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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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 NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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NUSCALE SUBCOMMITTEE

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TUESDAY

JANUARY 23, 2018

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ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Michael Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

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DANA A. POWERS, Member

HAROLD B. RAY, Member *

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW SUNSERI, Member

ACRS CONSULTANT:

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

MICHAEL SNODDERLY

ALSO PRESENT:

CLINT ASHLEY, NRO

BRUCE BAVOL, NRO

GARY BECKER, NuScale

THOMAS BERGMAN, NuScale

ANDREW BIELEN, RES

DERICK BOTHA, NuScale

BEN BRISTOL, NuScale

ALLYSON CALLAWAY, NuScale

NAN CHIEN, NRO

GREG CRANSTON, NRO

TIM DRZEWIECKI, NRO

SARAH FIELDS *

ROBERT GAMBE, NuScale

DARRELL GARDNER, NuScale

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ANNE-MARIE GRADY, NRO

REBECCA KARAS, NRO

SAMUEL LEE, NRO

JOHN MONNINGER, NRO

WILLIAM RECKLEY, NRO

JEFFREY SCHMIDT, NRO

ANGELO STUBBS, NRO

MATT THOMAS, NRO

BOYCE TRAVIS, NRO

* Present via telephone

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P R O C E E D I N G S

12:58 p.m.

CHAIR CORRADINI: Okay. The meeting will come to order. This is a meeting of the ACRS' NuScale Subcommittee.

My name is Mike Corradini, Chairman of the Subcommittee. Members in attendance today are Ron Ballinger, Dennis Bley, Gordon Skillman, soon to be Dana Powers, Matt Sunseri, John Stetkar, soon to be Jose March-Leuba, and Walt Kirchner.

And our consultant, Steve Schultz. Oh, and Charlie Brown and Dennis Bley, they're coming in all over the place. Dimitrijevic and Harold Rey is on the line.

I can't keep them all as to where they are in the world. Mike Snodderly is the Designated Federal Official for this meeting.

The purpose of today's meeting is to review the criteria the staff will use to determine whether NuScale's request for Exemption from General Design Criterion 27, combined reactivity control systems capability is acceptable.

Today we have members of the NRC staff and NuScale Power to brief the Subcommittee. The ACRS was established by statute and governed by the Federal

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1 Advisory Committee Act.

2 That means the Committee can only speak
3 through its published letter reports. We hold meetings
4 to gather information such as this to support our
5 deliberations.

6 But, I'll mention here, since we always
7 somehow come -- that all the members' comments are the
8 member's personal comments, just trying to get
9 information.

10 Interested parties who wish to provide
11 comments can contact our office regarding time after
12 the meeting announcement is published in the Federal
13 Register.

14 That said, we set aside ten minutes for
15 extemporaneous comments from the Members and the public
16 attending and listening in on these. Written comments
17 are also welcome.

18 The ACRS position on the U.S. NRC's public
19 website provides our charter, bylaws, letter reports,
20 full transcripts of all full and subcommittee meetings,
21 including slides presented here.

22 The rules for participation in today's
23 meeting were announced in the Federal Register Notice
24 of December 28, 2017. The meeting was announced as
25 an open and closed meeting.

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1 And if necessary we'll, after taking our
2 open session and getting comments from the general
3 public, we'll go to closed session to pick up any
4 particulars.

5 I'll just turn to the NuScale staff. If
6 we're getting into something that requires to go to
7 closed session, alert us. And we'll hold off and come
8 back to it.

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

12 A transcript of the meeting is being kept.
13 And will be made available as stated in the Federal
14 Register Notice. Therefore we request that
15 participants in this meeting use the microphones
16 located throughout the meeting room when addressing
17 the subcommittee.

18 Participants should find -- should first
19 identify themselves and speak with sufficient clarity
20 and volume so they can be readily heard.

21 And we have a bridge line established for
22 the public to listen to the meeting. To minimize
23 disturbances, this public line will be kept in a listen
24 in only mode.

25 And to avoid disturbance, I request that

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1 all members put their electronic devices like cell
2 phones and other things, in the off or the noise free
3 mode.

4 We will now proceed with the meeting. And
5 I'll call on Becky Karas of the Office of New Reactors
6 to begin today's presentation. Becky?

7 MS. KARAS: Thanks. I'm Becky Karas.
8 I'm the Branch Chief for the Reactor Systems Branch.

9 I just wanted to say, I appreciate the
10 committee's time today in reviewing the policy paper
11 regarding the NuScale request for an exemption from
12 GDC 27.

13 The staff views this as an important issue.
14 And that's one of the reasons for early engagement with
15 the ACRS on the acceptance criteria that we plan to
16 use to evaluate a return to power event resulting from
17 a design basis event, an AOO, or an accident, with a
18 failure of one control element assembly to insert.

19 I note this will be the first of a kind
20 criteria. There's other designs that have been
21 licensed to date achieve sub-criticality over the long
22 term.

23 There's some precedent for a short term
24 return to criticality for PWRs under certain conditions
25 with main steam line break. But they do achieve

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1 sub-criticality within a few hours of that event.

2 So, I note that we're very early in the
3 technical review. And we're currently auditing some
4 of the calculations.

5 So, we don't plan on a detailed technical
6 discussion of the analytical results. But we do look
7 forward to a productive discussion with the committee
8 on this criteria.

9 CHAIR CORRADINI: Okay. Thank you very
10 much. And I will turn to Darrell to lead us off for
11 NuScale.

12 I think your group is first up.

13 MR. GARDNER: Yes, sir. First of all, --

14 CHAIR CORRADINI: You need a green light
15 on. There you go.

16 MR. GARDNER: Thank you Mr. Chairman. My
17 name is Darrell Gardner. I'm Licensing Project Manager
18 with NuScale.

19 Thank you for the opportunity to present
20 before the subcommittee today. Talk about the
21 background of our design and consequence analysis in
22 support of the staff's paper that was just mentioned.

23 We have three presenters today. I'll let
24 them introduce themselves as they present.

25 And we'll get started. Derick.

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1 MR. BOTHA: Thank you. My name is Derick
2 Botha. Just a little bit of background, I've a --
3 my initial technical background, I was a mechanical
4 studies and mechanical engineer is my undergrad.

5 Also, I've got a Master's in thermal
6 systems design. I've got about seven years obviously
7 that's been doing safe analysis and thermal systems
8 analysis.

9 I then transitioned into doing licensing
10 work. So I've done that for about ten years, the last
11 ten years.

12 And more recently I've now transitioned
13 into our Office of Technology Department. I'm now the
14 Innovation Manager at NuScale.

15 I've spent about seven years at NuScale.

16 And prior to that I worked in South Africa on the PBMR
17 project. So that's the -- a really big project that's
18 a high frequent gas reactor.

19 So, thank you for listening to our
20 presentation today. I'm not going to spend too much
21 time on this.

22 But it gives you an idea of what work we'll
23 be covering. So if you can go to the next slide.

24 So, just for background, so if you look
25 at the NuScale design, we elected to use reactivity

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1 control systems that's well matched with the design
2 and the design characteristics.

3 Such that if you have power available or
4 if you were to lose power, in terms of safety capability,
5 we've got rods. We insert the rods and that puts the
6 reactor in a safe condition.

7 And that's irrespective of the event that
8 you're looking at. So, the event tree, the reactor
9 from a reactivity control perspective is handled the
10 same for all our events.

11 We also have a non-safe load chemical
12 binding control system. But that's not the system that
13 we're aligned in terms of design basis events and our
14 primary ports of insuring safety.

15 So, another characteristic of the NuScale
16 design is it's a pretty small core. And therefore each
17 of the control rods has got a higher relative worth.

18 So therefore if you have one of your control
19 rods that's stuck, there's a significant larger amount
20 of reactivity that you're not having to insert in your
21 reactor.

22 And as a result, there is a low probability
23 for the line to turn to power event. And that's what
24 we're going to be addressing today.

25 We've looked at that characteristic.

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1 We've looked at the design extensively in terms of our
2 reactor control systems and the options we have.

3 And specifically we also looked at the
4 regulatory requirements. And to address that we've
5 submitted a white paper to the staff and there's a
6 reference on the presentation.

7 And that covers also the specifically the
8 compliance with GDC 26 and 27. But also the --
9 NuScale's interpretation of intent of those GDCs.

10 And the two functions based on our
11 interpretation that those GDCs address is first the
12 protection function. That's rapid power reduction and
13 rapid shutdown to protect the fuel.

14 And then second from that is the shutdown
15 function. And that's the capability to hold the core
16 subcritical under cold conditions, or long term
17 shutdown if you will.

18 Just from the staff position with respect
19 to these two GDCs is that we require an exemption from
20 GDC 27. And as Becky points out, that is because of
21 the precedence.

22 So if you look at the precedent of previous
23 reactors, they're able to with the stack rod, maintain
24 a shutdown condition in the long term.

25 MEMBER BLEY: What -- maybe this is a

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1 question better asked of the staff later, and I will.

2 But, since you're the ones asking for an
3 exemption to GDC 27, I've read your discussions. And
4 your argument is unique, the plain language of the GDC.

5 What specific aspect of the GDC are you
6 requesting an exemption to? It seems that you're
7 requesting an exemption to some staff guidance on this
8 issue.

9 MR. BOTHA: Yeah.

10 MEMBER BLEY: But you're really -- not
11 really asking for an exemption from the GDC. Which
12 troubles me.

13 MR. BOTHA: Yeah. So, I think that from
14 NuScale's perspective that the answer I recall from
15 the exemption that we submitted as part of the
16 application is based on this precedent.

17 So the interpretation for the GDC is well,
18 you would require, the GDC would require shutdown.
19 Even though that's not in the literal language.

20 So, based on that interpretation, we're
21 requesting the exemption.

22 CHAIR CORRADINI: So, can I pursue Dennis'
23 question. And I'm sure the staff has an answer.

24 So, from your perspective you don't think
25 you need an exemption? But you've been instructed by

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1 the staff that -- to proceed that you should request
2 an exemption?

3 MEMBER BLEY: No. That --

4 CHAIR CORRADINI: Maybe that's brutally
5 blunt. But that's the --

6 MEMBER BLEY: But that's the question.

7 CHAIR CORRADINI: Sure.

8 MR. BOTHA: So that's the position we took
9 in the white paper. However, the white paper was
10 submitted before we submitted our application.

11 So, we've had negotiations with the staff
12 and decided to embark on the process of submitting our
13 application with an exemption.

14 And there are additional comments from --

15 MR. SCHULTZ: Are you going to present the
16 language that you provided for the exemption request?
17 That you provided in your application, now?

18 MR. BOTHA: Not as part of this
19 presentation. No.

20 MR. SCHULTZ: Okay.

21 CHAIR CORRADINI: It's part of the staff's
22 presentation.

23 MR. SCHULTZ: I know it's there. Maybe
24 we can have a dialog at that point in time when we talk
25 about that particular language.

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1 CHAIR CORRADINI: Yeah. I think somebody
2 from your group wants to say something.

3 MR. BECKER: Yes. Thank you.

4 CHAIR CORRADINI: You have to identify
5 yourself.

6 MR. BECKER: Gary Becker, Regulatory First
7 Counsel for NuScale Power. I just wanted to add to
8 the conversation on the exemption.

9 That it's our position that we took in the
10 white paper that we comply with the requirements of
11 GDC 27 has not changed. We stand by that assessment.

12 However, we submitted an exemption request
13 that GDC.

14 MEMBER SKILLMAN: Derick, let me ask this
15 question, please. In her opening comment, Becky
16 mentioned that there is precedent for this.

17 And I'm presuming that NuScale is saying
18 yeah, yeah, there's precedent, we can do this.

19 Can you explain the comparison between a
20 steam line break and the reactivity addition that comes
21 as a consequence of that steam line break. And why
22 that is an appropriate precedent that's basically
23 saying, I don't want to comply with General Design
24 Criteria 26 and 27.

25 I will just say up front, I see those as

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1 two entirely different approaches. So, I'd like to
2 know why a steam line break is a precedent for what
3 you are requesting.

4 MR. BOTHA: So just to clarify, if you said
5 entirely different approaches, are you referring to
6 the tenant?

7 MEMBER SKILLMAN: The main steam line
8 break. You've got a huge cooling reaction that will
9 drive moderator temperature coefficient to drive the
10 core positive, to drive reactivity.

11 I understand that.

12 MR. BOTHA: Um-hum.

13 MEMBER SKILLMAN: That's not what you're
14 talking about --

15 MR. BOTHA: Sure.

16 MEMBER SKILLMAN: In the basis of your
17 exemption request. So, I -- what I'm doing in my own
18 mind is rejecting the notion that there's a precedent.

19 MR. BOTHA: I understand.

20 MEMBER SKILLMAN: I don't think that
21 there's a precedent based on the steam line break
22 argument. There maybe another one.

23 But that one doesn't fit.

24 MR. BOTHA: So, I think there's two answers
25 to your question. The first is the -- just that the

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1 literal compliance question.

2 And that's got to do with the wording and
3 what they require on face value and intent. And we
4 don't intend to address that too much today. That's
5 not really the purpose of the presentation.

6 I think what you're alluding to is the
7 second aspect. And that's really the technical and
8 the safety questions associated with the underlying
9 functions that you address with the GDC.

10 So, I think those are two very different
11 events. And to today's presentation, the first off
12 presentation is to give you the like context so you
13 can understand the events we're talking about and the
14 context of our design.

15 So, I would agree with that statement.

16 MEMBER SKILLMAN: Thank you.

17 MR. BOTHA: Well, thank you. I think the
18 other point to make here, just based on some of the
19 discussion we had is, well this presentation, we're
20 really going to focus on context and explaining the
21 scenarios, the conditions under which you could have
22 a return to power.

23 But we're going to be focusing on the best
24 estimate or what we realistically expect to occur.
25 We're going to focus far less on the relation that occurs

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1 here, the Chapter 15 analysis that is in the
2 application.

3 And that's a concerted assessment. So,
4 that's just for context. As you go through the slides,
5 when we start talking about the event and when it can
6 occur, that's really based on the nominal conditions
7 and what we expect to happen.

8 Before we get into that, just some
9 additional background on our design. So, I'm going
10 to go over the two passive safe related heat removal
11 systems that we have in the NuScale design.

12 And the first one I'm going to cover is
13 the decay heat removal system. The way we actuate the
14 system, so that's a diagram showing the reactor module
15 with you'll see two condensers off on the sides.

16 And you'll see the steam generator in the
17 module. On the top of that module you'll see the full
18 feed and steam isolation valves.

19 There's more valves than that. But that's
20 depicted on this diagram. So, to actuate the system
21 you would actuate your -- you would close your feed
22 and steam isolation valves.

23 And then you would open the DHR valves that
24 sit in that loop that connects the steam generator and
25 the condensers on the side. That's depicted there on

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1 the sides of the containment vessel.

2 MEMBER MARCH-LEUBA: Excuse me Derick.
3 Can you get the mouse and point at when you're talking?
4 And as it's mentioned.

5 MR. BOTHA: Sure. So, those are the four
6 feed and steam isolation valves that would close. This
7 is the steam generator.

8 What's important to recognize is our
9 secondary side is on the inside of the tubes. That's
10 different from a traditional PWR.

11 And these are the DHRS condensers that sit
12 on the side. And so you can see a loop that's connecting
13 these two heat exchanges.

14 And those are the valves that would open
15 to allow the water inside of that system that's normally
16 there while you're removing heat, to start flowing.

17 And at that juncture, you'll remove heat
18 by boiling inside of the steam generator and
19 condensation inside of the DHRS and heat exchangers
20 which sits into the reactor.

21 CHAIR CORRADINI: And you only need one
22 of the two heat exchangers to function?

23 MR. BOTHA: That's correct. So we've got
24 two independent drains. And they each have two valves.

25 MEMBER STETKAR: Derick, you said you're

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1 going to emphasize best estimate analysis. Do our best
2 estimate analysis account for both of them operating?

3 MR. BOTHA: After.

4 MEMBER STETKAR: That's a yes or a no.

5 (Laughter)

6 MEMBER STETKAR: I want to know yes or no.

7 Honestly, I want to know yes or no. Do they? Or do
8 they not?

9 MR. BOTHA: That would be yes and no.

10 MEMBER STETKAR: No, no. You said you're
11 going to emphasize best estimate analysis.

12 MR. BOTHA: I mean -- yes. Yes.

13 MEMBER STETKAR: So that we can understand
14 the technical basis for your assertions.

15 MR. BOTHA: But yes.

16 MEMBER STETKAR: So do your best estimate
17 analysis account for both of them operating?

18 MR. BOTHA: The answer would be yes. And
19 the reason is you cool down faster when you have both
20 operating.

21 MEMBER STETKAR: That's correct. That's
22 why I asked the question.

23 MR. BOTHA: Okay. Thank you. Thank you.

24 Next one Allyson.

25 So I'll use the mouse again for this one.

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1 And so this is our ECCS system. And this system
2 ensures that we can provide adequate core cooling
3 without injection.

4 So which is different from a traditional
5 ECCS system where you would have to add water. So how
6 the system functions, is when you open the ECCS valves,
7 so there's two main valves at the -- sorry, three
8 arrangement valves.

9 Not supposed to be -- three main valves
10 at the top of the reactor pressure vessel. And two
11 recirculation valves at the bottom.

12 And once you've opened those valves so
13 depending on the size break you may have, you'll have
14 a different pressure response. But essentially what
15 happens, once you depressurize you now enable a stable
16 cooling loop where you're venting steam through the
17 vent valves.

18 That steam condenses on the inside of the
19 containment. And the heat is removed via -- through
20 the containment wall to the reactor pool.

21 And then your level inside containment will
22 then exceed your level inside the reactor pressure
23 vessel, which would drive liquid back into the core.

24 So that would be your ECCS function.

25 MEMBER KIRCHNER: What's the sequence for

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1 deciding when to go from your passive operation on your
2 proceeding slide to the ECCS system?

3 MR. BOTHA: So that depends on the event.

4 So our first however if you do have power, and if you
5 -- in that case you would actuate the system.

6 And now I'm talking about if you would have
7 AC power. Then you would actuate the system.

8 MEMBER KIRCHNER: The system being the
9 decay heat removal system?

10 MR. BOTHA: Well, your --

11 MEMBER KIRCHNER: Sorry, risk -- passive
12 decay heat.

13 MR. BOTHA: Yeah. Your ECCS, you would
14 -- yeah, you would be using the DHRS normally if it
15 was a loss of feed water event for example.

16 MEMBER KIRCHNER: Um-hum.

17 MR. BOTHA: But if you have a breach in
18 your system, say if you have a CVCS line break inside
19 containment for example, then the system would be
20 depressurizing.

21 And then at some point you would actuate
22 your valves to go to ECCS. If you do not have AC power
23 -- well, before I get to that, if you do have AC power,
24 as part of your normal shutdown sequence, at some stage
25 you open the valves anyway.

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1 Because when you got to refueling, that's
2 --

3 MEMBER KIRCHNER: You have depressurized.

4 MR. BOTHA: And flood the containment.
5 Now if you don't have AC power, we have limited capacity
6 on our batteries.

7 And we'd like to keep that operating as
8 long as possible. So, after 24 hours we would take
9 the load off, or reduce the load off the batteries.

10 And one of the things we'll do is open the
11 valves after 24 hours.

12 MEMBER KIRCHNER: Um-hum.

13 MR. BOTHA: Now, if you don't have any
14 power at all, then you would open them sooner. They
15 have a means for -- for not opening in high pressure,
16 but opening at reduced pressure.

17 But that would be in less then 24 hours.
18 That's if you have no power at all.

19 So, I'll proceed to the next slide. So
20 that was a bit of background on our design.

21 Now, as I mentioned, the two functions
22 that's addressed by those two GDCs, the first is your
23 protection function. And your -- and then secondly
24 your shutdown function.

25 So with regards to the protection

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1 functions, or protecting your fuel, our control rods
2 provide higher -- highly reliable means to rapidly shut
3 down the reactor for all events.

4 And that's even if you were to assume a
5 stack rod. So, we sufficiently fulfill the protection
6 function with our secondary control rods.

7 Now if you look at the shutdown function,
8 to characterize that, and as I mentioned, this is under
9 nominal conditions.

10 So you would -- so to give you a sense of
11 when you would see this low probably event, essentially
12 you would remain shut down after you've inserted your
13 control rods.

14 Indefinitely if one of them has inserted.
15 So if you've got all of them in, you'll stay shut down
16 indefinitely.

17 If you're in the first 70 percent of your
18 fuel cycle, you'll stay shut down even if you have a
19 stack rod. And then if you're -- if you're going
20 through a normal fuel cycle and you do have a stack
21 rod and you're at the end of your cycle, then what
22 happens if you have a stack rod is you have to get down
23 to very low power levels.

24 Because if you have -- at power levels above
25 100 kilowatts, you generate voiding, which adds

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1 additional negative reactivity.

2 So you've got to get the power down to less
3 then 100 kilowatts to reduce the voiding. So that you
4 have this return to power condition.

5 So, it's a really low power, a low
6 probability condition. It's also a low power condition
7 because you have to be below those powers to stay --
8 if we can have a return to power.

9 CHAIR CORRADINI: So, again, we're talking
10 about criteria. So, I'm just going to remind myself
11 and everybody else, we want to stay on discipline.

12 We're going to love to talk about your
13 example.

14 MR. BOTHA: Sure.

15 CHAIR CORRADINI: You skipped the middle
16 one. I don't understand the middle one. Indefinitely
17 with rods stuck out during first 70 percent of
18 equilibrium fuel cycle.

19 Can you explain that, please?

20 MR. BOTHA: So, as you go through your
21 two-year cycle, after you've reloaded your core, for
22 70 percent of that time, you'll start initially with
23 a high boron concentration.

24 And as you go through your fuel cycle, you
25 dilute your boron.

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1 CHAIR CORRADINI: Okay.

2 MR. BOTHA: So if you get to the last 30
3 percent then there's less boron on in the system to
4 concentrate as before.

5 MEMBER STETKAR: What determines that 100
6 kilowatts?

7 MR. BOTHA: So, Allyson, you want to --

8 MEMBER STETKAR: And if we're -- if we get
9 into proprietary stuff --

10 CHAIR CORRADINI: We'll wait. We can
11 wait, sure.

12 MR. BRISTOL: This is Ben Bristol. We'll
13 get -- I'm going to be describing this particular
14 condition in a couple more slides.

15 MEMBER STETKAR: Great. Okay.

16 MR. BRISTOL: Effectively it's the power
17 level that results in insufficient voiding in our ECCS
18 mode.

19 MEMBER STETKAR: Yeah. Okay. I'll wait
20 for a couple of sentences.

21 MR. BOTHA: Thanks for the question.

22 MEMBER SKILLMAN: I would like to ask
23 Derick another question. I was impressed that the
24 emphasis that you placed on the third bullet there,
25 would have to get below 100 kilowatts.

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1 Is that set wording that you used Derick,
2 have to get there, sounds to me like a sense of urgency.

3 MR. BOTHA: No. So --

4 MEMBER SKILLMAN: Would you maybe rephrase
5 or explain what you meant, please?

6 MR. BOTHA: So typically if you -- and I'm
7 going to get to this in the next bullet. If you go
8 through a normal fuel cycle, you're going to have decay
9 heat that's been built up.

10 So it takes a very long time or that decay
11 heat to reduce to less than 100 kilowatts. So I'm
12 essentially just saying, you wouldn't get there before
13 you've waited a very long time for decay heat to be
14 -- to decay away to lower values.

15 And that's for a typical fuel cycle, that's
16 going to be more than 30 days. And we have a footnote
17 there to indicate that that's going to be about 100
18 days to get there for a typical fuel cycle if you're
19 in the end of cycle.

20 So it's not that you're trying to get to
21 100 kilowatts. That's just the conditions under which
22 you would see a return to power.

23 If you had a higher decay heat values, you
24 wouldn't see a return to power.

25 MEMBER SKILLMAN: So explain the

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1 difference between the 100 days that you have on that
2 bullet and the -- the 30 days you have on that bullet
3 and the 100 days that you just described.

4 MR. BOTHA: So, the more then -- it's --
5 the 30 days is just a minimum. The 100 days is when
6 you go and actually look at the tables for a typical
7 decay heat curve when you get below 100.

8 MEMBER SKILLMAN: Below 100 kilowatts.

9 MR. BOTHA: That's right. Yeah.

10 MEMBER SKILLMAN: And the answer is, it's
11 a long time. It's three or four months.

12 MR. BOTHA: That's right.

13 CHAIR CORRADINI: So, Dick was going down
14 a path. If you don't mind, I just want to finish the
15 path.

16 I'm -- now I thought I understood the third
17 bullet. And now I don't. So, I'm in a condition.
18 Let me just lay out the condition.

19 I'm in a condition where I tried scrambling
20 the reactor. One rod is -- one rod bank, or one rod
21 control assembly --

22 MR. BOTHA: The seal control.

23 CHAIR CORRADINI: seal assembly has struck
24 out.

25 MR. BOTHA: That's right.

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1 CHAIR CORRADINI: I've lost power. So,
2 I don't have AC power to drive the CVCS to insert
3 additional boron.

4 MR. BOTHA: That's correct.

5 CHAIR CORRADINI: And I would have enough
6 boiling, enough void production that I'm not going to
7 be critical for which time? That's where I get
8 confused.

9 That's what -- I think where Dick was going.

10 Or unless I misunderstood your question. Am I down
11 the right path though what's happening here?

12 Because I --

13 MR. BOTHA: Yeah.

14 CHAIR CORRADINI: I get down in these
15 conditions, but I've lost almost everything. But
16 because of the natural circulation characteristic of
17 the reactor, it's going to have a little bit of bubbles
18 generated.

19 MR. BOTHA: Yes.

20 CHAIR CORRADINI: And that's good enough
21 to keep you sub-critical for a long time.

22 MR. BOTHA: That's right.

23 CHAIR CORRADINI: So, do I have that right?

24 MR. BOTHA: That's correct.

25 CHAIR CORRADINI: Okay.

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1 MR. BOTHA: So, the only way you can have
2 these events is exactly like you described. Is you
3 have to have a stack rod. You have to be at end of
4 cycle.

5 You have to have no AC power. You also
6 have to not only be at end of cycle, you would have
7 had to have a period when you were shut down for a long
8 time.

9 And then at a restart in the cycle such
10 that you now were in the cycle, had low boron and had
11 low decay heat. So that's the conditions that --

12 CHAIR CORRADINI: Say the last part again,
13 please. I'm sorry.

14 MR. BOTHA: You would have to shut -- you
15 would have to -- for more than 70 percent of your cycle,
16 shut down the reactor for a long time for decay heat
17 to subside.

18 Then restart the reactor. And then within
19 a -- for the first of two months, or a month or two
20 of reactor operation, you would have to have these
21 conditions occur.

22 Because if you go through a normal fuel
23 cycle, you would have enough decay heat present that
24 you wouldn't get to a return to power.

25 So again, this is under nominal conditions.

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1 MR. SCHULTZ: So when you say you have to
2 be shut down near the end of cycle for a long time.

3 MR. BOTHA: That's right.

4 MR. SCHULTZ: How long is that?

5 MR. BOTHA: That's more then three months.
6 Because that's the 100 days essentially.

7 CHAIR CORRADINI: That's where Dick was
8 asking the 30, the 50 and the 100 question.

9 MEMBER SKILLMAN: Let me say what I would
10 like to say here. I understand the first one.

11 The reactor shuts down, stays shut down
12 because you've got all the rods in. Sure.

13 The second case is the worst rod stuck out.

14 You say if we catch that within the first 70 percent
15 of the equilibrium fuel cycle, 24 months you're out
16 about 15, 16, 17 months, your boron concentration's
17 dropping 16 to 18 hundred.

18 And now you're down to about 500, 400 VBM.

19 MR. BOTHA: Um-hum.

20 MEMBER SKILLMAN: A number like that. The
21 reason from 70 to 100 you're stuck is because you can't
22 move enough water fast enough. Because you don't have
23 a safety grade injection system.

24 MR. BOTHA: That's correct.

25 MEMBER SKILLMAN: Okay. Hold that

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1 thought. And the third one, --

2 MR. BOTHA: I don't think --

3 MEMBER SKILLMAN: Yeah. It is.

4 (Off mic comment)

5 MEMBER SKILLMAN: No. It's not fast.

6 MR. BOTHA: Well, it's not --

7 MEMBER SKILLMAN: It's not.

8 MR. BOTHA: So you can add with CVCS. I
9 mean, you can add boron. But that's non-safety.

10 MEMBER SKILLMAN: You can pray. You can
11 pray you get it in there.

12 MR. BOTHA: Yeah. Sure. Sure.

13 MEMBER SKILLMAN: And the third one is fun
14 because you're depending on boiling.

15 MR. BOTHA: Yes.

16 MEMBER SKILLMAN: You're depending on
17 voiding. And so what adds to your favor is having an
18 abundant amount of decay heat --

19 MR. BOTHA: Yes.

20 MEMBER SKILLMAN: In the degeneration
21 rate.

22 MR. BOTHA: That's correct.

23 MEMBER SKILLMAN: But the same thing that
24 you're counting on for boiling to be the very phenomenon
25 that is injuring your fuel.

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1 So it just seems to me that you've lined
2 up some conditions here for your benefit that maybe
3 treacherous for the safety of the core.

4 MR. BOTHA: Yeah, so we -- so as part of
5 the safety analysis, we analyze each removal with
6 boiling, with our ECCS system, with maximum decay heat.

7 So that's done as part of the safety
8 analysis. So, this condition is with substantially
9 less boiling.

10 But just if you look at the normal decay
11 heat, so now you're talking about three megawatts and
12 more, right? That you're removing heat with your ECCS
13 system.

14 But boiling at those conditions are -- it's
15 a very low power density that you're talking about in
16 terms of the amount of boiling and heat you're removing.

17 And as Ben's going to cover later, your
18 ECCS system is more than sufficient, more than capable
19 to remove that heat. And doesn't present a challenge
20 to your fuel because you -- at those conditions you're
21 essentially at -- you're getting down to the 200 F or
22 Fahrenheit.

23 So it's low temperatures. So the boiling
24 you're talking about is not a lot of heat. It's not
25 nearly enough to heat up your cladding.

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1 So it's a very -- if you're talking about
2 this condition, it's a very benign, safe condition.

3 MEMBER KIRCHNER: Derick, when this
4 condition occurs, are you depressurized?

5 MR. BOTHA: In this specific condition,
6 yes. So --

7 MEMBER KIRCHNER: So you have more boiling
8 --

9 MR. BOTHA: That's right.

10 MEMBER KIRCHNER: At lower pressure.

11 MR. BOTHA: That's right.

12 CHAIR CORRADINI: But if I might just
13 return, unless I misunderstood your white paper, the
14 reason that you're not concerned is because you should
15 be far away from CHF.

16 MR. BOTHA: That's correct.

17 CHAIR CORRADINI: So boiling is perfectly
18 fine as long as I'm nowhere close to CHF.

19 MR. BOTHA: That's correct.

20 CHAIR SKILLMAN: Thank you for the
21 perspective.

22 MEMBER MARCH-LEUBA: Let me give another
23 perspective

24 MEMBER SKILLMAN: I'm done. Thank you
25 Gary, thank you.

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1 MEMBER MARCH-LEUBA: Also, I'm not an
2 expert on NuScale, I haven't reviewed it yet. So, bear
3 with me.

4 But there is a large fraction of the
5 breaking domain in time of NuScale where nothing
6 happens.

7 MEMBER SKILLMAN: Um-hum.

8 MEMBER MARCH-LEUBA: This is no fraction
9 where we may -- something may or may not happen. Right?

10 And there's a critical power which now you
11 call it 100 kilowatts, call it 50, call it 200.

12 MEMBER SKILLMAN: Um-hum.

13 MEMBER MARCH-LEUBA: But if you are above
14 it, you will get an insufficient boil to keep the reactor
15 subcritical.

16 And typically achieve that with decay heat.

17 MEMBER SKILLMAN: Um-hum.

18 MEMBER MARCH-LEUBA: So, and if you are
19 below that power, and below the power, you can have
20 the critic up higher.

21 MR. BOTHA: That's right.

22 MEMBER MARCH-LEUBA: You don't produce
23 sufficient boils to main it subcritical. So the
24 maximum power that you can achieve before the
25 criticality, --

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1 MR. BOTHA: That's right.

2 MEMBER MARCH-LEUBA: Is less then normal
3 decay heat.

4 MR. BOTHA: That's right.

5 MEMBER MARCH-LEUBA: Is that correct?

6 MR. BOTHA: That's -- substantially it's
7 saying it is.

8 MEMBER MARCH-LEUBA: So the worst thing
9 that could happen if you go critical is you stay at
10 early decay heat is still continuing to decay.

11 MR. BOTHA: That's right. That's
12 correct.

13 MR. SCHULTZ: Derick, the discussion here
14 focuses on the best estimate as you've indicated to
15 an extent.

16 MR. BOTHA: Yes.

17 MR. SCHULTZ: And you not the equilibrium
18 fuel cycle condition.

19 MR. BOTHA: Yes.

20 MR. SCHULTZ: Are there other fuel cycles
21 that maybe anticipated that would be worse?

22 MR. BOTHA: We don't expect so, because
23 -- and Allyson, you can add if I stray here.

24 But if you look at other fuel cycles, you'll
25 control that worse. We're expecting it will

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1 essentially be about the same.

2 We don't expect that a significant
3 departure from our control efforts that we have.

4 MR. SCHULTZ: So before one gets to an
5 equilibrium cycle, those cycles should be not much
6 different in terms of this --

7 MR. BOTHA: That's right.

8 MR. SCHULTZ: Issue and condition.

9 MR. BOTHA: They typically start with high
10 boron and dilute the boron as you go through this.

11 MR. SCHULTZ: Sure. Thank you.

12 MR. BOTHA: So, next slide. Thank you.
13 So, we looked at these conditions and then we used PRA
14 to conservatively try and estimate what the probability
15 of such an occurrence would be.

16 So, and the number that we calculated is
17 that it would be less than $10E$ to the minus 6 per reactor
18 module year. And the number is a contribution of really
19 three factors.

20 The first one is a probably of a stuck
21 control rod. So we just said any rod, not the worse
22 one. Just the probability of any rod would be stuck.

23 We also looked at the probability that your
24 CVCS would fail on demand. So if you would prepare
25 it to function it wouldn't be available.

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1 And then the last probable -- the last
2 contribution would be the probability that you were
3 in this condition where you were operating through a
4 normal fuel cycle, shut down for a long time, and
5 restarted at the latter part of your fuel cycle. And
6 then ended up in this condition.

7 And again, that's a conservative estimate.

8 MEMBER MARCH-LEUBA: What is your loss of
9 offsite power and battery power built into this?

10 MR. BOTHA: It takes that into account.
11 But I have --

12 MEMBER MARCH LEUBA: You don't take credit
13 for that quality? Or do you?

14 MR. BOTHA: No, so this is -- with PRA we
15 look at the probability of losing power. But that's
16 a -- you can use your onsite power systems even if you
17 lose offsite power as well.

18 Which seems to --

19 MEMBER MARCH-LEUBA: All right. But
20 that's where I was going. If you do take credit for
21 the batteries, the batteries have no safety rate.

22 MR. BOTHA: That's true, correct. But the
23 battery -- we can't use the batteries to charge with
24 CDCS.

25 So the batteries --

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1 MEMBER MARCH-LEUBA: But they cannot be
2 used to test CDCS?

3 MR. BOTHA: That's right.

4 CHAIR CORRADINI: Can or cannot?

5 MR. BOTHA: Cannot. Cannot.

6 MEMBER STETKAR: Let me just make a
7 comment. Without having seen one iota of your PRA
8 models, data, or assumptions, these numbers are
9 meaningless to us.

10 That is simply a statement that I wanted
11 to put on the record. It's my own personal opinion.

12 They are meaningless without the committed background.

13 MR. BOTHA: Yes. So, you would --

14 MEMBER STETKAR: So you could put any
15 numbers up there. Until we have an opportunity to
16 actually review the PRA, look at the completeness of
17 the scenarios, look at the frequencies of the scenarios,
18 including external events like seismic events.
19 Including internal fires. Including internal flooding
20 and anything else you can think of, these numbers are
21 meaningless.

22 MR. BOTHA: Sure. So I understand your
23 --

24 MEMBER STETKAR: So, probabilistic
25 assertions at this stage in the game, in my mind, don't

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1 carry much weight. Because -- at least with me, because
2 I've not had the opportunity to look at any
3 justification for any of those numbers.

4 MR. BOTHA: Sure.

5 MEMBER STETKAR: Any of the three numbers
6 that you cite on this slide.

7 MR. BOTHA: And while you wait for an
8 opportunity to look at the numbers, some additional
9 information I can give you is the first number there,
10 the stacked rod probability is based on industry data.

11 So, our control rods are similar to the
12 existing control rods in industry. And then the second
13 number in there --

14 MEMBER STETKAR: I'm familiar with that
15 data. And it's very sparse. And there's very large
16 uncertainty in those estimates.

17 Go on.

18 MR. BOTHA: Sure. Thank you for the
19 comment. So --

20 MEMBER BROWN: Probably being the one with
21 the least knowledge of all this, I'm an electrical guy.

22 So, in your white paper you make the statement -- I'm
23 trying to connect -- you're telling me why things won't
24 happen.

25 But yet in your white paper you state that

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1 under normal and accident conditions with a postulated
2 limiting stuck rod and conservative assumptions of low
3 level return to power is predicted during long term
4 response.

5 And that, I haven't heard anything that
6 you've -- that lays out how does that occur when we
7 talk about long term response.

8 Does that mean -- I just can't connect the
9 dots --

10 MR. BOTHA: Sure.

11 MEMBER BROWN: Based on the earlier
12 discussion. And it was right on the first page of your
13 white paper.

14 MR. BOTHA: White paper. I understand.

15 MEMBER BROWN: So, to me that doesn't sound
16 consistent with what you've been going through this
17 stork dance for the last half an hour.

18 MR. BOTHA: Sure. And the purpose of the
19 stork dance, if you may, --

20 MEMBER BROWN: I wasn't trying to be
21 pejorative. It's just --

22 MR. BOTHA: I understand.

23 MEMBER BROWN: It's just the back and forth
24 is what I meant.

25 MR. BOTHA: Yeah. So that's a good point

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1 that we're going to be transitioning and having a little
2 bit of what you mentioned.

3 But the purpose of that was really to give
4 you a sense of what we realistically expect to occur.

5 And I'm going to be handing it over to Ben.

6 But just to give you a short answer there,
7 is the purpose of the Chapter 15 analysis that gets
8 mentioned in the white paper, is going the opposite
9 way.

10 It's not looking at what's realistically
11 going to happen. It's looking at well, if I take these
12 considered assumptions, I can now demonstrate to you
13 that this is not going to endanger the fuel.

14 And then you end up, if you're going to
15 take those considered assumptions, you end up with an
16 event that looks very different then that. But that's
17 because of the conservative assumptions.

18 So, I'll take this opportunity to
19 transition to Ben Bristol.

20 MEMBER KIRCHNER: Well, one --

21 MEMBER BROWN: Let me -- can I finish?

22 MEMBER KIRCHNER: Go ahead.

23 MEMBER BROWN: I'm sorry. I didn't mean
24 it that way.

25 I guess I was under an understanding that

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1 we typically, and my colleagues can correct me if I'm
2 wrong, but we typically license stuff under a set of
3 conservative accidents.

4 MR. BOTHA: You're correct.

5 MEMBER BROWN: And you're effectively
6 arguing that we don't have to meet those in order to
7 say we're okay. That's what the purpose of the
8 exemption is.

9 That's what -- that's what I -- that's the
10 way I read what you said just now.

11 MR. BOTHA: So, I would -- I think the
12 exemption request and the reason we're asking for that
13 is I would decouple that from the safety analysis, which
14 Ben will very briefly address.

15 He's for the most part going to talk about
16 some of the inherent characteristics of our design.
17 And I -- so that's not necessarily the same question.

18 I think the question of the exemption is,
19 do you meet the requirements? And if you don't, you
20 need to go through an exemption process to demonstrate
21 that it's acceptable.

22 But the question of the safety analysis,
23 which is in the application, so that analysis is
24 presented as part of our Chapter 15, is to answer the
25 question, well will I challenge the fuel with

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1 conservative assumptions.

2 So, those I think are two separate
3 questions.

4 MEMBER BROWN: Okay. One more to go.
5 Maybe you're going to address this later, but --

6 MR. BOTHA: Sure.

7 MEMBER BROWN: If a response came back and
8 said no, we don't accept the exemption. And we don't
9 agree that you can allow -- you'd have to comply --
10 not comply.

11 You have to do what other plants have done.

12 MR. BOTHA: Sure.

13 MEMBER BROWN: How would that -- is that
14 -- are you all going to talk about what -- how that
15 impacts your plant design?

16 MR. BOTHA: So we --

17 MEMBER BROWN: What do we get in other
18 words if -- there ought to be a reason for why you're
19 doing that to some degree.

20 MR. BOTHA: That's correct. So we are
21 going to -- after Ben's slides, I'm going to get back
22 to some of the design considerations.

23 And I'll touch there on the reasons we
24 purposely did not look at alternatives. So these
25 things you could do in the design and the specific

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1 reasons we opted not to do them.

2 But, I think I'll, if it's okay with you,
3 wait until we're through.

4 MEMBER BROWN: I'm through. I just wanted
5 to make sure it was going to be talked about.

6 MR. BOTHA: Sure.

7 MEMBER BROWN: Okay. Thank you.

8 MEMBER BLEY: And before we go ahead,
9 there's a couple of things I want to toss on their table.
10 I'm not expecting you to respond to these.

11 My colleague Mr. Stetkar, said we haven't
12 seen where these numbers come from. And that's true.

13 On the other hand, we haven't seen all of
14 the details of the thermal hydraulics numbers or the
15 neutronics that back up the rest of this. We have to
16 see all of that eventually.

17 MR. BOTHA: Sure.

18 MEMBER BLEY: So, at this point in time,
19 there's no way we say everything's good. But, I think
20 what we're being asked to say is, if the analysis support
21 the things we've heard, is this a reasonable approach?

22 CHAIR CORRADINI: Can I just interject
23 with that?

24 MEMBER BLEY: Okay. But I want to finish
25 these before --

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1 CHAIR CORRADINI: All we're going to be
2 asked to talk about -- all were being asked to talk
3 about today is do we agree with the suggested criteria
4 by the staff.

5 MEMBER BLEY: Very good. The DDC itself,
6 and all of us know this, says what they need to do is
7 maintain the capability to cool the core.

8 It doesn't say anything about all these
9 other things. We've added the other things along the
10 way, often because they're simple substitutes for what
11 we're really trying to do.

12 From my point of view, it's always fair
13 to go back and say, should we do that? Or should we
14 do more precise and more accurate in how we deal with
15 these things?

16 And the last thing is our deterministic
17 and conservative analysis that are done, the stand ins
18 for kind of the right thing, because it's easier. And
19 it's always fair to look beyond that.

20 When we apply those and start applying them
21 to areas that are extremely unlikely, the real place
22 we ought to be -- the way we ought to be thinking about
23 that to me, is in a probabilistic point of view.

24 And they're bringing some of that in. And
25 eventually we have to deal with that.

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1 But, I just wanted to get those thoughts
2 on the record for our deliberations later. Go ahead.

3 MR. BOTHA: Thank you. So I'll take this
4 moment -- sorry.

5 MEMBER KIRCHNER: I just wanted to ask --
6 I've got a question and a clarification. You said that
7 the CVCS function -- and there was a dialog between
8 you and the Chairman on this CVCS.

9 And this is not powered by the battery
10 system?

11 MR. BOTHA: that's correct.

12 MEMBER KIRCHNER: So what is it powered
13 by?

14 MR. BOTHA: AC power. And you can power
15 it with your onsite AC sources.

16 MEMBER KIRCHNER: Okay.

17 MEMBER BLEY: We're going to be looking
18 at the AC power system for this plant later. We looked
19 at --

20 MEMBER KIRCHNER: Yeah.

21 MEMBER BLEY: The generic thing a while
22 back. Where they proposed a highly reliable instead
23 of safety grade, and wrote a letter on that.

24 And this is the highly reliable system.
25 They're not using it here.

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1 MEMBER STETKAR: That was DC. Highly
2 reliable DC.

3 MEMBER BLEY: Yeah. But we argued it was
4 both at the time.

5 MEMBER STETKAR: Yeah.

6 MEMBER BLEY: Because they were coupled
7 together.

8 MEMBER STETKAR: We did.

9 CHAIR CORRADINI: Keep on going. You're
10 going great.

11 MR. BOTHA: Thank you. So I'll use this
12 opportunity to give Ben Bristol a chance to discuss
13 the consequences of a return to power and some of the
14 inherent features of our reactor control.

15 MR. BRISTOL: My name is Ben Bristol. I
16 have a Bachelors and a Masters Degree in Nuclear
17 Engineering from OSU. I've been with NuScale for five
18 years working in the safety analysis and safety
19 engineering organizations.

20 As Derick mentioned, we're going to get
21 into a little bit of what this event could look like.
22 How the event progresses. And what the consequences
23 are.

24 So, to jump off the cooling the core
25 concept, one of the primary things we're focused on

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1 is, would this event challenge the systems that we
2 passively designed, Derick described them a little bit
3 earlier that are set out for core cooling and these
4 longer term passive functions when we don't have AC
5 power.

6 What we see is that whether the event be
7 a single rod stuck out, return to power event, or even
8 an event where all of the rods are out, both of those
9 systems are designed such that they scale and can remove
10 that heat.

11 And that's due to some of the self-limiting
12 characteristics of those systems that I'll describe
13 next.

14 So, if we were looking at an event that
15 progresses to our decay heat removal system actuating,
16 and that's the secondary loop, passive system, those
17 are events that don't involve breaks inside
18 containment.

19 If we have a loss of feed water for
20 instance, we would get a reactor trip on high
21 temperature or high pressure. That comes with the DHR
22 actuation.

23 As Derick mentioned earlier, the immediate
24 analysis of the event shows that the shutdown capability
25 of the rods with one stuck out is more than sufficient

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1 to take the core subcritical for an extended period
2 of time.

3 Eventually DHR will continue to cool the
4 RCS down to temperatures where this event could be
5 postulated. And what we see there is a moderator
6 temperature driven event, a little bit like a steam
7 line break.

8 These time scales are fairly different.
9 We have a power response. Ultimately the power causes
10 an increase in RCS temperature. And that turns the
11 power back around.

12 And we would reach an equilibrium condition
13 where the power is matched by the particular ability
14 of the DHR to remove the heat.

15 MEMBER KIRCHNER: What power level is that
16 that you estimate?

17 MR. BRISTOL: So the equilibrium power
18 level in our conservative analysis is about three
19 megawatts.

20 MEMBER KIRCHNER: So, perhaps another way
21 to say it, and this is pejorative, you end up in a
22 situation where you have the criticality, and you're
23 not really controlling it.

24 You're hands off and you're depending upon
25 a natural phenomenon, whether it's boiling, water

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1 temperature coefficient, whatever the coefficients
2 are, to limit that power level from going any further,
3 from increasing from that three megawatts.

4 So there it sits from now until whenever.

5 Isn't that the situation that you're pointing to?

6 MR. BRISTOL: That's correct.

7 MEMBER SKILLMAN: Okay. So it sits there
8 for six or eight months. Why is that okay?

9 MR. BRISTOL: That's incorrect.

10 MEMBER SKILLMAN: Thank you. Correct me
11 -- I'm not going to be corrected. You know, I watch
12 -- please proceed.

13 MR. BRISTOL: So, the event progression
14 that we'll get into, as Derick mentioned a little bit
15 earlier, is if we're in a situation where we have AC
16 power available, operators have the ability to add
17 boron, and we would mitigate the event that way.

18 If we have an extended loss of AC power,
19 what eventually happens is -- will result in the load
20 shedding that Derick described, where we actuate ECCS.

21 And then we go to the other mode where we
22 have the ECCS driven event. Which I'll get into in
23 the next slide.

24 MEMBER SKILLMAN: Will you give a time
25 scale for what the operator actions will result in?

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1 Will you have a time line that if you are in the
2 situation, approximately how long that will take to
3 bring the core to a subcritical --

4 MR. BOTHA: So I think what he just
5 described is if you go through the normal sequence of
6 -- thank you. What he just described is, if you go
7 through the normal sequence of events, you wouldn't
8 see this return to power on DHRS.

9 You would transition, so for normal
10 sequence events, you would transition to your ECCS
11 system automatically. So there's no operator action
12 required, because the system sheds the load on the ECCS
13 valves.

14 But that's what -- what actually would
15 happen.

16 CHAIR CORRADINI: I'm going to interject
17 that I don't think you're answering Dick's question.

18 MR. BOTHA: Sure.

19 CHAIR CORRADINI: But I'm not sure that
20 you guys are on the same wave length. The way if you
21 read the words, is you don't get a return to power.

22 MR. BOTHA: Under normal conditions --

23 CHAIR CORRADINI: Unless you have a set
24 of conservative assumptions under Chapter 15. And I'm
25 not sure that we're clear yet as to what those

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1 conservative assumptions are.

2 That's -- and I think Dick's asking is with
3 those assumptions, --

4 MR. BOTHA: Sure.

5 CHAIR CORRADINI: How long do you remain
6 critical?

7 MEMBER SKILLMAN: That's my question.
8 And what actions are you taking? And how long does
9 it take those actions to stop that criticality?

10 MR. BRISTOL: So what we demonstrate in
11 the analysis is that we'll reach an equilibrium
12 condition and stay there. That condition doesn't
13 challenge the ability of ultimately the pool to keep
14 removing the heat.

15 And so therefore if we were to stay in that
16 condition out to 24 hours when we have this automatic
17 actuation of ECCS that still doesn't provide any
18 additional challenge to our heat removal capabilities.

19 CHAIR CORRADINI: So it -- so at the
20 minimum it stays critical for 24 hours. At low power.

21 MEMBER BROWN: At three and a half --
22 roughly three or three and a half percent power --
23 megawatts, excuse me.

24 MR. BRISTOL: Yeah. You could postulate
25 that if we're considering Chapter 15.

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1 CHAIR CORRADINI: Right. Well, that's
2 where I think he's going. Let me push the point.

3 So tell me what happens at 24 hours by
4 natural logic of the design.

5 MR. BRISTOL: So, the last bullet
6 describes condition again, this nominal versus
7 conservative. Our nominal condition in these
8 operating modes, there's sufficient xenon in the system
9 to provide the negative reactivity necessary to
10 overcome the conservatism of the stuck rod.

11 MEMBER SKILLMAN: That's gone after about
12 eight to 12 hours.

13 MR. BRISTOL: So again, out to 24 hours
14 they're sufficient under the equilibrium conditions
15 in combination with the cooling curves, such that the
16 event doesn't occur.

17 MEMBER BROWN: And what about the Chapter
18 15 conditions though?

19 MR. BRISTOL: In those conditions we
20 predict just based on conservative assumption of decay
21 heat that we see the event within about two hours.

22 MEMBER BROWN: And how long -- I mean,
23 that's when you get to three or three and a half
24 megawatts?

25 MR. BRISTOL: That's correct, yes.

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1 MEMBER BROWN: And how long does it last
2 then? Is that a day or --

3 MR. BRISTOL: So we haven't established
4 --

5 MEMBER BROWN: Two days, or three days,
6 or four days? Or a week?

7 MR. BRISTOL: That would -- it would be
8 up to 24 hours when we transition to ECCS mode.

9 MEMBER KIRCHNER: And what happens then?

10 MEMBER BROWN: Yeah, what happens at 24
11 hours that you transition? Under the conservative
12 Chapter 15 conditions.

13 MEMBER STETKAR: Just don't -- with no
14 boron addition. Just say with no boron addition. What
15 happens then?

16 MEMBER KIRCHNER: Yeah.

17 MR. BRISTOL: That's implied in all of this
18 conversation.

19 MEMBER STETKAR: Not conservative, not 24
20 hours, not Chapter -- with no boron addition, what
21 occurs?

22 MR. BRISTOL: There's no boron addition.
23 You can go to the next slide. So, in ECCS mode what
24 we have is --

25 MR. BERGMAN: Ben, I -- Tom Bergman. I

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1 think the question is, what causes us to go to ECCS
2 at 24 hours?

3 There's a -- the batteries have a timer
4 that actuates ECCS after 24 hours by take -- that's
5 what he meant by shed the load.

6 The batteries shed the load at ECCS after
7 24 hours.

8 MR. BRISTOL: So, but you've got that --

9 MEMBER KIRCHNER: So you're at power,
10 you're at 24 hours, and then your battery timer or
11 something sheds the load and --

12 MR. BERGMAN: ECCS actuates.

13 MEMBER STETKAR: You transfer the flow
14 path.

15 MEMBER KIRCHNER: Yeah, to ECCS.

16 MEMBER STETKAR: Is what they do.

17 MEMBER KIRCHNER: So that depressurizes
18 the system at that point, right?

19 MR. BRISTOL: That's correct.

20 MEMBER KIRCHNER: Yes, at 24 hours. If
21 that happens then you'll depressurize.

22 MR. BRISTOL: Yes.

23 MEMBER KIRCHNER: And you're still at
24 three megawatts?

25 MR. BRISTOL: At that time we would be,

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1 yes.

2 MEMBER KIRCHNER: And so for now -- to what
3 pressure roughly does the system depressurize?

4 MR. BRISTOL: It will ultimately
5 depressurize down to sub-atmospheric conditions.

6 MEMBER KIRCHNER: Okay. So at three
7 megawatt power level in the core, you could create
8 substantial void, which is negative feedback.

9 MR. BRISTOL: That's right.

10 MEMBER KIRCHNER: Would you then invite
11 the possibility of oscillations like in BWR?

12 MR. BRISTOL: So --

13 MEMBER KIRCHNER: Do you see what I'm
14 saying? If your void production is substantial, you
15 could create density waves of some kind at the core.

16 MR. BRISTOL: And that's why our analysis
17 of --

18 MEMBER KIRCHNER: Collapses and goes to
19 a higher power.

20 MR. BRISTOL: Sure.

21 MEMBER STETKAR: We got an answer. Well,
22 I want to get past the minutia of what's happening in
23 seconds and minutes, and figure out what's happening
24 out oh, like 67 hours after the initiating event
25 occurred. With no boron addition.

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1 Where are you at 67 hours? And that's an
2 arbitrary time. Because I don't want to get tied up
3 with 24 or 48 or 72, or words like conservative or
4 anything.

5 So, at 67 hours, where does the core sit?
6 What is your power level in the core?

7 MEMBER MARCH-LEUBA: Can I help you guys?
8 They will have sufficient negative reactivity. From
9 the boron and the control loss to keep the reactor so
10 cooled.

11 Unless particularly for a critical void
12 fracture in the core. Let's call it 10 percent. If
13 you look at 10 percent voids in the core, you're super
14 heat.

15 You must generate enough power to use 10
16 percent void in the core. And you have to remain at
17 10 percent in the core either with decay heat --

18 MR. BOTHA: That's right.

19 MEMBER MARCH-LEUBA: Will regardless of
20 how first coming down from fission product or from
21 neutrons. But you will produce a critical void that
22 you need.

23 And that's the real condition. So, at core
24 pressure, that's three megawatts. When you go to a
25 lower pressure, to 15 percent power, you only need 50

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1 kilowatts.

2 But you will never get any more than 10
3 percent voids because this will be critical. You
4 cannot go above 10 percent voids.

5 The reactivity balance in the core does to allow
6 it. That's all their problems. But, I mean, I will
7 go from that point, it's you have critical void fraction
8 that will keep you safe.

9 And the core is going to maintain it one
10 way or the other.

11 MR. BOTHA: Sure.

12 MEMBER KIRCHNER: If you go subcritical,
13 then what happens?

14 MEMBER MARCH-LEUBA: If the decay heat is
15 sufficient to generate more than the loss, 10 percent
16 voids, you don't have neutrons. You only have gamma
17 sent out.

18 And once decay heat starts going down and
19 you have 10 percent voids, then --

20 MEMBER STETKAR: That's right. Then the
21 neutrons are going to make up for the difference.

22 MEMBER MARCH-LEUBA: Yes. There will be
23 some constants where there's a long time for this thing,
24 the transition is less than an hour.

25 And because, I mean, it can last -- so your

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1 time is a thousand seconds, two thousand seconds, we're
2 going through the loop.

3 So, there will be some solutions.

4 CHAIR CORRADINI: So, have we interpreted
5 your behavior correctly? Since the members over here
6 collectively told you how it would behave.

7 (Laughter)

8 MR. BRISTOL: Yes. That's consistent
9 with my points on this next slide.

10 We have a depressurization event in which
11 case the conditions are much different than when we're
12 in single phase conditions during DHR cooling.

13 And the analysis we have shows it takes
14 very little power to suppress the critical condition
15 such that it's well bounded by our analysis of the normal
16 decay heat conditions that we apply in our accident
17 analysis.

18 So the next slide --

19 CHAIR CORRADINI: But to get to -- I'm
20 going to not let Stetkar off the hook. He asked a
21 question, he kind of deserves an answer.

22 What I'm hearing is that, and I think Jose
23 said it best, is that either a combination of decay
24 heat or a little bit of fission power is going to keep
25 it at some void fraction that without anybody touching

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1 it is just going to sit there and cook along.

2 MR. BRISTOL: That's right. And that's
3 similar to our other mode in DHR where ultimately we
4 reach a power level that's equal to the DHR heat removal
5 capabilities.

6 And this would be the same case.

7 MEMBER STETKAR: That's what I was hoping
8 you would show. (Off mic comments) The power plus
9 the -- sorry.

10 The power plus the decay heat is enough
11 to give you sufficient void fraction to establish an
12 equilibrium condition.

13 When do those analysis, same question I
14 asked about heat removal efficiency. Your best
15 estimate analysis for DHRS. Do you have two loops or
16 one loop operating?

17 What assumptions do you make about heat
18 transfer from the core all the way out into the pool?

19 Because that's going to determine that core power
20 level.

21 MEMBER MARCH-LEUBA: Yeah, that three
22 megawatts, maybe when you sharpen the pencil we'll know
23 exactly how everything works. Maybe then.

24 MEMBER STETKAR: Yeah. And have you
25 looked at long term core decay heat removal? Not

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1 Chapter 15 analysis. Not 24 hours.

2 But how long can you sit there before you
3 have to put water in the pool? In the reactor pool,
4 the swimming pool? With 12 problems.

5 MR. BOTHA: I think that's a good overall
6 question in terms of a NuScale safety of the plant.
7 But just keep in mind that you only get into this long
8 term condition when you're at very low heat values.

9 So less than decay heat. So, for you to
10 --

11 MEMBER STETKAR: No, wait. Maybe I'm not
12 understanding what I just thought I walked you into.

13 MR. BOTHA: Sure.

14 MEMBER STETKAR: If you have low decay
15 heat, the reactor power is going to make up for the
16 difference.

17 MR. BOTHA: That's right.

18 MEMBER STETKAR: If you have hot decay heat
19 the reactor power is --

20 MEMBER MARCH-LEUBA: Maybe higher.

21 MEMBER STETKAR: Is -- might be a little
22 bit higher. But --

23 MEMBER MARCH-LEUBA: The thermal power
24 would be higher, because it's higher than the critical.

25 MEMBER STETKAR: Yes.

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1 MR. BOTHA: Sure. But after 24 hours
2 though, you're on ECCA. So, the amount of power you're
3 talking about when you have a return to power is in
4 order of 100 kilowatts.

5 So, if you talk about how much water I need
6 to remove heat, then the conservative case is not this
7 case. The conservative cases are one where decay heat
8 curve where you're not subcritical.

9 Because then you're putting more water into
10 your pool. If I've got decay heat, then I'm talking
11 about two orders of magnitude more.

12 Or so I have an order of magnitude more
13 heat then I have to produce. Or that will be producing
14 from decay heat.

15 Which will keep me subcritical. But that
16 will add more heat to my pool then in the 100 kilowatt
17 case.

18 CHAIR CORRADINI: I think where Member Stetkar is going
19 is do you have enough inventory to stand back and watch
20 12 of these things boil away? That's what I think --

21 MEMBER STETKAR: For some nominal period
22 of time?

23 MR. BOTHA: Yes, so --

24 MEMBER STETKAR: And I don't know what the
25 nominal period of time is.

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1 MR. BOTHA: So the answer is we have got
2 enough water for more than a month, and it's
3 substantially more than a month --

4 (Simultaneous speaking)

5 MEMBER MARCH-LEUBA: Let me make sure I
6 understand what was said before.

7 MR. BOTHA: Yes?

8 MEMBER MARCH-LEUBA: The transfer to ECCS
9 those valves are kept closed by the batteries?

10 MR. BOTHA: Yes.

11 MEMBER MARCH-LEUBA: And whether somebody
12 opens them up or you lose power after 24 hours they
13 will open in 24 hours, right?

14 MR. BOTHA: That's right.

15 MEMBER MARCH-LEUBA: So, for instance --

16 (Simultaneous speaking)

17 MEMBER BLEY: If the circuitry works, yes.

18 MEMBER MARCH-LEUBA: For a substantial
19 amount of time you are talking the depressurized power,
20 which is 100 kilowatts not still megawatts right?

21 MR. BOTHA: That's right.

22 MEMBER MARCH-LEUBA: Times 12 is a still
23 1.2 megawatts. It will require calculation, but it's
24 not --

25 MR. BOTHA: Yes. So the short answer is

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1 it's not a safety concern.

2 MEMBER MARCH-LEUBA: But with that said
3 I think that Dennis is right, what we're just talking
4 about today is not the details of those numbers.

5 MR. BOTHA: Sure.

6 MEMBER MARCH-LEUBA: It's whether GDC 27
7 applies or not and that's where we should be focusing
8 and then you come back here and convince us.

9 (Laughter)

10 CHAIR CORRADINI: I am going to take the
11 charge. I am glad you said that because I want them
12 to continue because we have strayed a bit off track
13 and as engineers we love the design, but can you proceed
14 on because I want to get to the Staff's presentation
15 and their criteria and if they think it's an appropriate
16 criteria.

17 MR. BRISTOL: Okay. So this is a little
18 bit of a summary slide that is just meant to explain
19 the scalability nature of both our ECCS and our DHR
20 heat removal capabilities.

21 As RCS temperature increases both those
22 systems will remove more heat, and then the triangle
23 and the asterisk there are the equilibrium conditions
24 that we expect in DHR mode and in ECCS mode.

25 MEMBER SKILLMAN: Mr. Chairman, I'd like

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1 to back up. I understand your desire to drive on, but
2 let me just ask you to go back one slide.

3 Either Derick or Ben, your comment, almost
4 closing comment on the previous slide was yes this
5 criticality will continue but it's not a safety problem.

6 If you look -- If you check the transcript
7 I think you're going to find those are the words that
8 you used.

9 MR. BRISTOL: That's correct.

10 MEMBER SKILLMAN: To me that is the
11 challenge in this meeting. What you have described
12 as not a safety problem I see is a major safety problem.
13 You have said it can be handled.

14 MR. BRISTOL: Yes.

15 MEMBER SKILLMAN: You have said the
16 natural phenomenon will take care of it. I would say
17 that is dandy, but that doesn't make it not a safety
18 problem, that makes it managed, but from my perspective
19 it's still a safety problem because you've got a
20 criticality that you are not in charge of.

21 MR. BRISTOL: Yes.

22 MEMBER SKILLMAN: It is a criticality that
23 you are depending on natural phenomenon that you think
24 take care of it, and you are probably accurate. I don't
25 challenge your capability to think it through from a

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1 physics and a neutronics perspective, and a thermal
2 hydraulic perspective.

3 But I think just the notion that we are
4 saying, yes, we can handle a meandering criticality
5 because in the course of time we know it's going to
6 be controlled, I am not sure that that's where we ought
7 to be as an industry and as a vendor.

8 And most of all, as we look at general
9 design criteria, at least those of us who were around
10 them in the early days, 26 and 27, it's almost
11 unthinkable, speaking for myself.

12 MR. BRISTOL: Yes.

13 MEMBER SKILLMAN: So I am stuck on this
14 idea that it's not really a safety problem. I believe
15 it is an operating challenge that remains a safety
16 problem.

17 MR. BOTHA: So I think I can respond to
18 that when we continue to the next slide.

19 MEMBER SUNSERI: Could I just maybe
20 provide a different view?

21 MR. BOTHA: Sure, go ahead.

22 MEMBER SUNSERI: I think it's the nature
23 of these new passive designs that design becomes a
24 controlling parameter and you are controlling the
25 design and you are saying the parameters with the design

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1 to control this criticality under these circumstances.

2 So it's not like it's some willy-nilly
3 reactor where the rain is making the thing critical --

4 MR. BOTHA: Yes, that's correct.

5 MEMBER SUNSERI: -- it's a very controlled
6 design specific, that type of controlling criticality
7 is through the design.

8 MR. BOTHA: That's correct.

9 MEMBER SUNSERI: So that's my fundamental
10 issue with the NRC's position that says it's not
11 reliably controlled. It is reliably controlled, it's
12 not just reliably controlled through an active system,
13 it's reliably controlled through a well-thought-out
14 design.

15 MR. BOTHA: Yes. Thank you, I appreciate
16 that comment. I think that fits in well with the next
17 slide. Thank you, Allyson. So we are going to address
18 the design considerations so I think that's an
19 appropriate comment.

20 And with respect to the design
21 considerations I think the inherent safety, as you
22 pointed out to the design, is pretty fundamental for
23 us in terms of our overall design principles and as
24 Ben pointed out if you look at the reactivity control,
25 inherent capabilities of this design, it's not just

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1 about a single rod but also there is a capability because
2 of those inherent bits of feedback mechanisms that you
3 can tolerate additional failures of multiple rods which
4 traditionally may not have been the case with earlier
5 designs.

6 So I would argue relying on those bits of
7 inherent features gives you the means to provide
8 additional safety and additional reliability, but back
9 to the presentation.

10 So we purposely elected to use standard
11 magnetic, or mag jack control rods. Firstly, because
12 there is a lot of experience with that in the industry,
13 it's well understood, and also it is well suited to
14 our design.

15 We have also looked at well is it sensible
16 to add additional reactivity control systems in terms
17 of safety-related control systems and we found that
18 that does not provide you additional safety if you add
19 these additional systems.

20 So we felt that the systems we have is
21 sufficient given that the inherent capability of the
22 design and also if you take into consideration that
23 the probability for a stack rod is extremely low.

24 That is not an apples to apples comparison,
25 but if you compare 2E to the minus 4 to a typical EECS

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1 system of liability that's very favorable.

2 And then after successful control rod
3 insertion you don't have to do additional things to
4 protect your core because it is protected.

5 And then if you look at relying on this
6 passive means for insertion, if you add additional
7 systems, so we looked at those, that does not
8 necessarily make the plant more safe in terms of
9 reducing your core damage frequency, but what it does
10 do is introduce additional failure mechanisms.

11 So by adding other systems you are
12 increasing the complexity of the design and introducing
13 additional things that can fail. So if you add a boil
14 injection system, for example, the practical way to
15 do that is to put it outside of containment and now
16 you have an additional penetration that is coming in
17 through your containment and reactor pressure vessel
18 that can fail and lead to containment bypass.

19 And if you look at the overall systems in
20 terms of their safety containment bypass is one of the
21 vulnerabilities for the exiting feat and something that
22 we don't want within our design. Next slide.

23 MEMBER STETKAR: Doesn't your CVCS already
24 have one of those penetrations?

25 MR. BOTHA: That is correct --

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1 MEMBER STETKAR: Okay.

2 MR. BOTHA: -- but you would add additional
3 ones, yes.

4 MEMBER STETKAR: No, no, if you made your
5 CVCS safety-related you wouldn't need an additional
6 penetration, so I am not persuaded by that argument.

7 MR. BOTHA: Yes.

8 MEMBER POWERS: And it wouldn't be a
9 passive design.

10 MR. BOTHA: It wouldn't be a passive
11 design.

12 MEMBER STETKAR: That's correct, it
13 wouldn't, by chance.

14 MEMBER POWERS: But it would be a safe one,
15 huh?

16 MEMBER STETKAR: It would be a different
17 design.

18 MEMBER SKILLMAN: Before you go on, has
19 the NuScale team ever considered what the operator's
20 environment would be if this event occurred in one of
21 the modules?

22 MR. BOTHA: So if you look at what we expect
23 to normally occur they wouldn't have to do anything
24 for a very long time and if they have AC power systems
25 available they will go through their normal shutdown

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1 sequence, so this wouldn't change how they operate the
2 plant.

3 As part of the -- As soon as you get systems
4 back online, to go to your normal refueling system you
5 have to add water, you can do that with your CVCS, we
6 also have a flood and drain system that we use as part
7 of our shutdown sequence.

8 So all of those systems are there and to
9 go to refueling you have to go and use those systems.

10 MEMBER BLEY: I'll chime in something here
11 quick, when we had our trip out to the site several
12 years ago we got to watch a series of drill exercises
13 in the control room ending with a cascading of many
14 problems.

15 My impression was I saw a lot more effort
16 to involve the operators in designing the displays and
17 the ability to deal with those displays than I have
18 ever seen elsewhere.

19 I don't know what's happened since that
20 time, and I hope before we finish this process we get
21 to see something here that shows us where that practice
22 has evolved and how the evolution of the control room
23 indication alarm and control systems have, what state
24 they have reached by now and the extent of operations
25 involvement in them, because I think that is going to

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1 be crucial to the ability to decide whether, at least
2 for us to decide whether we think this is going to be
3 an operable design, so I look forward to seeing more
4 of that later.

5 MEMBER SKILLMAN: Yes. My purpose is not
6 to be a cynic and it's also not to be negative here,
7 it's to be a challenger.

8 I just remember in an incident of one weeks
9 and weeks and weeks of good people like us looking at
10 instrumentation saying is it critical or isn't it and
11 if it is what more can we do.

12 And that didn't, that sense of trepidation
13 did not pass quickly, it went on for months, and so
14 I can imagine men and women in the control room saying
15 we think we are okay on Module 4 but after we've had
16 the worst event occur.

17 We think it shut down but we're not sure,
18 we think it's going to be okay because it's going to
19 take care of itself, but we don't know quite when.
20 The end will come.

21 And I would just suggest that brings into
22 this design a peculiarity that we can see coming even
23 now, because there isn't the certainty that you can
24 bring this core to a complete subcritical situation
25 under these circumstances.

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1 And it seems to me that that is a question
2 that deserves a compelling and strong answer. We know
3 we can shut that thing down, and that's why I am picking
4 on you.

5 MR. BOTHA: Yes. I appreciate --

6 MEMBER SKILLMAN: I am affected by
7 previous experience where a number of men and women
8 were involved in this and it just didn't go away easily.
9 It was really a nightmare.

10 MR. BOTHA: So I think in that particular
11 plant, in that plant to get to cold conditions you had
12 to insert rods, although you could account for a stacked
13 one, but then you also had to inject boron to get to
14 subcritical conditions to ensure you were safe.

15 MEMBER SKILLMAN: Six thousand PPM?

16 MR. BOTHA: That's right.

17 MEMBER SKILLMAN: That's correct.

18 MR. BOTHA: So you need to do both those
19 things. With this plant you can get there with rods
20 only. So you can get to a condition where you can ensure
21 safety without the need for additional boron.

22 You have that capability and you will use
23 it, but you don't need it to ensure safety. So that
24 provides additional protection then having to require
25 rods and injection.

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1 So I think if that's -- If you stand back
2 and look at the design holistically, which we did, and
3 we also looked at it within the context of the advanced
4 reactor policy statement, which was intended for the
5 NRC to bring about advanced reactors that are both safer
6 and easier to license.

7 So some of the goals that they put in there
8 had those two objectives in mind. And so if you look
9 at our design and the choices we made, the first one
10 is by relying on rods you have a system that is highly
11 reliable and less complex, and then further, as we
12 discussed, the reactor provides inherent protection
13 even if you were to see failures within that control
14 rods, new control rod system.

15 And I've got some quotes here, and I'm not
16 going to read the quotes, I am simply going to state,
17 so that would be the first quote. For the second quote,
18 so consistent with that quote, we provide a simple
19 shutdown system, control rods that passively insert
20 into the core and doesn't require operator action, so
21 you don't require operator action to get into that safe
22 state and it facilitates operator comprehension and
23 provides for reliable system functions.

24 And then, lastly, the control room system
25 design that we elected builds on extensive operating

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1 experience with the existing PWR.

2 MEMBER BLEY: Derick, you kind of, at least
3 for me you missed Dick's point a little bit.

4 MR. BOTHA: Sure.

5 MEMBER BLEY: It's one thing to say you
6 were retaining capability to go with the core, which
7 is what the GDC asked us to do. It's another, for an
8 operator in the plant, not an engineer having done a
9 calculation looking at it comfortably in the office,
10 but sitting in the plant with a plant that is cooking
11 away, it's low.

12 (Simultaneous speaking)

13 MEMBER BLEY: When we look at how the
14 operators are going to be trained and how they are going
15 to use this facility we're going to be interested in
16 how they know that this situation where they are not
17 completely shutdown, and they're pretty sure they are
18 not completely shutdown, how they understand that and
19 how they deal with it and how they continue and have
20 comfort, which is a different thing than the engineer
21 saying, yes, I'm sure it's okay, ahead of time.

22 MR. BOTHA: Yes.

23 MEMBER STETKAR: They are sure by the way
24 they are not shutdown because the instrumentation is
25 safety-related, so they are going to know they are not

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1 shutdown.

2 That is one of the things that they retained
3 being safety-related, so that has to be available.
4 They don't know they're not shutdown if they're not
5 shutdown.

6 (Simultaneous speaking)

7 MEMBER BLEY: -- level of discomfort.

8 (Simultaneous speaking)

9 MEMBER STETKAR: And most operators
10 traditionally have been trained to do something about
11 that.

12 MR. BOTHA: Sure. And --

13 MEMBER STETKAR: And unless you untrain
14 them or train them under the particular conditions that
15 they need to keep their hands off they're going to want
16 to do something.

17 MEMBER BROWN: Well and they are going to
18 want to inject the boron, which unless the power isn't
19 really isn't there they're going to do, so --

20 MR. BOTHA: That's right..

21 MEMBER STETKAR: There is another issue
22 with perception I think but if you look at the state
23 of trying to get plants built, designed and built and
24 operated today that now we are going to advertise
25 there's a plant sitting out there with just, you can't

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1 shut it down unless if you are under these more adverse
2 circumstances.

3 So Dick's point is valid. Matt's comments
4 were valid also relative to the design of the plant,
5 if I do understand the points.

6 MR. BOTHA: Yes.

7 MEMBER STETKAR: But perception can kill
8 you in these types of circumstances in terms of a bigger
9 picture.

10 I don't think we should totally ignore that
11 factor that, gee, we're going to sit there for some
12 long period of time and it's going to be critical, then
13 over-producing neutrons, and they're going to be
14 reading it on instruments and somebody can step back
15 and say, my God, we've got plants that we can't shut
16 down.

17 MR. BOTHA: Sure.

18 MEMBER STETKAR: And I just think
19 perception can drive everything we do, which we have
20 noticed over the last 35 years.

21 MR. BOTHA: Yes. So we went through those
22 same deliberations in coming up with the design as we
23 have it today. So we looked at the perception aspects
24 and the operational aspects as well, and I think I have
25 covered some of those points, so I understand your

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1 points and the implications.

2 So with regards to precedent, we've briefly
3 touched on the main steam line break and the return
4 to power which you would see in Chapter 15. The
5 precedent I am going to cover is more in, either in
6 the PRA sphere of precedent that the Agency has looked
7 at, as well as some of the GSIs.

8 So I am going to briefly go through this.
9 The first one is GSI-22 where the Agency looked at
10 inadvertent boron dilution. So this is when you are
11 going into refueling, the head is off, and somebody
12 adds deborated water to the system.

13 And there is a couple near misses in the
14 industry with regards to this and this is the frequency
15 based on those near misses that the predicted for
16 inadvertent return to power.

17 And that wouldn't necessarily challenge
18 core -- The part resolution is they said, well, you'll
19 get some voiding, that will limit the power you produce,
20 and, therefore, the consequences would be limited and,
21 therefore, they didn't take any action on this GSI.

22 The next one is NUREG-1449 and that NUREG
23 looks at, and for advanced ones has to look at the
24 shutdown or low-power PRA so that you just don't look
25 at your full-power cases but you look at what else could

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1 go wrong during conditions we are at low power or
2 shutdown and for the existing fleet they predicted a
3 core damage frequency for a rapid boron dilution in
4 the order of 1E to the minus 5 and that led to, that
5 was for core damage, that wasn't just simply a return
6 to power.

7 The next one is a lower probability. This
8 had to do with small-break LOCAs and the potential for
9 deborated water to collect in a certain part of your
10 system.

11 You then turn on a reactor coolant pump
12 and you push this deborated water into your core, that
13 results in a rapid reactivity insertion, and core damage
14 they predicted that to be 10 to the minus 9, or three
15 times 10 to the minus 3, it was a very low probability
16 event, and they advised to take that into consideration
17 for the operators to recommend to them don't turn on
18 the reactor coolant pumps.

19 The last one I think is relevant is ATWS.
20 So when the Agency looked at ATWS and looked at the
21 design considerations to address ATWS the goal, the
22 safety goal that they established for addressing ATWS
23 was 10 to the minus 5 per reactor year, so that was
24 the goal of limiting core damage, your core damage
25 contribution from ATWS.

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1 So the actions that came out of that
2 evaluation for BWRs and PWRs was to try and hit this
3 goal. So if you look at the -- In contrast to these
4 conditions, if you look at the return to power for the
5 NuScale reactor you're really talking about a benign
6 and a very low probability event.

7 So the next slide is our last slide, a
8 summary.

9 MEMBER BALLINGER: I've got to chime in
10 here from a material person.

11 MR. BOTHA: Yes.

12 MEMBER BALLINGER: These are precedents
13 in the strict definition of the word, but I am with
14 Dick here, these are accidents for which people are
15 taking active measures to remedy.

16 You are talking about an event where the
17 operators technically can't do anything, don't have
18 to do anything, so it's different. To use these as
19 precedents, these are just events that occur at which
20 point you get a return to power.

21 You are talking about a return to power
22 which you actually will allow.

23 MR. BOTHA: Yes.

24 MEMBER BALLINGER: Maybe I'm not saying
25 it the way it should be said, but that's a very different

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1 thing. That requires a really different attitude that
2 somebody has commented on, with the staff, with the
3 operating crew, and everything.

4 MR. BOTHA: Yes.

5 MEMBER BALLINGER: Because I just don't
6 buy that these are with the -- I look up the definition
7 of precedent, okay, but, you know.

8 MR. BOTHA: Yes. I think where the two
9 differences, right, and that these, the precedent you
10 are talking about significant consequences is the first
11 difference.

12 And I think the other difference is
13 material is if you look at events that are really in
14 the weeds in terms of low probability, if they are low
15 probability and low consequences do you want to do
16 additional things to the design to try and address that.

17 (Simultaneous speaking)

18 MEMBER BALLINGER: Well I'm not saying you
19 shouldn't, that it wouldn't work just fine.

20 MR. BOTHA: Sure.

21 MEMBER BALLINGER: I am just saying that
22 I am wondering whether using these as precedents is
23 the right way to --

24 PARTICIPANT: I agree.

25 MR. BOTHA: I understand.

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1 MEMBER BALLINGER: -- you know, explain
2 it to people.

3 MR. BOTHA: You're not comparing apples
4 to apples at this point.

5 MEMBER BALLINGER: No.

6 MR. BOTHA: I understand.

7 MR. SCHULTZ: And another part of that is
8 that when you display it and so the probability is to
9 make an argument that in comparison you have low
10 probability, low consequence.

11 MR. BOTHA: Yes.

12 MR. SCHULTZ: Part of that is certainly
13 true, but there is a lot more than just the probability
14 of the event that was considered in the evaluation and
15 the determination of actions taken.

16 MR. BOTHA: Sure.

17 MR. SCHULTZ: So you have to explore a lot
18 more to make a precedent comparison.

19 MR. BOTHA: Yes.

20 MR. SCHULTZ: And I know you have done
21 that, but --

22 MR. BOTHA: Yes.

23 MR. SCHULTZ: -- be careful when you
24 display it as if it were because of the probabilities
25 and that you make a conclusion that the NuScale design

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1 is in a particular position with the comparison to them.

2 MR. BOTHA: Sure. Thank you.

3 MEMBER SUNSERI: Well I would say it a
4 little differently, I would say to use as precedents
5 return to criticality is that potential result in core
6 damage is not a condition to your argument because your
7 argument is return to criticality is a non-event.

8 MR. BOTHA: That's correct.

9 MEMBER SUNSERI: It doesn't result in core
10 damage, it doesn't even come close to challenging the
11 cladding or the fuel or anything. So I would continue
12 to argue that you are controlling reactivity by the
13 nature of your design versus physical active systems.

14 MR. BOTHA: Thank you. So in summary, so
15 we have elected to use a safe layer control, control
16 rods as our primary reactivity control system, and that
17 is well suited to our design and the characteristics
18 of our design and that provides us with capability to
19 rapidly shut down the reactor to protect the fuel.

20 It is also able to reliably maintain the
21 reactor subcritical under cold conditions and then,
22 lastly, the passive features of the design and the
23 inherent features of the design provides for protection
24 against malfunctions in your control rods, even
25 malfunctions in multiple rods.

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1 And then the last two points there is we
2 designed our system to be aligned with the advanced
3 reactor policy statements and with the goals of that
4 statement, and then, lastly, a return to power as we
5 have described as a benign event with a very low
6 probability that is lower than the CDF frequency that
7 is predicted for licensed reactors. Thank you.

8 CHAIR CORRADINI: Are there questions by
9 the Staff?

10 MEMBER MARCH-LEUBA: Yes.

11 CHAIR CORRADINI: Jose?

12 MEMBER MARCH-LEUBA: I am going back to
13 Dennis's thing. I think this meeting went the wrong
14 way. You intend to convince us that if we give you,
15 if the Staff gives you a pass on GDC 27 it would be
16 okay with you.

17 We should be discussing whether it is okay
18 to give a pass on GDC 27 whether it is okay with you
19 or not. But with that said, are you going considering
20 reassigning the control rods, put a little more bite
21 on the control rods so you don't have to deal with this?

22 I mean -- Go.

23 MS. CALLAWAY: Allyson Callaway here. We
24 have looked at different control rod materials, control
25 rods that span more of the core, I guess those are the

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1 two major things that we have considered, and those
2 options don't provide any extra shutdown capability --

3 (Simultaneous speaking)

4 MEMBER MARCH-LEUBA: Your rods are black.

5 MS. CALLAWAY: -- we still have a stuffed
6 rod.

7 MEMBER MARCH-LEUBA: Your rods are already
8 black.

9 MS. CALLAWAY: Yes.

10 MEMBER MARCH-LEUBA: Anything with core
11 loading or, I mean I wouldn't change the length of the
12 cycle?

13 MEMBER KIRCHNER: Or reducing the work of
14 the assembly. Put more assemblies in.

15 MEMBER MARCH-LEUBA: And making your
16 cycles shorter will get rid of this, too, but, obviously
17 you don't want to do that.

18 MS. CALLAWAY: There are ways that we can
19 either cause the event to occur over a smaller portion
20 of the cycle or reduce the disparity of it, but it's --

21 MEMBER MARCH-LEUBA: It's more
22 important -- It has to be zero or you have to go through
23 the whole thing?

24 MS. CALLAWAY: Right. Yes, there wasn't
25 something that was obvious that was going to make it

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1 going away and evaluating those things determined that
2 it wasn't necessary based on our design principles to
3 be designing for that.

4 MEMBER MARCH-LEUBA: Okay.

5 CHAIR CORRADINI: Other comments?

6 (No audible response)

7 CHAIR CORRADINI: Okay. So this is a
8 perfect time to take a break. I'll have you guys exit
9 and have the Staff come on. Let's take a short break
10 till about 20 of and we'll have the Staff come and talk
11 about criteria.

12 (Whereupon, the above-entitled matter went
13 off the record at 2:25 p.m. and resumed at 2:39 p.m.)

14 CHAIR CORRADINI: Okay, let's get started.

15 We have the Staff up, or some elite core set of the
16 Staff. Jeff, do you want to --

17 (Simultaneous speaking)

18 MEMBER STETKAR: Turn your mic on.

19 MR. SCHMIDT: Hello, this is Jeff Schmidt
20 from Reactor Systems. I guess, you know, what I found
21 interesting in the discussion with NuScale, is, you
22 know, before I start my formal presentation, was a lot
23 of the discussion you guys had was the same discussion
24 the Staff had over months of time, so it was kind of
25 interesting to hear everybody's perspective.

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1 Again, I am Jeff Schmidt and I am going
2 to talk about the NuScale exemption request to General
3 Design Criteria 27.

4 MEMBER BLEY: Hey, Jeff?

5 MR. SCHMIDT: Yes?

6 MEMBER BLEY: Not to catch you off guard
7 before you get started --

8 MR. SCHMIDT: That's fine.

9 PARTICIPANT: Uh-oh.

10 MEMBER BLEY: You heard some discussion
11 about appearances and the like, why aren't you guys
12 urging them, didn't you guys urge them to request an
13 exemption to some of the guidance on meeting the GDC
14 rather than an exemption to the GDC, which they say
15 they are not doing, they say they are meeting the
16 language of the GDC, your paper in the end essentially
17 says the same thing, why did you do it the way you did?

18 MR. SCHMIDT: I mean do you have a
19 specific, like what guidance you are referring to?
20 You mean like the SECY papers or -- I'm not sure what --

21 CHAIR CORRADINI: Green light again,
22 Dennis.

23 MEMBER BLEY: The GDC simply says that
24 after all those things they have to maintain, the
25 capability to cool the core is maintained. To cool

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1 the core everything about --

2 MR. SCHMIDT: Reliably controlling
3 reactivity --

4 (Simultaneous speaking)

5 MEMBER BLEY: -- being fully shut down,
6 having been fully shut down comes from guidance for
7 a so-called precedent.

8 MR. SCHMIDT: That is correct.

9 MEMBER BLEY: It doesn't come from the GDC
10 itself.

11 MR. SCHMIDT: I think if you take the GDC
12 only within itself it could, the reliably controlling
13 reactivity, and I kind of get into this in the
14 presentation, that term, the reliability controlling
15 reactivity, and I heard it here during the discussion,
16 is somewhat of a nebulous term.

17 MEMBER BLEY: What?

18 MR. SCHMIDT: Reliability controlling
19 reactivity, whether that meant, you know, does
20 reactivity such that it equals the heat removal
21 capability, that could be one interpretation, and I
22 think that's what the NuScale interpretation is. The
23 reactivity control --

24 (Simultaneous speaking)

25 MEMBER BLEY: Reliably controlling

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1 reactivity changes.

2 MR. SCHMIDT: Changes, right.

3 MEMBER BLEY: Yes.

4 MR. SCHMIDT: Right.

5 MEMBER BLEY: Go ahead though where you
6 were going.

7 MR. SCHMIDT: Well I think that's the -- So
8 those were the words that were I think closely in play
9 here.

10 MEMBER BLEY: Okay.

11 MR. SCHMIDT: So that meant shut down or
12 not shut down. So if you look at it just in terms of
13 those words I can understand where you are coming from.

14 But if you look at it relative to say other
15 guidance and precedent then reliably controlling
16 reactivity in the long term, it's interesting, you have
17 to separate out the short term and the long term here.

18 MEMBER BLEY: Yes, and how do you do that?

19 (Simultaneous speaking)

20 MEMBER BLEY: Everything I read talked
21 about that on both sides. Tell me what short term
22 means. Honest, tell me what it means.

23 MR. SCHMIDT: Yes. Short term
24 effectively means during the active, one way to say
25 it, during the active part of the transient, right.

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1 It means within say seconds of the transient, of the
2 initiation of the transient.

3 In the long term what we were trying to
4 do is say, you know, the current fleet effectively goes
5 sub-critical at some point and stays subcritical and
6 goes on their residual heat removal or shutdown cooling.

7 So as was pointed out in the discussion
8 and as was pointed out in this presentation is that
9 there has been some precedent for PWRs to go recritical
10 in the short term for like a main steam line break,
11 right, a postulated accident.

12 MEMBER BLEY: For sure.

13 MR. SCHMIDT: So this is somewhat
14 uncharted territory that it would stay potentially
15 in the critical configuration assuming conservative
16 assumptions.

17 So there is no hard-and-fast short and long
18 term. One is like during the active part of the
19 transient and one is effectively its natural
20 equilibrium condition in the long term.

21 MEMBER BLEY: Go ahead.

22 MR. SCHMIDT: Okay. Well, I almost got
23 through the purpose. The purpose is to brief the ACRS
24 on the acceptance criteria the Staff plans on using
25 to evaluate NuScale's exemptions to General Design

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1 Criteria 27, Combined Reactivity Control System
2 Capability, as described in the draft Commission paper.

3 So a little technical background. NuScale
4 covered a lot of this so I'm going to go through it
5 relatively quick. Late in the pre-app the Staff
6 learned that the NuScale --

7 MEMBER KIRCHNER: Can I stop you there?

8 MR. SCHMIDT: Sure. I guess I --

9 (Simultaneous speaking)

10 MR. SCHMIDT: Okay, all right, I'm going
11 to stop.

12 MEMBER KIRCHNER: So what do you mean by
13 late in the pre-application?

14 MR. SCHMIDT: I mean --

15 MEMBER KIRCHNER: The Staff learned that,
16 or did NuScale learn that --

17 MR. SCHMIDT: I can't speak for --

18 MEMBER KIRCHNER: -- when they did the
19 analysis that it could return to power?

20 MR. SCHMIDT: It was -- Tim, memory, months
21 before the application?

22 MR. DRZEWIECKI: Yes, it was during a
23 discussion I thought of the gap letters associated with
24 GDC 27.

25 MR. SCHMIDT: So that would be months you

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1 would say before the --

2 MR. DRZEWIECKI: Yes, months before.

3 MR. SCHMIDT: Months before the
4 application?

5 MR. DRZEWIECKI: Maybe six months.

6 MEMBER KIRCHNER: Well I'm just curious
7 when the design team at NuScale or you in reviewing
8 found out that this system would return to power, or
9 did they know that from the get-go?

10 MR. SCHMIDT: Honestly, you'd have to ask
11 them.

12 MEMBER KIRCHNER: Okay.

13 MEMBER MARCH-LEUBA: Can I ask them?

14 CHAIR CORRADINI: Yes.

15 MEMBER MARCH-LEUBA: Is anybody close to
16 a microphone?

17 MR. BERGMAN: As Allyson noted we were
18 trying to solve it through design.

19 CHAIR CORRADINI: And you are?

20 MR. BERGMAN: Oh, sorry. Tom Bergman,
21 NuScale. We were trying to solve it through design
22 for quite some time, I would say half a year to a year,
23 when we realized there was really no desirable or
24 workable design solution.

25 We decided to pursue the approach we have

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1 taken in the application and I think we informed the
2 NRC Staff maybe May of 2016, because we submitted our
3 letter I think in June of 2016 on the topic.

4 MEMBER MARCH-LEUBA: Thank you.

5 MEMBER KIRCHNER: So we're backing into
6 this so to speak?

7 MR. SCHMIDT: I guess from the Staff's
8 perspective --

9 MEMBER KIRCHNER: I'm not being
10 pejorative, but I'm just thinking, you know, I'm
11 thinking back to the SECY papers that we were provided
12 for background and such and I would be interested,
13 because you fielded a question from Dennis about
14 reliability control, how you define that.

15 Is there any technical guidance that -- Are
16 you going to share that in your presentation, maybe
17 I shouldn't be interrupting?

18 MR. SCHMIDT: No. So --

19 MEMBER KIRCHNER: What does the reliable
20 word in that GDC mean to you?

21 MR. SCHMIDT: Well that's the thing we had
22 to figure out, right.

23 MEMBER KIRCHNER: Okay.

24 MR. SCHMIDT: And what the presentation
25 goes through is kind of how we got to the position and

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1 our response, in the gap letter response, is that, you
2 know, in the long term subcriticality is reliably
3 controlling reactivity.

4 MEMBER KIRCHNER: Because I mean it was
5 implied but it's not anywhere in the GDC, for to the
6 GDCs that exist now. It's not really well spelled out
7 in any of the SECY papers.

8 There is the EPRI advanced reactor,
9 advanced LWR, what was it called, I think a utility
10 requirements document or something?

11 MR. SCHMIDT: Utility requirements
12 document.

13 MEMBER KIRCHNER: Yes.

14 MR. SCHMIDT: Right.

15 MEMBER KIRCHNER: And there they defined
16 safe shutdown as it could be hot, not necessarily cold.

17 MR. SCHMIDT: Right, not necessarily cold.

18 MEMBER KIRCHNER: Right. But it implies
19 subcritical?

20 MR. SCHMIDT: Right. And we'll cover
21 that, it's SECY-94-084. So when we were trying to
22 wrestle --

23 MEMBER KIRCHNER: I'm sorry, I just wanted
24 to establish is there some regulatory guidance, some
25 body of literature that you go to to define reliable

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1 and safe shutdown or it's --

2 MR. SCHMIDT: Nothing that we could find.

3 MEMBER KIRCHNER: Okay.

4 MR. SCHMIDT: We had to construct it.

5 MEMBER KIRCHNER: Okay. Thank you.

6 MR. SCHMIDT: So, again, from the first
7 bullet there, I think the key wording there is "under
8 Chapter 15 design basis assumptions."

9 You heard this morning from, or afternoon,
10 form NuScale kind of what the expectation is kind of
11 in a realistic mode. You know, I am a Chapter 15 person
12 so I am going to look at this more from a design basis
13 standpoint with design basis assumptions.

14 So that's a fundamental difference I think
15 between what I am going to talk about and what they
16 talked about, just to keep that straight.

17 So in my world assumptions include a stuck
18 rod, which is consistent with the GDCs, loss of AC power,
19 non-safety related CVCS system is unavailable. I don't
20 credit it to mitigate a design basis event, and then
21 sufficiently negative MTC.

22 You know, there is -- In their minds it
23 occurs maybe only in the last third of the cycle, it
24 depends on what your MTC value is, it depends what your
25 stuck rod worth is, those are all core design dependent.

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1 If you take a conservative MTC it can occur earlier.

2 So using design basis assumptions, return
3 to power following most AOOs and postulated accidents
4 that will occur for the long term.

5 MEMBER BLEY: Jeff?

6 MR. SCHMIDT: Yes?

7 MEMBER BLEY: The Staff has not -- This
8 is an assumption on my part, or I'll change it, has
9 the Staff as yet analyzed the Chapter 15 results that
10 the Applicant is quoting here? You don't have great
11 confidence in --

12 MR. SCHMIDT: We are reviewing them.

13 MEMBER BLEY: You are --

14 MR. SCHMIDT: We are in Phase 1 of the
15 review.

16 MEMBER BLEY: Okay. But you haven't been
17 through it yet so you can't confirm their answers are --

18 MR. SCHMIDT: We have not completely been
19 through it.

20 MEMBER BLEY: -- correct just yet?

21 MR. SCHMIDT: No.

22 MEMBER BLEY: Okay.

23 CHAIR CORRADINI: And you probably have
24 RAIs?

25 MR. SCHMIDT: Yes.

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1 CHAIR CORRADINI: Okay, yes.

2 MEMBER BLEY: All right, yes.

3 MR. SCHMIDT: Yes. We have issued RAIs,
4 yes.

5 MEMBER BLEY: Okay.

6 MR. SCHULTZ: Jeff, is the review going
7 to include staff calculations?

8 MR. SCHMIDT: Yes, that's the plan. I
9 think in one coming slide it talks about confirmatory
10 runs.

11 MEMBER KIRCHNER: Can I interrupt again?

12 MR. SCHMIDT: Sure.

13 MEMBER KIRCHNER: I am just looking
14 at -- There it is. Just that bullet there, "using
15 design basis assumptions," "following most AOOs and
16 postulated," they all have return to power, not just
17 this one --

18 MR. SCHMIDT: It's not a single event like
19 say at a normal PWR main steam line break. It's when
20 they go on the decay heat removal system, depending
21 on your assumptions, they can go recritical until the
22 ECCS batteries wear out or if you assume no power at
23 time zero when the pass of blocks initiate ECCS.

24 MEMBER KIRCHNER: Okay.

25 MEMBER BLEY: Now from the Staff's point

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1 of view the AOOs don't need to meet the design basis
2 assumptions, right?

3 MR. SCHMIDT: No, they do.

4 MEMBER BLEY: They do?

5 MR. SCHMIDT: AOOs use design basis
6 assumptions. AOOs and postulated accidents are design
7 basis events and use the same conservative assumptions.

8 MEMBER BLEY: Okay. AOOs, too, okay.

9 MR. SCHMIDT: Yes. Maximum return to
10 power is roughly around 9 percent and peak pin power
11 due to the fact that we have this stuck rod is greater
12 than 50 percent, so you have a highly localized power
13 distribution.

14 Design remains subcritical if all control
15 rods insert. Again, we have not verified that, that's
16 just a statement and you heard it this morning from
17 NuScale. Go ahead, next slide.

18 CHAIR CORRADINI: So since you have done
19 this from the world of Chapter 15 --

20 MR. SCHMIDT: Yes?

21 CHAIR CORRADINI: -- there is a time of
22 "X," "X" could be an hour, minutes, I don't even know
23 what it is, where I am on a cool down curve and I haven't
24 gotten there yet and then I come back to a return to
25 power.

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1 MR. SCHMIDT: Right. That's what will
2 happen. I think you'll go down, you'll basically cool
3 down, and when you get enough positive reactivity from
4 the cool down you will return to power and return to
5 a new equilibrium state with fission power.

6 CHAIR CORRADINI: Okay.

7 MEMBER BLEY: Jeff, I am going to ask you
8 something, and you can tell me to wait on this, because
9 in the paper we read, you have a phrase that said, and
10 this is okay, you've given something, "and provided
11 the DBE sequence of events is not actually expected
12 to occur during the lifetime of the module."

13 Now AOOs are expected to occur once in 100
14 years.

15 MR. SCHMIDT: Right, sure, right.

16 MEMBER BLEY: But design basis events are
17 not.

18 MR. SCHMIDT: Well postulated accidents
19 are not.

20 MEMBER BLEY: Postulated accidents are
21 not?

22 MR. SCHMIDT: Right.

23 MEMBER BLEY: But we're having the same
24 situation for both AOOs and design basis events.

25 MR. SCHMIDT: Well we're trying to get

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1 there. I am not sure exactly -- Are you reading from
2 my slides or --

3 MEMBER BLEY: No, I'm not. I am reading
4 from the draft --

5 MR. SCHMIDT: Oh, the draft SECY paper?

6 MEMBER BLEY: SECY, yes.

7 MR. SCHMIDT: So I think -- I'm not sure
8 exactly what you reading but I am going to try --

9 MEMBER BLEY: I can read it to you if you
10 would prefer it.

11 MR. SCHMIDT: The basic is if you look at
12 it from say a probability event it's not expected to
13 happen in the lifetime of the plant, right, and those
14 PRA numbers have to be re-reviewed and agreed upon,
15 right.

16 That's really what we are saying there is
17 that that is part, it's not part of the Chapter 15
18 evaluation --

19 MEMBER BLEY: Yes.

20 MR. SCHMIDT: -- we assume that the
21 probability of occurrence is one from Chapter 15.

22 MEMBER BLEY: Right, from Chapter 15.

23 MR. SCHMIDT: From the exemption
24 standpoint we are going to look at the consequences
25 and the probability of occurrence.

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1 MEMBER BLEY: Okay. So that would then
2 mean the AOOs with a stuck rod really aren't AOOs
3 anymore, they're rare events, is what you are going
4 to require?

5 MR. SCHMIDT: Yes. Well --

6 MEMBER BLEY: And that's a reasonable
7 thing it seems to me.

8 MR. SCHMIDT: You got to separate out
9 Chapter 15 from the exemption.

10 MEMBER BLEY: Yes.

11 MR. SCHMIDT: So a stuck rod is always
12 taken in a design basis event and it will be taken in
13 Chapter 15. The exemption, which includes other
14 considerations, would effectively move the probability
15 outside of an AOO to something like a postulated
16 accident.

17 MEMBER BLEY: Normal definition, yes,
18 exactly.

19 MR. SCHMIDT: Yes.

20 MEMBER BLEY: That's what I was getting
21 at. Thank you.

22 MR. SCHMIDT: Yes. But, you know, keep
23 in mind, again, from Chapter 15 the rules of the road
24 are take a stuck rod and it does occur.

25 MEMBER BLEY: Yes. I understand that

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1 area.

2 MR. SCHMIDT: Okay. So as -- Do I need
3 to read GDC 27 or can we move --

4 CHAIR CORRADINI: Yes, let's stipulate
5 you've read it.

6 (Laughter.)

7 MR. SCHMIDT: Okay, all right. All right,
8 stipulated. Thank you.

9 PARTICIPANT: And we can, too.

10 MR. SCHMIDT: All right. But I mean we
11 have talked about it. It's reliably controlling
12 reactivity changes and the capability to cool the core,
13 those are the words in play on GDC 27, and the Staff
14 struggled with reliably controlling reactivity
15 changes.

16 So we looked for other guidance. So we
17 looked at SECY-94-084 and basically one of the criteria
18 there is as long as the reactor is subcritical, so that
19 provided us some information.

20 Go ahead, next slide. And then the
21 definition of a safety-related SCC says ability to
22 shutdown and maintain in a safe shutdown condition.
23 So, again, it didn't say a safety-related component,
24 it says, you know, provide enough such that your
25 adequate cooling is provided, it said shut down.

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1 So taking those two things and in context
2 of what our current licensed fleet looks like that's
3 how we kind of came to the reliably controlling
4 reactivity and the long-term means shutdown.

5 The NRC has license designs with return
6 to power in the short term during postulated accidents,
7 we have talked about that. NRC has not licensed a
8 reactor that does not achieve subcriticality in the
9 long term using only safety-related systems, and that
10 is important.

11 Staff's response to NuScale, as we know,
12 is that an exemption to GDC 27 would be required and
13 would warrant Commission consideration and direction.

14 And that is our gap letter response there, the ML1.

15 PDC 27, I think NuScale has already covered
16 this. It is basically saying, you know, we have
17 reliably controlled reactivity sufficiently that we
18 have that matches our cooling capability and, hence,
19 we are going to meet our fuel design limits, our SAFDLs.

20 Go ahead.

21 CHAIR CORRADINI: Can you just go back to
22 that, please. I'm sorry.

23 MR. SCHULTZ: But then they have added the
24 second portion of it to cover their circumstance.

25 MR. SCHMIDT: The second portion being?

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1 MR. SCHULTZ: The second paragraph. The
2 first paragraph is stating what is already written in
3 the GDC 27.

4 MR. SCHMIDT: Right.

5 MR. SCHULTZ: And then the second part
6 allows them to make the case that all is going to be
7 accomplished appropriately without the, with all of
8 the safety-related equipment, the control rod.

9 MR. SCHMIDT: Well I think there is two
10 aspects. One is all rods in and it's shut down, and
11 then two is if you have a stuck rod that you have adequate
12 cooling capability such that the SAFDLs are not met,
13 so the specified fuel design limits are not met, or
14 are met and that you haven't violated the minimum
15 critical heat flux. So I think it's two components.

16 And that last part is saying that, you know,
17 without margin for stuck rods they are not going to
18 return to power.

19 MR. SCHULTZ: Correct.

20 MR. SCHMIDT: So it is two components.

21 MR. SCHULTZ: Right.

22 CHAIR CORRADINI: Yes, and that's --

23 MR. SCHMIDT: Yes, it's both components.

24 MEMBER MARCH-LEUBA: Is now the time to
25 start throwing rocks at this? I don't see that second

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1 part of having anything to the general design criteria.

2 CHAIR CORRADINI: But that's their design
3 criteria.

4 MEMBER KIRCHNER: Yes, that's their
5 principle design criteria.

6 CHAIR CORRADINI: This is their PDC, not
7 the GDC.

8 PARTICIPANT: This is not the GDC.

9 MR. SCHMIDT: Yes, yes.

10 MEMBER KIRCHNER: That's the new one from,
11 the NuScale is part of the --

12 (Simultaneous speaking)

13 MEMBER MARCH-LEUBA: This is the one that
14 you proposed?

15 MR. SCHMIDT: Yes, this is the one I
16 proposed, that's correct.

17 MEMBER MARCH-LEUBA: I used GDC instead
18 of PDC, but --

19 CHAIR CORRADINI: Right, right.

20 MEMBER MARCH-LEUBA: Okay. So I don't see
21 that second part of having anything to do with PDC.
22 It only explains what maintaining the core cool means.

23 PARTICIPANT: Yes, and exactly right.

24 MEMBER MARCH-LEUBA: And that typically
25 is then is that in a regulatory guide, or an SRP, and

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1 general design criteria or "P" design criteria are just
2 like the Constitution, you don't mess with them.

3 And I am certain the people writing the
4 Constitution in the convention, same as the GDC, thought
5 that we are making sausage, but after you then they're
6 really good and I just don't see why -- I mean it doesn't
7 add anything.

8 MR. SCHMIDT: It does, so --

9 MEMBER BLEY: It would solve this fight.

10 (Laughter)

11 MEMBER MARCH-LEUBA: Well, no, because
12 it's a big stick to change the Constitution.

13 MEMBER BLEY: What is it, what are you
14 saying?

15 MEMBER MARCH-LEUBA: So I achieve the same
16 thing with a design rule or an SRP, I will make them
17 pay not a pound of blood, a ton of blood. The SRP should
18 specify every analysis they can possibly considerably
19 do to make sure that the core is cool and it's going
20 to keep them busy for the next two years but I will
21 not change the GDC.

22 I would make the second part of a good
23 document, like an SRP, because it doesn't say anything.

24 MR. SCHMIDT: Well it does say that at
25 least they have all rods in and they are subcritical.

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1 MEMBER MARCH-LEUBA: If they have all rods
2 in then this is identified in the first paragraph 2,
3 and that's what every other reactor does. Now we have
4 to deal with the fact that not all rods came in.

5 PARTICIPANT: And that statement --

6 MEMBER MARCH-LEUBA: And you satisfy that
7 one by maintaining the core cool.

8 MR. DRZEWIECKI: This is Tim. I think
9 what that second paragraph also does is it shows that
10 you have a safety-related system that can hold you in
11 a cold shutdown.

12 So that would be the only statement that
13 they would have in a licensing document.

14 MEMBER MARCH-LEUBA: But they don't
15 satisfy.

16 PARTICIPANT: Are you talking about this?

17 MR. SCHMIDT: All rods in they do.

18 PARTICIPANT: Yes.

19 MR. SCHMIDT: All rods in they do.

20 MEMBER MARCH-LEUBA: That would satisfy
21 the first part of two and that should -- I don't see
22 the part of having anything other than complication.

23 MR. SCHMIDT: Okay. Okay, all right.

24 MEMBER BROWN: This is their DCD.

25 MR. SCHMIDT: Yes, this is what's in their

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1 DCD.

2 MEMBER BROWN: Okay. And I guess I would
3 phrase Jose's comment a little bit differently. They
4 are fundamentally not needing the GDC 27 based on our
5 past performance.

6 They are saying we interpret it differently
7 and, therefore, we want to rewrite it in this form.
8 That's kind of like the Constitution change.

9 MR. SCHMIDT: I don't think that --

10 MEMBER BROWN: Let me finish. And they
11 can do that, all you have to do is accept it.

12 MR. SCHMIDT: Yes.

13 MEMBER BROWN: That's all you have to do
14 when you approve the DCD. You don't have to try to
15 change the wording and call it PDC 27, it's just what
16 they are going to do to meet, what they feel and they
17 need you to agree to this alternate approach.

18 That's all it is, it's an alternate
19 approach.

20 MR. SCHMIDT: It's an alternate approach.

21 MEMBER BROWN: But don't try to recast the
22 general design criteria into some other health lot of
23 work, that's all. And they can use similar words, just
24 don't call it, you'd just say we're asking for an
25 interpretative alternative to what is stated and this

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1 is what we, this the way we are designing, that's our
2 design principle.

3 And if you agree to that you have agreed
4 to it. If you didn't have exceptions you wouldn't need
5 rules. You can approve an exception.

6 MR. SCHMIDT: And I think that is what this
7 is trying to accomplish.

8 MEMBER BROWN: Yes, unfortunately it makes
9 it sound like you are changing the GDCs.

10 CHAIR CORRADINI: But maybe this is
11 a -- We're getting to a --

12 MEMBER BROWN: I'm done.

13 CHAIR CORRADINI: I don't think this
14 is -- Well, in my mind this is not technical. This
15 is what they own, this isn't what the NRC owns. This
16 is what they are writing down within their DCD that
17 explains how they meet --

18 (Simultaneous speaking)

19 MEMBER BROWN: The NRC is going to accept
20 this or not.

21 MR. SCHMIDT: Yes, the NRC probably will
22 approve this is in some fashion, maybe with
23 modifications, but in the end potentially it will be
24 approving this as part of the DCD.

25 MEMBER BROWN: I would phrase this as an

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1 alternative approach to needing GDC 27, that's all it's
2 supposed to, casting it into a form of a proposed design
3 criteria.

4 MEMBER BLEY: If I may I'll remind
5 everybody that in a month or two we're going to see
6 the advanced reactor design criteria.

7 MR. SCHMIDT: Yes.

8 PARTICIPANT: But I think this is --

9 MR. SCHMIDT: I was just about to print
10 that up is that, you know, we're going to be seeing
11 a lot of this as alternatives are going to show up in
12 PDCs, right, that's the whole ARDC construct, right.

13 PARTICIPANT: Yes.

14 MR. SCHMIDT: So this is a precursor to
15 hopefully future events.

16 MEMBER KIRCHNER: You think you saw it once
17 you're going to see it again?

18 MEMBER MARCH-LEUBA: For the record I
19 don't like it there either.

20 (Laughter)

21 (Simultaneous speaking)

22 MEMBER KIRCHNER: Yes, because it goes
23 back to reliability. I believe, and now this is
24 probably not in line with our meeting today, but if
25 I read the advanced reactor design criteria they want

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1 to strike the word "reliably controlling reactivity."

2 MEMBER MARCH-LEUBA: Well let's not talk
3 about all that.

4 MEMBER KIRCHNER: Yes, I'm not -- So I
5 wouldn't go there because that is a significant change
6 from the GDCs that they are using to look for an
7 extension.

8 MEMBER MARCH-LEUBA: The way I see it all
9 the other reactor operators, including myself, have
10 decided to go the cheap way to modify, to approve GDC
11 27, which is we go through critical, the core is cool.

12 That's a surrogate for reliably
13 controlling reactivity so the core remains cool which
14 is what they do with the stuck rod. They still control
15 their activity, they put it down and whenever they have
16 more time they will put more water.

17 And they have to demonstrate that the core
18 remains cool. It is going to cost them a lot of effort.

19 I mean I want to make sure they pay for not going the
20 cheap way, but it doesn't preclude it.

21 MR. SCHMIDT: I want to try to summarize
22 what you are saying is that if -- So subcritical is
23 the easy path in your mind?

24 MEMBER MARCH-LEUBA: Yes.

25 MR. SCHMIDT: I'm not going to argue that.

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1 If you are going to say power versus cooling capability
2 that's more complex. I agree with that, too.

3 MEMBER MARCH-LEUBA: And it's the same
4 criteria. Now we can write an SRP that makes their
5 life miserable or now going the cheap way, but I don't
6 think -- In my opinion changing the Constitution is
7 a, it's in the news now, it's nuclear option.

8 MR. SCHMIDT: So I think to be fair the
9 issue is is the Constitution is poorly worded in this
10 case or confusing or can be read multiple ways.

11 (Simultaneous speaking)

12 PARTICIPANT: Purposely so.

13 MEMBER MARCH-LEUBA: -- three pages on the
14 SRPs using new handbook, right?

15 PARTICIPANT: Right.

16 MR. MONNINGER: So, Jeff, this is John,
17 John Monninger from the Staff. So with regards to the
18 GDC it's interesting where you look at the applicability
19 of them to comparable light-water reactors versus
20 non-light-water reactors.

21 I'm 99 percent sure within the requirements
22 for NuScale they have to address the applicable of the
23 GDC because they are a light-water reactor and they
24 are then viewed as generally applicable.

25 There is some language in there in that

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1 regards and they are allowed to take alternatives to
2 it and they would come forth with the PDC. You know,
3 even though it is potentially the Constitution, the
4 broader Constitution of the Atomic Energy Act and all
5 the regs allow them to take departures, which they would
6 potentially be doing.

7 Now if you were to look at non-light-water
8 reactors or advanced reactors, which we have engaged
9 with ACRS, it's a different approach, there is the Reg
10 Guide out there.

11 And they would not need an exemption to
12 follow the ARDC and Reg Guide because the requirements
13 within Part 50 don't explicitly say that the GDC would
14 apply to those types of designs.

15 So, therefore, you could use the different
16 Constitution, the Reg Guide, the ARDC, and not need
17 an exemption for non-light-water reactors. Here you
18 do because of the terminology within Part 50. So I'm
19 not sure if that helps or not.

20 MEMBER MARCH-LEUBA: I would have to read
21 the Part 50, but my claim is that the design they showed
22 me a moment ago is likely to satisfy GDC 27 as written.
23 That's what I'm coming up.

24 PARTICIPANT: Yes.

25 MEMBER MARCH-LEUBA: And, therefore, my

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1 opinion is making demonstrative on making their live
2 miserable, demonstrating it, make sure we are sure that
3 it does, but if it does -- That second paragraph doesn't
4 tell me anything.

5 MR. SCHMIDT: Okay.

6 MR. SCHULTZ: Jeff, the reason I brought
7 up the second paragraph originally was that when I read
8 it it sounds like the statement that satisfies GDC 26
9 and the first paragraph, with only one phrase missing,
10 which isn't applicable to NuScale, satisfies GDC 27
11 as written.

12 MR. SCHMIDT: Right.

13 MR. SCHULTZ: So I am trying to understand
14 the element that says this is the exemption request.

15 MR. SCHMIDT: Again, the exemption request
16 is basically subcriticality in the long term, that's
17 the exemption request, right.

18 MR. SCHULTZ: And I read the second part,
19 it says, the last sentence of GDC 26 says, which is
20 without the stuck rod I am good. Does it not? Am I
21 misreading it?

22 MR. SCHMIDT: Um --

23 MR. SCHULTZ: I've got margin for stuck
24 rods, so they are capable of holding it's rods
25 subcritical without margin for stuck rods. That's the

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1 same as this last sentence in GDC 26, which NuScale
2 has said from the beginning that they meet.

3 MR. SCHMIDT: The last sentence in GDC 26
4 is to --

5 MR. DRZEWIECKI: "One of the systems shall
6 be --

7 MR. SCHMIDT: Is "shall be capable of going
8 to cold shutdown."

9 MR. SCHULTZ: Yes.

10 MR. SCHMIDT: And their CDCS system is --

11 MR. SCHULTZ: Subcritical into cold
12 condition.

13 MR. SCHMIDT: -- capable of doing that.

14 MEMBER SUNSERI: I think these words are
15 going to become relevant when you get to your three
16 criteria that you are going to specify for what is an
17 exceptional exemption on this topic.

18 PARTICIPANT: Yes.

19 MEMBER SUNSERI: Because I am reading
20 ahead, on Slide 9 you are actually, we'll actually get
21 to see the three criteria that you want to see met for
22 the exemption, right?

23 MR. SCHMIDT: Yes, right. And some of the
24 wording -- So that is correct. And some of the wording
25 in the PDC may change. I am just showing what is

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1 currently proposed in the PDC.

2 So I think this is all very valuable
3 feedback, but I think the basic idea is that, and NuScale
4 could speak if I don't capture it correctly, is that,
5 you know, you are matching the power to the heat removal
6 capability, right, and you are showing that your SAFDLs
7 are met.

8 CHAIR CORRADINI: But I guess I am
9 not -- You guys, I view what you are talking about is
10 a bit more legal. I see the first paragraph saying
11 that I am matching power to cooling and the second
12 paragraph saying that even so I still got to show I
13 don't exceed critical heat flux locally.

14 That's all it says. That's the technical
15 measure that even though power to flow matches, or power
16 to, heat production equals heat rejections, I still
17 might be in trouble if I exceed critical heat flux.

18 MR. SCHMIDT: Well critical heat flux is
19 necessary to be met in the N minus 1 configuration or
20 the stuck rod.

21 MR. SCHMIDT: Right.

22 PARTICIPANT: Right.

23 CHAIR CORRADINI: Then maybe I am like
24 Steve I am misreading that second paragraph though.
25 No?

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1 MR. SCHMIDT: Let's just say right now
2 that's what they are proposing --

3 CHAIR CORRADINI: Okay, fine.

4 MR. SCHMIDT: -- and we might have to work
5 on that.

6 CHAIR CORRADINI: But I do think that Matt
7 said it best is this is a setup for the three things
8 you are going to look at very specifically to see if
9 they meet from a criteria standpoint as a go/no-go.

10 MR. SCHMIDT: Right, that's correct.

11 CHAIR CORRADINI: Okay.

12 MR. SCHMIDT: Yes, I think, I hope my slide
13 will be clear.

14 CHAIR CORRADINI: Okay.

15 MR. SCHMIDT: Go ahead, next. Again, this
16 is from NuScale. This exemption will not impact the
17 consequence of any design basis event, will not create
18 any new accident precursors.

19 The NuScale plant incorporates reactivity
20 control provisions to assure the capability to cool
21 the core is maintained under postulated accident
22 conditions and to reliably and safely shutdown the
23 reactor.

24 Therefore, an exemption will not present
25 and undue risk to the public health and safety. That

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1 is kind of what they presented this morning.

2 So this is the Staff's review approach.
3 The Staff applied the Enhanced Safety Focused Review
4 Approach, or ESFRA, at the beginning of the review and
5 they did identify this issue as requiring more emphasis
6 in terms of review and scope compared to a traditional
7 review using the ESFRA tool.

8 So it was kind of like what Jose was saying,
9 it was like, you know, if you're subcritical it's kind
10 of easy, if you are not it gets more complicated, and
11 that's where we are, and using this tool identified
12 that issue early on as soon as we became aware of it.

13 Staff is early in the review of the
14 analysis, which is the Phase 1 review, and continues
15 to apply the ESFRA in its review.

16 Technical audits of NuScale analyses is
17 ongoing, and as well as the confirmatory analyses.
18 So we do plan on performing confirmatory analyses for
19 this event.

20 Here is the Staff's review and acceptance
21 criteria. Chapter 15, again, we talked about it
22 already, conservative analysis assumptions, worst
23 stuck rod, and using the minimum critical heat flux
24 ratio as the acceptance criteria to demonstrate
25 adequate cooling and to maintain the fission product

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1 barrier, being the clad.

2 This is consistent with methodology
3 typically used to analyze PWR main steam line break,
4 the short-term return to power. It does not consider
5 the probability of occurrence so the probability is
6 one.

7 The exemption will consider the Chapter
8 15 criteria I just discussed above, shutdown is
9 maintained assuming all rods are in, because that would
10 seem to be necessary, the probability of occurrence
11 is low, not within the lifetime of the module, and
12 NuScale presented some values for probabilities this
13 morning.

14 MEMBER STETKAR: Jeff?

15 MR. SCHMIDT: Yes.

16 MEMBER STETKAR: When I read through this,
17 convince me where you're going to address stable
18 long-term core heat removal given some equilibrium core
19 power, which might be anywhere from zero to non-zero.
20 Because I don't see you addressing that here.

21 So, supposed on that, pick some number.
22 You know, 2.73 megawatts or .16 megawatts positive core
23 power. And I'm sitting there, and as we said earlier,
24 and I'm sitting there and I'm cooking.

25 Where do your criteria for the exemption

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1 address the fact that I need to be able to sit there
2 without running out of water and without running out
3 of heat removal. Not short-term SAFDLs and not --

4 MR. SCHMIDT: Yes. Well, we're applying
5 the SAFDLs in the long-term. Yes. So there is really
6 two basic scenarios.

7 MEMBER STETKAR: Okay. If that's --

8 MR. SCHMIDT: Yes.

9 MEMBER STETKAR: Okay.

10 MR. SCHMIDT: Yes, so there's two basic
11 scenarios, at least the way I think of it is, one, is
12 you have the decay heat removal system. That's driving
13 your cool down. It's kind of aux feed and --

14 MEMBER STETKAR: Take that to 67 hours.

15 MR. SCHMIDT: Right. So --

16 MEMBER STETKAR: -- decay heat.

17 MR. SCHMIDT: Well, at some point the
18 batteries would support those systems --

19 MEMBER STETKAR: I'm at 67 hours and I'm
20 cooking at some non-zero core power level.

21 MR. SCHMIDT: Okay. But at 67 hours you
22 have effectively depleted your batteries and gone on
23 ECCS, and then you evaluate the SAFDLs under the ECCS
24 scenario.

25 MEMBER STETKAR: As long as what you said

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1 initially, that the SAFDLs need to be maintained ad
2 infinitum --

3 MR. SCHMIDT: Right.

4 MEMBER STETKAR: -- them I'm okay.
5 Because that should --

6 MR. SCHMIDT: Well, ad infinitum is a long
7 time but, it's in the long-term. Yes.

8 MEMBER STETKAR: Until --

9 MR. SCHMIDT: So it's under both modes.

10 MEMBER STETKAR: Okay. As long as that's
11 the interpretation because I didn't read that, I read
12 it as --

13 MR. SCHMIDT: It's intended to be in both
14 modes.

15 MEMBER STETKAR: Okay.

16 MR. SCHMIDT: Both on the decay heat
17 removal system and on the ECCS system.

18 MEMBER STETKAR: Okay. Okay, thank you.

19 MEMBER MARCH-LEUBA: I guess in the
20 long-term, what we're going to, is that we have some
21 kind of requirement on availability of passive cooling
22 water in the pool, which we know is humongous, but at
23 least there has to be an evaluation.

24 MEMBER STETKAR: That will get to FLEX
25 though.

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1 MR. SCHMIDT: Yes that's actually, I'm
2 looking at it in terms of a module and a module to drive
3 that pool dry --

4 MEMBER MARCH-LEUBA: If you lost AC power
5 you're likely to have lost power for all of it.

6 MEMBER STETKAR: I think 12 modules.

7 MR. SCHMIDT: But, you could.

8 MEMBER STETKAR: But 12 times --

9 MR. SCHMIDT: But even that --

10 MEMBER MARCH-LEUBA: You have to survive
11 12 --

12 MR. SCHMIDT: Okay, so that's, again, if
13 you have --

14 MEMBER MARCH-LEUBA: One and a half
15 megawatts.

16 MR. SCHMIDT: If you, yes right, if you
17 believe what NuScale is telling us, that's 30 days out.

18 I think you can restore power within 30 days or that's
19 the case they have to make I guess. But --

20 MEMBER STETKAR: As long as you're going
21 to ask them to make that case. That's what I was hanging
22 up on.

23 MR. SCHMIDT: Okay.

24 MEMBER STETKAR: Because, again, this
25 meeting, as Mike keeps reminding us, was to examine

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1 whether your criteria were adequate. And that's the
2 only thing that I could stumble over in the criteria
3 that I was kind of hanging up on. Because to me they
4 sounded --

5 CHAIR CORRADINI: Short-term.

6 MEMBER STETKAR: Short-term.

7 MR. SCHMIDT: Yes, go ahead, Tim.

8 MR. DRZEWIECKI: No --

9 MR. SCHMIDT: Yes, it wasn't meant to be
10 the short-term like you think of a Chapter 15 accident
11 analysis, it was a long-term cooling analysis. But
12 I'm not --

13 (Laughter)

14 MR. SCHMIDT: Yes. Well there actually
15 are, there are parts of the long-term cooling analysis
16 that reference back to Chapter 15.

17 But I think that's a fair comment within
18 the scope of the 30 days. So, I think that's something
19 we have to think about.

20 MEMBER STETKAR: Again, from my
21 perspective, as long as the Staff and the Applicant
22 are on the same page --

23 MR. SCHMIDT: Right.

24 MEMBER STETKAR: -- demonstrating this out
25 past whatever short-term versus long-term means --

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1 MR. SCHMIDT: You know, in most of the
2 scenarios there is, you know, saying you stay on decay,
3 the decay heat removal system, you're going to reach
4 some equilibrium power and you can sit there and you
5 can evaluate the SAFDLs for a long period of time.

6 If you assume, you go on ECCS and you've
7 lost your batteries, you can evaluate the SAFDLs there
8 too. The only thing is, you would run into problems
9 if you did drain the --

10 MEMBER STETKAR: If you ran out of water.

11 MR. SCHMIDT: -- in the pool.

12 MEMBER STETKAR: -- don't drain, boil the
13 water.

14 MR. SCHMIDT: Right. If the above are
15 met, the Staff anticipates recommending or granting
16 GDC exemption and the approval of the final version.

17 And that's why we put in the final version of PDC 27.

18 MEMBER POWERS: When you look at these
19 long-term, where you have defined long-term is like
20 30 days, do you know the materials behavior?

21 MR. SCHMIDT: Yes. I mean that's, so one
22 of the things we've discussed is, let's say you are
23 sitting at some fission power for a longer period of
24 time, are there any other fuel failure mechanisms that
25 would be not traditionally considered as a SAFDL?

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1 MEMBER POWERS: I'm reminded that you
2 accrue oxygen or hydrogen in the cladding, it losses
3 ductility.

4 MR. SCHMIDT: Right.

5 MEMBER POWERS: And here sometimes you're
6 operating at a low power, say a few percent, things
7 are cool so the ductility you gain at normal operating
8 temperature is no longer there.

9 MR. SCHMIDT: Right. Right.

10 MEMBER POWERS: And so any kind of event
11 that's strains the clad some more can lead to fracture.

12 MR. SCHMIDT: Right.

13 MEMBER POWERS: And I just wondered if you
14 considered that?

15 MR. SCHMIDT: We are considering
16 different, so, you just described to me a failure mode
17 of the cladding that may be occurring at low power over
18 a long period of time, right?

19 MEMBER POWERS: Right.

20 MR. SCHMIDT: So we are considering, are
21 there different failure modes. NuScale's current clad
22 is M5, which has low hydrogen absorption. And so, it
23 benefits them from say any loss of ductility due to
24 a hydrogen pick-up.

25 But we are considering those --

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1 MEMBER POWERS: That does not exempt them
2 from that.

3 MR. SCHMIDT: I'm sorry?

4 MEMBER POWERS: It does not exempt them
5 from that, it is a lower hydrogen pick-up.

6 CHAIR CORRADINI: He's saying they're not
7 immune to it, it's just less.

8 MR. SCHMIDT: Yes, right. And I'm not
9 saying it's not immune to it either I'm just saying
10 it has some beneficial properties.

11 MEMBER BALLINGER: Let me make this a
12 little more complicated.

13 MR. SCHMIDT: Okay.

14 MEMBER BALLINGER: If it's a local power
15 area --

16 MR. SCHMIDT: Yes, it is a local power.

17 MEMBER BALLINGER: -- hydrogen has a
18 tendency to migrate down the temperature grade.

19 MR. SCHMIDT: Okay.

20 MEMBER BALLINGER: So, you're sitting
21 there with your core in a configuration where you've
22 got the normal power distribution and the hydrogen is
23 wherever it goes --

24 MR. SCHMIDT: Right.

25 MEMBER BALLINGER: -- but now all of a

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1 sudden, you're in a situation where, yes, it's M5,
2 there's not a whole lot of hydrogen in there compared
3 to Zirc-4, but now you have a different thermal
4 distribution along one of these rods and now you can
5 get the hydrogen migrating down the temperature
6 gradient. So now you can get hydrogen concentrations
7 that may be a lot higher, locally in a spot, where it
8 wouldn't have been that way before.

9 MR. SCHMIDT: Right. But that's true of
10 any stuck rod configuration, the only difference here
11 is the time.

12 MEMBER BALLINGER: But we're not talking,
13 a stuck rod is for a couple hours or a couple of days
14 or something, we're talking about very long-term.

15 MR. SCHMIDT: Right.

16 MEMBER BALLINGER: So there's another, I
17 mean, I'm trying to --

18 MR. SCHMIDT: Right.

19 MEMBER BALLINGER: -- come up with some
20 kind of weird scenario that's not so weird.

21 MR. SCHMIDT: Right. Right.

22 MR. SCHULTZ: Jeff, with regard to the
23 considerations, going back to what Dennis asked before,
24 the probability of occurrence, what do you mean by that?

25 What will be the probability of occurrence,

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1 the occurrence of a stuck rod?

2 MR. SCHMIDT: No, a return to power. So
3 it includes all the considerations that might lead to
4 a return to power. So stuck rod --

5 MR. SCHULTZ: Okay.

6 MR. SCHMIDT: -- MTC, loss of AC power.
7 It's multiple events that lead to the return of power.

8 MEMBER STETKAR: So as long as, if the
9 lifetime of a module is, pick a number, 100 years, as
10 long as it's nine times ten to the minus three it's
11 okay?

12 MR. SCHMIDT: That's what we're thinking,
13 yes. I mean, we are wrestling with, not within the
14 lifetime of the module, it's hard to specify an
15 acceptable number. The clearest one was just to say,
16 never to occur and expect the lifetime of the module.

17 MEMBER MARCH-LEUBA: Changing the topic
18 back to your acceptance criteria. This is not an event
19 that happens after a double guillotine break or an AOO,
20 normal shutdown, because I want to go into maintenance
21 because I need to replace something, well get you into
22 this event?

23 MR. SCHMIDT: I think NuScale, I'm going
24 to actually turn it over to NuScale because I'm not
25 sure that that's true.

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1 MEMBER MARCH-LEUBA: You tried to shutdown
2 and one rod got stuck?

3 (Off microphone comment)

4 MR. SCHMIDT: Well, you have to lose your
5 normal condenser and feed water and --

6 MEMBER MARCH-LEUBA: Or you lost AC power
7 and you have a scram, okay.

8 MR. SCHMIDT: Okay. Then you're in AOO.

9 MEMBER MARCH-LEUBA: Then you want --

10 MR. SCHMIDT: Yes, then you're right.

11 MEMBER MARCH-LEUBA: But, data retrieved
12 there for at least 30 days, maybe six months, are we
13 going to have analysis of additional failures?

14 When we reach up to 15 we have positive
15 activity events.

16 MR. SCHMIDT: Oh.

17 MEMBER MARCH-LEUBA: Like the operator
18 tries to take control of the reactor, starts putting
19 really, really cold water in there.

20 MR. SCHMIDT: Right.

21 MEMBER MARCH-LEUBA: And now that you have
22 a month or two or three for the operator to mess up --

23 (Laughter)

24 MEMBER MARCH-LEUBA: -- can happen.

25 MR. SCHMIDT: We'll have to consider that.

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1 MEMBER MARCH-LEUBA: It has to be
2 considered because once you're in criticality, any
3 possible reactivity --

4 MR. SCHMIDT: Sure.

5 MEMBER MARCH-LEUBA: -- then that's bad.

6 MEMBER POWERS: Because the operators will
7 do something.

8 MR. SCHMIDT: I will say this --

9 MEMBER MARCH-LEUBA: And putting cold
10 water into the core is something one wants to do.

11 CHAIR CORRADINI: So, can I ask a question
12 so you clearly have gone off the criteria. Do you want
13 to get to this before we go off --

14 MR. SCHMIDT: I think I'm at the end. Yes,
15 I'm at the end. So let me address your question, is
16 that in most scenarios here that I can at least conceive
17 of, is that you would have adequate decay heat such
18 that you would void the core and be subcritical.

19 MEMBER MARCH-LEUBA: I agree a hundred
20 percent. But on the ones where you don't, they're all
21 going to be stuck. So that's why I was trying to make
22 the point that we don't really need to have, to waste
23 the afternoon on this exercise. We don't need an
24 exception.

25 (Laughter)

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1 CHAIR CORRADINI: Since we brought that
2 up, my impression is, in just talking with staff ahead
3 of time, my sense of it is, asking for the exemption
4 is partly to get the attention of the Commission such
5 that they're not surprised that they're a technical
6 design that's not your typical light water technical
7 design, it's just miniaturized.

8 MEMBER MARCH-LEUBA: If I was invested in
9 their company, which I'm not for the record, I will
10 want them to do that. Because I don't want to have
11 the licensee uncertainty three years from now.

12 CHAIR CORRADINI: Right.

13 MEMBER MARCH-LEUBA: You want to address
14 it now.

15 CHAIR CORRADINI: Absolutely. Did you
16 have more to say?

17 MR. SCHMIDT: I did not.

18 CHAIR CORRADINI: So, let me ask you a
19 couple of off-beat questions. If NuScale gets its DCD,
20 it must satisfy the MBDBE Rule, yes?

21 MR. SCHMIDT: The what rule?

22 CHAIR CORRADINI: The FLEX.

23 MR. SCHMIDT: I'm not reviewing that
24 section so I don't know.

25 CHAIR CORRADINI: Assuming, I sense of it

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1 is yes.

2 MR. SCHMIDT: Okay.

3 CHAIR CORRADINI: That would mean I,
4 within 24 to 36 hours, potentially have the ability
5 to bring additional power coupling the water, all that
6 supposedly good stuff on and inject through normal
7 systems.

8 MEMBER STETKAR: Be careful because you
9 said, for the record, 24 to 36 hours.

10 CHAIR CORRADINI: I can't remember what
11 the number was.

12 MEMBER STETKAR: No, some plants have
13 evoked 24, some plants have evoked 72, some plants have
14 evoked seven days I believe.

15 CHAIR CORRADINI: A few days.

16 MEMBER STETKAR: I think the max is seven
17 days.

18 CHAIR CORRADINI: I knew Stetkar would get
19 that. A few days. My only point is, I think leaving
20 it on the record that it's 30 days untouched is not
21 the right way to think of this.

22 My way of thinking about it is to the extent
23 this is a light water reactor, to the extent that the
24 FLEX rule, which I think is mitigation for whatever,
25 all the various consonance together, is that you would

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1 essentially, in a few days, bring things onsite and
2 perform potential actions that would get you this.
3 As low probability as I expect.

4 MEMBER RAY: My --

5 CHAIR CORRADINI: Hi, Harold.

6 MEMBER RAY: Yes, this is Harold Ray. Are
7 you sure that FLEX is intended to apply to new designs
8 like we're reviewing here?

9 CHAIR CORRADINI: It applies to any new
10 light water reactor design per the original rule. We
11 could ask somebody.

12 MEMBER RAY: All right.

13 MR. MONNINGER: So, this is John Monninger
14 from the Staff. So, currently the MBDBE rule is with
15 the Commission so there is no current rule in effect.

16 CHAIR CORRADINI: Oh, I think it was a
17 task.

18 MR. MONNINGER: With that said, the Staff
19 has looked at design certs and COLs in the past to see
20 to the extent that they meet the previous orders and
21 requirements and all that kind of stuff.

22 CHAIR CORRADINI: Okay.

23 MR. MONNINGER: With regard to the MBDBE
24 Rule, mitigating strategies rule, the applicability
25 is actually for the COL and not the design certification

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1 application.

2 CHAIR CORRADINI: Oh, excuse me.

3 MR. MONNINGER: With that said, if the
4 design certification Applicant, such as NuScale,
5 proactively decide to address aspects of it, they could
6 and the Staff would review to the extent we could.

7 CHAIR CORRADINI: Okay.

8 MR. MONNINGER: And NuScale is proposing
9 to meet aspects of the proposed rule. And we will
10 review that.

11 MEMBER STETKAR: And I think, John --

12 CHAIR CORRADINI: Thanks for clarifying.

13 MEMBER STETKAR: John.

14 MR. MONNINGER: Yes.

15 MEMBER STETKAR: And I think we've seen,
16 correct me if I'm wrong, I think we've seen, what I
17 don't remember is whether it's design certification
18 documentation or whether it's only COLs that establish
19 the coping times. For example, 72 hour coping time.
20 And I don't recall whether it's in the design
21 certification or the COL. COLs.

22 MR. MONNINGER: Yes. So most of the
23 design certs, besides, so most of the design certs,
24 be it the AP1000, well, the ESBWR, where done prior
25 to that so most of the aspects that the Staff has done

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1 with regards to potential compliance with the orders
2 have been with the COLs.

3 And generally they've showed, with
4 installed equipment, 24 hours and then with written,
5 up to 70. So there isn't much of a limitation at all
6 with regards to the passive designs. And we've had
7 discussions with NuScale and timeframes are
8 significantly in excess of the current designs.

9 The current designs may need to be, the
10 passive designs may need to refill a tank or turn on
11 a fan for recombinations but here you don't have that.

12 There is significantly potentially more time for the
13 NuScale design.

14 MEMBER STETKAR: Thank you.

15 MEMBER SKILLMAN: Mr. Chairman, I'd like
16 to make a comment.

17 CHAIR CORRADINI: Sure.

18 MEMBER SKILLMAN: That at least reflects
19 in whole or in part on your comment. As I understand
20 this design, and we've looked at it for a couple of
21 years now, the construct of the NuScale design is it
22 could be hopefully sited North of Caribou, Maine, it
23 could be sited in Denali in Alaska.

24 This is a standalone passive machine that
25 can be put almost anywhere. And good luck with FLEX.

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1 This machine is intended to be able to be licensed
2 almost anywhere on the face of the earth that meets
3 the PPE.

4 And so I think it would be inappropriate
5 for us to be thinking that FLEX would even be a part
6 of this. This machine has got to be able to take care
7 of itself.

8 And to me, that has some very significant
9 design requirements that back up into their power
10 design, they're non-IE design and the extent to which
11 that translates throughout the entire design.

12 CHAIR CORRADINI: Right. But the reason
13 I brought it up was, is that I can't imagine an
14 owner/operator would sit there for 30 days knowing that
15 this is how it's doing things, it would bring to bear
16 what it has onsite to essentially take it to cold
17 shutdown.

18 MEMBER SKILLMAN: Well, that begins with
19 the NSSS designer making sure that it can be brought
20 to cold shutdown.

21 CHAIR CORRADINI: Other comments? Have
22 you completed your presentation?

23 MR. SCHMIDT: I have.

24 CHAIR CORRADINI: Okay. Any questions
25 for Jeff instead of between us, because I want to

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1 continue the discussion as to how we proceed as a
2 Committee. Any questions for Jeff? Okay, thank you
3 very much.

4 MR. SNODDERLY: This is Mike Snodderly
5 from the ACRS Staff. So before Jeff leaves did you,
6 so right now the next interaction would be on Thursday,
7 February 8th from 8:30 to 10:30, this item is scheduled
8 for the full committee.

9 CHAIR CORRADINI: Well, what I was going
10 to do at this point is, we don't have anything in closed
11 session, I wanted to get public comments and then
12 discuss what the members comments and how we handle
13 potentially three questions, do we want to do a letter,
14 if we want to do a letter, what's the general conclusions
15 we want to put in it, because I think is not going to
16 be our typical letter.

17 MR. SNODDERLY: So Jeff and NuScale please
18 standby.

19 CHAIR CORRADINI: Yes. We're not
20 dismissing you from the room, we're just dismissing
21 you from the front of the table. You can stay there
22 if you want.

23 MR. SCHMIDT: Okay.

24 CHAIR CORRADINI: Okay. So, first of all,
25 is there anybody in the room that wants to make a public

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1 comment?

2 And we have the bridge line open. Is
3 anybody on the bridge line that would like to make a
4 comment from the public?

5 Okay. So, what I want to get from the
6 Members is your general comments but specifically about
7 the criteria. Because as I understand this, this SECY
8 is going to go in front of the Commission for their
9 information. And you guys have to explain if I got
10 this right.

11 It's not going to be a notation vote unless
12 one of the Commissioners decide they want a notation
13 vote, it's kind of like an FYI memo. This is where
14 the Staff is going, we want to let you know where we're
15 going and these are the criteria we're going to use
16 to judge the design.

17 MR. SNODDERLY: Right.

18 CHAIR CORRADINI: Okay. So have I got
19 that approximately correct?

20 MR. SNODDERLY: Yes.

21 CHAIR CORRADINI: Okay. So the question
22 for all of us is, do we want to write a letter about
23 this in terms of saying this is an acceptable criteria
24 for the exemption on GDC 27 or this is not or we really
25 don't think we want to say anything at this point till

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1 we see the design or what? And I'll start with Ron.

2 MEMBER BALLINGER: I think we need to write
3 a letter. I actually don't think they need the
4 exemption.

5 CHAIR CORRADINI: Well, okay. And that's
6 all we should say, from your perspective?

7 MEMBER BALLINGER: I have a bunch of
8 opinions but I'll hold them.

9 MR. SNODDERLY: I'm sorry, Mike, we didn't
10 unmute the phone, but it's unmuted right now --

11 CHAIR CORRADINI: Oh.

12 MR. SNODDERLY: -- so could you please ask
13 again if anyone from the public wants to make --

14 CHAIR CORRADINI: Oh, sorry. Let's go
15 back to the public comments. Are there anybody on --

16 MS. FIELDS: Hi. Yes, I have a comment.

17 CHAIR CORRADINI: Okay, could you please
18 state your name please and then give us your comment?

19 MS. FIELDS: Sarah Fields, S-A-R-A-H,
20 F-I-E-L-D-S. And I think this issue warrants a lot
21 more discussion.

22 And having listened to some of the NRC
23 NuScale meetings, I think there are a lot of other issues
24 having to do with the development of this design and
25 the approvals, the responses to RAIs that would impact

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1 this request for an extension. And I think that there
2 are other requests for extensions, other considerations
3 which might have accumulative effects.

4 I also don't see in this discussion how
5 this relates to how they're considering difficulties
6 in one or more of the modules. If they're just focusing
7 on a one module event rather than multiple module
8 events. Thank you.

9 CHAIR CORRADINI: Thank you. Is there
10 anybody else on the phone line that would like to make
11 a comment? Okay, hearing none, if we could just mute
12 the line again?

13 Let's go to our consultant, Dr. Schultz.
14 We'll just go around.

15 MR. SCHULTZ: Okay, appreciate the
16 discussions today. In reviewing the information
17 available, from both the Applicant and the Staff, even
18 with the presentations today and the information
19 related to the proposal for an exemption, I still do
20 struggle with the benefit that the proposed exemption
21 is going to in fact provide.

22 And I just go back to the GDCs and the basis
23 for their development and for their application. It's
24 clear that there are issues that are identified here
25 that need to be addressed, associated with long-term

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1 cooling following an event. I just don't see that an
2 exemption to the GDCs is the appropriate way to go to
3 identify them and then to address them.

4 What the Staff is proposed to do, what the
5 Staff is proposed to do needs to be done in terms of
6 the evaluations and the reviews of what NuScale has
7 developed. But I think the Staff could still conclude
8 that an exemption to the GDCs is not required.

9 CHAIR CORRADINI: Dr. Bley. Member Bley.
10 Former Chairman Bley. Happily, former Chairman Bley.

11 MEMBER BLEY: Now you got it. I think we
12 have to write a letter. I think it can be short. And
13 if we want, we could emphasize that we aren't accepting
14 the details here because we'll have to review them
15 later.

16 In principle, I agree with what the Staff
17 is doing and would support it. And that's the way I
18 would lean. Assuming we write a letter.

19 CHAIR CORRADINI: Anything else, Dennis?

20 MEMBER BLEY: No, that's enough.

21 CHAIR CORRADINI: Dick.

22 MEMBER SKILLMAN: Yes, sir. I agree with
23 Dennis. I believe that we should write a letter. And
24 I say that with two additional comments.

25 And that is assuming that a main steam line

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1 break recriticality is an acceptable precedent for
2 arguing that a long-term low power level criticality,
3 in my mind, is not appropriate.

4 And secondly, accepting a chronic
5 criticality, albeit at low power, with assumed
6 negligible fuel damage, is not consistent with the
7 intent of years of regulatory practice. Thank you.

8 CHAIR CORRADINI: The first part I've got,
9 I'm not sure I captured the second.

10 MEMBER SKILLMAN: Accepting a low-level
11 criticality, chronic low-level criticality --

12 MEMBER POWERS: On the contrary, we're all
13 thinking in reactor safety.

14 MEMBER SKILLMAN: -- albeit with little
15 or no fuel damage, it's just contrary to years of
16 regulatory practice. Thank you.

17 CHAIR CORRADINI: Dana.

18 MEMBER POWERS: Okay, we are, I vote we
19 have an exemption for request and we certainly allow
20 exemptions to the GDC. This particular request does
21 strike at the heart of all reactor safety thinking since
22 the nuclear era began.

23 The situation is the operator will have
24 lost control of his reactor. Nevertheless, we need
25 to look at the exemption request.

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1 And I rather like what the NRC has laid
2 out for the way they're going to look at it. They have
3 not been effusive in their disclosure, there apparently
4 is much more in what they're going to do than what's
5 written on the slides. We saw that with a little
6 interrogation.

7 I don't envy the Staff because they're
8 going to have to persuade that they've thought of
9 everything. And that's a lot by the way. But
10 nevertheless, as far as their approach, I rather like
11 it.

12 I do think it's premature to write a letter
13 until we have seen what the Staff is actually going
14 to approach this.

15 CHAIR CORRADINI: Premature for us to
16 write a letter.

17 MEMBER POWERS: For us to write a letter.
18 Premature for us to weigh in on this.

19 If we do write a letter, then I don't think
20 it's a short one, I think it's a rather lengthy one
21 because there are differences of opinions. And you're
22 not going to write a consensus letter you're going to
23 write a letter that says, here is what all the thinking
24 is on this Committee. And that, I think, cannot be
25 a short letter.

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1 CHAIR CORRADINI: Matt.

2 MEMBER SUNSERI: Thank you, Mike. At this
3 point of the review I don't see the need to write a
4 letter. Whether there's an exemption to GDC 27 or not
5 seem to me to be an administrative issue.

6 CHAIR CORRADINI: Can I interject one
7 thing?

8 MEMBER SUNSERI: Yes.

9 CHAIR CORRADINI: Just because you guys
10 said the same thing, and so what I'm interpreting you're
11 saying is premature to write a letter on the SECY, which
12 will go up to the Commission regardless?

13 I want to make sure we're clear. They're
14 going to send the SECY up which says, this is what we're
15 going to do and this is the criteria we're going to
16 do it, and that's the context?

17 MEMBER SUNSERI: Yes.

18 CHAIR CORRADINI: Okay. I'm sorry.

19 MR. SNODDERLY: I'm sorry, Mike, Mike's
20 not really a ACRS Staff. So right now, the draft SECY,
21 and it is a draft, I just want to remind you that there
22 is a placeholder in there right now where the Staff
23 references an ACRS letter.

24 CHAIR CORRADINI: Yes, well.

25 MR. SNODDERLY: Well, yes, but that's the

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1 way it --

2 CHAIR CORRADINI: Okay.

3 MR. SNODDERLY: -- that's in the public
4 record and that's --

5 CHAIR CORRADINI: Sure, that's fine.

6 MR. SNODDERLY: Okay.

7 CHAIR CORRADINI: I just want to make sure
8 that, because we're all on the same page. Go ahead,
9 Matt, I'm sorry. Excuse me.

10 MEMBER SUNSERI: It's okay. So, I'll
11 start again. I don't see the need for us to write a
12 letter at this time because whether or not an exemption
13 is used or not seems to me to be an administrative issue
14 associated, we'll get a chance to judge the technical
15 merits of whether this is safe or not safe later on
16 when we review the DCD and the SER and we have more
17 technical details about the design before us than what
18 we've seen to date.

19 So at that point in time I see that the
20 appropriate time for a letter documenting our technical
21 basis for our decision.

22 CHAIR CORRADINI: Okay. John.

23 MEMBER STETKAR: I'm kind of torn, I think
24 we should write a letter. Only to document the fact
25 that we have deliberated on the notion that a reactor

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1 can remain critical producing non-zero power and yet
2 satisfy the basic principles of health and safety of
3 the public.

4 Because I've read the general design
5 criteria and I will tell you they are not clear. Even
6 in the residual heat removal it says decay heat and
7 other, what does it say, system safety functions shall
8 be to transfer fission product decay heat and other
9 residual heat from the reactor core. So that implies --

10 CHAIR CORRADINI: Say that again please.

11 MEMBER STETKAR: Under GDC 34, where I go
12 to residual heat removal, which is where I'm kind of
13 long-term cooling it says, a system to remove residual
14 heat shall be provided.

15 The system safety function shall be to
16 transfer fission product decay heat and other residue
17 heat from the reactor core, at a rate such that specified
18 acceptable fuel design limits and the design conditions
19 of the reactor coolant system, reactor coolant boundary
20 are not exceeded. It doesn't say, big enough to
21 takeaway non-zero power.

22 And that's where I come down to where I
23 think that we should acknowledge that we've deliberated
24 on this and --

25 CHAIR CORRADINI: And? We've deliberated

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1 and?

2 MEMBER STETKAR: Well, I don't know what
3 where our deliberation is going to lead.

4 CHAIR CORRADINI: No. But in your
5 personal opinion, we've deliberated and --

6 MEMBER STETKAR: In my personal opinion,
7 as long as the Applicant can provide a convincing
8 argument that for the spectrum of things that can happen
9 to this plant, they can successfully remove power from
10 the core, that power could be produced by decay, fission
11 product decay or neutrons, I'm happy. That's what our
12 role is, is protecting health and safety of the public,
13 it isn't for making life easy for operators, it isn't
14 for the news media.

15 But I think if they're going to send it
16 up I think that the, I personally think the Commission
17 would want us to weigh in on it.

18 MEMBER BALLINGER: Can I make a statement
19 now to expand upon my three words?

20 CHAIR CORRADINI: Yes.

21 MEMBER BALLINGER: I was going to make the
22 heretical statement that the plant cannot only remove
23 decay heat but it can also remove heat from a criticality
24 event. Which is different.

25 MEMBER STETKAR: And that's my whole

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1 point, is --

2 MEMBER BALLINGER: Yes, that's --

3 MEMBER STETKAR: -- that if you just pick
4 and choose from the general design criteria, residual
5 heat removal, or long-term cooling, the way it's written
6 is the presumption that the core is subcritical.

7 MEMBER BALLINGER: Yes.

8 MEMBER STETKAR: The other subcriticality
9 thing is what we've been mincing with today.

10 MR. SCHULTZ: And the other piece is to
11 protect the fission product barriers. Clearly.

12 MEMBER BLEY: May I too chime back in?

13 CHAIR CORRADINI: Sure.

14 MEMBER BLEY: I'm no changing my opinion,
15 I think we ought to write a letter. If that letter
16 turns out to be very complicated I think that's okay.
17 If we can't come to a conclusion, I think that's okay
18 too.

19 I think the Commission would really want
20 to hear how we're settling out on this. One way or
21 the other or if we can't settle out in one place or
22 not.

23 MEMBER STETKAR: We've written letters in
24 the past that says, you know, typically we count bodies
25 but, the majority of the Committee felt this way and

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1 a minority or perhaps a couple minorities felt the other
2 way or we were equally split or, and that's useful to
3 the Commission.

4 CHAIR CORRADINI: Jose.

5 MEMBER MARCH-LEUBA: I'm going to agree
6 with my friend John, using different words of course.

7 (Laughter)

8 MEMBER STETKAR: Yes, but I'm just
9 counting one.

10 (Laughter)

11 MEMBER MARCH-LEUBA: Yes. I'm not
12 autographing that page for you.

13 CHAIR CORRADINI: Okay, thanks.

14 MEMBER MARCH-LEUBA: After listening to
15 what NuScale had to say about this, it is my belief
16 that they can make a, it's a high likelihood they can
17 make a good case, that they can keep the reactor cool
18 after one of these unlikely criticality events happen
19 after shutdown.

20 And therefore, and it is my belief that
21 that meets the spirit, if not the letter of GDC 27,
22 and therefore an exception is not needed. Because if,
23 they can make a case.

24 I don't know if they'll, I mean -- and as
25 I said before, they're going to be sorry they didn't

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1 go the easy way of proving subcriticality. Because
2 it's going to be difficult to make that case. But that
3 case can be made. And if that case is made, then you
4 meet GDC 27, which I think they can do.

5 And the proposed solution, which is this
6 PDC, just makes no sense to me. That second paragraph
7 is exactly a copy of the paragraph before, in 10 CFR
8 50, which is GDC 26. Let me read it to you.

9 Just the paragraph before it says, with
10 appropriate margin for malfunctions such as stuck rods,
11 specified acceptable fuel design limits are not
12 exceeded. One of the systems are capable of holding
13 the reactor more subcritical under core conditions.
14 It's the same paragraph with the two sentences reversed.

15 So even if we were to issue an exception,
16 the solution, the remedy, doesn't fix anything. It
17 doesn't have anything that we already don't have.

18 So in conclusion, I do think that these
19 guys can make a good case and I see a high probability
20 to success. I think I make that case.

21 But, because there is no regulatory guide
22 or SRP to guide them into how to make that argument,
23 I mean, in all other cases there is established law,
24 you follow that regulatory guide, you know how you have
25 to demonstrate it. Because there is no such thing,

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1 they're going to have to bring, to play bring me a rock.

2 They're going to make an analysis, they're
3 going to have to bring it to the Staff and the Staff
4 is going to say, this is not enough. Okay. So, it's
5 a risk NuScale is running.

6 But in my opinion, there is no need to
7 modify what I said before, what I called before the
8 constitution. And I will write a letter on that.

9 CHAIR CORRADINI: Walt.

10 MEMBER KIRCHNER: Let me start with a
11 personal view. And it's, I think I'm repeating other's
12 comments, but I think the precedent of a reliable
13 control system suggests that you would bring the reactor
14 to a subcritical state over the longer haul.

15 I think the collection of GDCs and other
16 supporting guidance that the agency uses points in that
17 direction. And personally, as a designer, I would try
18 very hard to avoid having to even make this exception.

19 Now having said that, I think under the
20 criteria that, and process that's been laid out by the
21 staff, I can see a way to, validating, granting such
22 an exception. But Jose may be right, the lawyers could
23 read what has been submitted by the Applicant and look
24 at the GDCs and say they meet the letter of the
25 requirements as written.

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1 But I think it would be a bad precedent
2 if we didn't do it through an exemption. Because I'm
3 looking ahead, it would be a bad precedent to have a,
4 I'm looking down the road a little bit. If this is
5 granted to NuScale as an exemption I'm comfortable with
6 that because that means the next person who comes along
7 has to really prove, technically, that they can meet
8 the criteria.

9 I'm very concerned about what I have seen
10 in drafts of the advance reactor design criteria where
11 they strike things like, well, I will control
12 reactivity. Especially for some of the designs that
13 we know, that are out there.

14 So, I kind of feel that even if the lawyers
15 could agree that they don't need an exemption, I think
16 the precedent that this sets of having a design that
17 could return to criticality "an uncontrolled manner
18 but designed for that," as an exemption is a better
19 way. And it gives some, I think, surety for NuScale
20 going forward as well.

21 MEMBER SUNSERI: So, let me make sure I've
22 got your comment because --

23 MEMBER KIRCHNER: Well, I've rambled a
24 little bit.

25 CHAIR CORRADINI: -- I've concluded I'm

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1 going to have a little bit of a tough time drafting
2 it. So, you think it needs an exemption, A, we should
3 write a letter about it --

4 MEMBER KIRCHNER: Yes.

5 CHAIR CORRADINI: -- but you think the
6 criteria are acceptable?

7 MEMBER KIRCHNER: I think the process and
8 acceptance criteria for review, laid out by the Staff,
9 assuming the additional information is forthcoming,
10 is a path forward, yes.

11 CHAIR CORRADINI: Charlie.

12 MEMBER BROWN: I'll just make the letter
13 harder for you.

14 CHAIR CORRADINI: Thanks, Charlie.

15 MEMBER BROWN: No. It won't make the
16 letter hard for folks to understand --

17 CHAIR CORRADINI: Okay, Charlie.

18 MEMBER BROWN: -- my personal opinion that
19 once a reactor is shutdown into subcritical it should
20 stay there. The bottom line, it not go re-critical
21 and you should not develop neutron power for days and
22 days, whatever that time may be, whether you think you
23 got it under control or not.

24 I just don't think it's a good idea and
25 I don't think we should set a precedent of going in

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1 that direction from a reactor design standpoint. A
2 reactor plant design standpoint.

3 That's my personal opinion. Regardless
4 of the way we want to wordsmith the exemptions.

5 With the disparate opinions and things,
6 it seems reasonable that we ought to try to write a
7 letter to get the various view points before the
8 Commission when they get the SECY. But we can debate
9 that when we decide to do it or not do it. But we might
10 start and find out it's too hard.

11 But my fundamental issue is not so much,
12 I'm not necessarily disagreeing with their technical
13 approach and their proposed design criteria they want,
14 I just don't think it's a good idea to sit there.

15 The longer a plant sits there critical,
16 generating neutron power after its shutdown supposedly,
17 is just a, you're just putting yourself into a position
18 for other things happening, which then complicates the
19 whole situation. You do not have means to take action
20 to control what's going on. That's my personal
21 opinion.

22 So I guess I would write a letter, but
23 that's my opinion as a throw in on, if I was writing
24 the letter, that's what I would say.

25 CHAIR CORRADINI: Okay. Vesna.

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1 MEMBER DIMITRIJEVIC: All right. Did I
2 activate it?

3 CHAIR CORRADINI: No, at the bottom. The
4 very bottom.

5 MEMBER DIMITRIJEVIC: Sorry. See, you
6 can see that I'm a beginner. Since I was beginning
7 I was trying not to really --

8 And because I just met this issue in
9 preparing for this meeting, this is my first time.
10 And I also don't really know the rules of engagement,
11 how do we do this.

12 MEMBER STETKAR: Don't worry about them.

13 CHAIR CORRADINI: And it's kind of like --

14 MEMBER STETKAR: This is the pirates code.

15 (Laughter)

16 MEMBER STETKAR: There are no rules.

17 CHAIR CORRADINI: They say it's more like,
18 where it's the fight in the movie and he says, what
19 are the rules, and the first rule is, there is no rules.

20 (Laughter)

21 MEMBER DIMITRIJEVIC: Okay. Well, when
22 I start listening to this I was mostly having the
23 impression, why we are discussing this.

24 Because one of the things is the charging
25 system or safety we would not be discussing this, is

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1 that a true statement? Because in Chapter 15 you will
2 credit injection of the bottom and we would not be sure
3 identify.

4 So I said, okay, well, what difference
5 makes is charging system is safety or non-safety because
6 for me, as a PRA person, doesn't make a damn difference,
7 it can fail in both cases.

8 So then I said, okay, if charging system
9 was safety and it failed, we will get, again, to the
10 situation that we have this low-level criticality,
11 right? Right.

12 So other difference in both the charging
13 safety, we can get to this question.

14 CHAIR CORRADINI: But they'd be in a happy
15 land with GDC 27.

16 MEMBER DIMITRIJEVIC: Yes, that's right.

17 So my first impression was they're not really breaking
18 GDC. Because, so that shouldn't be an exemption.

19 I think they proved they have reliably
20 controlled reactivity to my satisfaction. But then
21 when I listen to Charlie and I say, okay, can I think
22 about something, can I think something in coolant design
23 which can go so much wrong, because here so many things
24 have to go wrong.

25 They have to have an accident, involve the

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1 cooling, the rod has to get stuck, AC is not there,
2 charging system has to fail, operators have to be dead
3 basically. So, when you look in all of these things
4 which can go wrong, then you said, all right, I mean,
5 this is not going to happen.

6 But then I start thinking, in the coolant
7 design is something where we can get critical, what
8 can happen that we can get critical. And the only thing
9 I can think about, like start injecting rods or
10 something which we know is not going to happen.

11 So from that perspective I think that my
12 current position is that maybe this is not exemption
13 but on the other hand, maybe we still have to prove
14 that cooling of the core is maintained in the case that
15 they reach these low criticality.

16 So, to be honest with you, I mean, I have
17 a feeling that we can write a lifetime, we can write
18 very complex letter. That's obvious with the pages
19 and the pages. See, I am completely unfamiliar with
20 this.

21 CHAIR CORRADINI: Having to be the one
22 who's going to draft it, I hope not.

23 MEMBER DIMITRIJEVIC: No. Or we can write
24 some very simply like to say, that's exemption or not
25 exemption, if it's exemption, why is it exemption and

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1 what else they have to do, in our opinion.

2 And I think, actually, they concentrate
3 on reactivity. Maybe they should concentrate more on
4 core cooling, but maybe they proved that to
5 satisfaction. I mean, I don't really know but I would
6 keep it very simple whatever we do.

7 CHAIR CORRADINI: Harold, we haven't
8 forgotten California. Has Harold --

9 MEMBER RAY: It's my strong opinion that
10 we should write a letter. I would refer us to the
11 purpose of our meeting today, which was to review the
12 criteria the Staff will use.

13 A lot of our discussion has been the
14 criteria that we, ourselves, would use to reach a
15 decision about an exemption or whether one is needed.

16 But I agree with those who see this as an important
17 precedent.

18 There's a lot to come down the road for
19 us to say we've got nothing to say about the criteria
20 the Staff will use at this time. But we will use our
21 own standard or perspective or criteria, whatever you
22 want to call it, to review it later on. Review the
23 actual outcome, I think would be wrong.

24 I agree with, I think Walt's point that
25 we need to see ourselves here as, in the beginning of

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1 a process that's going to have a lot of twists, and
2 turns and not just focus on this particular
3 circumstance.

4 The Staff has concluded that they need an
5 exemption. They set forth some criteria to review it,
6 they've asked us for comment, or at least it's made
7 available to us for comment if we wish to make any,
8 and I think we should make some comment.

9 Even if it's a very simply letter saying
10 we agree. Albeit we think that perhaps the need for
11 the exemption is something we're not sure of. Or, I
12 don't know, I don't want to suggest what we would say,
13 but my point is, that for us to not write a letter and
14 to simply pass on it I think would be a mistake.

15 On the other hand, I don't think we should
16 go so far as to opine on what we think is acceptable
17 or not since we were just asked to look at the criteria
18 for granting the exemption.

19 CHAIR CORRADINI: Okay, thank you, Harold.

20 Okay, so my own personal opinion, but it's part of
21 the majority, is we have to write some sort of letter.

22 I personally think, Walt I think said it
23 best, that if you think down the road this would, I
24 won't even say appear, I would think this seems to be
25 an inappropriate approach if you had said it doesn't

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1 need an exemption.

2 This is different enough. There has got
3 to be some discussion as to why it is acceptable although
4 different. If it is acceptable, why it is acceptable
5 although different.

6 My own personal opinion is, I think they're
7 criteria are reasonable criteria both short and
8 long-term. But I don't sense that that's the unanimous
9 view, so I'd like to get some co-authors to the draft.

10 Also, you should remember that you all
11 agreed in the retreat that we just don't present a
12 letter, I have to present new graphs to have a discussion
13 again and then we're going to go write a letter. Well,
14 let me tell, we're going to do some things in parallel
15 here, all right.

16 So I will draft some general statements,
17 because Staff probably didn't realize that but we've
18 changed our letter writing process where we want to
19 have a come to, well, we want to have a discussion in
20 front of the full committee. And we're missing Joy
21 and we're missing, I guess we're just missing Joy.
22 Look at that. Oh, and Pete.

23 MEMBER STETKAR: Pete.

24 CHAIR CORRADINI: Excuse me, and Pete.

25 MEMBER STETKAR: And Margaret.

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1 CHAIR CORRADINI: And Margaret. I'm
2 sorry, it looked like a full table, I forgot. And have
3 a discussion with the full committee.

4 But I'd like to deputize a few people.
5 It sounds to me like Dick and Charlie are on the same
6 page relative to the inappropriateness of doing this
7 at all.

8 MEMBER SKILLMAN: I would be glad to.

9 CHAIR CORRADINI: And if I might get a
10 third person that, I won't say moderate but put it in
11 a context, I'd like to see if Walt could help moderate
12 and give me a paragraph or two. Because I think
13 although it might, I'm going to shoot for a short letter
14 and draft it, I do think Dana's point is fair that if
15 a letter is written, there's going to have to be on
16 the one hand and on the other hand. Okay?

17 And I think there is one hand here that
18 I want to get from you guys. So can I ask you and Charlie
19 and maybe Walt together --

20 MEMBER SKILLMAN: Yes.

21 CHAIR CORRADINI: -- to give me a couple
22 paragraphs on what you view as the appropriateness of
23 it? Okay.

24 And the other hand, I'd like to get maybe
25 something from our consultant because he doesn't have

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1 to enjoy the thrill of writing the letter.

2 MR. SCHULTZ: Do you want the view graphs?

3 CHAIR CORRADINI: No, I don't want you,
4 I simply want your opinion.

5 MR. SCHULTZ: Understood. You'll get it.

6 CHAIR CORRADINI: Okay. Because you said
7 I think, and what I took down from you though, is that
8 the criteria do provide, from your standpoint, an
9 acceptable shot at it.

10 MR. SCHULTZ: That's a part of it.

11 CHAIR CORRADINI: Okay.

12 MR. SCHULTZ: But it also feeds into Walt's
13 comments that something has to be done. Whether it
14 has to do with GDC 26 or 27, that's another issue.

15 CHAIR CORRADINI: Okay. And then
16 finally --

17 MR. SCHULTZ: I'll get those for you.

18 CHAIR CORRADINI: -- so that's an
19 assignment, finally, Jose and his good friend John --

20 MEMBER MARCH-LEUBA: My good friend John
21 has changed opinion so we're in disagreement.

22 CHAIR CORRADINI: Oh.

23 (Laughter)

24 MEMBER MARCH-LEUBA: Yes. It couldn't
25 last.

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1 CHAIR CORRADINI: On the record you were
2 at least in agreement that the criteria were reasonable
3 but it would be a tough sell. I'd like a couple
4 paragraphs on, this is doable based on the criteria,
5 this could be doable based on the criteria proposed
6 by the staff, but it's going to be a tough sell.

7 MEMBER MARCH-LEUBA: Our point, going to
8 Walt's argument, is we're going to make their life very
9 difficult. They're going to have to pay for this.
10 And so whether there has to be an exception or a lot
11 of analysis, that's got to be done.

12 CHAIR CORRADINI: Okay.

13 MEMBER MARCH-LEUBA: And I believe they
14 prefers an exception because they got licensing surety.
15 I mean, assurance.

16 CHAIR CORRADINI: So, and then the final
17 thing is, I sense we're not going to come down to a
18 consensus. I think this one is important enough that
19 if members want to write something that doesn't fit
20 in with the final conclusion or recommendation, we ought
21 to have added comments. I think the Commission would
22 appreciate that.

23 MEMBER STETKAR: We can handle that when
24 we write the letter.

25 CHAIR CORRADINI: I understand.

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1 MEMBER STETKAR: Because we've written
2 letters that within the body of the letter says, on
3 the one hand members believe this and on the other hand
4 they believe that.

5 MEMBER BLEY: But there is --

6 MEMBER STETKAR: It doesn't say the
7 consensus, it just says, on the one hand --

8 MEMBER BLEY: No, no, I'm going to agree.

9 CHAIR CORRADINI: But I would like to get
10 a conclusion --

11 MEMBER STETKAR: The added comment -- we
12 can discuss that during the letter writing --

13 CHAIR CORRADINI: Okay.

14 MEMBER STETKAR: -- we don't need to
15 discuss it now.

16 CHAIR CORRADINI: All right. So that's
17 what I thought I have heard and that's what I'd like
18 to do.

19 So I'm going to get something from Steve,
20 I'm going to get something from Dick and Charlie, with
21 Walt's help, and I'm going to get something from the
22 dynamic duo over here. Okay? All right? Okay.

23 I think I am happy. What Charlie? I mean,
24 yes, Member Brown.

25 MEMBER BROWN: In order to do this, I have

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1 a difficult time with my memory locator bits, and so
2 the faster we can get a copy of the transcript so I
3 can see what I said would be very useful.

4 CHAIR CORRADINI: We will ask the Staff --

5 MR. SNODDERLY: I've already asked for an
6 expedited transcript.

7 CHAIR CORRADINI: Okay.

8 MEMBER BROWN: Okay.

9 CHAIR CORRADINI: We'll get an expedited
10 transcript.

11 MEMBER BROWN: Yes, since we've got a short
12 time.

13 CHAIR CORRADINI: Okay. Yes, we have two
14 lovely weeks.

15 MEMBER BLEY: If the agenda I just got is
16 correct, this should be the only letter we have.

17 CHAIR CORRADINI: No, we have the research
18 review letter.

19 MEMBER BLEY: Oh, that's right.

20 CHAIR CORRADINI: Which we already have
21 had Draft 3 sent to me.

22 MEMBER BLEY: Oh. Why is that so hard.

23 CHAIR CORRADINI: So we do have two
24 letters. And that one is a long one, it's not a shorty.

25 MEMBER BLEY: But it's easier. Maybe not.

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1 (Laughter)

2 CHAIR CORRADINI: Okay. All right. With
3 that, I wanted to thank NuScale. Thank you very much
4 for taking the time to come here and give us a good
5 explanation of how this fits into the design. I thank
6 the Staff.

7 MR. SNODDERLY: Mike, what do you want on
8 February 8th from the Staff and from NuScale, any, I
9 mean, do you want similar types of presentations or --

10 CHAIR CORRADINI: Well, I don't want to
11 tell them what to do, but I think --

12 MR. SNODDERLY: No, but --

13 CHAIR CORRADINI: -- we have two hours.

14 MR. SNODDERLY: Right.

15 CHAIR CORRADINI: A portion, an hour for
16 NuScale. I would say that since 12 out of the 15 of
17 us here, you don't have to repeat everything.

18 I do think you want to walk through at least
19 the general picture, right, of what the design is and
20 where you get into this. Whether it be the best
21 estimate versus the conservative approach and why you,
22 and I think you'll get questions from others, as why
23 you didn't consider a hardware fix or why a hardware
24 fix is not doable given all the other things. Or, an
25 argument that this is better than a hardware fix. But

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1 I think that in that hour.

2 And then the Staff, I would just say, in
3 a similar vein, try to give us your views on the
4 criteria. If you come up with anything else, I mean,
5 Dana asked a good question that would be relative to
6 long-term failure mechanisms that would pop up that
7 you wouldn't have thought of otherwise. And I think
8 that would be something you might want to consider.

9 You thought that was a good idea, I'm just
10 going to remind you of it. Charlie.

11 MEMBER BROWN: Just one other thought for
12 the presentations and the meeting is that I did ask
13 about what you would do if you were direct, if you didn't
14 get acceptance of this and their explanation of the
15 hardware fixes was brief and not very well defined.
16 In my personal opinion, it was sparse.

17 CHAIR CORRADINI: So you're looking for
18 what exactly?

19 MEMBER BROWN: If you had to meet what
20 existing plants do, how would you modify the plant in
21 order to do that. And we had a little bit of discussion
22 about reactivity, rods, a few things like that.

23 But the other choice, I guess, was making
24 the, what it is, the CVCS, the safety system or something
25 like that.

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1 CHAIR CORRADINI: Well then -- so if I
2 might, I mean, my feeling was they should be ready for
3 questions like that, but I don't think it's appropriate
4 for them to start redesigning their plant for --

5 MEMBER BROWN: I didn't say that. That's
6 not what I said.

7 MEMBER STETKAR: We're not reviewing --

8 CHAIR CORRADINI: And we're not --

9 MEMBER STETKAR: We're not reviewing the
10 design.

11 CHAIR CORRADINI: -- we're focusing on the
12 criteria.

13 MEMBER BROWN: If that's what you want to
14 focus on, fine.

15 CHAIR CORRADINI: Well, that's the reason
16 that we're here is that the SECY --

17 MEMBER BROWN: I understand that.

18 CHAIR CORRADINI: The SECY is basically
19 saying that there's a need for an exemption and we're
20 going to review the exemption request based on these
21 criteria.

22 MEMBER STETKAR: And eventually we'll
23 review the design --

24 CHAIR CORRADINI: Right.

25 MEMBER STETKAR: -- to see whether it

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1 satisfies the basic need to protect the health and
2 safety of the public. Whether it's long-term cooling
3 or reactivity insertion or whatever.

4 CHAIR CORRADINI: Okay? All right, with
5 that --

6 MEMBER BALLINGER: Can I say one more
7 thing?

8 CHAIR CORRADINI: Feel free.

9 MEMBER BALLINGER: I mean, for this kind
10 of thing I always look for, we sometimes focus on
11 figuring out how it will work. I'd be interested in
12 knowing how it would not work.

13 In other words, you're into this scenario,
14 you're doing the cooling, it seems to be working, what
15 could happen that would make it not work?

16 CHAIR CORRADINI: Well I think --

17 MEMBER BALLINGER: That's nothing to do
18 with GDC 27.

19 CHAIR CORRADINI: I know, but I think if
20 I would redirect your question, is there something
21 missing from their criteria that would potentially
22 overlook a failure mechanism?

23 MEMBER RAY: That's right, Mike.
24 Exactly.

25 CHAIR CORRADINI: Okay, with that we're

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1 adjourned.

2 (Whereupon, the above-entitled matter went
3 off the record at 4:13 p.m.)

4

5

6

7

Shutdown Capability of the NuScale Power Module

Derick Botha
Ben Bristol
Allyson Callaway

January 23, 2018



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Outline

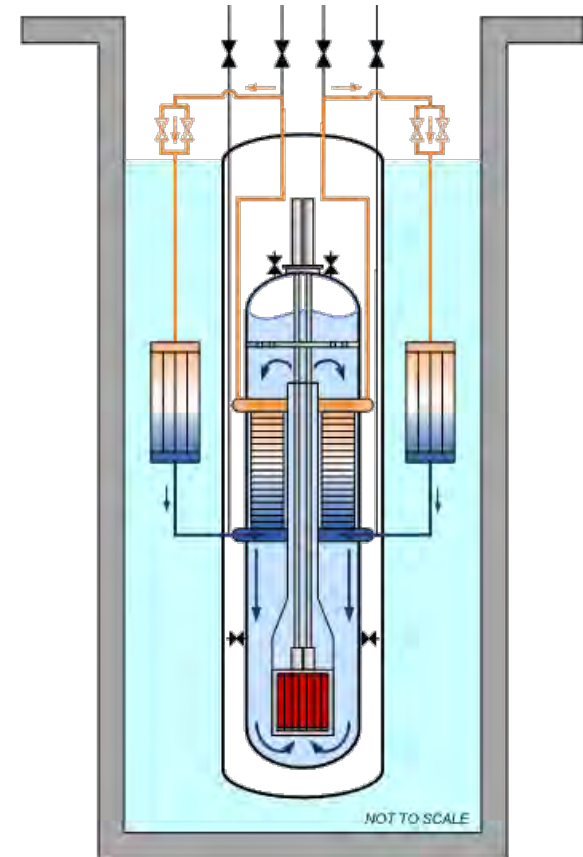
- Background
- Design Overview
- Reliable Means for Shutdown
- Consequence of a Return to Power
- Design Considerations for Shutdown
- Precedent for a Return to Power
- Summary

Background: GDC 27 Exemption

- Reactivity control systems are well-matched to the simplicity and passive safety of the NuScale design.
 - Safety-related control rods
 - Nonsafety-related chemical volume and control system (CVCS)
- Small core with higher control rod worth leads to potential for benign, low probability return to power event with highest worth rod stuck out (WRSO) assumption.
- NuScale’s white paper on reactivity control (LO-1116-51829, Nov 2016) addressed compliance with GDC 26 and 27, which address two separate reactivity control functions.
 - Protection function: Rapid power reduction to protect fuel
 - Shutdown function: Capability to hold the core subcritical under cold conditions
- NRC staff position (ML16116A083, Sep 2016): required an exemption from GDC 27 to depart from precedent (i.e., long term shutdown with WRSO).

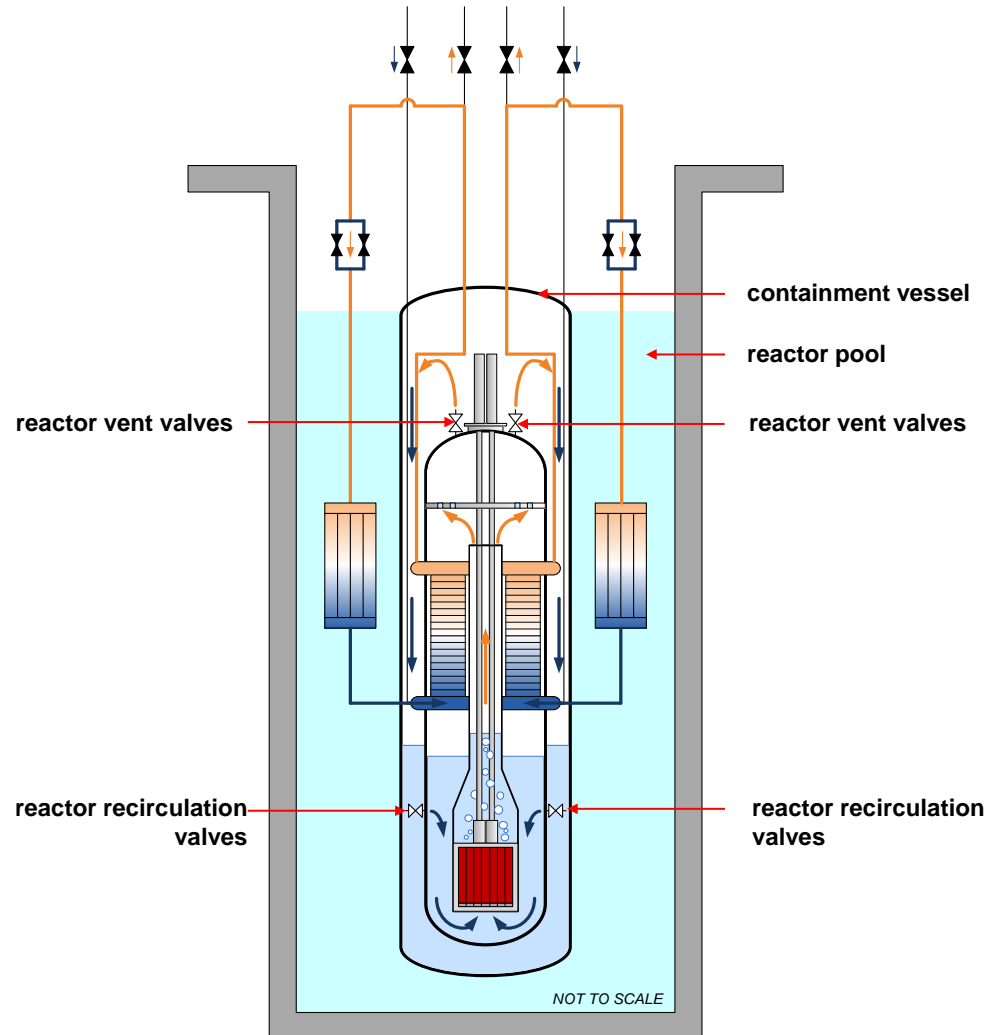
Design Overview: Passive Decay Heat Removal System

- Main steam and main feedwater isolated
- Decay heat removal (DHR) valves opened
- Decay heat passively removed via the steam generators and DHR heat condensers to the reactor pool
- DHR system is composed of two independent and redundant trains (1 of 2 trains needed)



Design Overview: ECCS and Containment Heat Removal

- Adequate core cooling is provided without the need for safety-related injection
- Reactor vent valves and Reactor recirculation valves open on emergency core cooling system (ECCS) actuation signal
- Decay heat removed
 - condensing steam on inside surface of containment vessel
 - convection to the pool fluid on outside vessel wall



Reliable Means for Shutdown

- Protection function: highly reliable safety-related means for achieving rapid reactor shutdown
 - In all cases, reactor immediately shuts down after a trip using control rods, with WRSO
- Shutdown function: under nominal conditions, the reactor remains shut down under cold conditions with reliance only on control rods
 - indefinitely when all control rods are inserted, **or**
 - indefinitely with WRSO during first 70 percent of equilibrium fuel cycle, **or**
 - for 30 days (typical) assuming WRSO while decay heat remains above 100 kW* because of negative reactivity feedback from voiding in the core.
- A return to power is a benign, low probability event that can only occur under a limited set of conditions (e.g., WRSO, loss of power, late in core life, and with low levels of decay heat).

*Depending on core burnup at shutdown, decay heat of 100 kW would be reached at 50 days BOC to 100 days EOC.

Reliable Means for Shutdown

- A return to power is highly unlikely ($< 1\text{E-}6$ per year) and involves
 - the probability of a stuck control rod ($2\text{E-}4$ per demand),
 - the probability of a CVCS failure to insert soluble boron ($8\text{E-}3$ per demand), and
 - the probability that the reactor is in a state that could result in a return to power with a WRSO ($4\text{E-}2$ to $1\text{E-}1$ per year).

Consequence of a Return to Power

- For licensed designs, a return to power can challenge heat removal system capacity of active safety-related systems, resulting in core damage.
- The capacity of NuScale's passive heat removal systems protects the core, irrespective of control rod performance.
 - Core is protected after a return to power with a WRSO, or even after a failure to trip the reactor (ATWS).
 - Reactor power is limited by negative reactivity feedback while removing heat with DHRS or ECCS.

Consequence of a Return to Power

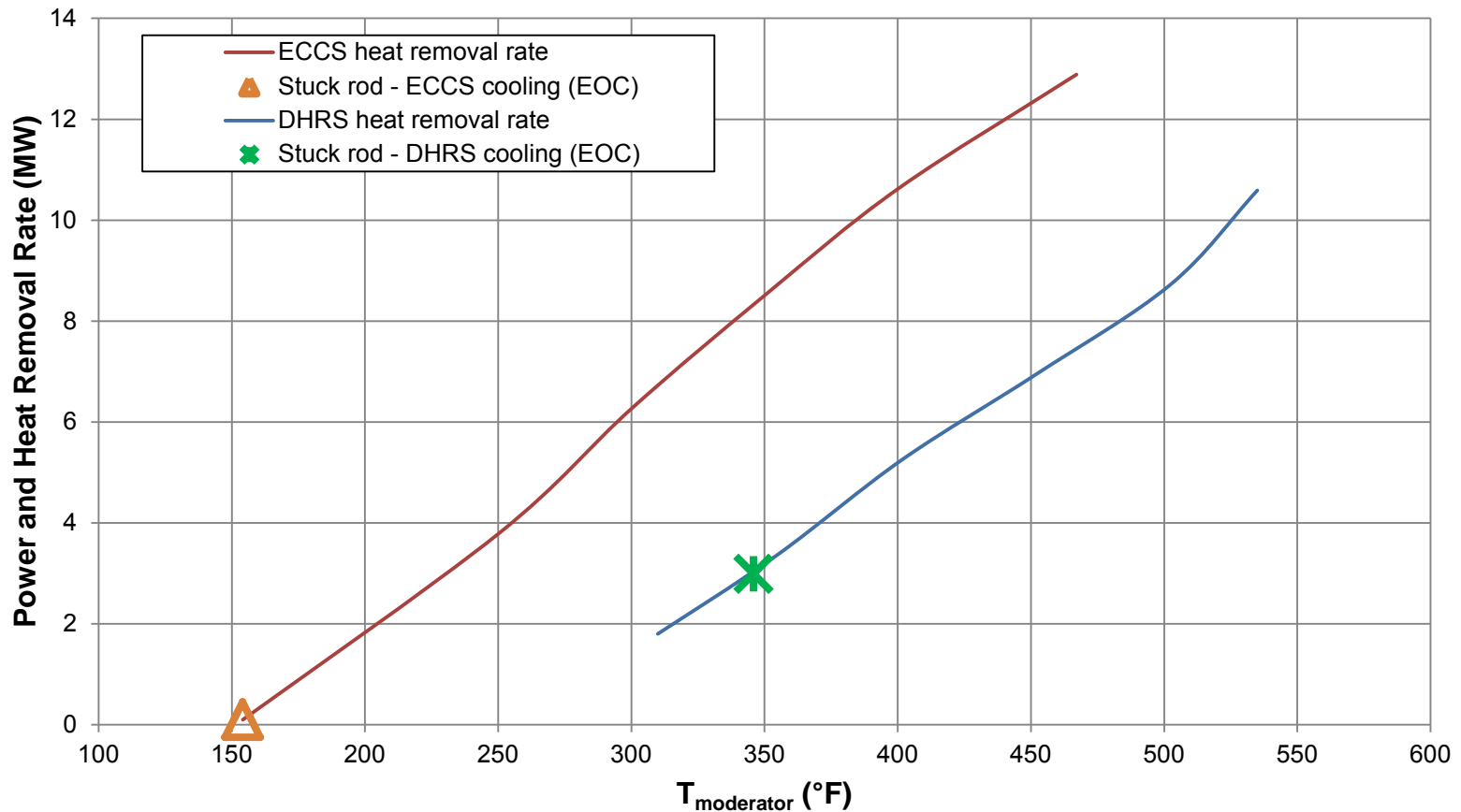
- DHRS heat removal example: Loss of feedwater with WRSO
 - DHRS heat removal characteristic in combination with negative moderator coefficient leads to self-limiting condition
 - higher power -> higher moderator temperature -> negative moderator feedback
 - DHRS capacity to remove heat is sufficient for power generated with a WRSO
 - A return to power with a WRSO while on DHRS is presented in Chapter 15 of the DCA
 - demonstrates that fuel remains protected using conservative deterministic analysis
 - Under nominal conditions, a return to power while using DHRS can be avoided
-

Consequence of a Return to Power

- ECCS heat removal example: RCS depressurization with WRSO
- Depressurization results in shutdown due to voiding, until voiding subsides
- ECCS heat removal characteristic in combination with moderator density decrease due to voiding leads to self-limiting condition
 - higher power -> lower moderator density due to voiding -> negative density feedback
- ECCS capacity to remove heat is sufficient for power generated with a WRSO
- A return to power with a WRSO while on ECCS (<100 kW) is bounded by normal ECCS cooldown with decay heat

Consequence of a Return to Power

- Equilibrium power after return to power with WRSO is within DHRS and ECCS heat removal capacity



Design Considerations for Shutdown

- The NuScale control rod design utilizes conventional external magnetic jack control rod drives because of extensive operating experience and well-documented reliability.
- The safety-related control rods provide sufficient shutdown capability. An additional separate safety-related reactivity control capability is not needed to ensure overall safety.
 - **Passive system reliability:** Low probability of a stuck rod ($2E-4$ per demand) compared to typical active ECCS unreliability ($1E-2$ per demand). After successful control rod insertion, no further operator actions are required to protect the core.
 - **Passive system simplicity:** The design relies on passive control rod insertion. The inclusion of additional safety-related capability will increase design complexity, and introduces additional failure modes that could, for example, result in containment bypass (due to external module piping connections that would be required to open).

Design Considerations for Shutdown

- NuScale design aligns with the NRC’s advanced reactor policy statement (73 FR 60612; October 14, 2008) for an advanced reactor design
 - “Highly reliable and less complex shutdown and decay heat removal systems. The use of inherent or passive means to accomplish this objective is encouraged (negative temperature coefficient, natural circulation, etc.).”
 - “Simplified safety systems that, where possible, reduce required operator actions, equipment subjected to severe environmental conditions, and components needed for maintaining safe shutdown conditions. Such simplified systems should facilitate operator comprehension, reliable system function, and more straightforward engineering analysis.”
 - “Design features that can be proven by citation of existing technology, or that can be satisfactorily established by commitment to a suitable technology development program.”

Precedent for a Return to Power

- GSI-22, Inadvertent Boron Dilution Events
 - 2E-4 per reactor year for a return to power
- NUREG-1449, Shutdown and Low-Power Operation
 - 1E-5 per reactor year for core damage due to rapid boron dilution
- GSI-185, Control of Recriticality Following Small-Break LOCAs
 - 3E-8 per reactor year for core damage due to inadvertent boron dilution during a small-break LOCA transient
- 10 CFR 50.62, ATWS
 - Goal to reduce ATWS CDF to less than 1E-5 per reactor year

In contrast, a return to power for NuScale is a low probability, low consequence event.

Summary

- Reactivity control systems appropriately matched with the simplicity and passive safety of the NuScale design provides:
 - rapid shutdown to protect fuel
 - reliable capability to maintain the reactor subcritical under cold conditions
 - passive heat removal provides protection against control rod malfunctions
- Design of reactivity control systems aligns with the NRC’s advanced reactor policy statement (73 FR 26349; October 14, 2008) for an advanced reactor design
- A return to power with a WRSO is a benign event with a lower probability than the core damage frequency of approved designs



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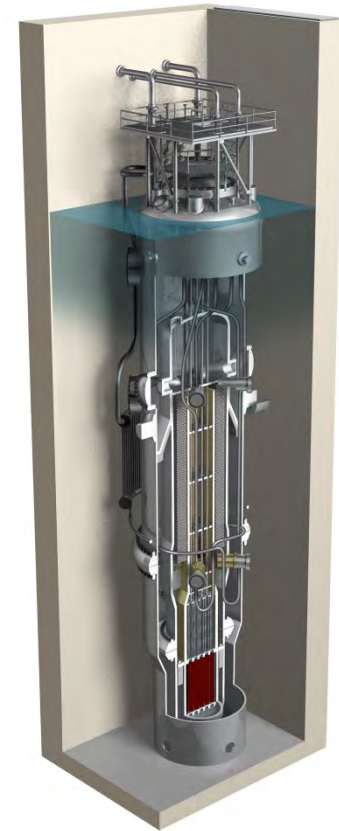
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NuScale Exemption Request to General Design Criterion 27

By
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1/23/2018

Purpose

Brief the ACRS on the acceptance criteria the staff plans on using to evaluate NuScale's exemption to General Design Criterion 27, "Combined Reactivity Control System Capability," as described in the staff's draft Commission paper

Technical Background

- Late in pre-application, the staff learned the NuScale reactor would return to and sustain fission power (become and remain recritical) under Chapter 15 design basis assumptions
- Assumptions include:
 - A stuck rod, which is consistent with current GDCs
 - Loss of AC power
 - Non-safety related Chemical and Volume Control System (CVCS) is unavailable
 - Sufficiently negative MTC (occurs during most of an operating cycle)
- Using design basis assumptions, return to power will occur following most AOOs and postulated accidents for the long term
- Maximum core return to power ~9%, peak pin power > 50%
- Design remains subcritical if all control rods insert

Regulatory Background

- General Design Criterion 27 states,
 - The reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.
- Staff review focused on meaning of “reliably controlling reactivity changes”
- SECY-94-084, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs,” stated,
 - “...that conditions other than cold shutdown may constitute a safe shutdown state as long as reactor subcriticality, decay heat removal, and radioactive materials containment are properly maintained for the long term.”

Regulatory Background (cont)

- Definition of safety-related SCCs in 10 CFR 50.2 states,
 - (2) The capability to shut down the reactor and maintain it in a safe shutdown condition
- The NRC has licensed designs which return to power in the short term following some postulated accidents (e.g., PWR Main Steam Line Breaks)
- The NRC has not licensed a power reactor that does not achieve subcriticality in the long term using only safety-related systems
- Staff's responded to NuScale that an exemption to GDC 27 would be required and such an exemption would warrant Commission consideration and direction prior to the staff's approval (ML16116A083)

NuScale's PDC 27 and Exemption Request

- PDC 27 in DCD Section 3.1.3.8 states,
 - “The reactivity control systems shall be designed to have a combined capability of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained

Following a postulated accident, the control rods shall be capable of holding the reactor core subcritical under cold conditions, without margin for stuck rods provided the specified acceptable fuel design limits for critical heat flux would not be exceeded by the return to power”

NuScale's PDC 27 and Exemption Request (cont)

- Exemption – no undue risk and public health and safety
“This exemption will not impact the consequences of any design basis event and will not create new accident precursors. The NuScale plant incorporates reactivity control provisions to assure the capability to cool the core is maintained under postulated accident conditions, and to reliably and safely shutdown the reactor. Therefore, the exemption will not present an undue risk to the public health and safety.”

Staff's Review Approach

- Staff applied the Enhanced Safety Focused Review Approach (ESFRA) at the beginning of the review
 - Identified this issue would receive more emphasis in terms of review scope and depth, compared to a traditional review, using the ESFRA tool
- Staff is early in the review of the analysis (Phase 1) and continues to apply ESFRA in its review
- Technical audits of NuScale analyses is ongoing, as well as staff confirmatory analyses

Staff's Review and Acceptance Criteria

- Chapter 15 review considers,
 - Conservative analysis assumptions, worst stuck rod and using minimum critical heat flux ratio (MCHFR) as the acceptance criteria to demonstrate adequate cooling and maintain the fission product barrier
 - This is consistent with the methodology typically used to analyze PWR main steam line break, short-term return to power
 - Does not consider the probability of occurrence (event probability is 1)
- Exemption review will consider,
 - Chapter 15 acceptance criteria are met (SAFDLs)
 - Shutdown is maintained assuming all control rods insert
 - Probability of occurrence is low (not within the lifetime of a module)
- If above are met the staff anticipates recommending granting the GDC 27 exemption and approval of a final version of PDC 27