
7 governed by the Federal Advisory Committee. As such,  
8 this meeting is being conducted in accordance with the  
9 provisions of FACA. That means that the Committee can  
10 only speak through its published letter reports.

11 We hold meetings to gather information to  
12 support our deliberations. Interested parties who  
13 wish to provide comments can contact our offices  
14 requesting time after the Federal register describes  
15 a meeting as published.

16 That said, we also set aside ten minutes  
17 for extemporaneous comments from members of the public  
18 attending or listening to our meetings. Written  
19 comments are also welcome. Mr. Mike Snodderly is the  
20 designated Federal official for the initial portion of  
21 this meeting.

22 Portions of the sessions on NuScale design  
23 certification application may be closed in order to  
24 discuss and protect information designed as  
25 proprietary. The ACRS section of the NRC's public

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1 website provides our charter, bylaws, letter reports,  
2 and full transcripts of all our full and subcommittee  
3 meetings, including all slides presented at the  
4 meeting. We receive no written comments or requests  
5 to make oral statements from the members of the public  
6 regarding today's sessions.

7           There is a bridge, a phone bridge line.  
8 And to preclude interruption of the meeting, the phone  
9 will be placed in a listen-in only mode during the  
10 presentations and committee discussions. In addition,  
11 a transcript of portion of the meeting is being kept.  
12 And it is requested that speakers use one of the  
13 microphones, identify themselves, and speak with  
14 sufficient clarity and volume so they may be readily  
15 heard.

16           And then, just remind everybody to please  
17 turn off your cell phones or put them on silent mode  
18 so they don't disturb our proceedings. With that, I'm  
19 going to turn the first portion of the meeting over to  
20 Walt Kirchner. And Walt, do you want to lay this out?

21           MEMBER KIRCHNER: Yes. We had a good  
22 Subcommittee meeting on August 24th, good interactions  
23 with the staff and the applicant. I think we'll hear  
24 more about that in today's session. And with that, I  
25 am going to look to Bruce, and turn it over to you,

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1 Bruce.

2 MR. BAVOL: Okay. Very good. Good  
3 morning.

4 VICE CHAIRMAN RICCARDELLA: Just one  
5 thing, Bruce. I think I need to recuse myself from  
6 these deliberations.

7 MR. BAVOL: Okay. My name is Bruce Bavol.  
8 I'm a project manager in the Office of New Reactors.  
9 This was the review of TR-0915-17564, Revision One,  
10 Subchannel Analysis Methodology for NuScale Project.  
11 To my right is the lead for the review, Mr. Syed  
12 Haider.

13 He will be discussing an overview of the  
14 scope of the review. What I'm going to do is just  
15 briefly go over the staff review timeline. Then, I'll  
16 turn it over to him. But also, we have -- we'll be  
17 going over any of the comments we went through during  
18 the Subcommittee meeting to see how that goes.

19 So, our staff review timeline, the NuScale  
20 Topical Report was submitted February 15th, 2017.  
21 This is Revision One. That was provided as an update  
22 for propriety and export control information in the  
23 topical report. Staff issued a number of REIs for  
24 them and received responses.

25 The applicable information is provided in

1 the handout. We plan to issue a final safety  
2 evaluation late in October of this year. And then,  
3 staff plans to publish an approved version, if all  
4 goes well, in the early part of 2019. With that, I'll  
5 turn this over to Syed Haider and he can go over an  
6 overview of the staff review.

7 MR. HAIDER: Thank you, Bruce. Good  
8 morning. My name is Syed Haider. I'm the lead  
9 technical reviewer at the NRO for the NuScale  
10 Subchannel Analysis Methodology document report,  
11 revision one that was submitted in February 2017 and  
12 is the subject of today's full committee meeting.

13 I would also like to acknowledge the  
14 contributions made to the current review by Matt  
15 Thomas, my colleague in the ecosystems branch and Joe  
16 Kelly from the office of research. While Matt and I  
17 performed the topical reviews and wrote the respective  
18 SER sections, Joe performed all necessary viper  
19 confirmatory analyses that were needed to support the  
20 review.

21 I would also like to thank Bruce Bavol,  
22 the PM, sitting next to me, for his effective  
23 management of all of our coordination needs with  
24 NuScale, was with the ACRS. Now, I'll summarize the  
25 highlights of the open and closed session staff

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1 presentations that I made, during the SER subcommittee  
2 meeting on August 24th. A subchannel analysis is  
3 typically used to calculate the baseline thermal  
4 hydraulic margin for the critical heat flux and the  
5 fuse central line temperature that feed into the DCD  
6 Chapter 4 and Chapter 15, even to specific safety  
7 analysis.

8 The staff conducted the review of the  
9 NuScale Subchannel Analysis Methodology Topical  
10 report, per general design criterion ten, on from 10  
11 C.F.R., Part 50, Appendix A. The related regulatory  
12 guide is stipulated in NuScale Design's specific  
13 review standard, section 4.4 on thermal and hydraulic  
14 design and 10 C.F.R., 50, 34, on the contents of  
15 applications and technical information.

16 So, essentially, the NuScale Subchannel  
17 Analysis Methodology uses the NRC-approved viper one,  
18 subchannel thermal hydraulic computer code to conduct  
19 the NuScale fuel design subchannel safety analysis.  
20 A viper one code that was doubled-up and has a PWR  
21 license and history.

22 It's worth clarifying that there is no  
23 viper two subchannel core. And viper one is also  
24 interchangeably used -- it's called viper. So both  
25 viper one and viper would refer to the same subchannel

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1 core. Viper has two versions, mark one and mark two.  
2 NuScale used the latest viper version, mark two, in  
3 the NuScale methodology that was approved in 1993.

4 While the earlier viper version, mark one,  
5 was approved by the NRC in 1996, the NRC approval of  
6 viper mark one and mark two core versions, is  
7 documented through the respective generic NRC safety  
8 evaluation reports that are cited.

9 The present slide also lists the four  
10 elements of approval for the NuScale Subchannel  
11 Analysis Methodology or NSAM, that NuScale applied  
12 for, as documented in the topical report. These four  
13 elements required the staff to focus on the viper  
14 code's applicability to the NuScale steady state and  
15 constant subchannel analysis.

16 Number two, whether the methodology  
17 fulfills the NRC's requirements specified in the two,  
18 generic ESRs issued by the NRC while approving viper  
19 versions mark one and mark two. And number three,  
20 whether the methodology is independent of any specific  
21 CHF correlation and is used for NuScale applications,  
22 with an NRC-approved NuScale specific CHF correlation.

23 And lastly, whether the treatment of  
24 uncertainties in the NuScale Subchannel Methodology is  
25 appropriate. So, the staff's review was focused on

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1 these four elements of approval that was sought by the  
2 applicant for the topical approval. The two generic  
3 SERs that document the NRC approval of viper versions  
4 mark one and mark two, identify a total of nine  
5 conditions and that an application of viper code has  
6 to meet.

7 These nine conditions that mainly deal  
8 with the viper modeling assumptions and qualifications  
9 provided the technical basis for the staff review of  
10 the NSAM topical report. Out of the nine conditions,  
11 the first five conditions belong to the viper mod one  
12 SER, while the later four conditions belong to the  
13 viper mod two SER.

14 The evaluation of NSAM topical report  
15 against the viper generic SER conditions required the  
16 staff to focus on several aspects of the methodology  
17 application and the treatment of uncertainties. Even  
18 though the generic viper one qualifications for  
19 subchannel analysis had been reviewed as a part of the  
20 original mod one and mod two approvals, the staff  
21 closely looked into certain technical areas to ensure  
22 the viper licensing applicability to the NuScale.

23 The staff presented the overriding  
24 concerns and the technical details are leading to  
25 their resolution during the closed session of the

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1 subcommittee meeting on August 24th. So, now I'll  
2 summarize some of the highlights of the August 24th  
3 presentations.

4 During the review, the staff raised and  
5 resolved questions about the in a sense, applicability  
6 gain of the thermal hydraulic parameters and any  
7 potential viper code limitation that would be  
8 applicable to the NuScale design.

9 The staff performed a confirmatory  
10 analysis to ensure that the NuScale and natural  
11 circulation design, normal and off-normal operating  
12 conditions in the subchannel and at the core exit,  
13 were more typical of EWIs. The staff also ensured  
14 that the core-on number criterion is met and the viper  
15 numerical solution is stable throughout the various  
16 design basis, transients, that were identified in the  
17 NSAM topical report.

18 The staff conducted a confirmatory  
19 analysis to ensure the in-led boundary condition  
20 consistency between the system level core and re-lap  
21 five and the viper subchannel calculations. The staff  
22 established that both codes were independently  
23 predicting the same, overall pressure drop across the  
24 core, which served as an over-arching check on the  
25 viper calculations. The staff also performed a

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1 confirmatory analysis to verify that the viper  
2 predictions are not sensitive to the core in-led flow.

3 And the viper solution is well-behaved in  
4 the neighborhood of the most limiting viper transient  
5 involving concurrent misoperation, single rod  
6 withdrawal. The staff also reviewed the viper model  
7 geometry.

8 The sensitivity studies the applicant  
9 performed which demonstrated the applicability of the  
10 axial and radial normalizations and the NSAM  
11 assumptions made for the axial and radial power  
12 distributions. The staff concluded that the NSAM had  
13 an overall conservative approach toward modeling the  
14 geometry, normalization, and power distribution.

15 During the closed session on August 24th,  
16 the staff also presented its review of the applicant's  
17 qualification of key viper models and assumptions,  
18 especially, the proofers for models used in the NSAM.  
19 In our review, the information the NRC staff  
20 considered, in addition to the NSAM topical report,  
21 revision one, included the responses to REIs 9080 and  
22 its supplement and REIs 9086, 9099, and 9129, as well  
23 as the documents NuScale furnished for the audit.

24 MEMBER REMPE: Excuse me. During our  
25 meeting -- and again, if I say something that needs to

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1 be answered later in a closed session, we'll deal with  
2 it then. But, I'd ask, well, in some cases, the staff  
3 said, well, we don't approve the final value.

4 We don't even approve the method, because  
5 you didn't fully document on how you got what some of  
6 the final values for condition three. And yet, in the  
7 final end statement, you said, yeah, we've approved  
8 things. And I just want to make sure I understand  
9 what you've approved.

10 So, when they come in with their final  
11 values for startup with a core loading, are you going  
12 to go back and look like, at all the input parameters  
13 as well as the processes they used to calculate those  
14 values again and say whether they get a thumbs up or  
15 down or what exactly did you approve? And I kind of  
16 think that's what I asked before.

17 And it's -- when you say you don't approve  
18 the values or even the way they calculated it in some  
19 of those cases, what -- you know, what did you approve  
20 and how will things change later on?

21 MR. HAIDER: Okay. I think you are  
22 specifically referring to the example. During the  
23 closed session, we tried to make it clear that there  
24 were certain example variables. And you are also  
25 documenting this at appropriate locations in the SER,

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1 that we are not approving this example variable, which  
2 was more of a middle of the range variable that they  
3 were using. But, the actual value will be approved  
4 when the methodology is applied in the DCB for Chapter  
5 4 and Chapter 15.

6 MEMBER REMPE: So, I can understand you  
7 didn't approve the example values.

8 MR. HAIDER: The example values.

9 MEMBER REMPE: But, you actually said, I  
10 didn't even approve the process you used because you  
11 didn't fully document it, and again, in certain  
12 places. And I don't have the SE in front of me, but  
13 I think in the discussion on values pertaining to  
14 condition three.

15 I -- was the radial power distribution,  
16 the bypass flows -- there were several of them where  
17 you note that the processes were also not approved.

18 MR. HAIDER: Okay. Some of those, whether  
19 we found that some of the methodology reserves were  
20 not sensitive to some of those parameters that we are  
21 considering.

22 MEMBER REMPE: Okay.

23 MR. HAIDER: We had some basis to believe  
24 that we could approve these numbers because the  
25 reserves were not sensitive to those values. While,

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1 for some other values, the numbers would be reviewed  
2 while the NSAM is applied to the Chapter 4, the  
3 respective Chapter 4 and Chapter 15 analysis. But, I  
4 mean, if you can give me a specific example that is --

5 CHAIRMAN CORRADINI: Maybe we should do  
6 that in closed session, if necessary.

7 MEMBER REMPE: Well, I don't even have a  
8 -- I'm going to have to -- do you have a printout  
9 Walt?

10 MR. KIRCHNER: But, if I just repeat -- I  
11 want to make sure that we're clear. The way I read  
12 condition three is, there was nothing there that  
13 caused you concern on how they met the requirement.

14 But, the proviso is, when I look at  
15 Chapters 4 and 15, you're going to have to look at the  
16 values chosen and the logic or the justification upon  
17 the logic they used to pick those values, because  
18 that's specific to the NuScale design.

19 MR. HAIDER: That's correct.

20 MEMBER REMPE: So, that might make me feel  
21 good if that is what it said, that again, not only did  
22 we not approve the value, we didn't really even  
23 approve the logic for it. But again, if something  
24 comes in with 4 and 15 that's radically different,  
25 you're going to change things. And I guess I didn't

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1 get that from the discussion or what I saw in the SE.

2 MR. HAIDER: Okay. Okay. But, that is  
3 indeed the case.

4 MEMBER REMPE: Okay. As long as that's,  
5 again --

6 MR. HAIDER: That's more -- and I can even  
7 give you an example.

8 MEMBER REMPE: Okay. That's fine. Again,  
9 maybe it's more tradition and I'm not aware of the  
10 tradition. But, I was puzzled when I read this  
11 because it sounded like, well, we approved it. But,  
12 yet, if I look at -- well, we didn't totally approve  
13 it.

14 MR. HAIDER: Okay. I think we can go into  
15 --

16 MEMBER REMPE: Okay.

17 MR. HAIDER: Into deeper in the closed  
18 session --

19 MEMBER REMPE: Okay. Thank you.

20 MR. HAIDER: So, during the open session  
21 of the SER's subcommittee meeting on August 24th, the  
22 staff presented how the applicant met the nine  
23 conditions from the viper mod one and mod two SERs.  
24 During the closed session, the staff provided  
25 additional proprietary details of the staff review of

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1 the NuScale Subchannel Analysis Methodology that were  
2 used to finalize the safety findings, as documented in  
3 the safety evaluation report with no open items and  
4 how various REIs and supplements were closed.

5 So, based on the information documented in  
6 the safety evaluation report, the NRC staff has  
7 reasonable assurance that the use of the viper one mod  
8 two code, now with the NuScale subchannel analysis  
9 methodology as described in the topical report, is  
10 appropriate for the NuScale fuel thermal hydraulic  
11 design and plant safety analysis, provided that  
12 condition one of the SER is met.

13 The staff also found that sufficient  
14 information has been presented by the applicant for  
15 its four, requested elements of approval. So, based  
16 on its review findings, the staff concludes that viper  
17 is applicable to the NuScale's steady state and  
18 transient subchannel analysis in using the methodology  
19 presented in the NSAM topical report.

20 NSAM fulfills the NRC's requirements, as  
21 specified in the two, generic SERs issued for viper  
22 mod one and mod two core programs. NSAM is  
23 independent of any specific CHF correlation and is  
24 used for NuScale applications with an NRC-approved CHF  
25 correlation that also meets condition one of this SER.

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1 NSAM describes an appropriate methodology for the  
2 treatment of uncertainties in the NuScale subchannel  
3 analysis.

4 So far, I have summarized the review and  
5 its findings in the open part of my presentation. I  
6 would invite any further questions about this staff  
7 review of the NuScale subchannel analysis methodology,  
8 before we move on to the three suggestions that the  
9 SER subcommittee made during the August 24th  
10 presentation for the staff of NRC.

11 On August 24th, the SER subcommittee  
12 members made three suggestions about the safety  
13 evaluation report for the staff to consider. The  
14 staff discussed the suggestions, found them valuable,  
15 and decided to incorporate all of them into the SER.  
16 The staff made those changes in the SER and has  
17 forwarded the advance copies of those changes in  
18 redline, strikeout, for distribution to the SER and  
19 its members.

20 Now, I'll go over each one of the three  
21 suggestions and explain what the staff did to address  
22 it. The next two slides explain the ACR suggestions  
23 and what staff did to incorporate those suggestions  
24 into the SER. So, the subcommittee's first condition  
25 one, that the staff had developed as a part of the

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1 present staff SER, which is documented in section five  
2 of the SER under conditions and limitations. The  
3 objective of the SER condition is to ensure that only  
4 NRC-approved correlations are used with NSAM.

5 Therefore, an applicant referencing the  
6 NSAM topical report in a subchannel safety analysis,  
7 would be required to reference an approved CHF  
8 correlation. However, the SER has commented that the  
9 condition could be made more restrictive to additionally  
10 ensure that a CHF correlation used for the safety  
11 analysis has also been approved using the same NSAM  
12 methodology, as the viper-based NSAM methodology was  
13 also used to develop a NuScale-specific CHF  
14 correlation, with the same set of frozen viper models  
15 and correlations.

16 The staff recognizes the circular nature  
17 of relation between the NSAM methodology and the  
18 approved CHF correlation. So, the staff also  
19 appreciated that its approval of the NSAM methodology  
20 for safety analysis partially relied on the fact that  
21 the same NSAM methodology was also used which helped  
22 allay the staff concerns about any phenomenological  
23 uncertainty due to the extended quality range  
24 encountered in the NuScale CHF correlation  
25 development. Therefore, as shown on the slide, the

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1 staff has appropriately worded the condition to ensure  
2 that the CHF correlation used with NSAM is not only  
3 approved by NRC, but it has also been demonstrated to  
4 be applicable for use with the NuScale subchannel  
5 analysis methodology topical report.

6 So now, the revised, two-part condition is  
7 inherently viper-specific, as was suggested by the  
8 subcommittee. An advance copy of the redline and  
9 strikeout of the revised conditions text has been  
10 provided to the SER. The second SER's comment belongs  
11 to a section on page 26 of the SER that the staff had  
12 titled.

13 The staff agreed that the ACR's comment  
14 that such a comprehensive title would be ideally  
15 suited for an SER that was dedicated to the subject.  
16 The staff sensitivity study presented in the SER  
17 section, was limited and only concerned with one  
18 aspect of instability within a rather narrow regime of  
19 reactor operation for a specific, limiting transient,  
20 involving rod misoperation.

21 But, the staff has kept the section in the  
22 SER, due to the need to demonstrate a stable viper  
23 solution in the NSAM methodology for a range of core  
24 in the flow. However, the staff has appropriately  
25 changed the title of the section to "Flow

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1 Participation Sensitivity Study" and has reworded the  
2 body of the text accordingly. The staff has basically  
3 rewritten this section title and made conforming  
4 changes to the first two paragraphs of the section to  
5 de-emphasize the instability aspects of the writeup  
6 and has, rather, focused on the core inlet flow  
7 variations.

8 The staff agrees that our study did not  
9 categorically demonstrate that the NuScale power  
10 module was not operating near approval and stayed with  
11 the point. And such a conclusion was not warranted to  
12 approve the subchannel methodology report. An  
13 advanced copy of the redlined/strikeout paragraph has  
14 been provided to the NCRS.

15 The following final comment from the NCRS  
16 was a correction proposed, which is figure one on page  
17 10 of the SER. The SER figure was intended to compare  
18 viper predictions of the fuel center line composition  
19 for the limiting concordance operation case for  
20 temporal relations and to conclude that the effect of  
21 boiling heat transfer correlation is negligible  
22 compared to the available margin, and regardless of  
23 the choice of boiling correlation.

24 However, the SER has duly pointed out that  
25 the chin and palm curves on figure one were not

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1 consistent with their descriptions within the body of  
2 the text. So, the staff cross-referenced the SER  
3 description with the viper predictions and concluded  
4 that even though the SER description and conclusions  
5 are correct, that the palm and chin legends on figure  
6 one had been mistakenly swapped at some stage of  
7 editing.

8 I know the staff has made the proposed  
9 correction and legends on figure one wholly represent  
10 the viper one predictions corresponding to the chin  
11 and palm correlation. An advance copy of the  
12 corrected figure one has been provided to the NCRS.  
13 This concludes my presentation for the open session.

14 The staff would like to thank the NCRS for  
15 giving valuable feedback that improved the overall  
16 quality of the SER. Now, I would invite any question  
17 still outstanding on this matter, again.

18 CHAIRMAN CORRADINI: Joy, did you -- can  
19 I ask just a -- did you want to go into closed session  
20 to talk about your thing?

21 MEMBER REMPE: Well, again, all I have are  
22 my notes, because I don't have a printout of the SE in  
23 front of me. But, as my notes indicated that there  
24 were several values that you didn't approve, such as  
25 the bypass flow, the instrument I-2 bypass flow, inlet

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1 flow distribution, radial power distribution, major  
2 mint and certainty value for delta H, et cetera. And  
3 that you note on page 28 of the SE that specific  
4 inputs will be approved.

5 In some cases, you said, even the process  
6 for getting those values were not approved. So, what  
7 I think that you've told me is, well, when the Chapter  
8 4 and 15 comes around, we'll look at those values.  
9 We'll look at the process they use.

10 And if we don't like the -- and I don't  
11 know how you're going to decide the numbers are too  
12 far off from what you believe is right. Because  
13 you've basically told us, I think, in open session,  
14 the values didn't affect the final result. Is that  
15 what you said?

16 MR. HAIDER: Some of the values, not all.

17 MEMBER KIRCHNER: No. It's not all.

18 MEMBER REMPE: So, if the --

19 MR. HAIDER: They will also be reviewed.

20 MEMBER REMPE: They'll be reviewed? And  
21 what will you use as a basis for reviewing it? I  
22 mean, this is something where the applicant as well as  
23 the NRC can get into trouble if you have an unclear  
24 agreement. And I just am wondering what the basis is  
25 that you'll judge it's appropriate or not.

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1 MR. HAIDER: The basis is also documented  
2 in the SER, like we were approving and why we were not  
3 approving this.

4 MEMBER REMPE: Right. But what will be  
5 deemed acceptable? I mean, do you have a -- I don't  
6 think I saw in the SER that you had comparison  
7 calculations for those values.

8 You said that they -- we didn't like the  
9 number or we don't approve the number. We didn't  
10 approve the process. So, when will you have a process  
11 that you approve?

12 MR. HAIDER: No. That's not true. And  
13 for a case for it, I mean, I can give you some example  
14 for which we even performed a confirmatory analysis  
15 and changed a number by five times and didn't see much  
16 compare on the results. So we were --

17 MEMBER REMPE: For each of those that you  
18 didn't approve the process --

19 MR. HAIDER: I can remember at least four.  
20 A couple of them we performed the confirmatory  
21 analysis.

22 MEMBER REMPE: Okay.

23 MEMBER KIRCHNER: Maybe I can jump in  
24 here. It seems to me, what they did was essentially  
25 use nominal values expected for the NuScale power

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1 module, and then exercise the methodology. And so,  
2 what was really being approved here was the  
3 methodology, the subchannel analysis methodology, not  
4 the specific parameters.

5 I believe that and I expect we will see  
6 that with Chapter 4 and 15. And then, it will be  
7 incumbent on the applicant to demonstrate that these  
8 are realistic and appropriate and, where necessary, to  
9 back it up with experiment or independent analysis.

10 So, I think -- like, in one example, where  
11 I think you used -- in relap five. And you did  
12 demonstrate comparable, overall core delta Ps. Is  
13 that correct?

14 MR. HAIDER: That's correct.

15 MEMBER KIRCHNER: So, that is an example  
16 of an independent calculation to just demonstrate that  
17 they're in the right ballpark.

18 MEMBER REMPE: Okay. So --

19 MR. HAIDER: And another example would be  
20 that we're mixing parameter.

21 MEMBER KIRCHNER: Yeah.

22 MR. HAIDER: We're changing the parameter  
23 by a factor of five.

24 MEMBER KIRCHNER: Right. When it comes to  
25 things like the actual inlet flows and how much is

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1 bypassed in the reflector, I think that is all to be  
2 demonstrated in Chapter 4. Is that correct?

3 MEMBER REMPE: Okay. So, okay. So, the  
4 criteria or condition three, is the applicant has to  
5 provide justifications for modeling assumptions to  
6 base flow models, heat transfer, and CHF correlations,  
7 and plant-specific data, such as turbulent mixing  
8 coefficients, et cetera, geometry notalization.

9 Sufficient information and justification  
10 have to be provided. And you've said, yes, they've  
11 met it. But yet, we didn't approve the value. We  
12 didn't approve the process in some of these cases.

13 And that's where I'm kind of struggling  
14 with is, is it enough or why didn't you say, well,  
15 they gave us some things, but we're going to review it  
16 carefully in Chapter 4 and 15?

17 CHAIRMAN CORRADINI: I guess my  
18 interpretation, Joy, is that, as Walt was saying,  
19 these are nominal values. Given the nominal values,  
20 the methodology's acceptable. But, it's essentially  
21 on the applicant to show that the values used for the  
22 design are appropriate and justified.

23 MEMBER REMPE: And how will the staff  
24 decide that in Chapter 4 and 15?

25 MEMBER KIRCHNER: We do it for any

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1 reactor.

2 MEMBER REMPE: With Chapter 4 of the  
3 design certification and 15, will there be benchmark  
4 calculations or will they just say, yeah, if the --

5 MEMBER KIRCHNER: It depends, at this  
6 juncture. But it would be the same with any new  
7 design. When Chapter 4 arrives, then you would have  
8 to look for either experimental data or other basis to  
9 justify something like the amount of bypass flow.

10 MEMBER REMPE: Okay. I --

11 MEMBER KIRCHNER: And if it can't be  
12 justified, then one would expect that would be a  
13 confirmatory item for a startup test, as an example.

14 MEMBER REMPE: Okay. I just -- I wanted  
15 to -- I didn't see some of these things clearly in the  
16 SE. And maybe that's just the way this is done  
17 always. But, I was still kind of struggling with  
18 well, it's approved, but they didn't approve a lot of  
19 the underlying processes as well as the values.

20 MEMBER BROWN: But, I guess my way of  
21 thinking about it, this is -- I would assume staff is  
22 going to take the same approach they did for APR 1400.

23 MR. HAIDER: Yes.

24 MEMBER BROWN: Which, some things were  
25 approved. Some things were left for confirmatory

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1 testing for startup. So, I assume that's what staff's  
2 going to do.

3 MR. HAIDER: Yes. That's precisely right.  
4 And whatever we do not accept, approve, we also  
5 documented that in the SER, so that it becomes a  
6 reference for the Chapter 4 and Chapter 15.

7 MEMBER REMPE: So, yeah, we'll be looking  
8 carefully at 4 and 15 to make that those values are  
9 addressed.

10 MR. HAIDER: That's right.

11 MEMBER REMPE: And I, again, I think  
12 that's just something we need to emphasize, okay?  
13 Thanks.

14 MEMBER KIRCHNER: Mr. Chairman, since  
15 there are no further questions from the committee, I  
16 think we can turn to any members of the public for  
17 comment. If there are any members of the public who  
18 wish to make a comment, please do so. Just state your  
19 name and your comment.

20 We're going to use the ten-second out  
21 there. Okay. Again, if there are any members of the  
22 public who wish to make a comment, please state your  
23 name and make your comment. There appear to be none.  
24 There appear to be none.

25 CHAIRMAN CORRADINI: We can close the

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1 line.

2 MEMBER KIRCHNER: We can close the line  
3 then. So now, Mr. Chairman, the question is whether  
4 members of the committee wish to go into closed  
5 session and have any further detail questions that  
6 might be of a proprietary nature?

7 CHAIRMAN CORRADINI: Anybody? I guess  
8 not.

9 MEMBER KIRCHNER: So, therefore, I don't  
10 think we need a closed session.

11 CHAIRMAN CORRADINI: Okay. Good.

12 MEMBER KIRCHNER: Thank you. I want to  
13 thank the staff for a very complete and thorough  
14 review of the applicant's submittal. Thank you.

15 CHAIRMAN CORRADINI: Okay. So, we're  
16 going to adjourn this session. We will probably have  
17 a read-through of the draft that the subcommittee put  
18 together of the letter report. This would be a good  
19 time to do that. So, staff can sit around for that if  
20 you want, okay? Thank you very much.

21 So, we'll take a couple of minutes, only  
22 a couple of minutes, to reconfigure so we can look at  
23 the draft letter report from the subcommittee that  
24 Walt has marshalled through the system. It's an open  
25 session. You can listen to it.

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1 (Whereupon, the above-entitled matter went  
2 off the record at 9:06 a.m. and reconvened at 10:12  
3 a.m.)

4 CHAIRMAN CORRADINI: It must not have been  
5 transmitted to us. That's good to know. Welcome,  
6 Dennis.

7 MEMBER BLEY: Thank you.

8 CHAIRMAN CORRADINI: Are you in beautiful  
9 Minnesota or beautiful New Mexico?

10 MEMBER BLEY: I'm still in New Mexico for  
11 a little bit longer.

12 CHAIRMAN CORRADINI: Okay. We'll not  
13 going to start for a couple of minutes. One other  
14 business item, Dennis, did you get the phone number  
15 for tomorrow's noon meeting?

16 MEMBER BLEY: I did. Thank you.

17 CHAIRMAN CORRADINI: Okay. And if you  
18 have question, we can discuss offline. But, I'll be  
19 there.

20 MEMBER BLEY: I got enough information  
21 from Derek to clarify things.

22 CHAIRMAN CORRADINI: Okay. Good. Okay.  
23 And we've got a line, so Derek can call in also.

24 MEMBER BLEY: I saw.

25 CHAIRMAN CORRADINI: Okay. All right. Do

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1 we need to mute the NuScale line? We'll turn it on if  
2 they call for lifeline. Otherwise, let's mute it. I  
3 don't want to have that crackling during the meeting.  
4 So, if the NuScale folks need to be called upon,  
5 you're either going to alert your folks in the room  
6 and we'll open the line, or we'll open the line to ask  
7 you a question.

8 But, we're going to mute the NuScale  
9 folks, just because of the background crackling.  
10 Okay. We're ready to go. Okay. We're back in  
11 session. And we're now going to take up the topic of  
12 the DCD, Chapters 7 and 8, with open items. And am I  
13 going to turn to Omid or somebody of major more  
14 influence?

15 MR. TABATABAI: We're going to go to Shana  
16 Helton.

17 CHAIRMAN CORRADINI: Oh, there she is.  
18 I'm sorry.

19 MS. HELTON: Hello.

20 CHAIRMAN CORRADINI: Shana, go ahead.

21 MS. HELTON: Good morning. Thank you. I  
22 don't know about the major more influence. I think  
23 you've got all the influential people sitting in front  
24 of you at the table today. But, I'll take the  
25 pleasure of giving some opening remarks.

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1 CHAIRMAN CORRADINI: Okay. Good. Thank  
2 you.

3 MS. HELTON: So, that you for that. So,  
4 my name is Shana Helton. I'm the Acting Director of  
5 the Division of Engineering and Infrastructure. And  
6 sitting in front of you at the table today, you've got  
7 Luis Betancourt and Dinesh Taneja. And they're from  
8 the Instrumentation Controls and Electronics  
9 Engineering Branch within my division in the Office  
10 New Reactors.

11 So, we're very pleased to be here today.  
12 It's a culmination of our safety evaluation with open  
13 items. We'll give you a briefing and where we're at  
14 with that, with the NuScale design certification  
15 review. I think we've had a lot of good interactions  
16 at the subcommittee level.

17 And that's helped influence what we're  
18 presenting to you today. So hopefully, we'll cover  
19 all the topics you want. And if not, I think we have  
20 time on the agenda for questions. And with that, I'll  
21 turn it on over. Thank you.

22 MR. TABATABAI: Thank you, Shana. Good  
23 morning everyone. Good morning, Mr. Chairman. Thank  
24 you very much for giving us this opportunity to  
25 present to you the Chapter 7 instrumentation and

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1 controls, as well as Chapter 8, electric power safety  
2 evaluation report, prepared by the staff.

3 We presented these SERs to the  
4 subcommittee back in June and also August of 2018. We  
5 received comments. We tried to average those comments  
6 in the revised SER. To my left and right, Luis  
7 Betancourt and Dinesh Taneja, will be presenting  
8 Chapter 7, instrumentation and controls.

9 And to my far right, Sheila Ray, is the  
10 lead reviewer for electric power. And, based on the  
11 agenda, we're going to start with Chapter 7. We just  
12 want to remind the Committee, we don't have any open  
13 items in the Chapter 7 SER, although we have, in a  
14 couple of places, saying that we are waiting for  
15 additional input from other branches to provide.

16 We have NuScale representatives in  
17 attendance and -- as well as on the phone, in case  
18 there are any more detailed questions that we need  
19 their assistance. I will call upon them to provide  
20 responses. Without further ado, I'll turn the  
21 microphone to Luis Betancourt to start our  
22 presentation of Chapter 7.

23 MR. BETANCOURT: Well, good morning. My  
24 name is Luis Betancourt. I am the Acting Chief of the  
25 Instrument and Controls Branch in the Office of New

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1 Reactors. We're happy to be here today to talk about  
2 Chapter 7. We have a lot of background in the slides.  
3 So, I would like the members to look at the slides  
4 nine and ten, even though we try to avoid the acronyms  
5 as much as I can in the presentation.

6 This slide is basically to show the list  
7 of the INC technical staff that participated in the  
8 review. As part of the timeline from 2014 to 2016, we  
9 actually had a lot of pre-application activities with  
10 the applicant.

11 These three pre-application interactions  
12 were so NuScale could actually embrace in the concepts  
13 of the service which actually led to them using the  
14 fundamental design principles to design the potential  
15 platform as well as the NuScale architecture.

16 It also provided us a lot of time to  
17 understand their design, as well as a lot of technical  
18 issues that they were actually facing at that time.  
19 In March of 2017, they submitted an application. And,  
20 at that time, we already knew what are the areas that  
21 we wanted to focus our attention, as far as the  
22 review.

23 Around the same time, the ACRS glossary  
24 approved the protection system platform topical report  
25 that is compared by reference in the application. So,

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1 between March 2017 to December 2017, we actually held  
2 five public meetings, each that contained 15 question.

3 And we were able to complete one audit  
4 that actually contained the analysis, and also an  
5 analysis for the system architecture, as well as the  
6 diversity, a segmentation analysis technical basis.  
7 Around January of 2018, we were able to complete the  
8 draft SER with open items.

9 Even though it says, open items, we didn't  
10 have any open items specifically on this SER. Open  
11 items are referred to under chapter section 18 of the  
12 application. So, when it came to March 2018, we were  
13 able to receive the traditional assigned certification  
14 and we were able to close all of the confirmatory  
15 items in April 2018.

16 Two weeks ago, we were able to present to  
17 the members at NCR subcommittee meeting and today we  
18 are here at the spot of the full committee. I would  
19 like to actually comment on both the staff and NuScale  
20 as part of these interactions.

21 Because we had a lot of help and  
22 collaborative involvement in being able to resolve all  
23 of these issues. This is the first time to win a  
24 critical path. So, for us, this was a good success  
25 story on how to do a review, a dissected focus review.

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1 So the way that we actually established the review was  
2 -- we call it a dissected focus review. You actually  
3 have two approaches.

4 One was, that the office established a  
5 policy of what they meant about having a safety focus  
6 review, which lined up perfectly with the framework  
7 that was in Chapter 7 or the review, specific standard  
8 developed by the INC staff.

9 The use of insights to enhance a safety  
10 focus review of the skill and design is consistent  
11 with the fundamental design principles of  
12 independence, redundancy, predictability, and  
13 repeatability, otherwise known as determinism,  
14 diversity, and simplicity.

15 This slide basically illustrates the way  
16 that we actually performed the review. If you look on  
17 your left, we started first with a tier one review,  
18 where, in Sections 2.5 and 2.6 of the application, we  
19 were able to review the design commitments and the  
20 inspections test analysis on a circumspect theory,  
21 otherwise known as I-Tech.

22 In the middle of the bin, that's where the  
23 majority of the focus -- we spent on the time. You  
24 will see the big bowl on the left. Basically, there  
25 were three that were IBR and were incorporated by

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1 reference, two technical reports, and one topical  
2 report. The topical court is what led into high  
3 interpretation.

4 Lot one that was already evaluated and  
5 approved by the NCRS and its staff. As part of  
6 technical review -- that contains 65, application-  
7 specific action items that were reviewed as part of  
8 Chapter 7.

9 And in parallel, we were able to review  
10 Chapter 9 and Chapter 14.35 on I-Tech and the  
11 communication systems. And even though we're not  
12 talking about that today and we're going to present  
13 that at a later stage, that was also part of the  
14 initial scope of the review.

15 On the left, we were able to have two  
16 assumptions. The first one is about at worst. And  
17 they'll have a slide that talks about that. And we  
18 have also another TMI action item, 50.34, that even  
19 though we're not the leap reviewer for that  
20 assumption, we actually provided support.

21 And that evaluation is contained in  
22 Chapter 8. Any questions? Okay. No questions is  
23 good. So, as part of the atmos assumption, as I  
24 mentioned before, this was evaluated and documented in  
25 Chapter 7, with assistance of repair systems and the

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1 BRA. To give a brief history, NuScale requested an  
2 assumption for the portion of the atmos rule requiring  
3 diverse equipment to initiate a tubal trip on the  
4 conditions indicative of an atmos.

5 They also stated that since a descent does  
6 include an auxiliary or emergency free water systems,  
7 that possibly the atmos rule requiring diverse and  
8 problematic free water initiation system is not  
9 applicable to them. Since they are relying the  
10 purpose of the rule is to reduce the risk associated  
11 with the atmos events.

12 The staff evaluated three major aspects of  
13 this request. First, we evaluated how the design  
14 reduced the risk of atmos redundancy, diversity,  
15 independence, with the NuScale model protection  
16 system. The built-in diversity of the model  
17 protection system reduces the probability of a  
18 familiar of scram.

19 Secondly, the staff evaluated how the  
20 disarm responds to an atmos event and is actually  
21 bonded by the disarm basis access analysis. And  
22 finally, the staff evaluation showed that the MPS  
23 designed resources and other contribution to the core  
24 damage frequency, which is lower than the safety goal.  
25 And 10 C.F.R. points us to rule-making documents.

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1 Therefore, the staff concluded that the on-the-line  
2 purpose of the rule was met by the NuScale design.

3 I think this is where we're going to be  
4 having a lot of questions. So, as part of the NCRS  
5 subcommittee Chapter 7, we have over here summarized  
6 at a high level the comments that we received. The  
7 first one is basically about the configuration of the  
8 data values.

9 And there was a concern that that  
10 configuration was not specified in the application.  
11 Our finding actually based that the application  
12 clearly contains a design feature as a one-way  
13 selection device from the model control system or the  
14 plan control system to the plan network.

15 DCPO 2, Section 7.29 states that an  
16 applicant must submit a cyber security plan in  
17 compliance with 10 C.F.R. 573. Our review took credit  
18 for this. But the compliance with the cyber security  
19 program with the licenses responsible for implementing  
20 the one-way data flow from the model control system or  
21 the plan control system to the plan data network,  
22 using hardware mechanisms.

23 This is clearly stated in Section B(1)(4)  
24 of the directive 5.71. However, the applicant  
25 recently submitted a letter. Through this, they

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1 awarded the firewall connection that actually resolved  
2 some of the software configuration issues that the  
3 NCRS was talking about at the last meeting.

4 And they committed to use an isolation  
5 device that, in their words, is basically enforcing  
6 the harbor mechanisms.

7 CHAIRMAN CORRADINI: Say the last part  
8 again, please?

9 MR. BETANCOURT: Oh, the last one?

10 CHAIRMAN CORRADINI: Yeah. The last part  
11 you said, they committed to what?

12 MR. BETANCOURT: They committed to us in  
13 the letter that was actually submitted to us on  
14 September 14. I don't know if you guys have seen that  
15 or not. Okay. So, in the letter, they actually  
16 submitted revised language that they removed the  
17 firewall language that a lot of members have some  
18 trouble.

19 MEMBER BROWN: Which firewall are you  
20 talking about, the one from the plant network out to  
21 the rest of the world? That's where the firewall is  
22 specified.

23 MR. BETANCOURT: Right.

24 MEMBER BROWN: The only place a -- that's  
25 the only one. All the rest of the PCS and the MCS

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1 communications were via this unit directional data,  
2 but it never mentioned the word firewall. That was in  
3 you all's SER where you called it that, which was an  
4 inconsistency.

5 MR. BETANCOURT: It was also --

6 MEMBER BROWN: Let me finish.

7 MR. BETANCOURT: Right.

8 MEMBER BROWN: So, when you talk about  
9 firewall, you're going to have to differentiate. The  
10 only firewall that they had in their Chapter 7 and --  
11 was from the plant network to the rest of the business  
12 network and all the rest of the -- the entire world  
13 can talk to this business network or whatever, okay?

14 MR. BETANCOURT: Right. And that's  
15 consistent. So --

16 MEMBER BROWN: So, if that's the software,  
17 whatever it is, that's where the cyber security  
18 controls are most critical.

19 MR. BETANCOURT: Right.

20 MEMBER BROWN: To relate or make the  
21 MCS/PCS a part of this cyber security, that's an  
22 implant communication device, not an ex-plant  
23 communication device.

24 MR. BETANCOURT: Right.

25 MEMBER BROWN: So, to put that together

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1 with this secure development environment in a cyber  
2 security plan is, to use a cumbersome word, absurd,  
3 okay? And there's no way that we should be dependent  
4 on that communication process implant.

5 MR. BETANCOURT: Right.

6 MEMBER BROWN: It ought to be similar to  
7 what we do from the main -- you know, the mocking  
8 protection system and the PPS, which are very explicit  
9 in how those communication modules -- you look at the  
10 Chapter 7, it states very explicitly that those are  
11 one way and they tell you how.

12 MR. BETANCOURT: Right.

13 MEMBER BROWN: They're only to transmit  
14 wire for those equipment or EEE devices or whatever  
15 they end up using, is the only one connected. So,  
16 there is actually a physical hardware limit on how  
17 those could be accomplished.

18 MR. BETANCOURT: Right.

19 MEMBER BROWN: And yet, here in the most  
20 vulnerable section of the communications, all the  
21 plant control systems, both all 12 module control  
22 systems, including the overall plant control system,  
23 is just connected through this nebulous isolation  
24 device, which can be, based on their comments in the  
25 subcommittee meeting, could be whatever they determine

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1 they want it to be in five years.

2 MR. BETANCOURT: Right.

3 MEMBER BROWN: So, that, to me -- this is  
4 to me. This is me speaking, right? This is not the  
5 committee speaking. That's me speaking.

6 MR. BETANCOURT: Right.

7 MEMBER BROWN: Does not make any sense.  
8 Largely because you have to separate the implant  
9 communications from the explant communications.

10 MR. BETANCOURT: Right.

11 MEMBER BROWN: I have no problem with the  
12 firewall. Obviously, that one's going to be a cyber  
13 security plant, you know, up in the plant network, out  
14 to the world.

15 MR. BETANCOURT: Right.

16 MEMBER BROWN: That's going to be what it  
17 is. But, we need a door from PCS and MCS to that  
18 plant. Right now, there's no door specified. It's an  
19 open door.

20 MR. BETANCOURT: Okay.

21 MEMBER BROWN: Keep in mind that that's my  
22 considerations or my thoughts, which I will be  
23 obviously recommending to the committee to either  
24 agree or disagree with.

25 MR. BETANCOURT: Right.

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1                   MEMBER BROWN: But, that's the position  
2 I'm coming from in terms of how I review, post their  
3 review.

4                   MR. TABATABAI: So, Member Brown, Actos,  
5 in technical reviewing this document, there were a  
6 couple of elements that played the rule and the way we  
7 reviewed it. You know, the safety focus review  
8 explicitly stated -- and I will review, we need to  
9 take credit for operational programs. Okay?

10                   So, in Chapter 13, where the operational  
11 programs are laid out, there is a CRL item for the  
12 serial applicant to submit a cyber security plan,  
13 okay? That is an operational program. So, we are  
14 taking credit for that as one of the items that has to  
15 occur in accordance with part 73, the cyber security  
16 program.

17                   And in Chapter 7, there are explicit  
18 statements made for the cyber security plan to be  
19 developed in accordance with part 73. So, recognizing  
20 that, and then we go to 5.71, and 5.708 specifically  
21 states that preventing encrypted data from bypassing  
22 checking mechanism -- it's implementing one-way data  
23 flows using hardware mechanism. So, it really  
24 provides guidance on how to develop a cyber security  
25 plan, for the given facility. So it is a problematic

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1 item. And looking at the operational programs and  
2 looking at that safety focus review, we are taking  
3 credit in our review of the operational program.

4 That was the approach that the staff used  
5 in looking at this realistically. And recently, we  
6 had to see we had received a direction from our Office  
7 Director which basically says, how do you approach a  
8 review which provides a reasonable assurance of  
9 safety.

10 And one of the guidance that we received  
11 from -- I would say, a direction that we received from  
12 our Office Director, it was to really, you know, take  
13 credit for operational programs in this as well. So,  
14 there's a couple of places.

15 I mean, I can quote the memo that we got  
16 from our Office Director, Fred Brown, that basically  
17 says, "Doing in-depth review of parts of the design  
18 certification application that requires site-specific  
19 parameters or values may not be necessary or efficient  
20 when there is no concurrent review of the combined  
21 license or early site permit application that  
22 references the design." I had no idea what that meant  
23 either.

24 CHAIRMAN CORRADINI: So, can I ask a much  
25 more uneducated question?

1 MR. TABATABAI: Sure.

2 CHAIRMAN CORRADINI: The way I view  
3 Charlie's comment, at this point, his comment, is you  
4 guys are doing it -- you guys -- the NuScale design is  
5 suggesting a way to handle it within the -- I'll get  
6 these wrong I think -- the MCS and PCS.

7 Oh, I'm sorry. Within the -- within a  
8 certain part of plant. And yet, in this part of the  
9 plant, they've chosen an unspecified approach. Why  
10 not simply adopt the same approach for all in-plant  
11 communication? That, I think, is the essence of  
12 Charlie's --

13 MEMBER BROWN: Well, okay. So, I have an  
14 answer for that.

15 CHAIRMAN CORRADINI: Is that close to  
16 being accurately, Charlie?

17 MEMBER BROWN: Relatively. I mean, the --  
18 right now, when you look at MPS, PPS -- that's the  
19 plant protection system and the module protection  
20 system, which is reactor-tripped and safeguards, I  
21 mean, the hardware is a hardware. And it's very, very  
22 explicit in Chapter 7 as to how it's accomplished.

23 CHAIRMAN CORRADINI: And so, my question  
24 is -- I interpret Charlie's comment to be, so why not  
25 just be that explicit and that simple for the other

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1 one?

2 MR. TABATABAI: Okay. Explicitly, it's  
3 there. So, this dial which presents a check-valve,  
4 essentially is a one-way communication. Now, what is  
5 missing at this stage of the application is the  
6 specification of this device, okay? Exactly, you  
7 know, what parameters and what specification.

8 So, those are really part of the, you  
9 know, as-built configuration when the plant is built.  
10 And so, there is that operational program that really  
11 requires the, you know, the critical digital access to  
12 be specifically identified that have to comply with,  
13 you know?

14 And read that 5.7 was very explicit on  
15 that as to what one of the inequalities or the  
16 characteristic of the diode has to be. So, from our  
17 point of view at this review, we are looking at that  
18 data buyer and saying, okay, it's typically one-way  
19 communication. And it will not allow any  
20 communication coming back into the network.

21 MEMBER BROWN: But, hold it, just a  
22 minute.

23 MR. TABATABAI: Right.

24 MEMBER BROWN: To quote the NuScale  
25 representative in subcommittee, he stated, we will

1 specify that in our application, if it is digital or  
2 hardware or software-based. In other words, software-  
3 based is just fine in the -- put aside all the other  
4 blathering about 5.71 and other type things. They  
5 explicitly stated that this would allow a software-  
6 based data diode, which a software --

7 MR. TABATABAI: Okay. I just --

8 MEMBER BROWN: Let me finish.

9 MR. TABATABAI: I'm sorry.

10 MEMBER BROWN: Which a software-based data  
11 diode, when it's controlled and configured that --  
12 very explicit ways they're operating, can't be  
13 compromised, as opposed to a hardware, one-way diode.  
14 And, right now, that's not clear, regardless if you go  
15 through all these other steps because red guide 5.7  
16 talks about the one-day data diode being a hardware-  
17 based that doesn't require --

18 MEMBER KIRCHNER: It's a guidance.

19 MEMBER BROWN: It's a guidance issue, not  
20 an explicit. It says, you've got to think about it.  
21 That's all it does. I mean, I was there. I wrote the  
22 letter on 5.71 ten years ago. So -- or eight years  
23 ago, whatever it was, back in 2010, I think.

24 MR. TANEJA: So, it's an operational  
25 program that has a, you know, a regulatory framework

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1 which really flowers. And, you know, where they are  
2 actually looking all the, you know, these critical  
3 data flows and, you know, whether or how they are  
4 protected.

5 So, you know, so the NRC -- so the reason  
6 we understand this to be an operational program is  
7 that cyber security is an evolving threat. Now, what  
8 today we consider secure, you know, five, ten years  
9 from now, may be, you know, somebody's probably -- a  
10 thief is going to figure out how to break that lock.

11 So, you know, so what is the security at  
12 that time? That's why I guess it is really, you know,  
13 an evolving stage where the program has to also be  
14 evolving. So, what is the requirement at the it's  
15 going to take place? And that's the way staff is  
16 looking at this thing.

17 MEMBER BROWN: Dinesh, I don't understand  
18 --

19 MR. TANEJA: Yes.

20 MEMBER BROWN: How we can say we're going  
21 to evolve --

22 CHAIRMAN CORRADINI: I mean, if the  
23 applicant wants to make a comment, that might help  
24 you.

25 MEMBER BROWN: I hope. But, my heart is

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1 not jumping with joy or apprehension that it's going  
2 to be anything like we would expect. Before he makes  
3 a comment, I would -- I'd just -- you're not -- don't  
4 leave. I just want to make one observation.

5 Every other applicant that we've come  
6 through have committed to make that off, outside the  
7 plant, communication from in-plant stuff, a hardware-  
8 based, data diode, explicitly. This is the only  
9 applicant that has come through saying, we can accept,  
10 and we're smart enough to be able to design it however  
11 we want to design it in five years.

12 And it's all going to come out okay.  
13 Trust us. And, quite frankly, the evolving nature of  
14 the ability of people to satisfy cyber requirements  
15 with software-based protocols that you have to  
16 monitor, check for threats, upgrade constantly, is  
17 always in reaction to being compromised.

18 MR. TANEJA: Yes. I understand.

19 MEMBER BROWN: Never, in terms of being  
20 able to prevent. And all you've got to do is -- you  
21 hear the news every day. So, that's the reason I'm as  
22 hard over as I am. And hopefully, I can convince my  
23 folks. Now I will let -- excuse me, for letting me  
24 blather on here before you go.

25 MR. ARNHOLT: No. Thank you. This is

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1 Brian Arnholt, the INC Supervisor with NuScale Power.  
2 At the subcommittee meeting, we did take back the  
3 recommendations from the subcommittee members. And we  
4 made a specific, explicit change in our FSAR to refer  
5 to these diodes as one-way, deterministic isolation  
6 devices.

7 MEMBER BROWN: Nope. It says -- it  
8 doesn't say one-way. It says, deterministic isolation  
9 device, which -- whatever that means. An RS-232 with  
10 only one line going out can be defined as a  
11 deterministic isolation device. But, it's not totally  
12 software-based. I mean, it's not totally hardware-  
13 based. Excuse me. Go ahead.

14 MR. ARNHOLT: Right. And I'm continuing.  
15 Where that language came from, it came from NEI-13-10,  
16 Revision 6, that was issued in 2017. It has received  
17 endorsement by the NRC staff. And we did contact  
18 several industry representatives to gather  
19 understandings about what is an industry best practice  
20 today.

21 And you're exactly right. Hardware-based  
22 devices are an industry best practice. We've actually  
23 contacted some vendor, and met vendors who supply  
24 hardware -- what they call hardware-based devices.  
25 There is actually software on either end of those

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1 hardware devices that functions.

2 So, we were very -- that's why we were  
3 very deliberate in the language we used. Now, with  
4 that said -- and I'll enter for the record what a one-  
5 way deterministic isolation device is. It refers to  
6 a boundary control device that transmits or receives  
7 network traffic in one direction only, which is  
8 enforced in the hardware design, not software.

9 No software configuration or  
10 misconfiguration will cause the boundary device to  
11 reverse the direction of data flow or become a two-way  
12 device. And in NEI-1310, they actually use, for  
13 example, the data diode. So, we removed any  
14 connotations that that device is configured or  
15 operates on a software leg.

16 MEMBER BROWN: Are those words in Chapter  
17 7 or are they just in this NEI document?

18 MR. ARNHOLT: There's a description in the  
19 NEI document. But, in Chapter 7, we call it a one-  
20 way, deterministic isolation device.

21 MEMBER BROWN: So, let me go backwards.  
22 The nice words you just talked about, you put those in  
23 Chapter 7, it may look acceptable once we see how  
24 they're -- but, right now, just saying deterministic  
25 isolation device is vague.

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1 MR. ARNHOLT: Right. And to add to what  
2 the NRC staff said about leveraging operational  
3 programs, why we chose that language, because that is  
4 an endorsed guidance that the current operating fleet  
5 is using today.

6 So, we took that approach to set up future  
7 CLL applicants, when they actually implement the cyber  
8 security provisions of their -- of the design when it  
9 meets the plan, to leverage what we put into our DCA.  
10 That was our intention.

11 MEMBER BROWN: Well, the role of is to try  
12 to ensure that we maintain a satisfactory safety  
13 posture, okay? That is defined in advance and doesn't  
14 "evolve in some later determination" because industry  
15 evolves as they go. In other words, we need somewhat  
16 well-defined, explicit statement of what is meant.  
17 And, right now, that's not in Chapter 7. It's  
18 fundamentally the difficulty.

19 CHAIRMAN CORRADINI: I think we're clear  
20 now.

21 MEMBER BROWN: There's enough words now in  
22 the transcript that that ought to be clear. It's just  
23 the -- once we went to the deterministic isolation  
24 device, that was even, in my opinion again, was more  
25 vague and ambiguous than a uni-directional data diode.

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1 That at least has, in the context of going and looking  
2 at products, has some context.

3 The way that was phrased does not. Now,  
4 your additional words that you talked about, if they  
5 were put together as such that it is very, very clear  
6 that these devices -- whatever hardware. I'm not  
7 worried about base stuff.

8 But, they are configured based on a  
9 physical configuration of transmit and/or receive that  
10 you cannot change by entering it with some code  
11 somewhere else on the device, in the device, or  
12 attached to the device through some other, you know,  
13 like a laptop or whatever. It ought to be a hardware  
14 configuration.

15 And once there, it can't be changed,  
16 unless you go in and take the device out and  
17 physically do something to it. And that's the thought  
18 process. And that sounds like what you were talking  
19 about, but it's just not in Chapter 7 right now.

20 MEMBER RAY: Mike, can I make a comment?  
21 Are you done, Charlie, for the moment?

22 MEMBER BROWN: Yeah. At the moment, for  
23 a moment. Am I ever done?

24 MEMBER RAY: I just wanted to make a  
25 comment to the members. This is a very specific and

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1 detailed example of a general issue. The staff  
2 mentioned taking credit for operational programs to  
3 which guidance exists and applies.

4 But, it does illustrate the process in  
5 which we're engaged now, but not later when this  
6 operational guidance, the red guide, is applied to an  
7 operational program. And we need to reflect on that.  
8 Charlie's trying to pursue something very specific  
9 that he's very interested in right now.

10 But, the essence of it will be that this  
11 credit that was referred to, is part of what we're  
12 reviewing. It's credit for guidance that will be  
13 applied to an operational program in the future. And  
14 we -- op review will be ancient history by then. So,  
15 I just want to make that point because we'll be  
16 talking about the generic aspects of the enhanced  
17 safety focus review approach at another time.

18 MS. HELTON: Is it okay if I pipe in just  
19 for a second? This is Shana Helton. On that topic,  
20 I think the staff has a strong sensitivity to what  
21 you're raising about what type of review we're doing  
22 now with the design certification and what type of  
23 review we'd be doing later, as part of the COL review,  
24 if and when one were to come. So, I think part of  
25 what we want to do -- there's the combination of

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1 products that will be referred to at the COL phase.  
2 Our staff safety evaluation is one of them.

3 And we're trying to be very clear about  
4 what would -- you know, why is it acceptable today, as  
5 a design serve? What needs to be evaluated as a COL  
6 item? I think we could say that we would be very  
7 specific in our SE writeup about the COL item that  
8 would have to be associated with this. Especially,  
9 with regards to the security plan.

10 MEMBER RAY: Well, I think that's an  
11 interesting point. And it illustrates the dialogue  
12 that I don't know has fully taken place on this point.  
13 In other words, things that we would ordinarily expect  
14 to resolve at this time, as Charlie was pursuing,  
15 you'll have another chance to see what the resolution  
16 is of the COL.

17 The understanding of that -- and having  
18 confidence in it is something that I don't think all  
19 of, at this point in time, are satisfied with. And  
20 yet, things are moving on and we need to find out how  
21 we can get a better understanding.

22 MEMBER BROWN: My point is, on the COL end  
23 of the thing, the only way the COL knows, on an  
24 explicit basis, what is desired, is through the DCD,  
25 where it's explicitly specified. Right now, the

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1 condition is not specified. So, he is up -- it's up  
2 on the air.

3 Five years from now, oh, I'll do it this  
4 way. And therefore, I've got these wonderful guides  
5 and we've got all these marvelous cyber security  
6 programs and this is going to serve us well. So, he  
7 doesn't know. Unless we tell him in the DCD where we  
8 want that hard wall for safety purposes.

9 Access to those plant control systems can  
10 put you into -- they can take over control of the  
11 plant. They can initiate every item in there and  
12 create an unknown, unknown plant conditions, that your  
13 protection system will not protect against.

14 And if you think you can protect that with  
15 some vague reference to something that'll be done by  
16 the COL years later, is -- I just can't even  
17 comprehend that because that -- it's an unknown,  
18 unknown. And it is a combination of events that we  
19 don't analyze for, that -- our whole analysis is very  
20 explicit in terms of what you have to look at.

21 And, I mean, it's like the atlas. We've  
22 determined in this circumstance, they don't have to  
23 comply with that. And we didn't take issue with that  
24 in our meeting because of the -- I think it was the  
25 analysis basis puts it outside the boundary conditions

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1 where we should have to consider that. That's a risk-  
2 informed type decision.

3 So, we have not -- we haven't really  
4 addressed it in Chapter -- I guess it will come up in  
5 Chapter 15 at some point. Is that correct? So, we'll  
6 hear that one again. But, the DCD is the only place  
7 that the COL has for reference, what is really  
8 desired.

9 And this is a major vulnerability. If  
10 you've got anything that's -- any doorway that's  
11 controlled by software is like giving a hacker a super  
12 highway into every -- and once he gets into this  
13 distributed control system, there are no boundaries.  
14 This is the first of the -- I'm not aware of any other  
15 total distributed control system that we've looked at  
16 in the other apps.

17 They've all been explicit systems for each  
18 and every component or system. That's not the case  
19 here. Now, they're all bundled together, even though  
20 it's segmented. I may be finished. I don't know.  
21 You can tell I'm over this.

22 MEMBER RAY: I just want to concur with  
23 Charlie so he's not alone. I think that should be a  
24 condition. If it's not called out now, then it should  
25 be added as a condition.

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1 MR. ARNHOLT: It may show up in our  
2 letter.

3 MEMBER RAY: Or just -- I'm going to  
4 approach this an example. It's an example. It's a  
5 real good example, but it's just an example.

6 MEMBER BROWN: Yeah. It's an example of  
7 something where we don't have total -- you look at the  
8 operational approach to that and it may not meet what  
9 we want later. That's all. And Harold's point was  
10 valid.

11 MALE PARTICIPANT: Member Brown, thank you  
12 very much for elaborating on this issue. So, I think,  
13 based on what NuScale's representative explained and  
14 the staff's review of additional information, I  
15 believe we have some additional clarification to make  
16 in Chapter 7, FSAR, final safety analysis report, as  
17 well as if there are any needs for our SER to be -- so  
18 --

19 CHAIRMAN CORRADINI: So, I think we need  
20 to move on. But, from a process standpoint, we're  
21 going to go with what we know is written. And we kind  
22 of know where some suggestions are by certain members.

23 MALE PARTICIPANT: And we will review your  
24 letter to make those quantifications.

25 MR. BETANCOURT: Anything else or -- no?

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1 I'm looking at the boss. So, the second comment that  
2 we got off here was about the motor control system and  
3 the plant control system technical analysis. And I  
4 believe the concern was that the SER implied that a  
5 failure of these systems could affect the motor  
6 protection system or the plant protective system.

7 So, the SER was clarified that a failure  
8 of these systems does not affect the safety function  
9 rather than the motor control -- motor protection  
10 system or the plant protection system. The third  
11 question was related to the plant impacts associated  
12 with true post-related failure.

13 So, RCS flow sensors -- and I think there  
14 was a comment. And the way that we clarified that in  
15 the SER was that the RCS low-flow protection actions  
16 are not credited in any design bases, accidents or  
17 transients.

18 Hence, the -- on the liability of the RCS  
19 flow variable, it's not a safety concern. So, I don't  
20 know if that addresses your question or not.

21 MEMBER RAY: Thank you. That does.

22 MEMBER BROWN: One comment on the  
23 segmentation thing. I think you included that in that  
24 revised of the SER.

25 MR. BETANCOURT: Right.

1 MEMBER BROWN: And I think I remember  
2 reading it. My question was -- my comment was, you  
3 all made the statement that the segmentation was  
4 necessary to prevent --

5 MR. BETANCOURT: The first impact to the  
6 motor protection system.

7 MEMBER BROWN: Yeah. In other words, it  
8 -- somehow it could go backwards and affect that.

9 MR. BETANCOURT: Right.

10 MEMBER BROWN: And I guess the thought  
11 was, you really needed to disconnect that thought  
12 because it really can't. It's a one-way communication  
13 and it can't go backwards.

14 The issue, to make sure I understand it,  
15 was you didn't want compounding failures within the  
16 control systems to result in a situation where the  
17 module protection system could not perform its  
18 function in accordance with the safety analysis. Does  
19 that -- did I phrase that right or --

20 MR. BETANCOURT: Yeah.

21 MEMBER BROWN: And I don't remember your  
22 exact words. But, I just wanted to make sure here --  
23 now, I've got in the record, that I can remember it,  
24 how I understood it when I read it. I'm trying to  
25 clarify that for the members here so they'll have some

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1 idea of what we -- what I was talking about.

2 MR. BETANCOURT: So, that was an oversight  
3 on our part. So, we've corrected that in the rest.

4 MEMBER BROWN: All right. Yeah. I  
5 thought you did. I didn't have any question when I  
6 read the revised SER.

7 MR. BETANCOURT: And the last comment was  
8 basically that we got a lot of the open items that  
9 were specific to Chapter 7. We removed that language  
10 from the SER, as well as some editorial changes that  
11 we saw.

12 We also included three new confirmatory  
13 items -- so, new letters that we received in July and  
14 the recent letter that the applicant submitted in  
15 September. That's actually now incorporated in the  
16 staff evaluation report.

17 MEMBER BROWN: Was that relevant to the  
18 SDOE-type stuff in those various paragraphs?

19 MR. BETANCOURT: Yeah. Right.

20 MEMBER BROWN: But, if those change based  
21 on what we're doing -- I just don't like the idea.  
22 I'm uncomfortably with coupling X-plans, programs, if  
23 I haven't phrased this properly earlier, with -- and  
24 I've tried to stay out of those. I totally understand  
25 what goes on relative to the plant network out to the

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1 world. But, once we're in-plant, those communications  
2 ought to be solid, relative to their either receive or  
3 transmit or both.

4 And the 57.0-1, is explicit and shows  
5 those fairly clearly. So, it allows us to look at  
6 that, as well as the other unidirectional, as well, as  
7 you specified, the bi-directional. And you can see  
8 where, you know, where you might have a problem or  
9 don't.

10 MR. BETANCOURT: Right.

11 MEMBER BROWN: So, that's -- now, had you  
12 all did -- let me ask one other question. You all  
13 made one other discussion relative to the MCS  
14 compromising the MPS. The same issue would apply to  
15 the PCS compromising the PPS, the plant protection  
16 system.

17 MR. BETANCOURT: Right.

18 MEMBER BROWN: I've assumed, based on the  
19 review of those communications that your analysis for  
20 MCS backwards to MPS, would also apply and show your  
21 satisfactory from PCS back to the P -- and I may  
22 explicitly state that in the letter just to make sure  
23 we have that on the record.

24 MR. BETANCOURT: And we were able to  
25 revise that in the SER.

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1 MEMBER BROWN: The last one?

2 MR. BETANCOURT: Look, in the version that  
3 we sent you earlier in the week, that was revised.

4 MEMBER BROWN: I couldn't find that. I  
5 looked explicitly for the same words that you applied  
6 for the MPS/MCS issue. I didn't -- I could not find  
7 it for the PCS.

8 MR. BETANCOURT: Okay.

9 MEMBER BROWN: So, if you can tell me what  
10 page of the SER that's on, I would appreciate that --  
11 the revised SER.

12 MR. BETANCOURT: Okay.

13 MEMBER BROWN: Okay. That's all I had,  
14 Mike.

15 MR. BETANCOURT: So, let's go to  
16 conclusions. So, to conclude the approach that the  
17 staff used for the precise specific review standard  
18 for Chapter 7, resulting in a single architecture and  
19 the high system design we compared the fundamental  
20 principles and this resulted in the completion of the  
21 safety evaluation in an efficient and effective focus  
22 matter.

23 And the staff concludes that the design to  
24 be saved on the compliance with applicable  
25 regulations. Any more questions before I transition

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1 the presentation to Sheila? Okay.

2 MS. RAY: Good morning. My name is Sheila  
3 Ray. I'm in NRR. My division is Engineering, the  
4 electrical engineering and new reactors license  
5 renewal branch.

6 MEMBER BLEY: Can I interrupt? This is  
7 Dennis Bley.

8 CHAIRMAN CORRADINI: Dennis, go ahead.

9 MEMBER BLEY: Yes, Sheila, I want to ask  
10 you a question that you can answer as you go through  
11 the presentation. But, as I looked through your  
12 slides, you're going to talk about the remaining two  
13 open items.

14 One of them relates to exemptions on DDC-  
15 17 and 18. But, the SER we reviewed and I believe  
16 during our subcommittee, there were also exemptions on  
17 33, 34, 35, 38, 41 and 44, that were still under  
18 review. Tell us about those and if those have been  
19 closed.

20 Because they were not in -- they were not  
21 closed in the version we read. And my last thing is  
22 related to the Chapter 7. I just want a second to  
23 thank Charlie for staying on the one-way  
24 communication. That's all for me.

25 CHAIRMAN CORRADINI: Do you have, Sheila,

1 what he's got?

2 MS. RAY: Yes.

3 CHAIRMAN CORRADINI: And so, just bring it  
4 up when it's appropriate, when you get to your  
5 exemption discussion, if you could.

6 MS. RAY: Sure.

7 CHAIRMAN CORRADINI: Thank you.

8 MS. RAY: Well, on slide two, I just  
9 wanted to mention we have a lot of reviewers for this  
10 Chapter and we appreciate their assistance. So, our  
11 SER is based on rev zero of the DCA. in phase 4, we  
12 will address the revisions from rev one of the DCA.

13 Our SER contains two major open items and  
14 we'll be discussing those. And our open-end  
15 confirmatory items will be closed in phase four of our  
16 review. So, on the -- regarding the NuScale design,  
17 the electric power system for the NuScale design is  
18 comprised of non-safety-related AC and non-safety-  
19 related DC power systems.

20 The design does not depend on off-site or  
21 on-site AC electrical power systems, including that  
22 from the transmission grid for safe operation. The  
23 non-safety AC systems are comprised of low, medium,  
24 and high-voltage systems, as well as backup diesel  
25 generators and auxiliary AC power sources. The on-

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1 site DC systems include the highly reliable EDSS and  
2 EDNS systems, both non-class one. Next slide.

3 Using the DSRS or SRP, as well as the  
4 graded review approach, the staff reviewed the design  
5 of the electric power systems necessary for the safe  
6 design and operation of the plant or whose failure  
7 might adversely affect their safety-related or risk-  
8 significant functions.

9 There are two major open items, one  
10 pertaining to the GDC 17, 18 exemptions and one on the  
11 electrical penetration assemblies. At this point, I  
12 will address Member Bley's comment on GDCs 34, 35, et  
13 cetera. Those are still remaining as open items at  
14 this point.

15 They are related to GDC 17 and 18. We  
16 will have more discussion with our Chapter 15  
17 colleagues and continuing reviewing that in phase  
18 four. Does that address your comment or question?

19 MEMBER BLEY: Let me get unmuted. Yes, it  
20 does. Thank you. I appreciate that.

21 MS. RAY: No problem. Next slide. So,  
22 this open item on the exemptions is recurring  
23 throughout Chapter 8, in that this open is referenced  
24 in Section 8.2 for off-site power systems, Section  
25 8.31 for on-site AC systems, Section 8.32 for on-site

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1 DC systems, and Section 8.4 for station blackout.  
2 Basically, this particular open item is repeated in  
3 each section of Chapter 8.

4 The NuScale design does not rely on  
5 safety-related AC or DC power systems. A topical  
6 report was submitted on the safety classification of  
7 passive nuclear power plant electrical systems. And  
8 the staff approved the TR with five additional  
9 conditions.

10 The open item relates to the exemptions to  
11 GDC 17 and 18, as described in DCA, Part 7, regarding  
12 the staff verifying that the design does not require  
13 safety-related power. In addition, the Chapter 15  
14 review on accident analyses is still ongoing.

15 The staff issued an REI regarding how the  
16 NuScale design meets the conditions of applicability  
17 and the five, additional conditions. The staff is  
18 currently evaluating the response as part of the  
19 Chapter 8 and 15 review.

20 MEMBER MOORE: So, just to make sure I get  
21 it, so this is connected to the major open item  
22 relative to how the TR is met by the actual design?

23 MS. RAY: Correct.

24 MEMBER MOORE: And we will see that in  
25 phase later?

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1 MS. RAY: Yes. When we come back,  
2 completing our phase four SER, and we come to ACRS in  
3 phase five.

4 MEMBER MOORE: So, let me ask a somewhat  
5 unsophisticated question. Since the TR was written by  
6 NuScale and their design supposedly meets it, is there  
7 some substantive reason for the delay? I would expect  
8 this would be clear. What am I missing?

9 MS. RAY: So --

10 MEMBER MOORE: Can you give me a hint as  
11 to why it's not closed at this point? Is the design  
12 being modified to meet it? I'm still struggling here.

13 MS. RAY: The staff wasn't clear on how  
14 the NuScale design does meet all of the conditions of  
15 applicability. And some of those are related to other  
16 chapters. So, until the other chapters are more  
17 complete, we cannot make our conclusion in Chapter 8.

18 MEMBER MOORE: Okay. So, what you're  
19 saying is, there are system interactions that have yet  
20 to be determined for transients, accidents, et cetera,  
21 et cetera?

22 MS. RAY: That's correct.

23 MEMBER MOORE: Okay. Fine. So, let me  
24 ask another one. So, until we see Chapter 15 and it's  
25 closed, 8 may never be closed? The open item in 8 may

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1 never be closed.

2 MS. RAY: That is correct.

3 MEMBER MOORE: Okay. Fine. Just  
4 checking. But, and last --

5 MS. RAY: Yes.

6 MEMBER MOORE: That then kind of returns  
7 back to the Chapter 7, because all of these  
8 assumptions are hooked together. Because the only  
9 open items that I saw in Chapter 7, were essentially  
10 those pointing to 8.

11 MS. RAY: Chapter 7, I don't believe, has  
12 any open items.

13 MEMBER MOORE: Well, there was reference.  
14 Well, then maybe I am --

15 MR. TANEJA: I didn't see any specific  
16 open items.

17 MEMBER MOORE: Okay. Excuse me.

18 MR. TANEJA: But, there are open items  
19 that reference Chapter 8 and 15.

20 MEMBER MOORE: Correct. That's my -- that  
21 was my point. Okay. Thank you. I'm just trying to  
22 refresh my memory.

23 MS. RAY: I understand. Next slide, slide  
24 seven. The second open item is regarding electrical  
25 penetration assemblies. And the staff issued an RAI

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1 regarding the non-Class 1-E, electrical penetration  
2 assemblies and their respective productive devices.

3 The applicant indicated that the non-Class  
4 1-E EPAs have no electrical circuits that use the  
5 associated containment penetration to perform a  
6 safety-related function and that the EPAs designed as  
7 non-Class 1-E are subject to the same EQ and seismic  
8 requirements as Class 1 EPAs.

9 Furthermore, the applicant provided  
10 clarity on the self-limiting protective devices, such  
11 that the maximum fault current in these circuits would  
12 not damage the penetration if the current was  
13 available indefinitely. The staff finds the response  
14 acceptable, since the non-Class 1-E EPAs will not be  
15 impacted by a fault and are subject to the same EQ and  
16 seismic requirements as Class 1 EPAs.

17 Currently, as a confirmatory item in the  
18 draft, phase four, SER. And just for a conclusion, we  
19 are working on our phase four review and these are the  
20 two open items. So, at this time, I'll take any  
21 questions.

22 MEMBER MOORE: I'm back to -- as the  
23 official, designated worrier, I'm still -- this is  
24 probably not -- let me state my concern, and then,  
25 maybe this is not the forum to discuss it, but you'll

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1 take it back to the higher-ups.

2 MS. RAY: Yes.

3 MEMBER MOORE: I'm trying to understand,  
4 in a logical fashion, if all of these things are  
5 connected, which is the first logical thing to look at  
6 in phase four, so the other bubbles start falling? In  
7 other words, is Chapter 15's accident analysis the  
8 key? It strikes me, that's the key.

9 That is, I want to show in my simple mind  
10 that the sourcer is X and when I apply the sourcer of  
11 design-basis accidents, we've satisfied it. The  
12 accident analysis shows that I keep the core cool and  
13 I can, essentially, get the ultimate heat sync.

14 Once I satisfy all of that, all of these  
15 other things are going to meet. So, am I right in  
16 that simple-minded thought process?

17 MS. RAY: I guess I would --

18 MALE PARTICIPANT: Mr. Chairman, I'd like  
19 to make a comment on that. You're absolutely right.  
20 We all are actually making adjustments to our  
21 schedules for phase four review and before we come to  
22 the ACRs to present our phase fours reviews.

23 So, we are taking into account what  
24 portions of, for instance, Chapter 8 requires input  
25 from Chapter 15, so we can schedule those

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1 presentations in tandem so there is a full picture to  
2 be presented to the ACR.

3 CHAIRMAN CORRADINI: Okay. And the reason  
4 I'm -- and I figured you'd tell me that. But, so --  
5 my concern kind of revolves around this. I think,  
6 when the time has come, the committee members are  
7 going to want to look at this carefully.

8 And therefore, if somehow, all of a  
9 sudden, the schedule starts slipping, so be it. Just  
10 so we're clear two years in advance and there's no  
11 surprises. Okay. I've said it.

12 MALE PARTICIPANT: We understand the  
13 comment.

14 CHAIRMAN CORRADINI: Okay. Thank you.  
15 Are you guys done?

16 MS. RAY: Yes.

17 CHAIRMAN CORRADINI: Dennis, did you have  
18 any more -- you wanted to be online to make sure you  
19 had your questions asked.

20 MEMBER BLEY: I did. And my questions are  
21 all pretty well answered. I want to follow-up on what  
22 Mike just went through. And I think when it comes  
23 time to close this out, we need to have real clarity  
24 on all the conditions in tables 3.1 and 3.2 of the  
25 topical are met and especially how the staff has

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1 concluded that all of their conditions have been met  
2 as well. I'm sure that'll be in that phase four SER.  
3 But, we will be looking closely at that. And that's  
4 all for me.

5 CHAIRMAN CORRADINI: Okay. Thanks,  
6 Dennis. Are there other members that have --

7 MEMBER KIRCHNER: Do we have a running  
8 document table, for lack of the right description, of  
9 all of the exemptions that are being requested and  
10 what they -- in other words, we have open items here  
11 that relate to Chapter 15.

12 We've seen this before. Is there some  
13 table that the staff is maintaining that kind of  
14 summarizes the overall application and what the --  
15 connects the dots, as these open items and exemptions  
16 are dispositioned?

17 Because we are getting it piecemeal. For  
18 example, it's quite a while back we had exemption at  
19 GDC 27. I don't want to reopen the topic, I just --  
20 but from a process standpoint --

21 CHAIRMAN CORRADINI: But, it's still  
22 sitting out there. It's still sitting out there, is  
23 your point.

24 MEMBER KIRCHNER: Yeah. And if,  
25 subsequent to Chapter 15 analysis, it's determined,

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1 for example, in that particular case that the CBCS  
2 system needs electrical power, then that changes both  
3 your INC and your electrical SERs.

4 MR. TANEJA: That's great. Actually, as  
5 far as the table view mentioned, of course the DCA,  
6 design certification application, is comprised of  
7 several parts. And one part, I think it's part four  
8 I believe, that lists all of the exemption requests.  
9 So, that table exists there.

10 The way that the staff is dispositioning  
11 or making a decision on those exemptions, is based on  
12 documenting the results of those exemption reviews  
13 within each chapter that they apply to. For instance,  
14 we have, of course, Chapter 17, 18. And all of these  
15 GDC exemptions that we have, we will have a write-up  
16 on.

17 In this case, of course, we don't have the  
18 answers. So, we are pointing at -- pointing to  
19 Chapter 15 SER to -- and then, of course, when we  
20 finalize the SER, we bring everything together that we  
21 have, a complete resolution for each item.

22 CHAIRMAN CORRADINI: But, I think what  
23 Member Kirchner's getting at is kind of a subset,  
24 maybe a superset of my worry which is, normally, we  
25 don't worry about process. We worry about technical

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1 things.

2 But, the technical issues are so  
3 interconnected, I think we have to do -- we do have to  
4 understand somehow the process so we're not confused  
5 that we thought it was closed and it's not or it's  
6 connected and we weren't aware of it or -- so, I think  
7 I'll take the action item on our side to work with  
8 Mike Snodderly to get some clarity.

9 MEMBER KIRCHNER: Okay.

10 CHAIRMAN CORRADINI: Any other member?

11 MEMBER MARCH-LEUBA: Are we grossly ahead  
12 of schedule? Can I take quotes? It is such a strong  
13 word.

14 CHAIRMAN CORRADINI: Actually that is such  
15 a strong word, but go ahead.

16 MEMBER MARCH-LEUBA: Can I put a couple of  
17 sentences on the record? And it refers to the  
18 previous topic of discussion, so it might open up.  
19 But, what I wanted to put on the record --

20 CHAIRMAN CORRADINI: But, if I might? Are  
21 we talking about Chapter 7 and 8?

22 MEMBER MARCH-LEUBA: Seven.

23 CHAIRMAN CORRADINI: Oh, okay. I'm sorry.

24 MEMBER MARCH-LEUBA: The staff, on ACRS,  
25 should not be in the business of specifying solutions.

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1 What the staff on ACRS should specify is requirements.  
2 And this is -- refers to that diode. What the staff  
3 should ensure is that there is a one-directional  
4 communication and with sufficient reliability and  
5 confidence that that will happen.

6 And then, it's up to the applicant to  
7 decide how they want to satisfy that requirement.  
8 That's stupid, if they put a hardware-based data  
9 diode, then all their review will sail through and  
10 they don't have to do anything. If they want to use  
11 a software system, they're going to have to spend out  
12 the money and time and incur risk.

13 But, we should not be in the business of  
14 specifying a particular solution that it has to be a  
15 diode from manufacturer X, with serial number 1234.  
16 I just wanted to put in the record that even though we  
17 kind of go that direction, what we really should do is  
18 -- the requirement is that it has to be unidirectional  
19 with extremely high properties.

20 CHAIRMAN CORRADINI: Thank you. Other  
21 member comments?

22 MEMBER BROWN: Mike, Mr. Chairman, at the  
23 risk of maybe a little tongue in cheek, let me be a  
24 little tongue in cheek as I say this. I think the  
25 question you asked, is there a logical sequence

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1 through what are the remaining big nuggets that we  
2 need to address, is yes.

3 I think that there is a yes answer to that  
4 question. But, here is my tongue in cheek. So, we  
5 started with six modules, no, 12. They can all fail.  
6 Well, don't worry, because we've got lots of water.  
7 There won't be a common mode failure. We don't have  
8 a container. We have something else.

9 And oh, by the way, we don't need volume  
10 control system, because it's all passive as long as  
11 those valves open. And that's how come we don't need  
12 off-site power, because we've got boo-coos of  
13 batteries and we're going to go to lead acid batteries  
14 so the footprint's smaller.

15 So, we've got criteria 17 and 18. We've  
16 got exemptions for off-site power. We're scratching  
17 our head about common mode failure or what happens  
18 when one module's up in the air and the crane fails.  
19 What is the sequence to get us through this forest?  
20 I think the sequence is through the electrical power.

21 If we resolve and agree, we really don't  
22 need off-site, if we can agree on the exemptions for  
23 electrical power, and become comfortable with  
24 reactivity insertion, and become comfortable that we  
25 really do not need a makeup chemical control system,

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1 and that the paths of cooling systems cool because of  
2 the inventory of the water and a large pool is never  
3 compromised, we cut a path through this.

4 So, I think it really does begin with  
5 electrical power. And I think the first dominos are  
6 going to be criteria 18 and 18. That's tongue and  
7 cheek. But, I've been thinking about this since we  
8 started this. I'm intrigued by the box of batteries  
9 and then not needing off-site power.

10 And that has major siting implications,  
11 which are appropriate for an SMR. But, maybe as we  
12 work our way through this, this might set the path for  
13 how we go to the next SMR. Thank you.

14 MEMBER RAY: Implicit in a lot of these  
15 discussions is what I've sometimes referred to as  
16 incremental decision-making. I won't call it  
17 approval, but decision-making.

18 One way to handle it is, well, no  
19 decisions count until the final, until all of the  
20 steps are laid out clearly at the end. Even though  
21 this looked okay a year ago, the fact is, now we have  
22 the complete picture and what we thought was going to  
23 work, won't. And that seems, inevitably, inherent in  
24 what we're about here and it just needs to be  
25 explicit. It needs to be clear to everybody that

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1 something that was agreed upon in step three, may have  
2 been based on assumptions that are not valid once we  
3 see step four.

4 That's the same sort of thing we've been  
5 saying. And I don't find and I haven't been engaged  
6 in the process that we're talking about here  
7 previously. But, I just -- as I look at what's in  
8 front of me now on that subject, it's just not  
9 explicit.

10 It's not clear that there is a final  
11 decision point, once all the information is available,  
12 whether it has to do with off-site power or what it  
13 has to do with, is we're not able to make a decision  
14 on everything until everything is made explicit and  
15 clear.

16 I think that's the same thing you're  
17 talking about. You're talking about making decisions,  
18 Mike, at least as I understood your point, first here  
19 and then there, and which one's more important than  
20 the next one.

21 And should we do this first and that?  
22 Maybe the answer's yes, but I haven't been involved in  
23 thinking through the process enough to know whether it  
24 is or not. The one thing I can say is, it's not  
25 explicit in anything I've seen that nothing counts

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1 until the end.

2 MEMBER REMPE: But, I think this one's  
3 very complicated. Maybe AP-1000 was just as  
4 complicated. And some sort of table that documents  
5 what chapters need to look at what items that we've  
6 identified, just a tracking thing -- I agree with what  
7 you're saying, Harold.

8 It's not a done deal until it's a done  
9 deal. But, I think that some sort of documentation  
10 would help us remember. It seems like there's a lot  
11 of things that we're trying to remember.

12 MEMBER RAY: Well, I don't disagree, Joy.  
13 I just am saying that -- and AP-1000 would be an  
14 example. It, of course, didn't use this enhanced  
15 process that we're engaged in now. And nothing was  
16 final until it was final.

17 Although, there were times when we got  
18 lectured about, I thought you agreed to this a year  
19 ago and now you're disagreeing with me. Well, that  
20 was because you have brought to the table information  
21 that we didn't have then.

22 And that was the end of it, as far as that  
23 process was concerned. This is perhaps different.  
24 We'll have to talk about that separately.

25 CHAIRMAN CORRADINI: But, as I said, I

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1 think it's my action item for the committee to try to  
2 understand with Mike the path that the staff wants to  
3 take and to see, from our standpoint, does this make  
4 sense.

5 Because I think we, technically, need to  
6 be able to have time to kind of mull over these  
7 things. And I just don't want things to all arrive in  
8 one, fell swoop at the end and us being told that  
9 there's not enough time.

10 Because we'll make enough time because we  
11 have to feel comfortable for the technical standpoint.  
12 That's all I want to make sure. So, we'll go the  
13 staff and find out what they're thinking is. Dennis?

14 MEMBER BLEY: Yeah. I'd like to get in  
15 one more thing, since we don't go around the table at  
16 the end. I really agree with this last discussion.  
17 I think it's important. But, Jose brought up  
18 something that I do want to comment on related to  
19 Chapter 7, this one-way communication bit.

20 And he is, of course, right. And I should  
21 be the one of everybody saying this. And whatever is  
22 proposed, it's an issue of is it reliable enough. My  
23 own, personal reason why I've been pushing with  
24 Charlie for very specific hardware choices for the  
25 one-way communication is I spend a fair amount of my

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1 spare time reading reports from a number of  
2 organizations in the states and around the world of  
3 odd things that have happened inside computer systems.

4 And I've reached the point that I don't  
5 think you can reach that point of being sufficiently  
6 reliable without having that anchored in hardware.  
7 But, the underlying principle is exactly as Jose said.  
8 I agree with that.

9 CHAIRMAN CORRADINI: Okay. Thank you,  
10 Dennis. All right. I don't see any more members  
11 jumping on. So, I think we want to go to public  
12 comments. So, if anybody's in the room, we're going  
13 to open up the outside phone line.

14 MR. SNODDERLY: So, Mike, this is Mike  
15 Snodderly. I think Shana Helton of the staff wanted  
16 to make a statement real quick.

17 CHAIRMAN CORRADINI: Oh, okay. But, let's  
18 get the outside phone line open. Shana, did you want  
19 to go ahead? Please feel free.

20 MS. HELTON: Oh, okay. Thanks. Yeah. I  
21 think earlier in the presentation on Chapter 7, we  
22 alluded to an expectations memo from the office  
23 director. And I just wanted to clarify that I think  
24 we raised that too, as an explanation for our  
25 philosophy applied during the review. That's -- the

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1 memo itself is not something we're ready to share on  
2 the ACRS record in detailed form. But, just for the  
3 high level philosophy and awareness.

4 CHAIRMAN CORRADINI: That's fine. It's  
5 quoted. It's on the record. But, I understand your  
6 point. It was more to give us background.

7 MS. HELTON: Yes.

8 CHAIRMAN CORRADINI: Okay.

9 MR. SNODDERLY: So, the memo exists.

10 CHAIRMAN CORRADINI: That's fine.

11 MR. SNODDERLY: There's just not extent  
12 strong enough to put it on the record.

13 CHAIRMAN CORRADINI: Understood. Okay.  
14 Is there -- we have nobody from the audience here in  
15 the room to make a comment. Is there anybody on the  
16 phone line that wants to make a comment? Please, make  
17 a noise. The line's open. I know. So, I hear  
18 nothing.

19 So, we'll close the line and thank  
20 everybody. And we're going to thank the staff and  
21 NuScale for listening in. And we're done with our  
22 session. We have PNP in 20 minutes. And we also have  
23 some of the members going to a side meeting on PRA in  
24 20 minutes. So, we will wait until after lunch to  
25 read through the draft letter, which, thanks to Member

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1 Brown, is comprehensive. We're going to convene back  
2 here at 12:45.

3 (Whereupon, the meeting in the above-  
4 entitled matter was concluded at 11:20 a.m.)  
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Presentation to the ACRS Full Committee  
Staff Review of NuScale Topical Report

**TR-0915-17564, REVISION 1**

**“SUBCHANNEL ANALYSIS METHODOLOGY”**

**Presenters:**

Bruce Bavol - Project Manager, Office of New Reactors  
Syed Haider, Ph.D.- Reactor Systems Engineer, Office of New Reactors  
Matt Thomas - Reactor Systems Engineer, Office of New Reactors

September 6, 2018  
(Open Session)

---

# NRC Technical Review Areas/Contributors

- Containment and Ventilation Branch  
NRO/DSRA/SCVB:  
Syed Haider (Lead)
  
- Reactor Systems NRO/DSRA/SRSB:  
Rebecca Karas (BC)  
Jeffrey Schmidt  
Timothy Drzewiecki  
Matt Thomas

---

# Staff Review Timeline

## TR-0915-17564, “Subchannel Analysis Methodology”

- NuScale submitted its Topical Report (TR)-0915-17564-P, “Subchannel Analysis Methodology,” Revision 1, on February 15, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17046A333).
- Staff issued the following request for additional information / NuScale provided response:
  - RAI 9080 – 09/11/2017 (ML17254A439) / 11/09/2017 (ML17313B205) & S1 (ML18061A109)
  - RAI 9086 – 09/09/2017 (ML17252A688) / 10/30/2017 (ML17299A973)
  - RAI 9099 – 09/02/2017 (ML17251A368) / 09/13/2017 (ML17251A368)
  - RAI 9129 – 11/17/2017 (ML17321A597) / 01/15/2018 (ML18015A012)
- Staff plans to issue its final SER in late October 2018.
- Staff plans to publish the “-A” (approved) version of the TR in early 2019.

---

# Scope of the Staff Review (1/2)

- Regulatory Basis
  - General Design Criterion (GDC) 10, “Reactor Design,” in 10 CFR Part 50, Appendix A
  - NuScale DSRS , Section 4.4, “Thermal and Hydraulic Design”
  - 10 CFR 50.34, “Contents of Applications; Technical Information”
- NRC approved VIPRE-01 subchannel analysis code, version MOD-02
- Elements of approval for the NuScale Subchannel Analysis Methodology (NSAM)
  - VIPRE-01 applies to the NuScale steady-state and transient subchannel analyses
  - Methodology fulfills the NRC’s requirements in the SERs for VIPRE-01, MOD-01 and MOD-02.
  - Methodology is independent of any specific CHF correlation, and is used for NuScale applications with an NRC approved CHF correlation.
  - Methodology for treatment of uncertainties in the NuScale subchannel methodology is appropriate.

---

# Scope of the Staff Review (2/2)

- Technical basis for the NRC staff review
  - Nine conditions in the generic SERs for VIPRE-01 MOD-01 and MOD-02
  - VIPRE-01 modelling assumptions and qualifications
- Areas requiring additional review
  - NSAM applicability range and VIPRE-01 code limitations
  - NuScale operating conditions
  - Stability of the numerical scheme
  - Inlet flow BC consistency; Core flow sensitivity
  - Model geometry, nodalization, power distribution
  - Qualification of VIPRE-01 MOD-02 models
- Information considered by NRC staff
  - NuScale Topical Report, TR-0915-17564, Revision 1, “Subchannel Analysis Methodology”
  - Responses to RAIs 9080, 9086, 9099, 9129 & Audit documents

---

# Staff SER Conclusions

- The NRC staff has reasonable assurance that the use of the VIPRE-01, MOD-02 code with the NSAM described in the TR is appropriate for the NuScale fuel thermal-hydraulic design and plant safety analyses, provided that the present SER condition is met.
- Elements of NSAM Approval
  - VIPRE-01 applies to the NuScale steady-state and transient subchannel analysis.
  - NSAM fulfills the NRC's requirements in the SERs for VIPRE-01, MOD-01 and MOD-02.
  - NSAM is independent of any specific CHF correlation and is used for NuScale applications if the methodology requirements are satisfied and if the NRC approves the CHF correlation as confirmed by Condition 1 of this SER.
  - NSAM describes a methodology for treatment of uncertainties in the NuScale subchannel analysis that is appropriate.

---

# Additional ACRS Comments (1/3)

**Comment 1** – Consider rewording:

Condition 1, “An applicant referencing this TR in the safety analysis must also reference an approved CHF correlation. The basis for this Condition is provided in Section 4.1 of this SER.”

**Response** – Condition 1 has been reworded to the following:

An applicant referencing this TR in the safety analysis must also reference an approved CHF correlation [which has been demonstrated to be applicable for use with TR-0915-17564.](#) The basis for this Condition is provided in Section 4.1 of this SER.

---

# Additional ACRS Comments (2/3)

**Comment 2** – Consider rewording the title, “Two-Phase Flow Instability” Found in SER (page 26)

**Response** – Reworded title to, “Flow Perturbation Sensitivity Study” and made corresponding changes to the body of the text:

- a. Removed/revised “instability” language
- b. Struck sentence that stated, “Consequently, the staff confirmed that the NPM was not operating near a two-phase instability point.”

Note – An advance copy of the redline strikeout paragraph was provided to ACRS membership.

---

# Additional ACRS Comments (3/3)

**Comment 3** – Thom vs. Chen graph – check that it is properly represented in the SER (page 10) **Figure 1** “Effect of the boiling heat transfer correlation on the fuel centerline temperature for the control rod misoperation case”

**Response** – Corrected legend in Figure 1 (Chen/Thom)

Note – An advance copy of the corrected **Figure 1** was provided to ACRS membership.

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**Questions/comments from members  
of the public before the closed  
session starts?**



# **Safety Evaluation with Open Items: Chapter 7, Instrumentation and Controls**

## **NuScale Design Certification Application Review**

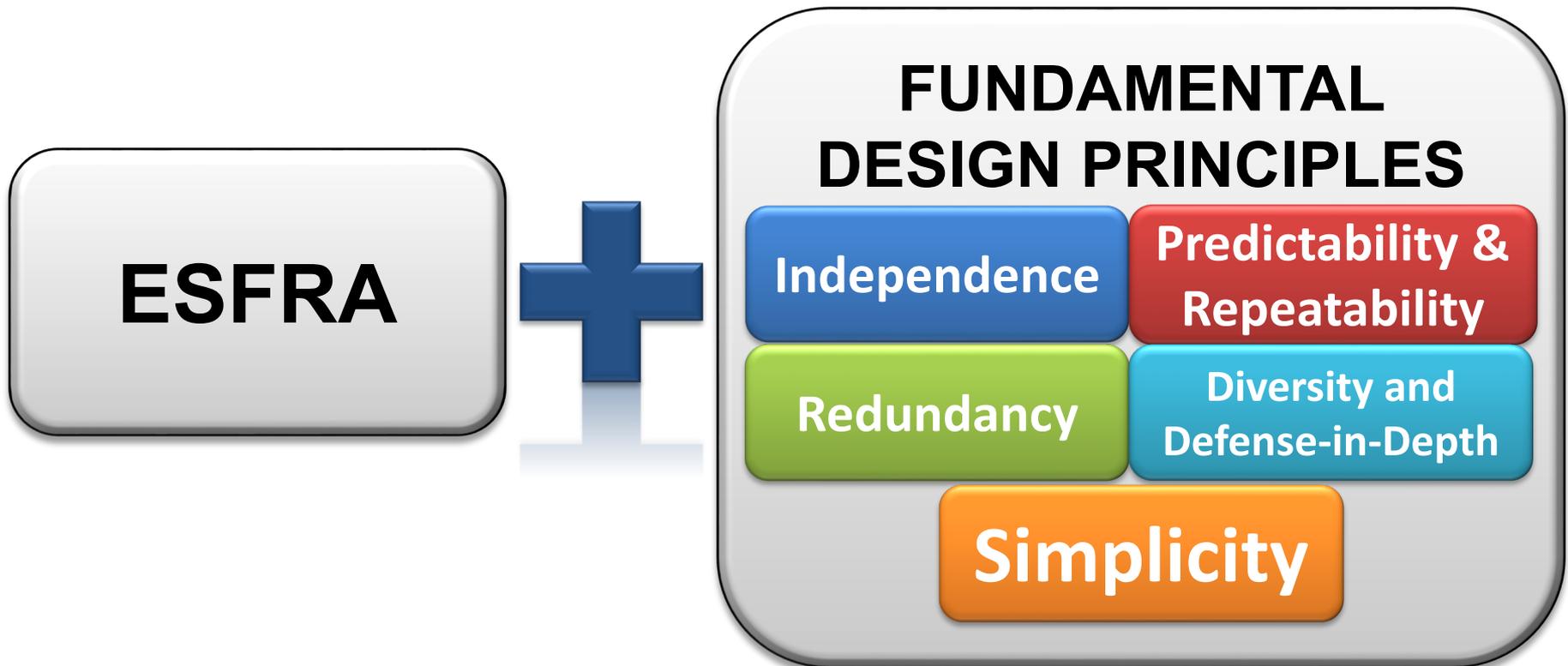
ACRS Full Committee Meeting  
September 6, 2018

- **Technical Staff**
  - Joseph Ashcraft, NRO
  - Sergiu Basturescu, NRO
  - Luis Betancourt, NRO
  - Derek Halverson, RES
  - Dawnmathews Kalathiveetil, NRO
  - Dinesh Taneja, NRO
  - Yaguang Yang, RES
- **Project Manager**
  - Gregory Cranston, Lead Project Manager
  - Omid Tabatabai, Chapter Project Manager

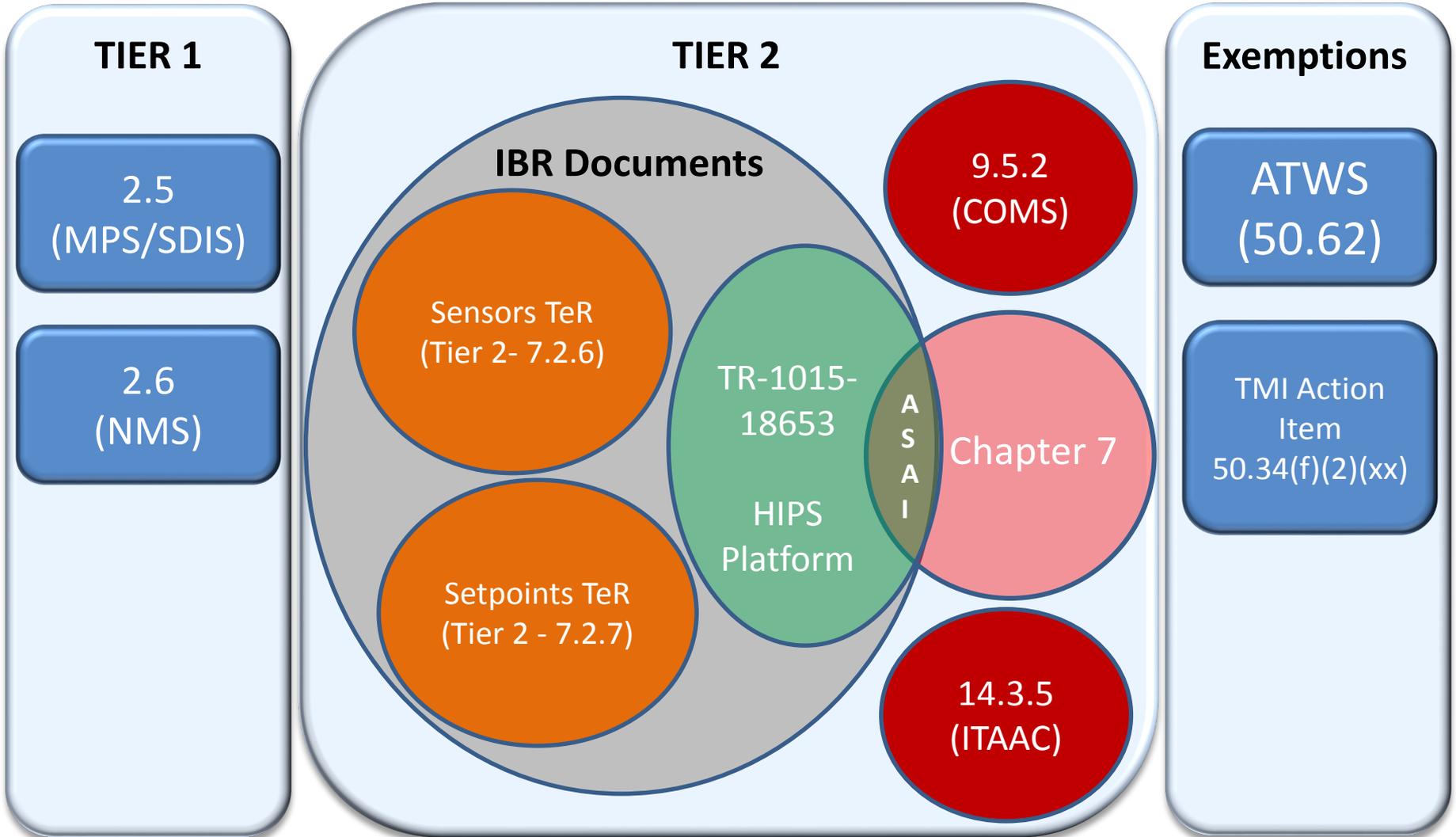
# Timeline

| Date                       | Activity  |
|----------------------------|---|
| 2014 – 2016                | Pre-application Activities                                  |
| September 2016             | Readiness Review  |
| March 2017                 | Accepted Revision 0 of the DCD for Review                   |
| April 2017                 | ACRS Full Committee Meeting on HIPS Platform Topical Report |
| March 2017 – December 2017 | Held 5 Public Meetings / Issued 9 RAIs / Completed 1 Audit  |
| January 2018               | Draft SE with Open Items Completed                          |
| March 2018                 | Applicant Submitted Revision 1 of the DCD                   |
| April 2018                 | Confirmatory Items Incorporated into Revision 1 of the DCD  |
| August 2018                | ACRS Subcommittee Meeting                                   |
| September 2018             | ACRS Full Committee Meeting                                 |

# Safety-Focused Review



# NuScale DCD Evaluation



# **10 CFR 50.62(c)(1) Exemption**

## Three aspects to acceptance of exemption

- Built-in Diversity of the MPS
- ATWS Response Bounded by Plant Design and Chapter 15 analysis
- ATWS contribution to CDF is well below the target CDF  $1 \times 10^{-5}$ /reactor year

# **ACRS Comments from NuScale Chapter 7 SC Meeting**

SER with open items updated to address ACRS  
SC questions related to:

- Configuration of the data diodes
- MCS and PCS Segmentation Analyses
- D3 Coping Analysis
- Editorial Changes

# Conclusion

- The approach of DSRS Chapter 7 resulted in:
  - A simple I&C architecture and the HIPS design, which are based on the fundamental design principles
  - A completion of safety evaluation in an efficient and effective manner (safety-focused)
- The staff finds the I&C design to be safe and that it complies with applicable regulatory requirements

# Acronyms

- ACRS: Advisory Committee on Reactor Safeguards
- ASAI: application-specific action item
- ATWS: anticipated transient without scram
- CCF: common-cause failure
- CDF: core damage frequency
- CM: communications module
- COMS: communication systems
- D3: diversity and defense-in-depth
- DBC: digital-based CCF
- DCD: design control document
- DCIP: Division of Construction Inspection and Operational Programs
- DLSE: Division of Licensing, Siting and Environmental Analysis
- DSRA: Division of Safety Systems and Risk Assessment
- DSRS: design-specific review standard
- DSS: division of safety systems
- EDSS: highly reliable direct current power system
- EIM: equipment interface module
- ELVS: electrical distribution system
- EP: emergency preparedness
- ESFAS: engineered safety features actuation system
- ESFRA: enhanced safety-focused review
- EQ: environmental qualification
- HIPS: highly integrated protection system
- HPN: health physics network
- I&C: instrumentation and control
- IBR: incorporated by reference
- ICIS: in-core instrumentation system
- ITAAC: Inspections, Tests, Analyses, and Acceptance Criteria

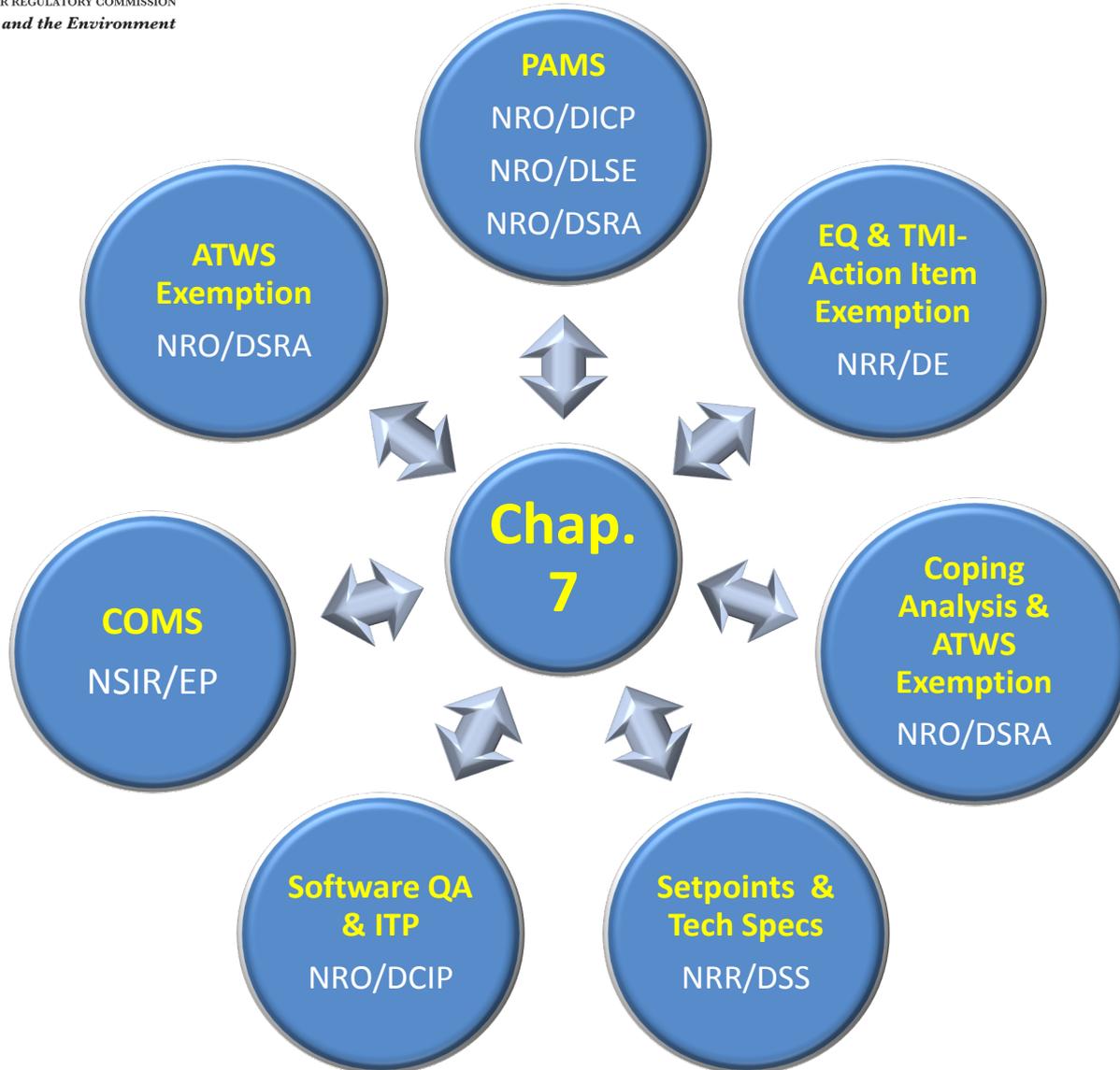
# Acronyms

- MCS: module control system
- MPS: module protection system
- NRC: U.S. Nuclear Regulatory Commission
- NMS: neutron monitoring system
- NRO: Office of New Reactors
- NRR: Office of Nuclear Regulation
- NSIR: Office of Nuclear Security and Incident Response
- NuScale: NuScale Power, LLC
- PAMS: postaccident monitoring system
- PCS: plant control system
- PPS: plant protection system
- QA: quality assurance
- RAI: request for additional information
- RES: Office of Nuclear Regulatory Research
- RTS: reactor trip system
- RM: fixed area radiation monitoring
- SBM: scheduling and bypass module
- SC: subcommittee
- SFM: safety function module
- SDIS: safety display and indication system
- SER: safety evaluation report
- SVM: scheduling and voting module
- TeR: technical report
- TMI: Three Mile Island

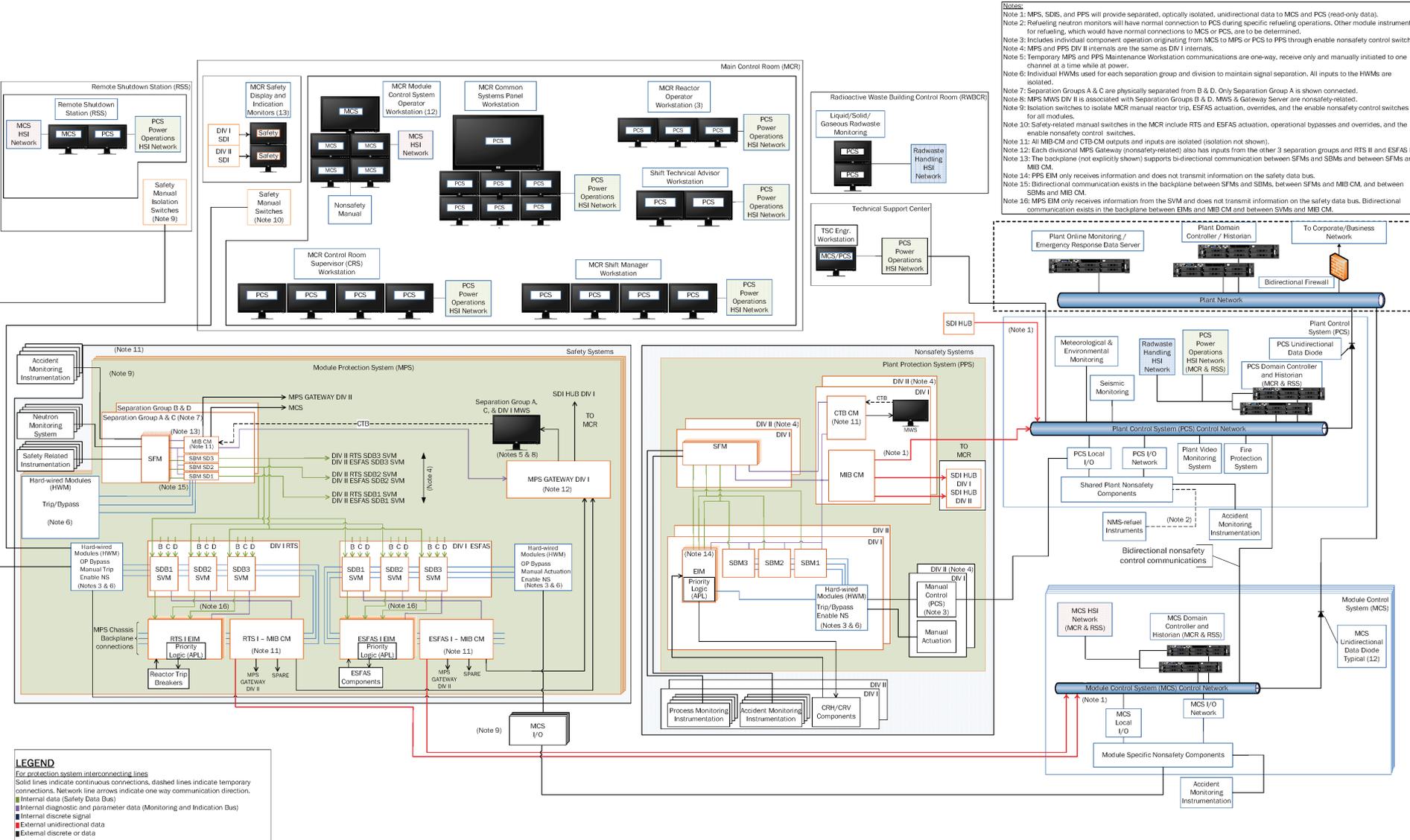


# Backup Slide

# NRC Staff Interfaces



# NuScale I&C Architecture



**Notes:**

Note 1: MPS, SDS, and PPS will provide separated, optically isolated, unidirectional data to MCS and PCS (read-only data).

Note 2: Refueling neutron monitors will have normal connection to PCS during specific refueling operations. Other module instruments for refueling, which would have normal connections to MCS or PCS, are to be determined.

Note 3: Includes individual component operation originating from MCS to MPS or PCS to PPS through enable nonsafety control switch.

Note 4: MPS and PPS Div II Internals are the same as Div I Internals.

Note 5: Temporary MPS and PPS Maintenance Workstation communications are one-way, receive only and manually initiated to one channel at a time while at power.

Note 6: Individual HWMs used for each separation group and division to maintain signal separation. All inputs to the HWMs are isolated.

Note 7: Separation Groups A & C are physically separated from B & D. Only Separation Group A is shown connected.

Note 8: MPS MWS Div II is associated with Separation Groups B & D. MWS & Gateway Server are nonsafety-related.

Note 9: Isolation switches to isolate MCR manual reactor trip, ESFAS actuation, overrides, and the enable nonsafety control switches for all modules.

Note 10: Safety-related manual switches in the MCR include RTS and ESFAS actuation, operational bypasses and overrides, and the enable nonsafety control switches.

Note 11: All MIB CM and CTB CM outputs and inputs are isolated (isolation not shown).

Note 12: Each divisional MPS Gateway (nonsafety-related) also has inputs from the other 3 separation groups and RTS II and ESFAS II.

Note 13: The backbone (not explicitly shown) supports bi-directional communication between SFMs and SDBMs and between SFMs and MIB CM.

Note 14: PPS EIM only receives information and does not transmit information on the safety data bus.

Note 15: Bidirectional communication exists in the backbone between SFMs and SDBMs, between SFMs and MIB CM, and between SDBMs and MIB CM.

Note 16: MPS EIM only receives information from the SVM and does not transmit information on the safety data bus. Bidirectional communication exists in the backbone between EIMs and MIB CM and between SVMs and MIB CM.

# Safety Classification

**A1**

MPS & NMS

**A2**

None

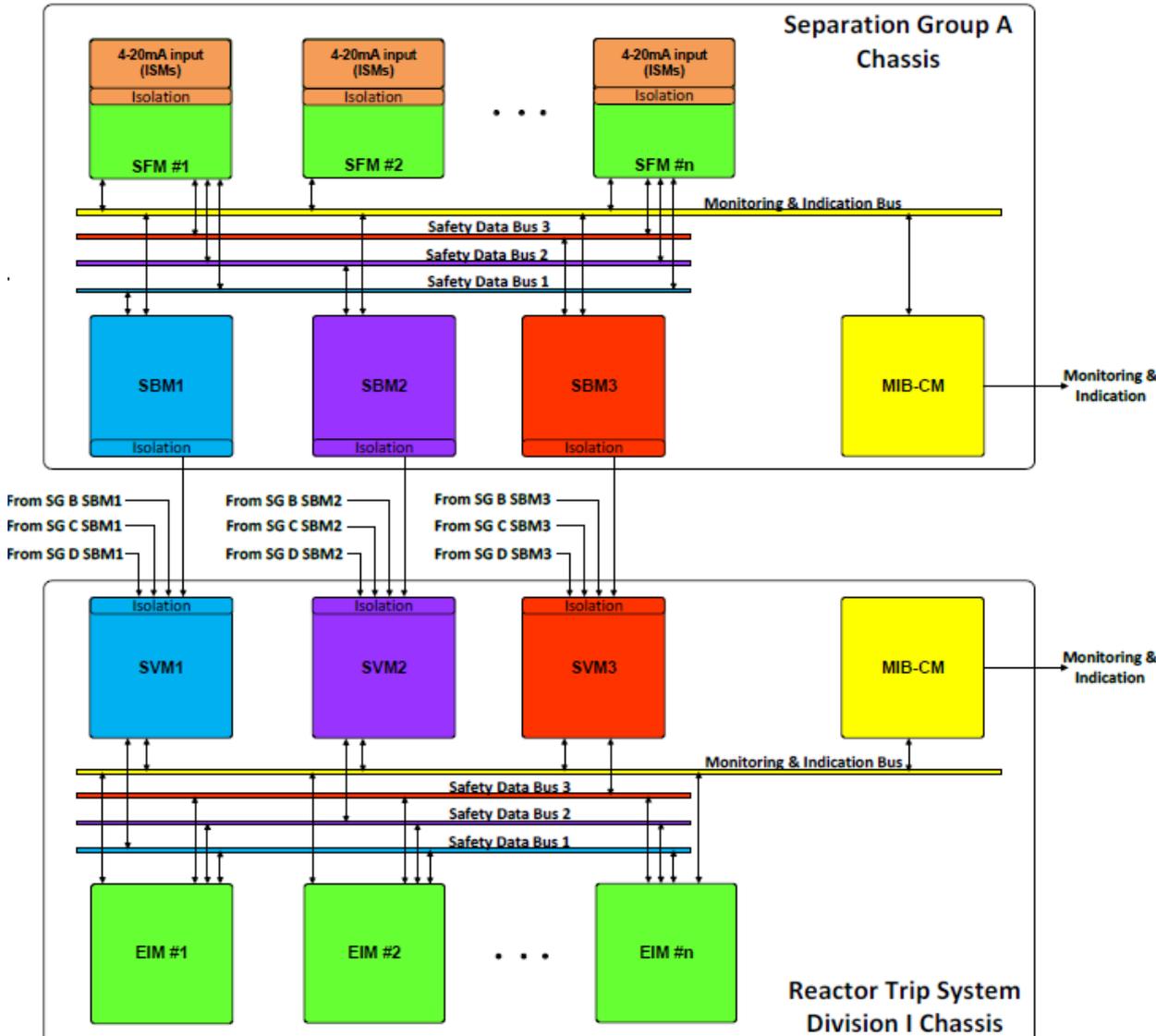
**B1**

None

**B2**

HPN, ICIS, MCS, NMS,  
PCS, PPS, SDIS, RM

# Independence



**Physical**

**Electrical**

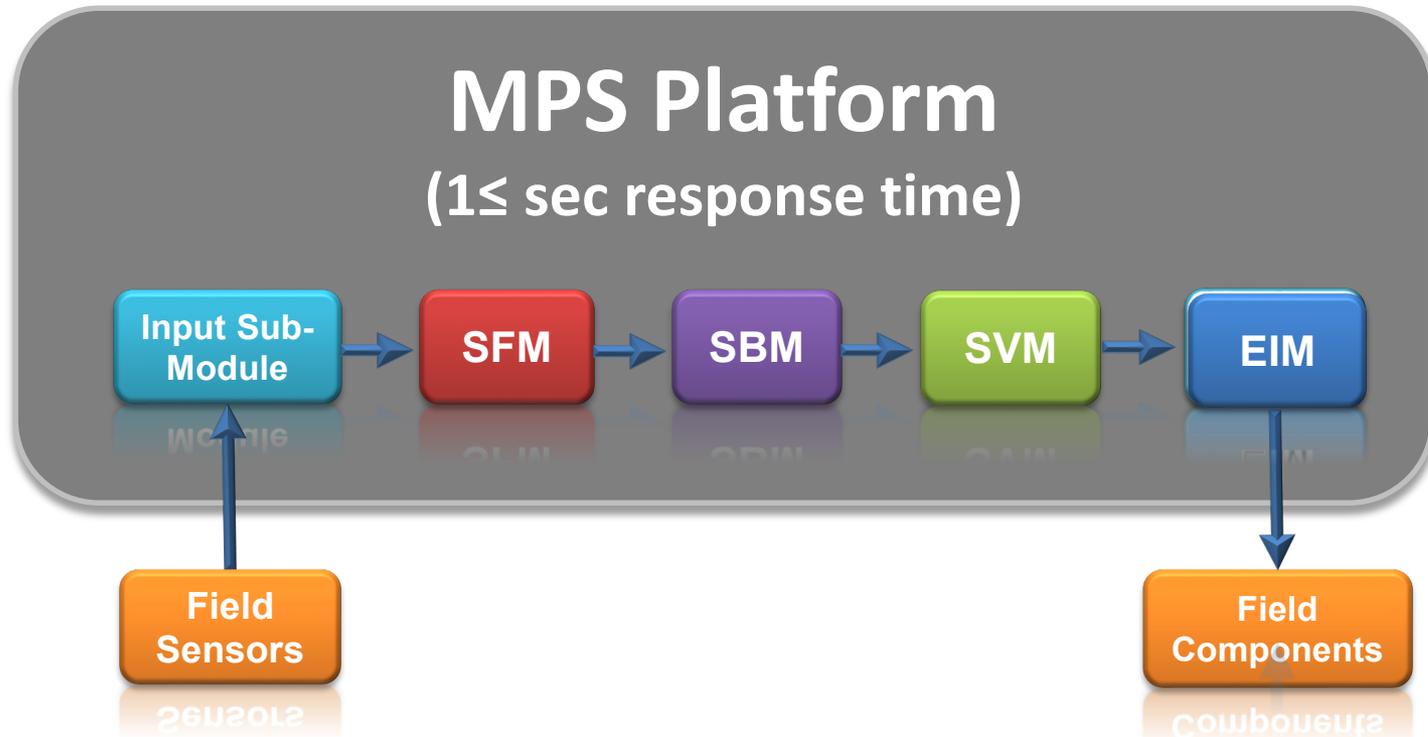
**Communications**

**Functional**

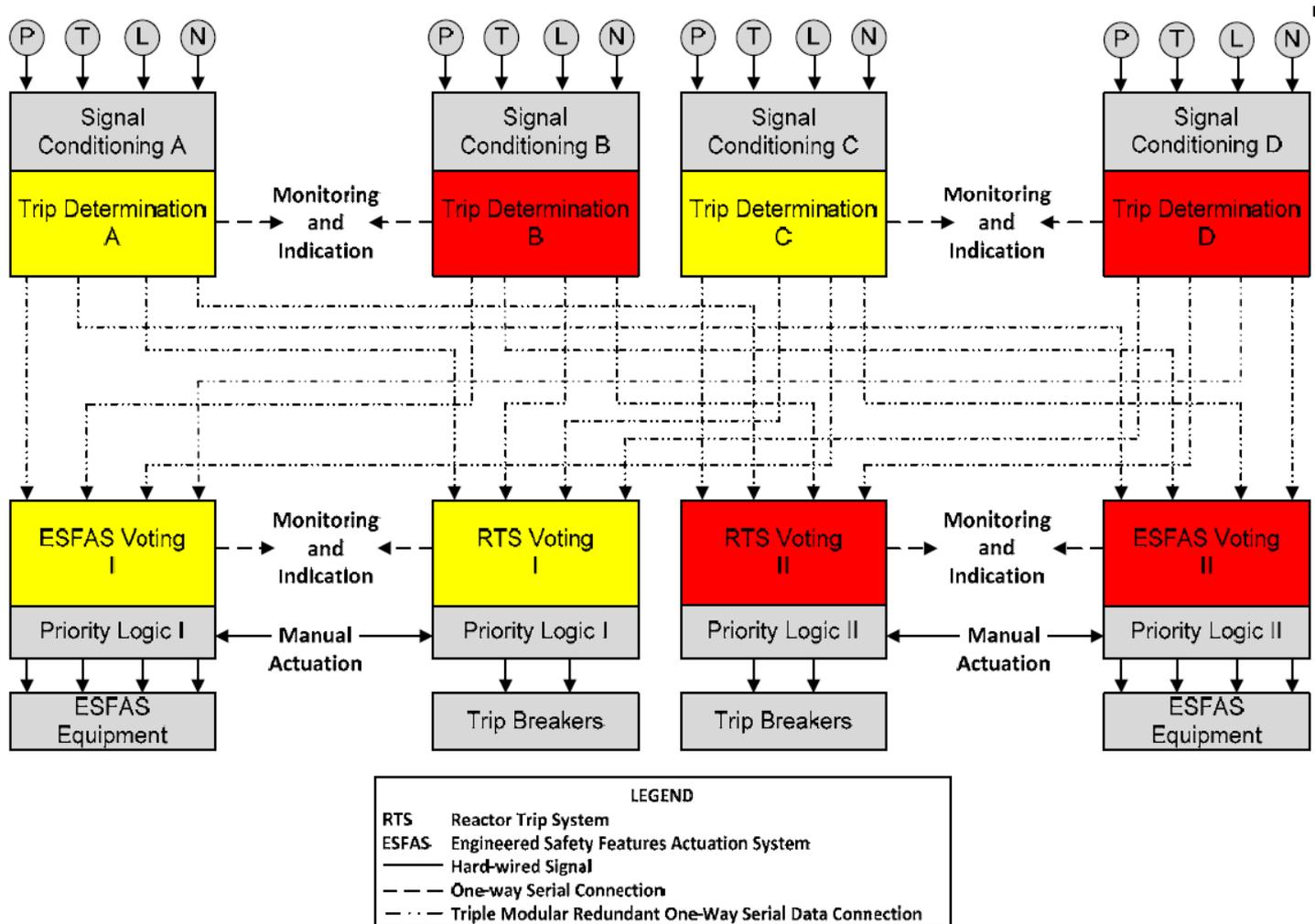
# Redundancy

- **MPS Redundancy**
  - Four separation groups and two divisions of RTS/ESFAS
  - Internal Platform Redundancy
- **NMS Redundancy**
  - Four separation groups
- **Post-Accident Monitoring**
  - Two divisions of SDIS

# Predictability and Repeatability



# Diversity and Defense-in-Depth



# Diversity and Defense-in-Depth (Cont.)

Effect of Digital-Based CCF on MPS built-in Diversity

| Event  | Module | A | C | B | D |
|--|--------|---|---|---|---|
| Transient or DBE with no DBC   | SFM    | ✓ | ✓ | ✓ | ✓ |
|  | CM     | ✓ | ✓ | ✓ | ✓ |
|  | EIM    | ✓ | ✓ | ✓ | ✓ |
| Transient or DBE with DBC<br>(modules exhibiting functional and equipment diversity) | SFM    | ✗ | ✗ | ✓ | ✓ |
|  | CM     | ✓ | ✓ | ✓ | ✓ |
|  | EIM    | ✓ | ✓ | ✓ | ✓ |
| Transient or DBE with DBC<br>(modules exhibiting only equipment diversity)           | SFM    | ✗ | ✗ | ✓ | ✓ |
|  | CM     | ✗ | ✗ | ✓ | ✓ |
|  | EIM    | ✗ | ✗ | ✓ | ✓ |

KEY

DBE: Design-Basis Event

SFM: Safety Function Module

CM: Communication Module

EIM: Equipment Interface Module

CCF: Common-Cause Failure

DBC: Digital-Based CCF

✓ - Available to perform function

✗ - Not available to perform function

 - Division I modules

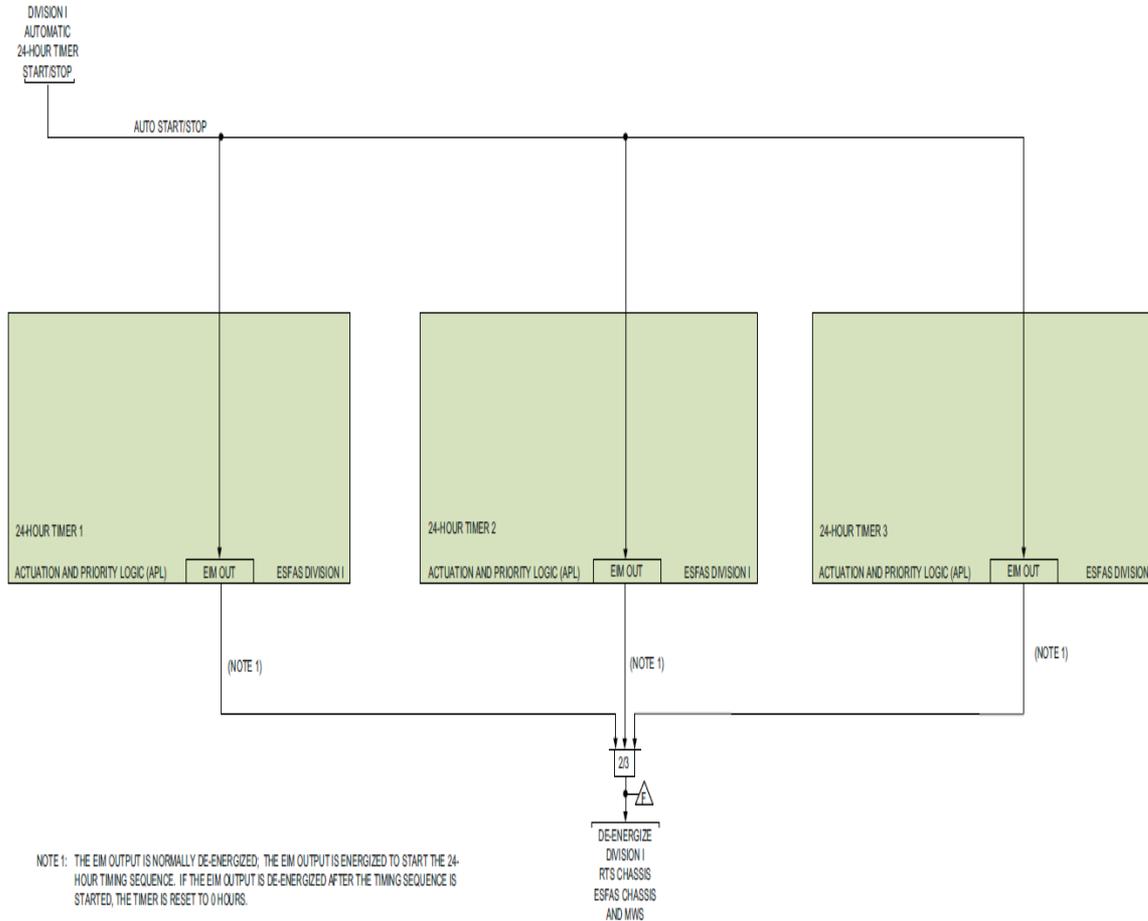
 - Division II modules

# Simplicity

- The I&C architecture and systems incorporate the fundamental design principles with an overall focus on simplicity
- NuScale passively safe I&C design results in a simple I&C design solution
  - Simple RTS/ESFAS functions
  - No closed/open loop control
  - All safety-related functions are “de-energize to actuate”

# **Non-Safety-Related Systems Segmentations**

- Segmentation of the MCS and PCS ensures that a failure of these systems does not adversely affect the safety functions
- This segmentation prevents any multiple failures resulting in spurious actuations or situations which put the plant in an unanalyzed condition
- Staff audited the technical basis of the segmentation analyses for both the MCS and the PCS



## 24-hour timers

- 24-hour timers are part of the MPS boundary
- Powered by the non-safety-related EDSS

## MPS Undervoltage Design Feature

- Upon voltage degradation conditions, the MPS fails into a safe state

Source: DCD Tier 2, Figure 7.1-1ai: Loss of AC Power to ELVS 24 Hour Timers Division I

# **10 CFR 50.34(f)(2)(xx) Exemption**

- 10 CFR 50.34(f)(2)(xx) specifies power provisions for pressurizer relief valves, block valves, and level indicators
- Staff finds pressurizer level instrumentation is not necessary to maintain natural circulation cooling



# **Presentation to the ACRS Full Committee**

**NuScale Power, LLC  
NuScale Design Certification Application Review**

**Safety Evaluation with Open Items: Chapter 8**

**ELECTRIC POWER**

September 6, 2018

- **Technical Staff Reviewers**

Sheila Ray, P.E.

Raul Hernandez

James Strnisha

Nadim Khan

Luis Betancourt

Timothy Drzewiecki

Robert Fitzpatrick

Clinton Ashley

Jeffrey Schmidt

Fanta Sacko

Thomas Scarbrough

- **Project Managers**

- ♦ Lead Project Manager - Gregory Cranston
- ♦ Chapter 8 Project Manager - Omid Tabatabai

## Overview of Chapter 8 Review

- ♦ NuScale submitted its DCA, Rev 0, in December 2016, and a Rev 1, on March 15, 2018. The staff's SER is based on the review of Rev 0 of the DCA.
- ♦ Issued a total of 10 RAIs with 25 Questions. All RAIs have been responded.
- ♦ The staff's SER with Open Items contains two open items and will be discussed in the subsequent slides.
- ♦ Open and Confirmatory Items will be closed in Phase 4 of the Review.

# Technical Topics

## Chapter 8 – Electric Power

### Technical Topics

- NuScale Design:
  - ♦ The electric power system for NuScale design is comprised of non-safety related AC (or ac)(alternating current) and non-safety related DC (or dc) (direct current) power systems.
  - ♦ This design does not depend on onsite or offsite AC or DC electrical power system, including that from the transmission grid for safe operation.
  - ♦ The NuScale Power Plant design with non-reliance on electrical power accommodates a site location where an offsite transmission grid is not available.
  - ♦ The Offsite Power System includes the switchyard and one or more connections to a transmission grid, micro-grid, or dedicated service load.
  - ♦ The following nonsafety-related systems are the major constituents of the onsite AC power system
    - Electrical High Voltage System (EHVS) (13.8 kV)
    - Electrical Medium Voltage System (EMVS) (4.16 kV)
    - Electrical Low Voltage System (ELVS) (480 Volts and 120 Volts)
    - Backup diesel generators (BDGs) (480 volts)
    - Auxiliary ac power source (AAPS) (13.8 kV)
  - ♦ The onsite DC power systems include the non-Class 1E EDSS and the non-Class 1E EDNS.
  - ♦ A safe and stable shutdown is automatically achieved and maintained for 72 hours without operator actions.

# Technical Topics

## Chapter 8 – Electric Power

### Technical Topics

- Staff's review:
  - ♦ The staff reviewed the design of the electric power systems necessary for safe design and operation of the plant, or whose failure might adversely affect their safety-related or risk-significant safety functions.
  - ♦ The staff reviewed the design of the electric power systems in accordance with the applicable DSRS or SRP and consistent with the graded review approach.
  - ♦ The staff reviewed the offsite and onsite power system to ensure that it will perform its design function during all operating and accident conditions.
  - ♦ The staff reviewed the information pertaining to SBO in the FSAR to determine whether the design is capable of withstanding and recovering from a complete loss of ac electric power for a minimum of 72 hours.
  
- Open Items
  - ♦ Exemptions to GDC 17 and 18 regarding the staff verifying that the design does not require safety-related power
    - Pertains to all sections in Chapter 8
  - ♦ Electrical Penetration Assemblies
    - Pertains to Section 8.3.1

# Technical Topics

## Chapter 8 – Electric Power

### Open Item 8.3-1 – Exemptions to GDC 17 and GDC 18

- FSAR, Tier 2, Section 8.3 and DCA Part 7 state that the design does not rely on safety-related AC or DC power systems
  - ♦ This position is supported by the application of the evaluation methodology described in NuScale topical report (TR)-0815-16497, “Safety Classification of Passive Nuclear Power Plant Electrical Systems.”
- The open item relates to the exemptions to GDC 17 and 18 regarding the staff verifying that the design does not require safety-related power.
- Furthermore, the staff’s evaluation of accident analyses are in Chapter 15 which has not been completed to demonstrate that
  - 1) fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and
  - 2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.
- Staff issued a safety evaluation approving TR-0815-16497 with five additional conditions.
- The NuScale DCA did not directly address the conditions of applicability and the five additional conditions.
- NRC staff issued RAI 9359, Question 1-1, to address the conditions of applicability and the additional conditions associated with TR-0815-16497.
- Staff is evaluating the RAI response.

# Technical Topics

## Chapter 8 – Electric Power

### Open Item – Electrical Penetration Assemblies

- Staff enquired about non-Class 1E electrical penetration assemblies (EPAs) as well as protective devices.
- The applicant responded to RAI 9308.
  - ♦ The applicant indicated that non-Class 1E penetrations have no electrical circuits that use the associated containment penetration to perform a safety-related function. However, EPAs designated as non-Class 1E are subject to the same equipment qualification and seismic requirements as Class 1E EPAs.
  - ♦ The applicant provided clarity on self-limiting protective devices, such that the maximum fault current in these circuits would not damage the penetration if that current was available indefinitely.
- The staff finds the response acceptable and currently, in the draft P4 SER, this is a confirmatory item.

# Summary

- Two Open Items:
  - ♦ Electrical Penetration Assemblies
  - ♦ Relating to the exemptions to GDC 17 and 18, regarding the staff verifying that the design does not require safety-related power.
- Staff's review:
  - ♦ Currently working on Phase 4 review.