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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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674TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

OPEN SESSION

+ + + + +

WEDNESDAY, JUNE 3, 2020

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The Advisory Committee met via Video
Teleconference, at 9:30 a.m. EDT, Matthew W. Sunseri,
Chairman, presiding.

COMMITTEE MEMBERS:

MATTHEW W. SUNSERI, Chairman

JOY L. REMPE, Vice Chairman

WALTER L. KIRCHNER, Member-at-large

RONALD G. BALLINGER, Member

DENNIS BLEY, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

JOSE MARCH-LEUBA, Member

DAVID A. PETTI, Member

PETER RICCARDELLA, Member

1 ACRS CONSULTANT:

2 MICHAEL CORRADINI

3 STEPHEN SCHULTZ

5 DESIGNATED FEDERAL OFFICIAL:

6 ZENA ABDULLAHI

7 CHRISTINA ANTONESCU

8 CHRISTIANA LUI

9 QUYNH NGUYEN

10 MICHAEL SNODDERLY

12 ALSO PRESENT:

13 KATI AUSTGEN, NEI

14 BRUCE BAVOL, NRR

15 ERIC BENNER, NRR

16 BEN BRISTOL, NuScale

17 SARAH BRISTOL, NuScale

18 ROBERT CALDWELL, NRR

19 PAUL CLIFFORD, NRR

20 MICHAEL DUDEK, NRR

21 SARAH FIELDS, Public Participant

22 PAUL INFANGER, NuScale

23 MARVIN LEWIS, Public Participant

24 PHILIP McKENNA, NRR

25 MICHAEL MELTON, NuScale

1 SCOTT MOORE, Executive Director, ACRS
2 REBECCA PATTON, NRR
3 ZACK RAD, NuScale
4 HANNAH ROOKS, NuScale
5 STEPHEN VAUGHN, NEI
6 MICHAEL WATERS, NRR

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P R O C E E D I N G S

9:30 a.m.

CHAIR SUNSERI: The meeting will now come to order. This is the first day of the 674th Meeting of the Advisory Committee on Reactor Safeguards. I am Matthew Sunseri, the Chair of the ACRS. I'll call the roll. Ron Ballinger?

MEMBER BALLINGER: Here.

CHAIR SUNSERI: Dennis Bley?

(No audible response.)

CHAIR SUNSERI: Charles Brown?

MEMBER BROWN: Here.

CHAIR SUNSERI: Vesna Dimitrijevic?

MEMBER DIMITRIJEVIC: Present.

CHAIR SUNSERI: Walt Kirchner?

MEMBER KIRCHNER: Present.

CHAIR SUNSERI: Jose March-Leuba?

MEMBER MARCH-LEUBA: Here.

CHAIR SUNSERI: Dave Petti?

MEMBER PETTI: Here.

CHAIR SUNSERI: Joy Rempe?

VICE CHAIR REMPE: Like the gavel, Matt.

CHAIR SUNSERI: Yeah, thanks. Peter Riccardella?

MEMBER RICCARDELLA: I'm here.

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1 CHAIR SUNSERI: And myself. Okay. We've
2 got Dennis Bley on here. I thought I saw him on the
3 list.

4 MR. NGUYEN: Dennis, I unmuted you,
5 Dennis.

6 CHAIR SUNSERI: Dennis, we can't hear you.

7 MEMBER BLEY: I can. Hi.

8 CHAIR SUNSERI: Okay, great. All right.
9 We have a quorum, and I would like to also note the
10 presence of Michael Corradini and Stephen Schultz, our
11 consultants on this matter this week. The ACRS was
12 established by Atomic Energy Act and is governed by
13 the Federal Advisory Committee Act. The ACRS section
14 of the U.S. NRC public website provides information
15 about the history of the ACRS and provides documents
16 such as our charter, bylaws, Federal Register notices
17 for meetings, letter reports, and transcripts of all
18 full and subcommittee meetings, including all slides
19 presented at the meetings.

20 The Committee provides its advice on
21 matters -- on safety matters to the Commission through
22 its publicly available letter reports. The Federal
23 Register notice announcing this meeting was published
24 on May 22nd, 2020 and provided an agenda and
25 instructions for interested parties to provide written

1 documents or request opportunities to address the
2 Committee. The Designated Federal Official for this
3 meeting is Ms. Zena Abdullahi.

4 During this meeting, the Committee will
5 take up the following: Regulatory Guide 1.236,
6 Pressurized Water Reactor Control Rod Ejection and
7 Boiling Water Reactor Control Rod Drop. We intend to
8 produce a letter on this topic. Second, Reg Guide
9 1.187, Guidance for Implementation of 10 CFR 50.59,
10 Chances, Tests and Experiments Regarding Digital
11 Instrument and Control Upgrades. We also intend to
12 produce a letter on this topic.

13 We will continue our review of NuScale
14 area of focus on boron redistribution, and this will
15 take up the bulk of our time during this week's
16 meeting. Time permitting, we will consider the
17 content of our final letter report on NuScale DCA, and
18 we have a planning and procedure session scheduled for
19 Friday morning.

20 As reflected in the agenda, portions of
21 the NuScale session may be closed in order to discuss
22 and protect information designated as sensitive or
23 proprietary information. A phone bridge line has been
24 opened to allow members of the public to listen in on
25 presentations and committee discussion. We have

1 received no written comments or requests to make oral
2 statements from the members of the public regarding
3 today's or this week's sessions.

4 There will be an opportunity for public
5 comment, and we have set aside time in the agenda for
6 comments from members of the public attending or
7 listening to our meetings. Written comments may be
8 forwarded to Ms. Zena Abdullahi, the Designated
9 Federal Official. A transcript of the open portions
10 of the meeting is being kept, and it is requested that
11 speakers identify themselves and speak with sufficient
12 clarity and volume so that they can be readily heard.

13 As this is the continuation of our use of
14 virtual meetings, we are still applying our lessons
15 learned from previous meetings. And so those lessons
16 learned are that the presenters should pause
17 frequently to allow members to interject questions or
18 ask to interject comments or ask questions. We will
19 be taking short breaks approximately every hour for
20 ergonomic considerations.

21 Additionally, participants should mute
22 themselves when not speaking. It can be very
23 distracting when there's background noise, especially
24 when you have 48 participants right now. So you can
25 imagine. And we do have the capability to mute people

1 from our end if we think that there's a distraction
2 occurring. Are there any questions about the meeting
3 logistics from the members?

4 (No audible response.)

5 CHAIR SUNSERI: Okay. I have two items of
6 current interest to bring up. The first, as we
7 contemplate the return to face-to-face meetings, we
8 are following Agency guidance. Right now, there's a
9 graded approach being put in place. There's four
10 phases, zero, one, two, three. We are currently -- I
11 think we're currently in Phase 0, maybe transitioning
12 to Phase 1. But from all our studying of the phases,
13 it looks like we will not continue with face-to-face
14 meetings until we are securely in Phase 2 of that
15 plan. And there'll be more discussion of this during
16 the PMP session later this week.

17 Second item is because of our extensive
18 workload as we try to complete our NuScale DCA review,
19 we are planning an extra meeting in a week in July.
20 So normally, we only have one meeting per month.
21 We're planning an extra meeting, and that's right now
22 targeted for the week of July 20th. And once again,
23 more information will be provided during the PMP
24 session.

25 So that's all the opening comments that I

1 have. We will continue with the agenda now on
2 Regulatory Guide 1.236, Pressurized Water Reactor
3 Control Rod Ejection and Boiling Water Reactor Control
4 Rod Drop. And I turn to Walt Kirchner, the
5 Subcommittee Chair, to lead us through this second.
6 Walt?

7 MEMBER KIRCHNER: Yes, thank you. Good
8 morning. Thank you, Mr. Chairman. Today -- let me
9 back myself up. On May 5th, 2020, the combined ACRS
10 Metallurgy and Reactor Fuels and Thermal-Hydraulic
11 Phenomena Subcommittees held a meeting on Regulatory
12 Guide 1.236, Pressurized Water Reactor Control Rod
13 Ejection and Boiling Water Reactor Control Rod Drop
14 Accidents, Regulatory Guide 1.236.

15 In today's meeting, we'll hear
16 presentations on the topic. There's a long history
17 related to this Regulatory Guide. The staff briefed
18 the ACRS back in 2007 when this was in its genesis and
19 again in October 2016. In today's meeting, the staff
20 will present the finalized draft of what was Draft
21 Guide 13.27, now Regulatory Guide 1.236. And I note
22 the timeliness of this topic given our agenda later
23 this afternoon. With that, we'll now proceed and call
24 on Paul Clifford of the staff to make his
25 presentation. Paul?

1 (No audible response.)

2 MEMBER KIRCHNER: Matt, am I still
3 connected?

4 CHAIR SUNSERI: Yeah, yeah, you are. I'm
5 looking at Paul. He's muted right now. Paul, if
6 you're talking, unmute your line. There you go.
7 There you go.

8 MR. CLIFFORD: That's not the first time
9 I've done that.

10 CHAIR SUNSERI: Go ahead, Paul. Good
11 morning.

12 MR. CLIFFORD: Good morning. Hello, I am
13 the Senior Level Advisor for Reactor Fuel in the
14 Office of Nuclear Reactor Regulation. I have been in
15 NRR's Division of Safety Systems since 2003. Prior to
16 that, I worked in the commercial nuclear industry for
17 16 years.

18 The focus of my 30-plus years of
19 experience has been in fuel design and performance,
20 core reload safety analysis, and plant operations. I
21 will be presenting -- I will be providing a brief
22 presentation, which is kind of an abridged version of
23 what was presented back in early May on Reg Guide
24 1.236, which provides guidance for evaluating a
25 nuclear reactor's initial response to a postulated

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1 control rod ejection or control rod drop accident.

2 Today, we will start off with an overview
3 of the postulated reactivity insertion accidents and
4 applicable regulatory requirements, then a brief
5 summary of the guidance document, and a timeline of
6 the staff's guidance and how it evolved with the
7 expanding empirical database from in-pile prompt pulse
8 testing programs. I will describe stakeholder
9 comments received by two public comment periods, then
10 we will walk through the guidance with emphasis on
11 what has changed since 2016 which is the last time the
12 full committee was briefed. Then I will describe
13 cladding hydrogen uptake models, which were developed
14 to aid in the implementation of this guidance. And
15 finally, I will describe staff efforts to support a
16 relatively new industry initiative on fuel rod burnup
17 extension. On to Slide 3.

18 The safety significance of a reactivity
19 insertion accident is evident from the fatal accident
20 which occurred at the U.S. Army's prototype modular
21 reactor SL-1. On January 3rd, 1961, SL-1 experienced
22 a prompt critical power excursion leading to a steam
23 explosion as a result of an improper central control
24 rod withdrawal. All three operators were killed as a
25 result of the physical trauma received in the violent

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1 explosion.

2 Even if the operators had somehow shielded
3 themselves from the explosion, lethal amounts of
4 radiation was released into the building. On the
5 left, you see an old INL safety poster, which shows
6 what remained of the SL-1 reactor. This nuclear
7 accident was likely on the minds of the AEC when they
8 drafted the general design requirements a few years
9 later.

10 So GDC-28 limits the amount and the rate
11 of reactivity insertion to protect the reactor coolant
12 pressure boundary and ensure a coolable geometry. In
13 addition, Parts 50 and 100 establish limits on
14 radiation exposure for the general public. Reg Guide
15 1.236 provides an acceptable means to meet these
16 regulations. Moving on to Slide 5.

17 Reactivity insertion accidents are safety
18 significant because of their potential ability to
19 challenge fuel rod integrity, fuel bundle geometry,
20 and the integrity of the reactor pressure boundary.
21 The uncontrolled movement of a single control rod out
22 of the core results in a positive reactivity insertion
23 that promptly increases local power. This movement of
24 a single control element is considered the limiting
25 reactivity reinsertion accident. Of the various

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1 postulated single failures to a control rod drive
2 system which may initiate an uncontrolled movement of
3 a single control rod, the PWR control rod ejection and
4 BWR control rod drop are the considered the most
5 limiting scenarios for the current operating fleet.
6 On to Slide 6.

7 Building upon the latest research data,
8 Reg Guide 1.236 represents a significant advancement
9 in guidance. It separately captures fabrication,
10 burnup, and corrosion effects on fuel rod performance
11 under RAI conditions. Section C.1 defines limits on
12 the applicability of the guidance. Section C.2
13 provides acceptable analytical inputs, assumptions,
14 and methods. Section C.3 provides fuel rod cladding
15 failure thresholds based on multiple failure
16 mechanisms. Section C.4 directs the reader to the
17 applicable guidance for regulatory consequences.
18 Section C.5 provides allowable limits on RCS pressure.
19 And Section C.6 provides allowable limits to ensure
20 coolable geometry.

21 Appendix B and Appendix C were provided to
22 help with the implementation of the guidance.
23 Appendix B provides transient fission gas release
24 correlations, and Appendix C provides acceptable
25 cladding hydrogen uptake models. So that's kind of a

1 very brief outline of the Reg Guide itself. Now on to
2 Slide 7.

3 This slide shows the evolution of
4 Regulatory Guides beginning in 1974 with the release
5 of Reg Guide 1.77 and ending in today's briefing. Reg
6 Guide 1.77 provided guidance for PWR control rod
7 ejection only. And at the time, it was based on a
8 very limited database, and I'll show that in the next
9 few slides.

10 1980, there was a publication which
11 reevaluated the data up to that point and made
12 recommendations for changes to the guidance. In 2004,
13 it was RIL-0401 issued by the Office of Regulatory
14 Research which identified new phenomena and ultimately
15 concluded that there was sufficient margin in the
16 existing operating fleet such that immediate action
17 wasn't necessary, but at the same time recommended
18 updates the guidance. In 2007, the staff issued
19 Interim Acceptance Criteria and Guidance and Standard
20 Review Plan which is NUREG 0800, Chapter 4.2, Appendix
21 B.

22 2017, we went out for public comments in
23 DG-1327. And in 2019, we went out for a second round
24 of public comments, and I'll be talking about those.
25 But first, let's get back to the empirical database

1 which drives this guidance. In-pile prompt critical
2 power excursion type testing is required to understand
3 the phenomena, identify damage mechanisms and failure
4 modes, calibrate analytical models, and establish
5 analytical limits to ensure acceptable fuel
6 performance.

7 In 1974, the year Reg Guide 1.77 was
8 issued, the empirical database consisted of 10 in-pile
9 prompt reactivity insertion accidents conducted at the
10 Special Power Excursion Research Test Reactor Program,
11 known as SPERT. This figure here presents the data
12 that was available at that time. It shows as a
13 function of peak radial fuel enthalpy versus fuel rod
14 or fuel specimen burnup.

15 The closed symbols represent the failure
16 where failures were reported, the open symbols where
17 failure was not reported. And as we move forward,
18 you'll see the same type of -- how the data is
19 presented with the failed closed and the open symbols
20 denoting non-failure. And you'll also notice as you
21 see the population grow in the data, there's different
22 symbols for the different test reactor programs.

23 So moving on to 1980. From 1978 to 1980,
24 a series of in-pile tests were conducted at the Power
25 Burst Facility in Idaho. These additional tests

1 suggested a need for new analytical limits. A
2 threshold for coolable geometry was reduced from 280
3 calories per gram to 230 calories per gram. And the
4 threshold from cladding failure was reduced from 170
5 calories per gram to 140 calories per gram for
6 irradiated fuel.

7 However, based on advanced analytical
8 methods, it was concluded that no imminent safety
9 concern existed in the operating fleet. As such, the
10 guidance was not revised. However, many plants
11 implemented reduced limits. By 2004, the empirical
12 database had expanded significantly with in-pile test
13 programs being conducted in France, Japan, and Russia.

14 In response to reported PCMI cladding
15 failures at lower than expected deposited energy, the
16 NRC completed a detailed safety assessment which was
17 published in RIL-0401. Once again, based upon the
18 research in advanced analytical methods, the staff
19 concluded that there was no imminent safety concern.
20 However, at that time, it was recognized that the
21 guidance needed to be updated. So in 2007, the staff
22 issued, as I mentioned, SRP 4.2, Appendix B which was
23 interim guidance, which included new cladding failure
24 thresholds, coolability geometry limits, and transient
25 fission gas release correlations.

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1 This graph shows where we are today.
2 Tests conducted since the interim guidance was issued
3 or highlighted here in red. This data, including the
4 latest and greatest, was used to form this final
5 guidance which is in Reg Guide 1.236.

6 I think it's worth mentioning that the
7 amount of data that has been generated in the last 10
8 years has slowed down significantly from what we've
9 seen in the past, and that was due to post-Fukushima.
10 I think we saw the information coming out of NSRR in
11 Japan started to diminish. CABRI was shut down as
12 they transitioned from a sodium loop to a water loop.
13 And then they ran into some regulatory issues I
14 believe that had to do with seismic qualification of
15 the reactor building. And that delayed CABRI for 10
16 years.

17 But now, we're starting to see an uptick
18 in data, and we expect more and more data in the next
19 few years, driven a lot about by accident tolerant
20 fuels. But CABRI is up and running. NSRR is back up
21 and running. And now we have the TREAT facility in
22 Idaho, which is expected to start producing more data.
23 So we're living exciting times now.

24 Now we're on to Slide 12. So the next two
25 slides talk about the public comments we received.

1 Following the ACR briefing in 2016, DG-1327 went out
2 for public comments. Comments were received from 12
3 stakeholders with a total of 124 comments. Over 100
4 comments were accepted and prompted changes to the
5 guidance. This pie chart shows the distribution of
6 comments to the various area of the guidance. In
7 addition, public workshops were held during and after
8 the public comment period.

9 In 2019, DG-1327 went out for a second
10 round of public comments. Comments were received from
11 seven stakeholders with a total of 54 comments. Over
12 30 comments were accepted and prompted changes to the
13 guidance. And this updated pie chart shows the
14 distribution of comments received in 2019.

15 Slide 14 summarizes major changes which
16 were prompted by the public comments. First, we
17 expanded the fuel burnup range to 68 gigawatt days for
18 metric ton uranium rod average burnup, and we'll talk
19 about that later in the presentation. That's in
20 Section C.1 of the guidance.

21 We improved the analytical requirements in
22 Section C.2. There was significant changes to the
23 analytical guidance. For example, we separated the
24 PWR and the BWR guidance to make it more useful and
25 more easily read. We revised the PCMI cladding

1 failure threshold curves in Section C.3. We removed
2 the radiological source term information, which was
3 previously in Section C.4, and that included
4 analytical requirements, fission product gap release
5 fractions, and analytical procedures. And they will
6 be moved to a future revision or Reg Guide 1.183.

7 We amended the implementation section to
8 reflect the revised permission guidance on backfit
9 which is in Section D of the guidance. And we added
10 cladding hydrogen uptake models in Appendix C. Okay.
11 So before we move on and we start getting into -- hold
12 on a sec. Before we move on and start getting into
13 the major sections of the guidance which are updated,
14 are there any questions?

15 (No audible response.)

16 MR. CLIFFORD: Not hearing any, we'll
17 continue. So on to Slide 16. On this slide, I'm
18 going to show you photographs of fuel rod specimens
19 from the SPERT-CDC test program. When we define an
20 analytical limit on damaged core coolability, what we
21 are trying to preserve is the fuel pellet stack within
22 the fuel rod cladding within a fuel assembly bundle
23 array, essentially a known configuration which both
24 shows the geometry which can be modeled and
25 demonstrated to be coolable but also limits fuel-

1 coolant interaction.

2 And here's the progression which shows
3 increasing energy deposition and the effects on the
4 fuel rod. As you can see as we get up above 300
5 calories per gram, the rod is no longer within a known
6 configuration and you start to see cladding melting,
7 deformation, fuel melting, and dispersal. So on to
8 Slide 17.

9 Here is the guidance to ensure you have
10 coolable geometry. It consists of two parts. A loss
11 of fuel rod geometry limit, 230 calories per gram, is
12 based on the earlier test at SPERT, PBF, and NSRR,
13 purely an empirical limit. Note that this has not
14 changed since 2016. And second is a limited
15 centerline melt which avoids fuel-coolant interaction.

16 It's worth noting of the two criteria
17 which are separately evaluated, fuel melt becomes more
18 limiting at about middle of life, around 30 gigawatt
19 days. Note that the combination of the two preserves
20 coolable geometry and satisfies GDC-28. And there's
21 only been editorial -- slight editorial changes
22 relative to 2016.

23 Okay. On to Slide 18, we're going to get
24 into radiological consequences. So in order to
25 perform radiological consequence assessment, it

1 requires a conservative estimate of the total number
2 of failed fuel pins from all failure modes. That
3 includes high temperature cladding failure from prompt
4 critical scenarios. DNB and CPR are thermal limit
5 cladding failures for non-prompt scenarios, PCMI
6 cladding failure, and cladding failure as a result of
7 fuel melt. And there's separate guidance for each one
8 of these.

9 It also requires a conservative estimate
10 of the fission product release fraction from each fuel
11 rode, and that includes what is accumulated in the
12 fuel rod plenum region from steady-state gas release,
13 transient fission gas release which occurs during --
14 as you would expect, during accidents, and any
15 additional releases as a result of fuel melt. The
16 guidance associated with the fission product
17 inventories has been moved out of this Reg Guide and
18 into a future revision of Reg Guide 1.183. And that
19 was prompted by public comments.

20 Next we'll get into the cladding failure
21 threshold. The first one is high temperature cladding
22 failure threshold, and on the screen is the guidance
23 itself. It consists of multiple failure thresholds.
24 The first results from a ductile failure mode and the
25 second from a brittle failure mode.

1 All of these failure modes are associated
2 with boiling prices, and the first one, the brittle
3 failure, has to do with oxygen induced embrittlement
4 of the cladding. The ductile failure has to do with
5 cladding creep, ballooning and bursting. And as I
6 mentioned, they're divided based on the severity of
7 the event for prompt critical event scenarios. There
8 is an empirically-based failure threshold, which is
9 shown here on this figure. And for nonprompt, we fall
10 back to the DNBR thermal design list.

11 Failure mode is from PCMI. That's pellet
12 cladding mechanical interaction, and here's the
13 guidance --- here's the text, sorry, that's in the
14 guidance. Cladding failure threshold curves are
15 provided as a function of fuel enthalpy rise versus
16 cladding hydrogen content. And the reason we chose
17 this metric is because the data shows that the failure
18 of the cladding is more sensitive to hydrogen content
19 than it is burnup.

20 And besides the overall concentration of
21 hydrogen in the cladding, PCMI is also sensitive to
22 the zirconium hydride distribution and orientation
23 within the cladding wall itself. So cladding
24 distribution is influenced by thermal and mechanical
25 treatment during manufacturing and also by the stress

1 state prevailing during hydride precipitation. This
2 first micrograph shows a cross section from a hybrid
3 of PWR cladding manufactured in the stress-relieve
4 annealed state.

5 The OD oxide layer is up here. It's
6 clearly visible at the top of the micrograph. These
7 lines here are zirconium hydrides, which are
8 precipitated along grain boundaries. Hydride
9 precipitants preferentially precipitant along
10 circumferal direction in the stress-relieve annealed
11 state.

12 In addition, hydrides preferentially
13 reside towards the cooler outside surface. So
14 hydrides will precipitate in a cooler region of the
15 cladding but also in a higher stress state. So here
16 you see very high concentrations of what we call
17 hydride rim. And as you can notice down towards the
18 bottom, there's less. So upon the failure mode here
19 is from the OD in. And so you get an immediate crack
20 in the oxide layer which goes in a brittle fashion
21 through the hydride lines and then it kind of becomes
22 more in a ductile fashion, this classic 45 degree
23 angle here.

24 The second micrograph shows a cross
25 section from a high burnup BWR cladding manufactured

1 in a fully recrystallized state. And RXA cladding
2 exhibits randomly oriented hydride distributions and
3 orientation as you can see. There's not that clean
4 orientation here where it's more random.

5 However, the radial hydrides provide a
6 pathway for crack propagation. As a result, RXA
7 cladding is much more sensitive to hydrogen content.
8 As you'll see, crack begins on the outside, and the
9 oxide starts following these radially oriented
10 hydrides. And then you start to see more of a ductile
11 fashion towards the end.

12 So in summary, PCMI failure is sensitive
13 to both the overall concentration of the hydrogen and
14 to the orientation of the hydrogen. So both have to
15 be accounted for in the failure mechanism. As a
16 result, the staff developed separate failure curves.
17 There's an SRA cladding failure threshold curve for
18 high temperatures. There's also one for low
19 temperatures. There's an RXA cladding failure
20 threshold curve for high temperature and for low
21 temperature.

22 MEMBER BALLINGER: This is Ron Ballinger.
23 Back on Slide No. 21 for the BWR, is that the liner on
24 the inside?

25 MR. CLIFFORD: Correct. This is a liner

1 cladding. As you can see, there's a high
2 concentration of hydrides in the sponge region.

3 MEMBER BALLINGER: Yeah.

4 MR. CLIFFORD: And we'll get into -- talk
5 about we developed separate curves to account for that
6 also. We'll get to that. Thanks for bringing that
7 up. So we've developed four different PCMI failure
8 curves, and I'll just kind of walk through them.

9 They presented as a function of the
10 increase in peak radial average fuel enthalpy versus
11 excess cladding hydrogen. This plot here shows one of
12 the curves that's presented in Reg Guide 1.236, and it
13 also shows the previous version of this curve which
14 was in DG-1327. Here's the SRA hot. Here's the SRA
15 cold. Here's RXA hot and RXA cold.

16 Okay. That brings me into the next
17 discussion which was just brought up. In response to
18 numerous fuel rod failures during normal operation in
19 the BWR fleet in the 1970s and '80s, the industry
20 developed barrier cladding. The root cause of these
21 fuel failures was PCI stress corrosion cracking.
22 Barrier cladding consists of a natural or low alloy
23 zirconium liner on the ID of standard Zirc-2 cladding
24 and has been shown to be less susceptible to PCI
25 stress corrosion cracking.

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1 One unexpected benefit of the liner was
2 its higher affinity for hydrogen. This micrograph,
3 similar to the micrograph we showed in the RAI failure
4 on the previous slide, shows a cross section of
5 irradiated Zirc-2, the cladding segment. The
6 zirconium hydrides are clearly visible.

7 Notice a concentration of hydrides within
8 the cladding lining on the ID. Here's the -- some of
9 this at the other one, there's a higher concentration
10 of zirconium hydrides in this barrier liner. Hence,
11 the liner depletes the base metal of the detrimental
12 effects of hydrides. And studies have shown that the
13 liner remains ductile even with the higher
14 concentration of hydrides.

15 This plot shows the applicable empirical
16 database used to develop the RXA PCMI failure curves.
17 The blue symbols represent test segments consisting of
18 Zirc-2 cladding with barrier lining. Note that these
19 barrier tests are the most important since they define
20 the shape and slope of the curve.

21 The test results shown in blue were
22 shifted to account for the presence of up to 30
23 percent of the zirconium hydrides within the barrier
24 liner. Using the scale test results, the staff
25 developed RXA PCMI cladding failure curves for both

1 barrier and nonbarrier fuel types. So we essentially
2 have now six PCMI failure curves, SRA cold, SRA hot,
3 RXA cold, RXA hot, RXA with barrier cold, RXA with
4 barrier hot. So are there any questions on cladding
5 failure thresholds before we move on?

6 (No audible response.)

7 MR. CLIFFORD: Okay. Moving on to Slide
8 28. Okay. As I mentioned earlier, in addition to RIA
9 type guidance, we also provided some guidance which
10 would help with the implementation of the Reg Guide.
11 So in support of the 50.46(c) rulemaking several years
12 ago, the staff developed acceptable conservative
13 cladding hydrogen uptake models.

14 These models were part of the public
15 comment period for DG-1263 in 2014 and were published
16 in a draft Reg Guide 1.224 in 2015. These models were
17 also presented during ACR briefs on 50.46(c).
18 However, given the status of 50.46(c), the staff
19 decided to include these hydrogen models here in this
20 Reg Guide because they're needed to implement the
21 hydrogen-dependent PCMI failure threshold curves.

22 This figure shows the BWR hydrogen uptake
23 model along with the supporting database. For PWRs,
24 conservative hydrogen pickup fractions were provided.
25 And this figure here shows the predicted cladding

1 hydrogen content using the conservative 20 percent
2 pickup fraction for Zirc-4 versus the measured
3 cladding hydrogen content. So essentially, we took
4 the available alloy-specific database of cladding
5 hydrogen content measured and we defined a
6 conservative uptake fraction, which would bound the
7 majority of the data. And that's what was provided in
8 Reg Guide 1.224 and is now reflected in this Reg Guide
9 here.

10 MEMBER BALLINGER: This is Ron Ballinger
11 again. I mentioned this during the subcommittee
12 meeting. But with respect to Slide 28, what's not
13 shown is the difference between M5, optimized Zirlo,
14 and Zircaloy 4. Since Zircaloy 4 is no longer --
15 effectively no longer in use for fuel cladding, this
16 slide, while correct, is not reflective of the current
17 status of PWR cladding, I don't think.

18 MR. CLIFFORD: So that is correct. Zirc-4
19 is no longer loaded as batch fuel in the United
20 States. Zirlo, optimized Zirlo, and M5 are the three
21 that are used today. In addition, so we have two
22 effects of alloy composition which are reflected in
23 the guidance. The first is there is alloy-specific
24 hydrogen pickup fraction which is based on the data,
25 and you can see changes for each of the alloys.

1 And also, to implement this, you're using
2 a best estimate alloy-specific corrosion model, which
3 each of the vendors have approved. So they would
4 capture the corrosion rates for each of the alloys in
5 their approved models, and then they would apply this
6 conservative alloy-specific hydrogen uptake -- sorry,
7 cladding hydrogen uptake fraction to their models. So
8 they would capture the alloying effects. In other
9 words, the M5 would have a very, very low corrosion
10 rate, and in addition, have a lower pickup fraction
11 rate. So as a result, the hydrogen at the end of life
12 would be much lower than you would see in the Zirc-4,
13 which would have a higher oxidation rate and a higher
14 pickup fraction.

15 MEMBER BALLINGER: So the slide then, the
16 lower right-hand one for PWR, that predicted versus
17 measured line is for Zircaloy 4, using the Zircaloy 4
18 model, right?

19 MR. CLIFFORD: Correct. That's just for
20 Zirc-4 using a Zirc-4 model. And there would be one
21 of those plots for each of the alloys.

22 MEMBER BALLINGER: Okay.

23 MR. CLIFFORD: And that's what was used to
24 come up with the pickup fractions. But to implement
25 these, as I mentioned, each of the vendors would use

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1 their accrued oxidation models which vary based on
2 alloy.

3 MEMBER BALLINGER: Yeah, it would be good
4 to have slides which include the predicted versus
5 measured for all of the models and the data on them.

6 MR. CLIFFORD: Yeah. And the only reason
7 I didn't get into a lot of details is because this
8 isn't something I developed for this application. It
9 was developed back in 2014, and it's been presented in
10 more detail in the past. That's the only reason.

11 Okay. The next topic, which is Slide 29,
12 is burnup extension. So in support of the near-term
13 licensing actions which we expect, to extend allowable
14 fuel rod average burnup from roughly 62 gigawatt days
15 to 68 gigawatt days, the staff completed a critical
16 assessment of the empirical database supporting Reg
17 Guide 1.236. And that is published there, that ADAMS
18 ML number.

19 For each portion of the guidance, the
20 staff investigated the sensitivity to burnup and
21 assessed the extent of the empirical database
22 available for each portion of the guidance. That
23 means each section of the guidance, meaning the high
24 temperature failure threshold curves, the PCMI failure
25 threshold curves, the core coolable geometry

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1 analytical limits, and the fission gas release
2 correlations. Based upon this work, the staff was
3 able to extend the applicability out to the projected
4 goal for the industry of 68 gigawatt days. And we
5 went into more detail on this four weeks ago.

6 For the sake of time, we're moving on, the
7 final slide, conclusions. So based upon the latest
8 research data, revised research data, and new analysis
9 and international perspectives, the NRC has developed
10 the guidance that's in Reg Guide 1.236. It represents
11 a significant advancement in guidance.

12 As I mentioned earlier, it separately
13 captures fabrication, burnup, and corrosion effects on
14 fuel rod performance under RAI conditions. ACRS and
15 stakeholder involvement started prior to 2017.
16 There's been several ACRS briefings beginning with the
17 Interim Guidance. Actually, ACRS briefings began back
18 in 2003, I think, when -- before RIL-0401 was issued.
19 There's been numerous public workshops and three
20 rounds of public comments if you consider the interim
21 guidance, and then here the final guidance.

22 VICE CHAIR REMPE: So Paul?

23 MR. CLIFFORD: Yes.

24 VICE CHAIR REMPE: This is Joy. I have a
25 comment. During the subcommittee meeting, as I

1 recall, I mentioned that perhaps the technical basis
2 document might be useful because there were a lot of
3 changes made, sometimes even in the most recent round
4 of public comments. And I think your response was,
5 yeah, there is basically a patchwork of references,
6 and this would be a good recommendation to come from
7 ACRS. And in your opinion, what's the likelihood of
8 such a knowledge management document being generated
9 at this time with other pressures going on in the
10 Agency? Is it likely that's going to occur without
11 some sort of push perhaps from ACRS?

12 MR. CLIFFORD: I mean I think we've got a
13 lot of work coming down the pike. If we look at
14 burnup extension, enrichment extension, accident
15 tolerant fuel, certainly, a recommendation from the
16 ACRS would put a lot more pressure on us to get it
17 done. I think it's an excellent idea. And I think if
18 you recommend it, there'd be 100 percent chance it'd
19 get done in a timely fashion. If you don't recommend
20 it, I think it'll be put on a priority list. But I'm
21 not sure where it would lie on that priority list.

22 VICE CHAIR REMPE: Thank you for your
23 comment.

24 MEMBER BALLINGER: This is Ron again. The
25 CABRI tests, the original CABRI tests, that was a fast

1 reactor test, right?

2 MR. CLIFFORD: Correct, in a sodium loop.

3 MEMBER BALLINGER: In a sodium loop. And
4 so the deposition rates that were achievable with that
5 configuration will likely be quite different than the
6 conversion to the water loop. Am I right? In other
7 words, when they do test using the water loop, are
8 they going to try to duplicate the original test in
9 the sodium loop?

10 MR. CLIFFORD: Yeah, and that's exactly
11 what they're doing. That was the SIP-Q which was run
12 last year. SIP-Q, Q being qualification, which they
13 tried to duplicate one of the previous tests. So
14 they're trying to benchmark it.

15 I think the weight of deposition is driven
16 by the helium-3 loop. Basically, they have a coil
17 with helium-3 which absorbs neutrons, and then they
18 quickly evacuate it.

19 MEMBER BALLINGER: Yeah.

20 MR. CLIFFORD: And that's what drives the
21 shape or the width of the pulse. I still think -- I
22 think they have the same system.

23 MEMBER BALLINGER: Okay. Do we have
24 documentation of the comparison so far?

25 MR. CLIFFORD: Unfortunately, the test was

1 not successful. It turned out that, in the
2 preparation of the specimen, there was some flaws and
3 the rod became waterlogged. So when they tested the
4 rod, instead of -- they expected it to survive up to
5 140 calories (phonetic) per gram, but it failed at 30.

6 MEMBER BALLINGER: I think I do remember
7 that. Okay. But they're planning on doing a proper
8 comparison still?

9 MR. CLIFFORD: Correct. So, there was a
10 test that was originally scheduled for, I think, March
11 or April. But I think it got postponed due to the
12 COVID-19. But they're expecting to run two to three
13 tests a year.

14 MEMBER BALLINGER: Because when I look at
15 the -- it's a graph on Slide 29. I'm just doing a
16 ballpark number here, but it looks like a very
17 significant number of them were from the original
18 CABRI test.

19 MR. CLIFFORD: Slide 29?

20 MEMBER BALLINGER: The squares.

21 MR. CLIFFORD: Right.

22 MEMBER BALLINGER: Especially out at high
23 burnup.

24 MR. CLIFFORD: The squares, right. So the
25 others are kind of, like, a barrel shape. I was kind

1 of running out of symbols. So those little barrel
2 shapes, those are all the NSRR. And I believe there's
3 about 80 of those NSRRs, by far the vast majority of
4 the population we have. But, as I mentioned, we
5 expect more from CABRI and from TREAT (phonetic) now.
6 So, we expect a lot more data, so it's pretty
7 exciting.

8 MEMBER BALLINGER: Thank you.

9 MEMBER KIRCHNER: Other members, further
10 questions of Paul?

11 Hearing none, Mr. Chairman, do we turn now
12 to public comment?

13 CHAIR SUNSERI: If you are finished with
14 your presentation and material, yes, it would be
15 appropriate.

16 MEMBER KIRCHNER: I think, Paul, you're
17 finished at this point, aren't you?

18 MR. CLIFFORD: Correct, yes.

19 MEMBER KIRCHNER: Thank you for an
20 excellent presentation. I note that this was 30
21 slides of very detailed information in about 30
22 minutes. So, well done.

23 Okay. So, Mr. Chairman, I think we can
24 turn to any public comment.

25 CHAIR SUNSERI: Okay. So, comments, let's

1 open the public line for comment.

2 Thomas, can you hear me?

3 (No response.)

4 CHAIR SUNSERI: Christiana, do we know if
5 the public line is open?

6 MS. LUI: I am testing that right now.

7 CHAIR SUNSERI: Thank you. Any members of
8 the public, if you're on the line and can hear, would
9 you make a -- at least voice your presence so we know
10 the line is open?

11 (No response.)

12 CHAIR SUNSERI: Christiana, what'd you
13 find out?

14 MS. LUI: Probably the lines are muted.

15 CHAIR SUNSERI: Okay. Is Thomas
16 available? I don't see him on the line. Is there
17 anyone else that can unmute that line besides Thomas?

18 MR. MOORE: Mr. Chairman, this is Scott.
19 Thomas, I think, has the only link to the public line.
20 So we'll have to come back to that and get Thomas.
21 He's directly patched into the public line.

22 CHAIR SUNSERI: Okay. All right, then.

23 MR. MOORE: So we'll work on that.

24 CHAIR SUNSERI: Okay. So, I guess what we
25 need to do here is put the public comments on hold

1 until we know we can get that line open. We know that
2 we owe them the opportunity.

3 And let's see. We are at the agenda,
4 here, around 10:20. So, Walt, you have a report
5 drafted for this topic?

6 MEMBER KIRCHNER: Yes, I have a letter
7 drafted for this topic for this Reg Guide. So, it's
8 a long letter. What is our timeframe, Mr. Chairman?

9 CHAIR SUNSERI: Maybe you can read that
10 letter in by 11 o'clock.

11 MEMBER KIRCHNER: Oh, definitely, yes.

12 CHAIR SUNSERI: If we can get that read by
13 11 o'clock then we'll take a break at 11:00. And that
14 would put us pretty much on time.

15 MEMBER KIRCHNER: Yeah. I will need the
16 staff's assistance to put the letter up, because I do
17 not have a hard copy of that letter.

18 CHAIR SUNSERI: Right. So, Scott or
19 Sandra, are you available, Sandra Walker?

20 MS. WALKER: Yes.

21 CHAIR SUNSERI: Can you pull up the Reg
22 Guide 1.236 draft report, draft letter?

23 MS. WALKER: Okay. Let me look for it
24 now.

25 CHAIR SUNSERI: And Scott or Larry, will

1 you report when we have reached Thomas and can get
2 that public line open. We'll just pause where we're
3 at to let them comment.

4 MR. MOORE: Yes, Chairman. We'll do that.
5 And Larry had to drop off for another meeting.

6 CHAIR SUNSERI: Okay.

7 MR. NGUYEN: Sam, you don't need to
8 transcribe the reading of the letter.

9 CHAIR SUNSERI: But we do need him to hang
10 on for the next part.

11 MR. NGUYEN: Correct.

12 CHAIR SUNSERI: So I suppose at this --

13 VICE CHAIR REMPE: We also have to
14 transcribe the public comments whenever they are
15 available, correct?

16 CHAIR SUNSERI: That's correct. That's
17 correct. So what we'll do now is I'm going to time
18 mark this. We'll go off the transcript at this point
19 in time so that you don't have to record all this back
20 and forth to getting the phone line set up.

21 (Whereupon, the above-entitled matter went
22 off the record at 10:23 a.m. and resumed at 10:24
23 a.m.)

24 CHAIR SUNSERI: Sam, you with us?

25 MR. NGUYEN: Yes, he says yes.

1 CHAIR SUNSERI: Okay. All right. So the
2 public line is open. Do any members of the public
3 have a comment or statement they would like to make in
4 regards to Regulatory Guide 1.236?

5 (No response.)

6 CHAIR SUNSERI: Can any members of the
7 public listening in simply acknowledge their presence
8 so that we know that the line is open?

9 PARTICIPANT: Hello.

10 CHAIR SUNSERI: Okay. Thank you very
11 much. Any members of the public wishing to make a
12 comment, please do so at this time. State your name
13 and your comment.

14 (No response.)

15 CHAIR SUNSERI: All right. There are no
16 public comments. Thomas, we can close the public
17 line. At this point, we will go off the transcript.

18 (Whereupon, the above-entitled matter went
19 off the record at 10:24 a.m. and resumed at 11:17
20 a.m.)

21 CHAIR SUNSERI: Okay. It is 11:17. We
22 are reconvening the session. Do we have our
23 transcriber online?

24 MR. NGUYEN: The bridge line and
25 transcriber are activated.

1 CHAIR SUNSERI: Okay. I'm going to do a
2 quick roll call to confirm a quorum. Ron Ballinger?

3 MEMBER BALLINGER: Here.

4 CHAIR SUNSERI: Dennis Bley?

5 MEMBER BLEY: Here.

6 CHAIR SUNSERI: Charles Brown?

7 MEMBER BROWN: Here.

8 CHAIR SUNSERI: Vesna Dimitrijevic?

9 MEMBER DIMITRIJEVIC: Yes.

10 CHAIR SUNSERI: Walt Kirchner?

11 MEMBER KIRCHNER: Here.

12 CHAIR SUNSERI: Jose March-Leuba?

13 MEMBER MARCH-LEUBA: Yes.

14 CHAIR SUNSERI: Dave Petti?

15 MEMBER PETTI: Here.

16 CHAIR SUNSERI: Joy Rempe?

17 VICE CHAIR REMPE: Here.

18 CHAIR SUNSERI: Pete Riccardella?

19 MEMBER RICCARDELLA: Present.

20 CHAIR SUNSERI: And myself. All right.

21 So we have a quorum.

22 As a matter of unfinished business from
23 our last session, there was a member of the public
24 that had wished to make a public comment on the phone
25 line but wasn't able to do that. So he sent it in.

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1 I'm going to read in this comment. And just keep in
2 mind that we don't respond to the comments. But I
3 wanted everybody to hear the comment so that we can
4 consider it in our further deliberations. So let me
5 pull this email up.

6 All right. Here is the comment. And it
7 is from Matty F. My question is when and whether the
8 RG will be updated as new CABRI and TREAT data comes
9 in with an addendum to use for accident power fuel
10 with coating and non-Zircaloy iron-chromium-aluminum
11 clad?

12 That's the comment, so it's in the record
13 now. And we'll close that item up. And we are ready
14 to transition now into the next topic, which is Reg
15 Guide 1.187, Guidance for Implementation of 10 CFR
16 50.59, Changes, tests, and experiments regarding
17 digital instrumentation and control upgrades.

18 So, Charlie, I'll turn it over to you as
19 Subcommittee Chair for any introductions and to lead
20 the discussion.

21 MEMBER BROWN: Okay. I'll keep it fairly
22 straightforward. All the members were at the May 20th
23 subcommittee meeting, so the presentation was -- as
24 you most probably remember, there was a discussion at
25 the end between NEI and the staff regarding part of

1 their clarification for 4.3.6 in the Reg Guide.

2 And so they've had an opportunity over the
3 last two weeks to work that out. We did get a copy of
4 the revised highlighted Reg Guide. I think it was
5 yesterday, which still highlighted where the changes
6 were. And then I guess I will let Eric go ahead and
7 make some opening comments, explain what the issue
8 was, and how they then resolved it. Eric, I'll turn
9 it over to you.

10 MR. BENNER: Thank you, Member Brown.
11 Yeah, we're just going to go -- we heard some
12 feedback, both from the members and other
13 stakeholders, at the subcommittee meetings. We've
14 made a number of changes that we feel are responsive.
15 We understand that it may not be still as clear as
16 some stakeholders would like where we think we've made
17 a good faith effort in those comments.

18 We feel pretty comfortable that the
19 document that we presented to you today, or have
20 shared with you and will discuss today, is a solid
21 guidance document. We note that we will perform
22 inspector training. We will have a public meeting
23 close to the issuance of the document, and we would
24 participate in any industry workshops that the
25 industry intends to have. So if there are areas that

1 could benefit from additional discussion, we would
2 intend to use those forums to provide that further
3 clarification.

4 MEMBER BROWN: Okay. Eric, I didn't want
5 to interrupt you. Go ahead if you've got some.

6 MR. BENNER: Nope, that was the end of my
7 statement.

8 MEMBER BROWN: Okay. So I take it from
9 your statement that you and the staff is currently --
10 you considered the changes you have made to be where
11 you can go relative to the various back and forth?

12 MR. BENNER: Yes.

13 MEMBER BROWN: And subsequent to this
14 meeting, your intention is to be able to issue it?

15 MR. BENNER: Correct.

16 MEMBER BROWN: Okay. I just want to make
17 that clear to everybody as we go through. And I will
18 let you go ahead and make your presentations.

19 MR. BENNER: Okay. With that, I will turn
20 it over to Mike and Phil.

21 MR. McKENNA: Okay. Good morning. This
22 is Phil McKenna. I'm a branch chief in the Division
23 of Reactor Oversight. Next slide, Tekia.

24 Okay. Again, the purpose of this brief
25 was, again, we received a letter back in 20 June 2019

1 to come brief the ACRS on our final product of the Reg
2 Guide and to explain how the exception in the draft
3 Reg Guide was resolved. Next slide, please.

4 And one slide on the timeline. From the
5 last ACRS full committee meeting, we had several
6 public meetings where we discussed examples and
7 proposed language changes to the Reg Guide. With
8 that, we came to a conclusion in the April-May
9 timeframe when NEI submitted their final version of
10 Appendix D on May 13th for endorsement. Next slide,
11 please.

12 Just a reminder for the exception, we're
13 only talking about one of the criteria in the 50.59
14 rule, and that was Criterion 6, which is create the
15 possibility for a malfunction of an SSC with a
16 different result than any previously evaluated in the
17 FSAR as updated. Next slide, please.

18 This was the exception in the Reg Guide.
19 In the draft Reg Guide, this slide is not meant to be
20 readable but just to show you the length of the
21 exception. And, basically, it dealt with Step 5 and
22 Step 6 of Section 4.3.6 in Appendix D, where we took
23 exception to using the term "safety analysis" in lieu
24 of "FSAR as updated" when they were making -- or when
25 a user would go through that six-step process. Next

1 slide, please.

2 Again, we held a public meeting in June
3 where we went over examples. And in that public
4 meeting, NEI did clarify when they were talking about
5 safety analysis they did not mean accident analysis.
6 They meant anywhere where a safety analysis resides in
7 the FSAR.

8 And also in that meeting when we presented
9 the examples, we realized in our Reg Guide that the
10 current wording could lead a user, a licensee, to
11 submit a license action request when it wasn't
12 necessary. So we knew the Reg Guide wording needed to
13 be adjusted. Next slide, please.

14 So, again, this was the major change to
15 Appendix D, the revised wording in blue. And Section
16 4.3.6 and the six-step process where the wording of
17 safety analysis was removed, and the added words were
18 "malfunctions of an SSC important to safety previously
19 evaluated in the UFSAR," which brought the language in
20 the six-step process closer to the rule language.
21 Next slide, please.

22 So, now I'm going to go into the
23 clarifications in the Reg Guide itself. There are two
24 new clarifications, which Mike Waters will discuss,
25 and I'll go over the older clarifications that may

1 have been slightly reworded based on public comment
2 period that we held back in 2019.

3 So, the first clarification is in regard
4 to the relationship of NEI 01-01. That document is
5 still endorsed by the NRC, but we made clear in the
6 clarification that in the endorsement of NEI 96-07,
7 Appendix D, it's only applicable to digital
8 modifications and not generically applicable to the
9 entire 50.59 process. Next slide, please.

10 On human-system interface, again, this was
11 reworded slightly from the draft Reg Guide. But this
12 clarification highlights that in 96-07, Rev. 1 proper,
13 in that, that human-system interface automatically
14 screened in to a evaluation. In this case, NEI 01-01
15 changed that guidance and is highlighting in the
16 endorsement of Appendix D that we should use the
17 screening guidance that is in Appendix D even though
18 that differs from NEI 96-01, Rev. 1 proper. Next
19 slide, please.

20 And, lastly, this, again, was a
21 clarification that was in the old -- or the draft Reg
22 Guide. In resolving the comments, we had removed one
23 of the clarifications and used this clarification to
24 resolve the comment, revise the words slightly. We
25 got feedback from NEI that that revised wording may

1 have been a little misleading. So we changed the
2 wording back to the wording that was used in the draft
3 Reg Guide. So, this is one change from the 5/20
4 subcommittee meeting. Again, we said we would go
5 ahead and use the wording that was in the draft Reg
6 Guide.

7 Next slide, please. Okay. Now I'm going
8 to hand it over to Mike Waters, who will talk about
9 the final two clarifications. And, again, these were
10 new clarifications from when we last briefed the ACRS
11 full committee in June of 2019.

12 MR. WATERS: So, good morning. As Phil
13 previously noted, Section 4.3.6 has a six-step process
14 to help determine whether results are bounded by
15 existing analysis in the FSAR. And, as a reminder,
16 Step 6 of the text in Appendix D provides guidance for
17 verifying that both basic assumptions in the FSAR are
18 still valid and that the new results of the CCF are
19 still bounding in terms of satisfying the FSAR
20 acceptance criteria.

21 The two phases to highlight are the basic
22 assumptions of acceptance criteria. The Reg Guide
23 provides those two clarifications on understanding and
24 use of these. This is needed because there's not an
25 existing definition or discussion of these concepts in

1 NEI 96-07. Bottom line, there's a third bullet that
2 the broader clarification on acceptance criteria is
3 NRC has determined for 50.59(c) that licenses may also
4 consider where all applicable acceptance criteria are
5 satisfied to demonstrate that no possibility for a
6 malfunction with a different result has been created.

7 This clarification is important to make
8 because NRC considers this to be a different approach
9 than the current guidance in 96-07 for addressing
10 different results. And we wanted to make sure that
11 this was clarified for future use when someone has
12 both Appendix D and 96-07 side-by-side for addressing
13 different results. And as far as NEI comments -- and
14 Phil, please correct me -- we just had minor edits
15 here to this clarification as a result of the
16 comments. Next slide, please.

17 Again, this is actual text from the Reg
18 Guide. And this is what we called a two-prong test
19 looking at basic assumptions and acceptance criteria.
20 The basic concept here, again, with this test is that
21 licensees will need to ensure that the existing
22 analysis results can be correctly compared to the
23 results of the proposed change. In the context, the
24 wording of Section 4.3.6 of Appendix D, basic
25 assumptions relate to concern of the validity of

1 existing evaluations of malfunctions.

2 So the clarification here was revised
3 based on the comments we heard from NEI at the last
4 subcommittee meeting. The clarification was revised.
5 It does note that the appendix specifies that the
6 single failure criterion in this type of basic
7 assumption. In addition, the clarification revised to
8 clarify that the term basic assumptions includes
9 assumptions such as (telephonic interference) reactor
10 protections systems would be performed and that create
11 engineered safety system functions will be performed.
12 It may also include assumptions regarding the extent
13 to which normally operating systems function, and
14 extent to which normally operating instrumentation and
15 controls are assumed to function.

16 This revised clarification is based on the
17 construct of accident analysis chapters and the
18 language we use in our SRP for reviewing accident
19 analysis. At the subcommittee meeting, there was a
20 question raised by NEI regarding a clarification on
21 the methods evaluation and the reference to decreases
22 in redundancy and diversity. So we revised the Reg
23 Guide to note that departures from methods evaluation
24 are evaluated under Criterion 8 and the detailed
25 guidance is found in Section 4.3.8 of NEI 96-07.

1 We also agreed that the detailed guidance
2 for Criterion 2 in NEI 96-07 address the reductions of
3 redundancy from potential CCFs. The NEI guidance for
4 Criterion 2 states that a change that would reduce
5 component redundancy would require NRC approval. We
6 believe that's sufficient. They don't need to have
7 that as a basic assumption.

8 The second prong, the acceptance criteria
9 we talked about earlier, just to re-highlight, there's
10 multiple clarifications. Primarily, that Reg Guide
11 notes that applicable acceptance criteria must be
12 based on the licensee's FSAR. It does note that
13 licensees may need to refer to supporting documents
14 referenced in the FSAR to determine applicable
15 criteria.

16 It also clarifies for the purpose of
17 complying with the rule licensees cannot use
18 regulations, the SRP, or any other documents not in
19 FSAR licensing basis as applicable acceptance
20 criteria. This is really important because Criterion
21 6 requires comparison to results in the existing FSAR.
22 I believe here, too, there were some minor wording,
23 and we added a sentence suggested by NEI.

24 With that, that's the summary of the
25 clarifications. Just to reiterate, because the use of

1 basic assumption and acceptance criteria is new here,
2 and we wanted to provide clarity to both licensees and
3 NRC inspectors in avoiding uncertainty down the road.
4 I'll turn it back over to you, Phil.

5 (Pause.)

6 MR. McKENNA: Sorry. I was on mute. Next
7 slide, please, Tekia. Okay. So, this is the final
8 slide in the presentation, which summarizes the
9 changes we made --

10 MEMBER BROWN: Phil, can I interrupt you
11 for a second?

12 MR. McKENNA: Absolutely.

13 MEMBER BROWN: I went through the
14 highlighted version. Can you go back to the previous
15 slide and make sure Mike is available? This
16 paragraph, what did you say initially about this?
17 These words, are these the ones that are now reflected
18 in the revised version subsequent to the 20 May?

19 MR. WATERS: This is actually text from
20 Appendix D, Step 6. So this is the text we are
21 clarifying. This is the primary text where it says
22 basic assumptions no longer being valid, e.g., single
23 failure assumption is not maintaining, or if an
24 existing safety analysis is no longer valid. So this
25 is text from actual Appendix D. In the clarification

1 we do quote this text. What I said verbally was our
2 clarification to this guidance right here.

3 MEMBER BROWN: Okay. Let me backtrack a
4 second here. When I go back to your Section D, which
5 is whatever number this is, 2b, 2d, which is the basic
6 assumptions and acceptance criteria. I'm looking at
7 the 5/20 version. It looks like -- this looks like
8 what I read on the 2020 May version. Is that correct?
9 You all quoted that out of Step 6.

10 MR. WATERS: Yes.

11 MEMBER BROWN: Is that correct? Okay.
12 I'm trying to make sure that was in the version we
13 reviewed, this was a pullout that you quoted. And
14 then you provided clarifications.

15 MR. WATERS: Exactly.

16 MEMBER BROWN: Okay. And so the
17 clarifications that you're going to talk about are the
18 stuff you highlighted that come after this pullout
19 that you're working on. Is that what you're going to
20 be doing, Phil?

21 MR. McKENNA: Well, yes, I will summarize
22 it. Mike just went over what the changes were on that
23 clarification from the 5/20 meeting. So, the major
24 change was to the definition of basic assumption where
25 we removed any of the language that mixed in Criterion

1 8 with method of analysis. And then we added language
2 from the SRP which describes basic assumption. So
3 that was the major change to basic assumption.

4 MEMBER BROWN: Okay. And that's down in
5 the -- if I look at the paragraph right after this
6 inset paragraph that you all copied, that's the
7 failure of either prong of test results is the
8 paragraph I'm looking at. You made a small change
9 right in the second sentence. The previous version
10 stated, as stated above, this is new guidance not
11 already in 96-07. That was referring to that
12 paragraph. You all revised that to say this guidance
13 is not provided. Is that just wordsmithing, or is
14 there something hidden in that?

15 MR. McKENNA: No, there's nothing hidden
16 in that. That was just a clarification that made it
17 more clear to the user. And that was based on a
18 recommendation from NEI.

19 MEMBER BROWN: Okay. And then the
20 remainder part of that, which says, which does not
21 discuss basic assumptions in this context is then
22 repeated. So all right. So it's a little bit of
23 wordsmithing then.

24 MR. McKENNA: That's correct.

25 MEMBER BROWN: Okay. So the key elements

1 come in the following paragraph where you talk about
2 the first prong. And, fundamentally, from what I can
3 see, almost everything is taken -- the first prong,
4 you made some fairly wide-ranging changes.

5 MR. McKENNA: That's correct.

6 MEMBER BROWN: If somebody hasn't read the
7 words, you might -- I'm just giving you a heads up.
8 You might need to provide -- don't speed go through
9 this. You better kind of explain the remaining
10 changes in the first prong paragraph and the
11 subsequent paragraph, as well as the one that comes in
12 the second prong paragraph. Okay?

13 MR. McKENNA: Yes.

14 MEMBER BROWN: It took me a while last
15 night, walking my way through it, to pick up some of
16 the nuances, which I've now forgotten. Okay. That's
17 all I wanted to make clear where we were in the
18 original reviewed document. You can go on.

19 MR. McKENNA: Okay. Next slide. So,
20 again, this summarizes the points made in the 5/20
21 subcommittee meeting and how we drafted those points.

22 So, the first point was that it appears to
23 unnecessarily insert the purpose of Criterion 8 into
24 consideration of Criterion 6. So, all through that
25 final exception -- or, sorry, final clarification in

1 the Reg Guide, we removed any language that talked
2 about method of evaluation and put one pointer in one
3 paragraph that said method of evaluation is a
4 evaluated under Criterion 8. So we've resolved that
5 comment that way. In several places in that
6 clarification method of evaluation was mixed in to the
7 description.

8 MEMBER BROWN: Okay. I remember that.
9 And I saw that you did remove those. Okay. Thank
10 you.

11 MR. McKENNA: The next comment was that it
12 may not fully account for revised Section 4.3.6
13 guidance. So, again, the major revision we made to
14 the final clarification which we just discussed on
15 basic assumption and acceptance criteria, we revised
16 the definition of basic assumption, removed any
17 discussion there on method of evaluation, and then
18 added text in there which further defined, in our
19 view, what basic assumption is. And that --

20 MEMBER BROWN: Go ahead. I'm sorry. Go
21 ahead.

22 MR. McKENNA: Yeah, and that was the five
23 examples we pulled out of the accident and transient
24 analysis section of the SRP.

25 MR. WATERS: Phil, we also removed the

1 linkage to reduction in redundancy and diversity,
2 which was a significant comment we heard.

3 MR. McKENNA: Yes. Thank you, Mike. So,
4 one of the significant comments that we received from
5 NEI was that we shouldn't have brought in the
6 redundancy comment in from Criterion 2. So we removed
7 that also.

8 MEMBER BROWN: So that's -- the sentence
9 you removed was the one that stated, "further, for
10 purposes of this guidance, basic assumption may
11 include assumptions such as redundancy, diversity,
12 defense-in-depth in addition to the single failure
13 criteria assumption given in 4.3.6."

14 MR. McKENNA: That's correct. That was
15 removed.

16 MEMBER BROWN: That sentence has been
17 removed because it's covered in Criteria 2?

18 MR. McKENNA: That's correct.

19 MEMBER BROWN: Okay. All right. Got
20 that.

21 MR. McKENNA: Okay. And then the next one
22 which I had covered in an older clarification --

23 MEMBER BROWN: Before you go on, could you
24 provide the committee with -- when you say you added
25 or you revised it, the key add here is, with the

1 guidance in 4.3.6, list the single failure criteria as
2 a type of basic assumption. Then you added the words,
3 in addition, the basic assumptions include but is not
4 limited to assumptions that credit plant reactor
5 protection system functions will be performed,
6 credited engineered safety functions will be
7 performed, these are examples, regarding the extent to
8 which normally operating plant systems will function
9 and regarding the extent to which operating plant
10 instrumentation control are assumed and safety-related
11 systems or components continue to meet their
12 requirements. Those are the key examples that you
13 provide?

14 MR. McKENNA: That's correct, for the
15 definition of a basic assumption.

16 MEMBER BROWN: Okay. All right. Was that
17 -- did you have any -- I don't want to use the word
18 blowback. Were there any concerns with those
19 examples?

20 MR. McKENNA: Not on our end. I mean, we
21 had --

22 MEMBER BROWN: I'm not asking you to tell
23 me what NEI thinks. We'll see what that is. But,
24 from your perspective, this provided some of the
25 clarifications that you wanted to make sure came out?

1 MR. McKENNA: Absolutely. So, we felt
2 that, in the Reg Guide -- sorry, in the Appendix D,
3 where it talked about basic assumptions, it gave, for
4 example, single failure criteria that we really needed
5 to have a definition for basic assumption for the
6 UFSAR.

7 MEMBER BROWN: All right. Okay. Go
8 ahead. You're going on to your third bullet, I think,
9 next.

10 MR. McKENNA: Right.

11 MEMBER BLEY: This is Dennis Bley. I just
12 want to sneak one minor thing in. I read through this
13 pretty carefully, and I think you guys did a good job.
14 For me, it clarified a lot of things. For other
15 members, if you've been reading through this, the
16 yellow highlight isn't the only thing that changed.
17 Some of the other words changed, like the stuff
18 Charlie was just talking about here. But it works
19 pretty well.

20 The only minor nit I would ask you about
21 is the first prong of the test paragraph. Now that
22 you've clarified basic assumption, I don't know why
23 you need the last sentence that says you believe that
24 the clarification is warranted. But that's minor.

25 MR. McKENNA: Okay. We can take that into

1 consideration.

2 MEMBER BROWN: Do you have a basic -- do
3 you know why or remember why? See, that's not in the
4 previous -- that was in the previous, yes -- is there
5 somebody in the background? Have I lost everybody?

6 MR. MCKENNA: Nope, nope. We're still
7 here.

8 MEMBER BROWN: Okay. I thought there was
9 a gang fight going on in the background.

10 I'm back looking at the first prong lead-
11 in paragraph, which you all did make to lead into what
12 you did in the next paragraph. And I just want to
13 make it clear that those words were in the previous
14 version. It doesn't really do anything other than it
15 states your belief that you needed to clarify some
16 stuff. Anyway, so, go ahead with your third bullet,
17 I guess.

18 MR. MCKENNA: Okay. So, for the third
19 bullet on this slide, again, this dealt with one of
20 the clarifications that was in the original draft Reg
21 Guide about the RIS 2002-22, Supplement 1. Again, we
22 revised that wording back to the original wording in
23 the draft Reg Guide. We agreed with NEI's comment on
24 that.

25 MEMBER BROWN: Okay. The way I read this

1 one, Phil, is you also made a change to just the title
2 for Item C.

3 MR. McKENNA: Right. I forgot to point
4 that out. That is correct.

5 MEMBER BROWN: It was software failure,
6 and now it says sufficiently low likelihood of
7 software common cause failure.

8 MR. McKENNA: That's correct.

9 MEMBER BROWN: It's clearly a better
10 example of what you're talking about with the RIS
11 reference. And I didn't remember, when you talk about
12 -- said you went back to the original, is that the one
13 in the November of last year?

14 MR. McKENNA: Yes.

15 MEMBER BROWN: 2019?

16 MR. McKENNA: Well, it was for the Reg
17 Guide that we presented at the June 2019 meeting.

18 MEMBER BROWN: Oh, the June one. Okay.
19 All right. Of last year?

20 MR. McKENNA: That's correct.

21 MEMBER BROWN: Yeah. The public meeting.
22 Is that the public meeting you had after the
23 subcommittee meeting?

24 MR. McKENNA: That is the document that
25 went out for public comment.

1 MEMBER BROWN: Okay. All right. Thank
2 you. Is that the only time you've issued this for
3 public comment?

4 MR. McKENNA: That is correct.

5 MEMBER BROWN: So that May 30th date still
6 stands?

7 MR. McKENNA: Yes. Yes. That was the
8 only time we issued the document for public comment
9 with an FRA, right.

10 MEMBER BROWN: Okay. It's relevant to my
11 letter. That's why. I had a question mark by that in
12 my letter. Thank you.

13 Okay. Go ahead. The major -- just to
14 make sure the members -- since most of them probably
15 have not read all this. And you correct me if I'm
16 wrong, Phil. It looks like the major change going
17 backwards was after the words -- in the document we
18 reviewed on May 20th, right after the sentence that
19 ended "for the purpose of 10 CFR 50.59 evaluation."
20 You added back in "and may be used in conjunction with
21 Appendix D, Revision 1." That was back in the earlier
22 June version, correct?

23 MR. McKENNA: Say that one more time,
24 Member Brown.

25 MEMBER BROWN: Okay. I looked at the

1 first Item C, 2C. It's worded roughly the same until
2 you get until the end where you added "and may be used
3 in conjunction with NEI 96-07, Appendix D, Revision
4 1."

5 MR. McKENNA: That's correct.

6 MEMBER BROWN: Okay. So, yeah, there was
7 a minor -- I think you changed provide to providing.
8 All right. I just wanted to make sure people
9 understood that there was -- it was really just
10 referencing the Appendix D, Revision 1 that we've been
11 dealing with, relative to the RIS.

12 Now where are we? Are we on Bullet 4 or
13 Bullet 3? Does anybody else have any comment on
14 anything that I just said? Clarifications?

15 (No response.)

16 MEMBER BROWN: Okay. Go ahead, Phil.

17 MR. McKENNA: So, the final comment we
18 heard from NEI during the presentation on the May 20th
19 meeting was that the two-prong test that we describe
20 in the clarification was not new, that holders or
21 licensees have always used the two-prong test. So we
22 slightly modified that wording in the Reg Guide to say
23 that it's new guidance for the two-prong test, to
24 recognize that users may have to use the two-prong
25 test before.

1 So, that is the end of --

2 MEMBER BROWN: Hold it. Hold it. Hold
3 it.

4 MR. McKENNA: Yeah.

5 MEMBER BROWN: Don't run away from me
6 here. You actually added a bunch of stuff in
7 addition, you had some what I call purple highlighting
8 change. But then you added this whole sentence to
9 talk about, "nonetheless, some FSARs may not clearly
10 identify or specify acceptance criteria." It seems to
11 me you modified that a bit to be more clear relative
12 to where they get acceptance criteria.

13 MR. McKENNA: So, that is correct. So, we
14 did, in the final paragraph of the Reg Guide, we made
15 some editorial changes to that to make the identifying
16 acceptance criteria clearer. So, we combined the
17 final two paragraphs of the Reg Guide and reworded
18 that to what we think is a more clearer how to
19 identify acceptance criteria.

20 MEMBER BROWN: Yeah, okay. I just wanted
21 to make sure that's clear. You didn't add anything,
22 but the way you -- it seemed to read better to me than
23 the old one.

24 MR. McKENNA: Thank you.

25 MEMBER BROWN: Dennis, did you have any

1 problem with that one?

2 MEMBER BLEY: No, I think the changes they
3 made are all good improvements.

4 MEMBER BROWN: Yeah, that's what I
5 thought, also, unless -- from the standpoint. I think
6 it was a productive effort, although it's been
7 compressed in terms of trying to get it done. I know
8 it's been difficult.

9 All right. So, that's the third bullet.
10 If you want to go on to the next slide, you can. I
11 have no idea where we are in slides now.

12 MR. McKENNA: The next slide? I believe
13 that was the final slide.

14 MEMBER BROWN: Before we transition, do
15 any of the other members have any other questions?

16 I will iterate to the other members, I did
17 not presume any of you, since we just got this
18 yesterday, but Dennis and I did walk through this
19 thing, and this seemed to address the stuff and makes
20 some improvements pretty clearly in our estimation.

21 So, if there's no other questions, why
22 don't we go ahead and switch over to NEI? Matt, do we
23 normally take five minutes here or something like
24 that, ten minutes, to let them switch over or for
25 people to walk around for an ergonomic break?

1 CHAIR SUNSERI: Yeah, I mean, we can do
2 that, but it's only been 30 minutes since our last
3 break. So, go ahead. Just transition.

4 MEMBER BROWN: Okay, fine. NEI, you want
5 to go ahead and take the slides?

6 MR. VAUGHN: Yes, Member Brown. This is
7 Steve Vaughn with NEI. I will bring up our slides
8 right now.

9 MEMBER BROWN: Okay.

10 MS. AUSTGEN: And while Steve does that,
11 this is Kati Austgen with NEI. Can you all hear me
12 okay?

13 CHAIR SUNSERI: Yeah.

14 MS. AUSTGEN: Okay.

15 CHAIR SUNSERI: Are you going to be doing
16 the talking, Kati?

17 MS. AUSTGEN: I will be doing the talking,
18 yes. So, Steve Geier is normally with us.
19 Unfortunately, he's out on a personal matter right
20 now. So I'll convey his regrets that he cannot be
21 with us.

22 MEMBER BROWN: Matt? Matt? Is Matt still
23 there?

24 CHAIR SUNSERI: Yes.

25 MEMBER BROWN: I need about three minutes

1 to go take care of a loose end here. Can we take
2 three minutes for this transition?

3 CHAIR SUNSERI: Yes, okay. So we'll
4 resume at 12:00 o'clock.

5 MEMBER BROWN: Okay. Thank you.

6 CHAIR SUNSERI: So we are in recess until
7 12 o'clock.

8 (Whereupon, the above-entitled matter went
9 off the record at 11:54 a.m. and resumed at 12:00
10 p.m.)

11 CHAIR SUNSERI: It's 12:00, so we'll
12 reconvene. I'll call the roll. Ron Ballinger?
13 Dennis Bley? Vesna is here, okay. Charles Brown,
14 you're there.

15 MEMBER BROWN: Yes.

16 CHAIR SUNSERI: Vesna Dimitrijevic?

17 MEMBER DIMITRIJEVIC: I am here.

18 CHAIR SUNSERI: Walt Kirchner?

19 MEMBER KIRCHNER: Here.

20 CHAIR SUNSERI: Jose March-Leuba?

21 MEMBER MARCH-LEUBA: Yes.

22 CHAIR SUNSERI: Dave Petti?

23 MEMBER PETTI: Here.

24 CHAIR SUNSERI: Joy Rempe?

25 VICE CHAIR REMPE: Yes.

1 CHAIR SUNSERI: Pete Riccardella?

2 MEMBER RICCARDELLA: Present.

3 CHAIR SUNSERI: Okay, and myself. We have
4 a quorum. Ron, I'm sure, will be joining us shortly.
5 All right, so we have the NEI slides up. You may
6 continue, Charlie, and NEI.

7 MEMBER BROWN: Okay, Steve, do you want to
8 go ahead and proceed with the opening comments on the
9 NEI presentation?

10 MS. AUSTGEN: Actually, this is Kati.
11 I'll just take it.

12 MEMBER BROWN: Okay, that's fine. Go
13 ahead.

14 MS. AUSTGEN: Thank you. So, again, this
15 is Kati Austgen with NEI, and our slides, much like
16 the staff's, are recapping what we shared with the
17 subcommittee on May 20, and then we have looked at the
18 staff's updates to the draft reg guide and we still
19 have one more point to discuss on that, and we'll get
20 to that on slide four.

21 So, our second slide here again gives the
22 summary of changes since the feedback last year from
23 the ACRS meetings and the NRC staff. As the staff
24 indicated, these changes really happened in Section
25 4.3.6 of 96-07, Appendix D, and that's the section

1 dealing with Criterion 6.

2 The changes were to include additional
3 guidance on identification of malfunction results
4 applicable to SSCs solely required to comply with
5 regulations and license conditions, and then we
6 clarified the activities which either invalidate basic
7 assumptions in the safety analyses or that do not meet
8 acceptance criteria create a different malfunction
9 result, and so I think the staff represented the
10 content of Appendix D correctly, so we'll go onto our
11 third slide.

12 We also updated the examples in Section
13 4.3.6 once we had alignment with the NRC staff on what
14 the guidance in the section should say. We then
15 improved the example wording so that it would more
16 clearly align with that guidance.

17 We revised the examples to clearly state
18 the objectives and the application of the guidance,
19 and we tried to clearly explain how to compare the
20 results of malfunctions to the associated safety
21 analysis acceptance criteria where it was something
22 that actually dealt with the safety analysis. As I
23 mentioned, some of our examples talk about regulations
24 themselves.

25 So, then our fourth slide, as I indicated,

1 many of our comments on the last draft and now the
2 last couple of drafts because the NRC staff did update
3 after the May 20 subcommittee meeting, many of those
4 comments have been addressed.

5 The clarifications that are still there,
6 for the most part, I'll say are good. Again, the
7 staff did address our concerns on things like how we
8 acknowledge the RIS and removing the appearance of
9 bringing in Criterion 8.

10 However, we're still a bit concerned that
11 the basic assumption clarification appears to confuse
12 the guidance in NEI 96-07, Appendix D, the six step
13 process in Section 4.3.6, and we're not sure that it's
14 really adding the clarity that the staff intend.

15 So, we view this clarification as
16 unnecessary because the items that NRC seeks to
17 clarify on basic assumption are adequately addressed
18 in Appendix D in our opinion and/or they are
19 understood by safety analysis subject matter experts
20 using their existing processes that already have
21 controls in place to remain within the confines of a
22 particular safety analysis.

23 So, specifically, safety analysis
24 professionals will know how to perform their work in
25 the context of the guidance in Appendix D, and the

1 Section 4.3.6 process structure and examples cover the
2 landscape of digital I&C activities needing guidance.

3 I did hear during the staff presentation
4 that they were attempting to reflect some information
5 from the standard review plan in the items that
6 they've enumerated, and so if this is truly necessary,
7 then a reference would be helpful to ensure that there
8 is common understanding of the staff's intent and that
9 there is some connection to the standard review plan.

10 I'll pause there for any questions or
11 discussion.

12 MEMBER BROWN: I guess I'll ask the
13 question. If I want to contrast your -- if I can
14 bring these up together here and make sure I do it
15 right. Your bullets say the clarifications. That's
16 the entire item B, is that correct?

17 MS. AUSTGEN: Yes.

18 MEMBER BROWN: The entire item B, the
19 entire item D, whatever other numbers go along with
20 that, so 2.d in the reg guide under guidance --

21 MS. AUSTGEN: Yes.

22 MEMBER BROWN: -- or regulatory guidance.
23 So, your point being is that you think it's confusing,
24 doesn't do anything, and the entire thing, the entire
25 two pages or page-and-a-half are unnecessary and

1 should be deleted. Is that the position you're taking
2 or the --

3 MS. AUSTGEN: Well, so we can get specific
4 to within this 2.d, so Appendix D, Section 4.3.6, Step
5 6, basic assumptions and acceptance criteria, we
6 stepped through the different paragraphs as you were
7 discussing with the staff what changes they had made.

8 So, the most significantly revised
9 paragraph that they have within this clarification is
10 the, "In the context of this test, NRC understands
11 basic assumption to refer," and then they enumerate
12 several items, which if I understand correctly, the
13 staff are saying that those items were informed by the
14 standard review plan.

15 As we reviewed this in preparation for
16 today's meeting, we think that the topics enumerated
17 or the items enumerated are already covered within the
18 six step process of Criterion 6.

19 They're illustrated appropriately within
20 the examples in Section 4.3.6, and that, you know,
21 again, when industry comes upon a change where they
22 have a digital activity that must address software
23 common cause failure in Criterion 6 because they were
24 not able to make a finding of sufficiently low
25 likelihood, they will clearly have to engage their

1 safety analysis staff.

2 And again, this aspect of basic assumption
3 is all within the safety analysis wheelhouse and does
4 not need clarification in Appendix D or in this reg
5 guide endorsing it.

6 So, we simply think it would be cleaner to
7 let the safety analysis professionals follow their
8 existing guidance and process, and not try to
9 summarize it.

10 MEMBER BROWN: So, you're talking about
11 only the "in context" paragraph?

12 MS. AUSTGEN: Yes, I mean, certainly we
13 could live without the rest, but the rest doesn't
14 necessarily give us heartburn or add additional
15 confusion, but when we start trying to summarize
16 things and we start saying, "includes, but is not
17 limited to," that's where folks on the industry side
18 start to say, "Okay, well, where are the boundaries?
19 What am I really looking at?"

20 MEMBER BROWN: Well, this was the same
21 paragraph where the method of evaluation -- that's
22 where you had your concern relative to Criterion 8
23 last time also.

24 MS. AUSTGEN: Yes, and we had suggested
25 that the staff delete that outright.

1 MEMBER BROWN: Well, they did.

2 MS. AUSTGEN: Yeah, well, they did, and
3 then they added something in its place, and so, again,
4 if something is necessary there, you know, perhaps
5 this could be addressed with some reference to the
6 standard review plan, some reference to, you know, how
7 the staff came up with these things that are captured
8 under basic assumptions.

9 MEMBER BROWN: Is the staff listening?

10 MR. McKENNA: Oh, yeah, we're here. This
11 is Phil.

12 MEMBER BROWN: Were you aware of this
13 before you saw their slides this time? I mean, the
14 paragraph has kind of been there. It's been revised
15 obviously.

16 MR. McKENNA: Aware of what, Member Brown?

17 MEMBER BROWN: Of their issue here, or
18 their additional issue.

19 MR. McKENNA: Yeah, so we've always said
20 up front that since basic assumption is not defined,
21 it needs to be defined. So, NEI did not define basic
22 assumption, so we needed to define it.

23 MEMBER BROWN: Okay, so from your
24 standpoint right now, this is the way you would issue
25 your reg guide?

1 MR. McKENNA: That's correct.

2 MEMBER BROWN: Okay.

3 VICE CHAIR REMPE: So, Charlie, I'll step
4 into this. I have a question for NEI.

5 MEMBER BROWN: Yeah.

6 VICE CHAIR REMPE: The last time we met,
7 I think Kati said, "Well, we can live with the way it
8 was, but some changes would make it better." Can you
9 live with it the way it is now, Kati?

10 MS. AUSTGEN: I think we would need a
11 little bit more time to reflect on what this
12 particular paragraph means.

13 So, you know, we got the updated reg guide
14 language on Monday, and, you know, we've digested it
15 as best we can, but clearly we've not reached out to
16 all of our stakeholders.

17 As I mentioned, I just learned in the
18 course of this meeting that the staff looked to the
19 standard review plan for this information, so we've
20 not had an opportunity to look at that.

21 It's possible that we could live with it,
22 but I don't know yet, and as I said, I think, you
23 know, folks, licensees have the tools that they need
24 to be able to implement the guidance.

25 MEMBER BROWN: Let me interrupt. You

1 know, this has been a very difficult subject for
2 years, decades, and a lot of times, there's words
3 people would like to be a little bit different, but
4 you take it and then you use it to the best that you
5 can with the way you view it, and then you work out
6 the details when you get to an end product some place
7 along the line.

8 I mean, you either get this out or you
9 don't get it for a while. I mean, in my life, I've
10 had to live with a lot of different things that I
11 didn't particularly care for, but I learned how to
12 work with them.

13 And whether, you know, you say they're
14 derived from the SRP or not derived from the SRP, it's
15 nothing particularly new. They just enumerated them
16 a little bit differently, and if it only existed with
17 the SRP, maybe you figure you got a little bit more
18 wiggle room.

19 I'm not trying to be negative. It's just
20 sooner or later, you'd like to get something out that
21 people can work with that improves the overall
22 situation the way we are now, and I'm not trying to
23 make a judgment one way or the other because I can't.

24 I haven't worked in that world, but at
25 some point, you need to fish or cut bait, and the

1 staff is trying to accommodate and improve the
2 situation, and at some point, you need to be able to
3 work with that. That's just an observation. I'm not
4 making a judgment.

5 MEMBER BLEY: Charlie, it's Dennis.

6 MEMBER BROWN: Yeah, Dennis, go ahead.

7 MEMBER BLEY: We really don't need to go
8 through the arbiters to get something that everybody
9 is perfectly in agreement on. I think --

10 MEMBER BROWN: I know that.

11 MEMBER BLEY: -- we have something we can
12 comment on at this time.

13 MEMBER BROWN: Yeah, I understand that.
14 I'm just trying to make sure -- to provide a little
15 focus of the points, that's all, for subsequent
16 discussion. Okay, so, NEI, are you all finished?

17 MS. AUSTGEN: Yes, we've got one last
18 slide which just reemphasizes that we do think there
19 have been improvements in the guidance over the last
20 almost year now. We are seeking a common
21 understanding of the guidance as that will provide
22 much needed confidence.

23 And once endorsed, we'll move onto
24 industry training and we very much appreciate the
25 NRC's intent to contribute to that industry training

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1 so that, again, we'll have the common understanding of
2 how these guidance documents work together. That's
3 all for NEI.

4 MEMBER BROWN: Hold on.

5 CHAIR SUNSERI: Charlie?

6 MEMBER BROWN: Yeah, I had a phone call.
7 I thought it was my facility for my wife, but it
8 wasn't. Okay, all right, then I guess at this point,
9 we'll be ready to solicit some comments. Before I do
10 that, are there any additional comments from members
11 before I go off to the public comments?

12 Okay, hearing none, is the public line
13 open, Christina?

14 MS. LUI: Thomas, can you please open the
15 lines?

16 PARTICIPANT: The public bridge line is
17 open.

18 MEMBER BROWN: I didn't hear that. What
19 did he say?

20 MS. LUI: The lines are open.

21 MEMBER BROWN: The line's open, okay,
22 thank you. Is there anybody on the public line that
23 would like to make a comment relative to this meeting?
24 Is there anybody out there that could just say
25 something to let us know that it is open?

1 PARTICIPANT: It's open.

2 MEMBER BROWN: Thank you very much.
3 Hearing no one stepping forward, I will go ahead and
4 close the bridge line, Christina. And Matt, I guess
5 that's it. I'll turn it back over to you.

6 CHAIR SUNSERI: Okay, Charlie, thank you.
7 We've got about 30, 25, a little over 25 minutes left
8 for this session. Do you feel that's sufficient time
9 to read in your letter?

10 MEMBER BROWN: Yes.

11 CHAIR SUNSERI: Okay.

12 MEMBER BROWN: It's not that long. It's
13 only about a couple hundred lines long or so. It's
14 not like Walt's tome.

15 CHAIR SUNSERI: Yeah, yeah, so let's just
16 proceed smartly through it. Keep focused on that.
17 Let's see if we can get the letter up, and the idea
18 would be to read through and get high level comments
19 if we have sufficient time.

20 MEMBER BROWN: Okay.

21 CHAIR SUNSERI: So, Sandra, can we get the
22 Reg Guide 1.187 letter up?

23 (Whereupon, the above-entitled matter went
24 off the record at 12:18 p.m. and resumed at 1:46 p.m.)

25 VICE CHAIR REMPE: Okay, so this meeting

1 will now reconvene. I will start off on behalf of
2 Matt Sunseri to go through the roll call, and if I
3 forget a member out of order, holler at me, okay? Ron
4 Ballinger, are you present?

5 MEMBER BALLINGER: Yes, here.

6 VICE CHAIR REMPE: Dennis Bley? Dennis,
7 are you there? It looks like he's not yet on, so
8 we'll skip that. Charlie, are you there?

9 MEMBER BROWN: Yes, I am.

10 VICE CHAIR REMPE: Vesna, are you here?

11 MEMBER DIMITRIJEVIC: I am.

12 VICE CHAIR REMPE: Walt Kirchner, are you
13 here?

14 MEMBER KIRCHNER: Here.

15 VICE CHAIR REMPE: Jose, are you here?

16 MEMBER MARCH-LEUBA: Yes.

17 VICE CHAIR REMPE: Dave, are you on?

18 MEMBER PETTI: Here.

19 VICE CHAIR REMPE: I think I -- oh, Pete
20 Riccardella, are you on?

21 MEMBER RICCARDELLA: I'm here.

22 VICE CHAIR REMPE: Okay, and I'm going to
23 skip myself, and Matt, are you back on yet? So, then
24 right now, we're missing Matt and Dennis, but we still
25 have a quorum. And Walt, I believe you're in charge

1 of this next session, so I'm going to turn it over to
2 you and let you start.

3 MEMBER KIRCHNER: Thank you, Madam
4 Chairman. Yes, we're at an important juncture in our
5 review of the NuScale design certification
6 application. We have a major amendment to address.
7 The issues identified related to boron redistribution.

8 So, we will hear from both the applicant
9 on design changes that were made, as well as from the
10 staff on their plans to complete their review of this
11 amendment.

12 Again, I just want to underscore I think
13 our expectations, that is the members of the
14 committee, is that from the applicant, we get a
15 thorough description of the design changes that were
16 made and why, and the supporting analysis to
17 demonstrate that these changes mitigate the concerns
18 with the potential of reactivity insertion accidents
19 as a result of boron dilution or redistribution in a
20 number of scenarios.

21 So, with that, I think we're at a point
22 where we'll turn it over to NuScale, and I believe
23 Matthew Presson is going to make some opening comments
24 and then lead us through this presentation. Go ahead,
25 Matt.

1 CHAIR SUNSERI: Which Matt are you talking
2 to? This is Matt.

3 MEMBER KIRCHNER: Welcome back, Matt. No,
4 I'm addressing Matthew Presson from NuScale. I
5 believe he is going to speak first.

6 CHAIR SUNSERI: Yeah, okay, I am back on.
7 This is Matt Sunseri. I am back online now. I don't
8 know what happened. My Skype froze, but it's all
9 cleared up now.

10 MEMBER KIRCHNER: Just --

11 VICE CHAIR REMPE: While we have a quick
12 interruption, can we confirm that Dennis is on too
13 because he did not respond earlier?

14 MEMBER KIRCHNER: Dennis, are you there?

15 MEMBER BLEY: Yeah, can you hear me now?
16 I've been yelling.

17 MEMBER KIRCHNER: Yes, yes, thank you,
18 Dennis, okay.

19 VICE CHAIR REMPE: Thank you.

20 MEMBER KIRCHNER: Okay.

21 MR. PRESSON: All right, well, perfect.
22 Apologies, my mic was on mute, but it seems like that
23 worked out.

24 MEMBER KIRCHNER: Go ahead, Matthew.

25 MR. PRESSON: Thank you, Walt, and good

1 afternoon, everyone on the call. This is Matthew
2 Presson with NuScale, and I'd like to thank you all
3 for your time during this presentation.

4 The purpose of this presentation is, as
5 you said, to provide information on the design and DCA
6 changes related to this boron distribution topic. So,
7 we presented some preliminary information on the topic
8 in the April ACRS session, and this follow-up looks to
9 provide some of the final changes that were made
10 following that.

11 So, moving to slide two, the presenters
12 for today will include myself, Matthew Presson,
13 licensing project manager. We also have Paul
14 Infanger, our licensing specialist in Chapter 15.

15 We'll have Ben Bristol, supervisor of
16 system thermal hydraulics, Hannah Rooks, supervisor of
17 NSSS systems and analysis, and Sarah Bristol,
18 supervisor of probabilistic risk assessment.

19 Slide three provides our agenda, and slide
20 four will provide a little more background on the
21 topic, but I wanted to provide at a high level here
22 kind of some of that information.

23 So, following a review of questions that
24 were posed to us in February, NuScale identified that
25 in some specific postulated Chapter 15 events, we did

1 not have the approved analytical tools available to
2 really answer those questions on boron redistribution.

3 So, in light of our commitment to safety
4 and instead of looking to redevelop those tools,
5 NuScale chose to implement a few targeted design
6 changes to preclude those postulated boron dilution
7 events.

8 So, during today, as shown on the agenda,
9 we'll be presenting information on the background of
10 these postulated events, the design changes that we
11 incorporated to preclude them, and the analytical
12 results following our review of those changes.

13 And moving onto slide four, I will pass
14 this off to Ben Bristol and he'll cover a little bit
15 of the background.

16 MEMBER KIRCHNER: Since you used the word
17 a couple of times, preclude these events, does that
18 include mitigate? And I'm making the distinction
19 because are you saying you're just going to be -- the
20 approaches and the design changes is to preclude the
21 event and mitigate the consequences or just preclude
22 the event?

23 MR. PRESSON: Got you, yeah, so I think
24 the answer to that would be both. We're primarily
25 focused on precluding those events which kind of fell

1 outside of our analytical basis, but some of the
2 design changes that were implemented do assist in
3 mitigating the event as it progresses, those boron
4 redistribution events.

5 MEMBER KIRCHNER: Yes, so I don't want to
6 get ahead of you and your colleagues, but, you know,
7 for example, you've added these holes in the riser,
8 and we would be much interested to know how you
9 analyzed their performance and how they were effective
10 in either precluding or mitigating the boron dilution
11 kind of events that are of concern.

12 MEMBER BALLINGER: Yeah, this is Ron. I'm
13 echoing Walt, but also adding the why. Why were they
14 needed?

15 MR. PRESSON: Understood, and I believe we
16 should have slides covering that in the open
17 presentation, the why, as well as a little bit of
18 information on their mitigating ability.

19 We definitely have a lot more design-
20 specific prop information to provide in closed
21 session, but we should be able to provide information
22 on that here in the open discussion.

23 MEMBER MARCH-LEUBA: Hi, Matt, this is
24 Jose. Let's go into detail on the why a little bit
25 more. Did you do a risk-informed evaluation of -- I'm

1 going to call it Revision 4 of the FSAR, which is the
2 January configuration. When I say Rev. 4, I mean the
3 January configuration, okay?

4 So, did you make a risk-informed
5 evaluation of the situation? Because you mentioned
6 that your concern is that you didn't have the tools to
7 analyze it, yet you apparently have the tools now to
8 analyze the fix.

9 MR. PRESSON: Yeah, and the analysis being
10 specifically mixing of boron, so to what degree boron
11 would mix within the RCS.

12 MEMBER MARCH-LEUBA: Right, and if you use
13 the method that you're going to show us in the closed
14 session, I have lots of problems with those, and we'll
15 go into detail once we close the session because
16 almost everything there is proprietary, but if you use
17 that method and you close the holes, you dilute the
18 downcomer. I mean, there is no question whatsoever
19 that you do.

20 So, my question is did you evaluate what
21 was the risk of the plant under Revision 4
22 configuration? That's what a risk-informed evaluation
23 would have done.

24 MR. PRESSON: Yeah, let me take a second
25 and check with our PRA folks on that. I can say that

1 we can definitely cover the riser holes discussion
2 probably to some extent in open, but definitely in the
3 closed discussions.

4 MEMBER MARCH-LEUBA: Okay, it's okay. Let
5 me leave that question.

6 (Simultaneous speaking.)

7 MEMBER KIRCHNER: Let's leave that
8 question on the table and go ahead. Go on, Matthew,
9 with your presentation at this point because --

10 MR. PRESSON: Yeah.

11 MEMBER KIRCHNER: -- we can come back to
12 that.

13 MR. PRESSON: Yeah.

14 MR. BRISTOL: This is Ben Bristol. Can
15 you hear me?

16 MEMBER KIRCHNER: Yes, Ben, we can hear
17 you.

18 MR. BRISTOL: Okay, Jose, I think we'll
19 get into a little bit of that. I may touch on it
20 somewhat through the next few slides I have, and then
21 we have some PRA-specific insights.

22 I would say that as we identified the
23 different conditions, most of the analysis of the
24 identification of the condition was performed
25 deterministically, and that led us to the decision to

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1 make the design change which we believe was a
2 conservative decision making process with the idea of
3 safety in mind. A detailed analysis of what could
4 have happened under the Revision 4 design
5 configuration, we had looked at that somewhat.

6 Generally, in terms of the risk insights,
7 what we had seen is that the redistribution phenomena
8 results in boron accumulating in the core region which
9 is helpful for metrics and safety.

10 There were certain conditions that we
11 could postulate deterministically which that boron,
12 the accumulated boron could potentially be displaced
13 through ECCS actuation, and that was the area that we
14 really focused on the design to ensure that preclusion
15 of the redistribution of the phenomena would allow us
16 to characteristically transition to ECCS cooling
17 without the need for the consideration of shutdown or
18 potential boron core dilution events.

19 So, that was really kind of the focus of
20 this analysis, and the design changes were carefully
21 made to ensure that they limited the impact in other
22 areas of the design, particularly with the
23 consideration of risk insights.

24 MEMBER MARCH-LEUBA: And by now, you guys
25 know me and know that I don't like this risk thing, so

1 I'm really applauding and encouraging what you've
2 done.

3 Instead of trying to do a more detailed
4 analysis to show that we really don't want to raise
5 SAFDLs or try to figure out whether the frequency is
6 too low or too high and make an argument, you went in
7 there and fixed it.

8 MR. BRISTOL: Right.

9 MEMBER MARCH-LEUBA: Great, I mean, that's
10 great. Now, don't get too cocky because when we go
11 into closed session, I'm going to beat you on the
12 model that you used to demonstrate it, but this will
13 work.

14 We'll have to -- when we finish, when the
15 staff finishes the review, we'll have to figure out if
16 the size, which I don't know if it's proprietary, the
17 diameter of the holes is sufficient, or it's too much,
18 or it's too little, but putting a hole in there will
19 eliminate many, many of these problems, not all of
20 them. We'll come back later.

21 MR. BRISTOL: Okay, so and I think in the
22 April presentation, much of the information was
23 closed, so I don't have quite as much detail here, but
24 I will be speaking to some of the things we were
25 seeing and then the design changes we were making for

1 the purposes of this public session.

2 Just in terms of the background, the issue
3 was raised during the February Chapter 15, and
4 actually I think it was the topical report ACRS
5 discussions about particularly the identification of
6 the progression of slower LOCA type scenarios and the
7 potential impact of DHR cooling under those scenarios.
8 We went back and starting looking at those.

9 MEMBER KIRCHNER: I think we have someone
10 who needs to mute their phone or their computer. Go
11 ahead, Ben.

12 MR. BRISTOL: Okay, I'll keep moving
13 through slide four here. So, under certain
14 conditions, I think there were two things that we saw
15 that could occur during ECCS actuation that we
16 discussed previously.

17 One is the condensate that accumulates in
18 containment is generally expected to be of lower
19 concentration than that in the RCS, and should ECCS
20 actuation occur sufficiently late, then the condensate
21 accumulation in containment could push, could have
22 sufficient level to drive a fair amount of the reduced
23 borated liquid from containment back to the RCS and
24 potentially into the core.

25 The other phenomena that we noticed was a

1 level swell type phenomena where if the riser head
2 uncovered and was cooling on DHR prior to ECCS
3 actuation, the depressurization transient could
4 actually restore the loop to some degree that could
5 drive the RCS coolant back into the core or the
6 downcomer coolant back into the core.

7 Of those scenarios, we identified that
8 small changes in boron concentration can have a
9 relatively significant impact on reactivity, and so we
10 were motivated to preclude any significant
11 redistribution-related phenomena to ensure that the
12 downcomer concentration or containment concentration
13 couldn't actually work its way back into the core at
14 any significant rate.

15 So, as we have discussed previously,
16 NuScale entered this into the corrective action
17 program and we started our evaluation of the potential
18 consequences, and we're looking for the design changes
19 necessary to preclude the behavior of deborated fluid
20 entering the reactor core. Next slide, Matthew.

21 MEMBER KIRCHNER: Ben, this is Walt
22 Kirchner.

23 MR. BRISTOL: Yeah.

24 MEMBER KIRCHNER: I think your colleague,
25 Mike Melton, would like to make a comment. Mike, are

1 you there? He may not -- he may be muted. We'll come
2 --

3 MR. MELTON: Thank you. I'm not muted.

4 MEMBER KIRCHNER: Okay, go ahead, Mike.
5 Yes, you're on.

6 MR. MELTON: I can unmute myself. I was
7 going to add a little bit a few slides ago, but I
8 think we got through it, and so I'm going to let Ben
9 continue and then I can interject when I need to.

10 MEMBER KIRCHNER: Okay.

11 MR. MELTON: So, thanks for bringing me up
12 and I'll go back on mute. Back to Ben. Thank you.

13 MEMBER KIRCHNER: All right, Ben,
14 continue, please.

15 MR. BRISTOL: Okay, next slide. So, this
16 was already touched on a little bit, but just to
17 reset, the boron dilution analysis and distribution
18 analysis that NuScale had done and was reviewed by the
19 NRC was largely centered around the transport
20 mechanisms after ECCS actuation.

21 So, characteristically, the boil off rate
22 in the core and the condensation in containment and
23 recirculation causes a redistribution effect, and we
24 had spent a fair amount of time evaluating that and
25 confirming that under all conditions where we were in

1 ECCS cooling mode, that boron was preferentially
2 accumulating in the core, which is provided that it
3 doesn't over accumulate and create boron
4 precipitation-related concerns, then that's helpful
5 for the characterization of shutdown and shutdown
6 margin.

7 So, as we were looking through that, and
8 Matthew kind of alluded to this earlier, the effects
9 of potentially lower boron concentration entering the
10 core during an ECCS type transience, we had not, you
11 know, developed the methods and models necessary to
12 ensure that the three-dimensional effects of boron
13 distribution in the core wouldn't result in a core
14 safety concern.

15 Generally, we didn't see significant
16 enough dilution scenarios that would cause a
17 catastrophic core reactivity event. However, with
18 deterministic analysis where we're assuming a rod is
19 stuck out of the core and we're applying calculational
20 uncertainty, it becomes a very difficult problem to
21 prove necessarily that under all conditions we would
22 meet, you know, SAFDLs and acceptance criteria.

23 In addition, as we were looking through
24 the analysis, we had identified that there were a
25 couple of minor design changes that we could implement

1 relatively straightforward and demonstrate that we
2 could preclude the phenomena from occurring, and
3 therefore making the analysis unnecessary of those
4 conditions.

5 MEMBER BALLINGER: This is Ron. So, what
6 you're saying is that the holes are basically there
7 for a Chapter 15 problem?

8 MR. BRISTOL: So, I'll get into that.
9 Ron, I'll get into that in a little bit once we start
10 talking about that, but I would say that the
11 characterization of the potential phenomena is
12 certainly deterministically postulated, but I think as
13 we were looking through it, there was a lot --

14 There's obviously a lot of benefit in
15 terms of operational simplicity and things that would
16 need to be considered, you know, during event recovery
17 actions, that generally having design features that
18 preclude significant boron redistribution would make
19 the overall design safer and simpler.

20 MEMBER BALLINGER: Thank you.

21 MR. BRISTOL: Sure. So, where we are
22 currently in the process, the NRC has initiated an
23 audit reviewing the design changes and the analysis of
24 those design changes, and we're still working through
25 that. Next slide? Thank you.

1 So, of the events, I'll speak to this for
2 a little bit here. As I mentioned a couple of slides
3 ago, where this all started was the consideration of
4 slower LOCA events that actuated ECCS on high
5 containment level with the consideration that some of
6 those events could take several hours until ECCS
7 actuation would occur.

8 And because of the figures of merit within
9 generally the LOCA analysis where we're looking to
10 demonstrate core coolability, the additional
11 consideration of boron distribution had not previously
12 been looked at in as much detail.

13 And our general understanding of the
14 phenomena related to that was as ECCS is actuated,
15 generally we see core transient behavior and fluid is
16 displaced from the RCS into containment until the
17 levels equalize and the pressures equalize, and then
18 slow recirculation of the condensate from containment
19 is established, and we established the stable cooling
20 under that configuration.

21 As I had mentioned, when we started
22 looking further into it, there was very specific and
23 unique cases where if the ECCS was actuated while the
24 riser level was still relatively high, then there was
25 this swell behavior that we saw that could cause a

1 core in surge type transient phenomena.

2 Under those conditions, the time frame was
3 still sufficiently short that the overall dilution,
4 while challenging in deterministic analysis space with
5 uncertainties applied, normally probably wouldn't
6 generate a significant reactivity event.

7 And as we were looking at those cases, it
8 became apparent that if we had events that were
9 eventually going to lead to an ECCS actuation, then we
10 would simply actuate them sooner, and we ended up
11 developing a new ECCS actuation signal which I'll
12 speak to a little bit later. The other phenomena --

13 MEMBER MARCH-LEUBA: What type of event --
14 because the one we were most worried about is the
15 various load developing LOCA, I mean a one gallon per
16 minute type of LOCA, the smallest of the small breaks
17 which will take an hour or two before the level in the
18 containment trips the ECCS, and DHRS would have been
19 working and condensing steam on top of the downcomer
20 for hours. But you're talking about a different one
21 now, one that is fast and it can produce flow
22 distribution into the core. Can you explain that one?

23 MR. BRISTOL: No, I think we're speaking
24 of the same event, right? The larger breaks, and
25 particularly, you know, just for example's sake, if we

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1 were to postulate a full break of the discharge line
2 of CVCS, we see the transient progress relatively
3 quickly and there is not enough time for a boron
4 redistribution and DHR-driven condensate effect to
5 cause any significant boron redistribution, and we get
6 to ECCS cooling, you know, well within the first hour
7 of the event transient.

8 MEMBER MARCH-LEUBA: I agree. It has to
9 be an hours type of event, not minutes.

10 MR. BRISTOL: That's right. The
11 condensation accumulation rate relative to the volume
12 that we have in the RCS is pretty small. However,
13 events that do spend several hours getting to ECCS
14 actuation, those were the events that we identified
15 the concern with.

16 MEMBER MARCH-LEUBA: Yeah, unfortunately,
17 the smallest of the small break LOCAs are the ones
18 that have the highest frequency, but keep going.

19 MR. BRISTOL: Sure. So, that's kind of a
20 high level description of the LOCA scenarios. The
21 other phenomena that we have in the system is under
22 conditions, non-LOCA conditions, we can end up in DHR
23 cooling scenarios.

24 And the DHR is an efficient enough heat
25 removal system that the RCS temperature will drop and

1 continue dropping, and what happens is the level in
2 the RPV drops or shrinks along with the temperature
3 decreasing.

4 And the system is designed such that under
5 certain conditions, if inventory hasn't been added,
6 then we would get the RCS level to drop down to the
7 top of the riser, and once that occurs, then there's
8 a potential for continued shrinkage to the point where
9 we could get some steaming and condensing between the
10 riser and downcomer side.

11 Generally, you would expect an internal
12 circulate convective circulation pattern to be
13 established where boron would continue to be
14 reasonably well mixed.

15 However, because of the time frames we're
16 considering there and in our Chapter 15 analysis
17 space, clear out to 72 hours, we're observing while
18 the phenomena was very slow in developing, you could
19 potentially start generating a gradient that was
20 beyond the, you know, critical boron concentration in
21 the downcomer.

22 And the margins that we ended up
23 calculating under those conditions were sufficiently
24 small that we were motivated to provide the flow path,
25 and this is where the riser holes came in, to ensure

1 that the very slow condensation accumulation would be
2 prevented from a boron redistribution standpoint and
3 we would keep where we would limit the amount of
4 gradient that could be developed between the riser and
5 the downcomer to a very small fraction.

6 MEMBER BALLINGER: This is Ron Ballinger
7 again. I don't remember the number, but what is the
8 tech spec limit on unidentified leakage?

9 MEMBER KIRCHNER: .5 GPM.

10 MEMBER BALLINGER: .5 GPM, so a 1 GPM
11 LOCA, if you want to call it that, would be above the
12 tech spec limit and would be noticed right away, am I
13 right?

14 MR. BRISTOL: Correct.

15 MEMBER MARCH-LEUBA: Yes, that would be
16 correct, but then you get a scram (audio interference)
17 start.

18 MEMBER BALLINGER: Okay, so all I'm saying
19 is for something like that to go on for a long period
20 of time is almost problematic because of the tech spec
21 limit.

22 MEMBER MARCH-LEUBA: No, they don't have
23 any safety grade makeup. They don't have any power to
24 make it up.

25 MEMBER BALLINGER: Okay, we're getting

1 conflated with the Chapter 15 with the natural
2 operation now.

3 MEMBER MARCH-LEUBA: I know, but the claim
4 is that this is a possible plan that can handle
5 anything, and in particular, one gallon per minute, it
6 can handle it, and it will scram.

7 It will close the containment and the
8 level will start rising, and the downcomer will start
9 operating and you eventually are going to open. So,
10 okay.

11 MEMBER BALLINGER: Okay, all right, well,
12 we'll keep going.

13 MEMBER KIRCHNER: So, Ben, this is Walt
14 Kirchner.

15 MR. BRISTOL: Yeah.

16 MEMBER KIRCHNER: Another interruption.
17 You've given us some time frames, which is useful.
18 So, have you done kind of like bounding analyses?
19 When do you start accumulating? How long does it take
20 you? Is it more than 24 hours to accumulate a
21 significant amount of diluted water in the downcomer
22 under DHRS operation?

23 MEMBER MARCH-LEUBA: I believe, Walt, that
24 that's in the proprietary presentation. Maybe we can
25 postpone it until later on.

1 MEMBER KIRCHNER: Yeah, well, just take
2 that maybe under advisement as a question because I
3 think time, you know, time is a big, another factor
4 for consideration in the review of these analyses. Go
5 ahead, Ben.

6 MR. BRISTOL: Yes, certainly it's on the,
7 you know, on the order of several hours. What we were
8 noticing under the, you know, the LOCA conditions or
9 the slower leak conditions is that the steam generator
10 would continue to uncover, and as the tubes start to
11 uncover, then it becomes a much more effective
12 condenser, and so that would increase the rate. Those
13 were cases though that we had identified early
14 actuation of ECCS could preclude that event
15 progression quite reliably, and we spent --

16 MEMBER KIRCHNER: Right, right.

17 MR. BRISTOL: -- a fair amount of time
18 analyzing that.

19 MEMBER KIRCHNER: All right.

20 MR. BRISTOL: The conditions where we're
21 more of a shrinkage-driven problem, those are much,
22 much slower in progressing, and we had, you know, we
23 had identified the time frame of concern being beyond
24 the 24-hour time frame.

25 MEMBER MARCH-LEUBA: One example I put in

1 one of the papers I wrote was a hurricane is going to
2 hit your plant and you are asked by the NRC to go
3 shutdown and go into a safe shutdown while the
4 hurricane is going through to DHRS operation, and you
5 might stay there for three or four days. And I know
6 it's not the typical Chapter 15 analysis, but it is
7 quite expected anticipated occurrence.

8 MR. BRISTOL: Sure, and I think under
9 those conditions and normal shutdown, or even rapid
10 shutdown, one of the more important things to do is
11 add inventory in order to, you know, maintain the
12 operability of the module. If the inventory starts
13 shrinking too much, then we'll get an automatic
14 containment isolation.

15 So, it's one of the key considerations in
16 operability, not necessarily from a core coolability
17 standpoint, but just from an operability standpoint as
18 inventory addition.

19 So, the other thing we had analyzed is
20 the, you know, anticipated transients without scram,
21 and we had looked a little bit.

22 Generally, what we see there is that the
23 boron accumulation effects are helpful making those
24 analyses more limiting at the end of cycle condition
25 when there's lower boron concentrations in the system.

1 Okay, next slide, Matthew?

2 MEMBER MARCH-LEUBA: No, no, don't go
3 there, not yet. I was --

4 MR. BRISTOL: Okay.

5 MEMBER MARCH-LEUBA: All right, I wanted
6 to first say that let me -- I'm not nice to you very
7 often, so in the route of the bypass orifices, the
8 holes, it's a good thing. That was the right answer.

9 And now we need to argue about the
10 diameter of the holes for you, and we'll argue for a
11 month on that, but it is the right thing to do and it
12 is good that you guys did LOCA and DHRS in hours, but
13 there is a situation that I don't see in FSAR or in
14 any of your slides, and it is the following.

15 After you have an ECCS actuation, there
16 are a million scenarios that get you there. Okay, I
17 don't care how you got there. You opened your RRVs.
18 Your three levels, the riser, the downcomer, and
19 containment are at about the same elevation.

20 Now your steam generator is completely
21 uncovered and whatever heat is coming out of the core,
22 which if it's a few minutes after shutdown, will be
23 three to five megawatts.

24 In an hour, it could be a megawatt, goes
25 into condensing on the simulator, and then when you're

1 in this DCCS mode, you are going to be raining water
2 into the downcomer.

3 At what rate? I don't know, but the fact
4 that you will deborate when you're in ECCS mode is, I
5 mean, it's almost impossible not to fail to operate.
6 The question is how long it will take.

7 The problem, and I know you realize this,
8 but I'm not sure that you realize that if now the
9 operator, because he has a rupture on the CVCS line or
10 he doesn't have the proper procedures, he starts CFDS
11 containment flooding and you start raising the level
12 the containment, and that RRV starts flooding water
13 into the top of the downcomer and pushing that
14 deborated downcomer into the core.

15 So, my claim is that any moment, any time
16 you go into ECCS mode, you start deborating the
17 downcomer. If one hour, 10 hours, 100 hours after
18 this happens, you start containment flooding, you have
19 the same problem that we had before with ECCS
20 actuation.

21 And Chapter 19 has -- I mean, even your
22 slides here have a line that says, "And we can recover
23 by starting CVCS." It gave me the impression that you
24 just haven't thought this through.

25 So, don't do it now. Save it for the

1 closed session or save it for tomorrow, but I'm going
2 to postulate -- I mean, I'm going to tell you that
3 everything you did was good except maybe the model,
4 but my concern right now is ECCS mode, deboration,
5 following by CVCS actuation.

6 And even if a COL applicant later on
7 decides that that is a bad thing and we're going to
8 have procedures not to actuate containment flooding,
9 they will have to take an exception against your FSAR
10 because your FSAR tells them to use CFDS.

11 This slide, I don't know what number it
12 is, this slide right here, three or four for now, will
13 tell us to use CFDS to recover from that condition.
14 We got a problem.

15 MR. BRISTOL: So, I'll start addressing
16 that with the -- I think we agree, and we've actually
17 added a statement in Chapter 15 in the FSAR
18 acknowledging that under ECCS, extended ECCS cooling
19 conditions, that redistribution is expected, and have
20 actually made the statement that any recovery actions
21 will need to consider this with respect to the
22 shutdown margin as part of the recovery actions.

23 As, you know, as we've talked in previous
24 meetings, those actions cannot be specified, you know,
25 at the design certification stage, but I think I

1 understand your concern and I believe that we have
2 addressed it fairly explicitly now within our FSAR.

3 MEMBER MARCH-LEUBA: Yeah, but my concern
4 is when somebody takes time to think about this,
5 they'll have to take an exception on your approved
6 design because your approved design says to use CFDS,
7 the containment, yeah, CFDS.

8 MEMBER KIRCHNER: Now, I just note, Jose,
9 that Ben used a word, extended ECCS operation, so that
10 begs the question. You've probably done some bounding
11 analyses on what amount of dilution would take place
12 in the downcomer. It seems to me that one can then
13 infer a tech spec, that you have to essentially
14 intervene to mitigate the situation in X hours.

15 MEMBER MARCH-LEUBA: Let me run you by
16 what a LOCA would look like in the plant. A LOCA
17 happens. The scram is automatic. Containment
18 actuation is automatic. Within a few minutes,
19 everything gets -- the ECCS actuates and everything
20 gets --

21 MEMBER KIRCHNER: Right.

22 MEMBER MARCH-LEUBA: -- stable and nice.
23 The operators breathe a sigh of relief and call the
24 engineering staff. The engineering staff now starts
25 thinking what happened? Why did it happen? Can we

1 fix it?

2 In the meantime, part of the engineering
3 staff is also making calculations to figure out what
4 happened to the core, to the fuel with the actual
5 transient, and this takes time.

6 This is time for the resident inspector,
7 the NRC resident inspector to go into the control room
8 and look over the shoulder, get their cell phone and
9 call headquarters who is going to send out an
10 inspection team that's not going to let you touch the
11 reactor until --

12 MEMBER KIRCHNER: No.

13 MEMBER MARCH-LEUBA: -- they show up there
14 and they find out --

15 MEMBER KIRCHNER: This is not how you
16 operate, Jose. They can do a calculation that shows
17 --

18 MEMBER MARCH-LEUBA: You have a LOCA.

19 MEMBER KIRCHNER: You're helping them
20 solve the problem rather than listening to how they've
21 solved the problem, but I would just submit that one
22 can do a bounding analysis on extended ECCS operation
23 and make an estimate of where you get to a point,
24 based on where you are in the life cycle, the
25 beginning of cycle and end of cycle, where you get to

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1 a point where you have to be concerned about boron
2 dilution, and that suggests that there's a time limit
3 where you intervene with the containment flood and
4 drain system before you cross that juncture.

5 But anyway, we're trying to solve their
6 problem. Let's hear from Ben and NuScale what they
7 are doing.

8 MEMBER MARCH-LEUBA: Yeah, I just wanted
9 to posit the concern I have. Everything else is
10 essentially solved. We need to cross the Ts and dot
11 the Is and review all of their math, but it's solved.
12 I'm still concerned with the ECCS, long term ECCS
13 actuation following by CFDS operation, so, yeah, you
14 can go on.

15 MR. BRISTOL: Okay, and I think I would
16 add the CVCS has the capability of injecting into the
17 riser, which would be obviously the first choice, and
18 even if that somehow was failed, injection can be
19 applied through the pressurizer spray line, and that
20 dumps -- that would inject boron directly on top of
21 the downcomer, and the injection rates are
22 sufficiently slow that there's a variety of mechanisms
23 where safe recovery can occur.

24 However, as we've spent some time talking
25 about this, you know, the specifics of those

1 procedures are, you know, not available and not worked
2 out at this stage, but the system has the capability
3 of recovery from a variety of different conditions
4 that could be postulated.

5 MEMBER KIRCHNER: Ben, would you make a
6 note for the closed session? When one looks at your
7 line diagrams in the FSAR for CVCS, that distinction
8 isn't apparent that when you turn on CVCS that you can
9 control whether it goes into the spray.

10 I note that somewhere in the FSAR, it
11 indicated that you are continually spraying when the
12 CVCS system is working. So, you've made a distinction
13 that I don't think is apparent in reading the FSAR,
14 nor looking at the line diagrams in Chapter 9.

15 So, could you take a note of that?
16 Because one of our concerns is that you start
17 spraying, you then quickly drop the pressure, and you
18 can -- you know, the core conditions are saturated as
19 a result.

20 You get a quick expanse of the inventory
21 that's in the core and the riser, and that will then
22 bring in, you know, the cold, diluted content of the
23 downcomer. Do you see what I'm saying? The
24 depressurization -

25 MR. BRISTOL: Well --

1 MEMBER KIRCHNER: -- could induce a
2 downcomer flow in. So, you don't have to answer in
3 real time, but could you explain that perhaps in the
4 closed session?

5 MR. BRISTOL: Sure, and just to kind of
6 characterize, the conditions under ECCS cooling are
7 already quite depressurized. Once ECCS is actuated,
8 we quickly depressurize the system such that the
9 inventory addition for, you know, proposed event
10 recovery type scenarios would simply just be filling
11 the pressurizer through the spray line.

12 And I think the only reason we would be
13 thinking of doing that is if we had an indication that
14 the break occurred on the injection line or we had
15 some reason why the injection line, you know, wasn't
16 functional.

17 Then the spray could be added through the
18 pressurizer, and the pressurizer holes are located
19 over the downcomer, and so it would fall into the
20 downcomer, reborating the downcomer prior to the
21 establishment of long-term passive cooling with the
22 containment flood and drain system.

23 MEMBER MARCH-LEUBA: My complaint is not
24 that it cannot be done. It is just that we use risk-
25 informed objectives for everything we want to do, but

1 then we introduce on this type of scenarios.

2 And in my mind, the consequences of
3 putting all that water into the core is terrifying.
4 That this is not something that should be related to
5 the COL, hoping that a COL will do it.

6 And taking credit for reactions that are
7 complex and require a diagnosis and understanding, I
8 mean I've been to control rooms many times and they do
9 a great job, but they make mistakes too. And I don't
10 see how come that is not part of the PIA.

11 All the sequences, how come they're not in
12 the risk? Because we're claiming a tremendously low
13 frequency, when we have a really full scenario that
14 depends on the operator identifying it and doing the
15 right thing without safety power.

16 Anyway, I said it. It's on the record.
17 Go ahead.

18 MR. BRISTOL: Okay. So I think we're --
19 are we in slide 7?

20 VICE CHAIR REMPE: Just so you know, Ben,
21 I think we lost Matt Presson, and we don't have the
22 screen, although we -- the members have copies of your
23 slides and just keep us posted on what slide you're
24 on.

25 MR. BRISTOL: Okay.

1 MR. NGUYEN: So Matt just responded in the
2 IM chat, so he's here still.

3 MR. PRESSON: I can see the screen.

4 MR. NGUYEN: For the presenter, I
5 recommend stop sharing the screen and try to load it
6 again to refresh for everyone.

7 MR. PRESSON: All right, will do if I can.

8 MEMBER MARCH-LEUBA: If everything else
9 fails, get off of Skype and come back in.

10 MR. PRESSON: Yeah. It's currently not
11 letting me hit the stop presenting button, so jump off
12 and jump back on.

13 MEMBER KIRCHNER: So this question is for
14 Mike Snodderly. Mike, do you have the ability and
15 authority to put up the slide?

16 MR. SNODDERLY: I was thinking the same
17 thing. So yeah, I'm going to request the screen
18 control.

19 MEMBER KIRCHNER: Yeah. And then it seems
20 like we had Matt on audio, so you can just have Ben
21 indicate when he wants to change the slides if you can
22 load it.

23 MR. SNODDERLY: Can everyone see my
24 slides?

25 MEMBER KIRCHNER: Yes. We see them, Mike.

1 So go ahead and --

2 MR. SNODDERLY: Ben, what slide do you
3 want me on? Ben, first --

4 MR. BRISTOL: Slide 7.

5 MR. SNODDERLY: Everyone should be able to
6 see slide 7.

7 MEMBER KIRCHNER: There it is. Yeah,
8 that's it, Mike. Thank you very much. Go ahead, Ben.
9 And just indicate to Mike when you want to go on to
10 the next slide.

11 MR. BRISTOL: Sure. So as we've kind of
12 been discussing along the previous slides, the design
13 considerations, primarily two, for the events that we
14 know were going to end up in ECCS actuation, we
15 identified that actuating ECCS sooner would preclude
16 the boiling distribution because of the timeframe
17 required for the boiling and condensing effect that
18 actually caused the redistribution phenomenas to
19 occur, and provided that ECCS was actuated prior to
20 any redistribution phenomena, then we could preclude
21 the phenomena of a large influx of unborated water to
22 the core for the smaller and slower progressing LOCA
23 type scenarios.

24 The other sort of newer edition at least
25 to the ACS's consideration is the inclusion of the

1 riser holes as a design feature. We have identified
2 that as really being a robust design feature that we
3 could make sufficient to preclude the redistribution
4 phenomena of concern, while not actually impacting the
5 normal operation of the RCS and normal operation of
6 the module itself. So okay, slide 8.

7 Specifically as related to the ECCS
8 actuation, what we saw characteristically was a
9 depressurization and a pressure in temperature type
10 phenomenon that we could use to identify if we were in
11 an event, you know, with the MPX sensors that already
12 existed in the design, we could target the events
13 where we were losing inventory because of the way that
14 the temperature and pressure observed or measured in
15 the T-hot location that's located at the top of the
16 riser. And specifically if the pressure were to drop
17 while the temperature remained high, then we knew we
18 were in a loss of inventory type scenario as opposed
19 to just a normal DHR cooldown.

20 And in terms of risk insights, I think I
21 would say this is one of the areas that we've spent
22 some time with the PRA and the events that they
23 analyze, and as the ACRS is aware there's very few
24 causes of core damage -- maybe back up one slide
25 there, Mike.

1 One of the contributors is events that
2 require an ECCS demand where the valves or a
3 combination of the valves don't reposition as
4 intended. So it was important to us to ensure that we
5 weren't sending events that otherwise were safe and
6 stable on DHR cooling and not sending those events to
7 ECCS just to solve the problem that we were, you know,
8 kind of postulating deterministically.

9 So there was design consideration that
10 went into what events we were sending to ECCS and
11 attempting to ensure that they were only events that
12 would otherwise have ultimately ended up in ECCS or
13 needed to go to ECCS for extended core cooling.

14 MEMBER MARCH-LEUBA: And I support
15 everything you said. I mean we don't need to talk to
16 anyone we don't need to. Can you explain to me, do we
17 need this 800 psi? What is it protecting against?

18 MR. BRISTOL: So 800 psi is we looked at
19 a spectrum of different LOCA events and LOCA
20 progressions with a variety of different, you know,
21 DHR considerations considered, and what we typically
22 observed that 800 psi was about the time at which the
23 riser was starting to uncover.

24 So that's where the 800 psi kind of came
25 from, from the perspective of the smaller LOCA events,

1 800 psi was about the time at which the riser would
2 start to uncover. And obviously it's the loop and
3 circulating back that's the first initiator of the
4 onset of more of a boiling and condensing type
5 phenomena where the redistribution phenomena starts to
6 come into play.

7 MEMBER MARCH-LEUBA: And your core level
8 sensor is non-safety grade, even though it is safety
9 grade because of the standards in the riser, but it's
10 considered not to be safety grade. It would have been
11 to have a scan at another level.

12 MR. BRISTOL: So we certainly considered
13 the low RCS level, but again as I was just kind of
14 talking about, low RCS level itself doesn't determine
15 if an event is a shrinkage related DHR cooldown event
16 versus a loss of inventory event.

17 MEMBER MARCH-LEUBA: But you have the same
18 interlocks. But anyway, that's what I have done.

19 (Telephonic interference.)

20 MEMBER BLEY: Excuse me, this is Dennis.
21 Jose, when you're talking, could you talk a little
22 more slowly? It gets garbled a bit over this
23 connection.

24 MEMBER MARCH-LEUBA: Am I getting a bad
25 connection today?

1 MEMBER BLEY: Well it's not a bad
2 connection, but when you talk real quickly it's hard
3 to follow over the microphones and things we're using.

4 MEMBER MARCH-LEUBA: So I -- let me
5 repeat. I offer that if I was designing the plan,
6 which I'm not, I would -- I was asked by a member why
7 do we have the 800 psi scam, and I told the member, I
8 don't know. And it turns out now we know the 800 psi
9 is a substitute for the level --

10 MEMBER BLEY: For level, mm-hmm.

11 MEMBER MARCH-LEUBA: Yeah. So it's good.
12 Okay. It does occur.

13 MR. PRESSON: And this is Matthew Presson
14 for a quick correction for the record. On slide 8,
15 that less than 800 psi line should be less than 800
16 psi, 900 plus or minus 100.

17 MEMBER MARCH-LEUBA: Okay, perfect.

18 MR. BRISTOL: Okay, slide 9. So yeah,
19 just to summarize on that slide, the 800 psi with the
20 temperature interlock allows us to identify the loss
21 of inventory conditions while not actuating ECCS for
22 events that otherwise did require ECCS actuation
23 previously.

24 Another one of the design changes or
25 issues that we had identified, again as I mentioned at

1 the top of the presentation, the level accumulation in
2 containment, if it's above the equilibrium level after
3 ECCS has depressurized the RCS and the RPV, and the
4 pressures between containment in the RPV equalize,
5 then there's a manometer head that can force fair
6 amounts of the containment coolant back into the RCS.

7 That was quite simple to preclude by
8 simply dropping the containment level actuation point
9 down into the range where nominal containment level is
10 established. So --

11 MEMBER MARCH-LEUBA: If I remember
12 correctly, on the limiting LOCA you were not dripping
13 on level. I mean the level was providing the initial
14 signal, but you have to wait for the IAV to open. So
15 if you provide a set point up to 52, will the IAV
16 allow you to open then?

17 MR. BRISTOL: Yeah, and so ---

18 (Simultaneous speaking.)

19 MEMBER MARCH-LEUBA: -- record, the level
20 drops two feet above the core inside the vessel
21 because of the IAV. Isn't that --

22 MR. BRISTOL: Yeah, and that's what I
23 would characterize as -- for the purposes of providing
24 a conservative LOCA analysis, that analysis technique
25 assumes that DHR doesn't function.

1 Under those conditions, obviously if that
2 were considered, then the condensate accumulation in,
3 you know, in the RPV is characteristically different.
4 The boron transport analysis did not use that
5 analytical technique and instead analyzed something a
6 little bit more realistic to the design, in which case
7 the DHR has the capability of depressurizing the
8 system well below the IAV block range, well prior to
9 the ECCS actuation signal.

10 MEMBER MARCH-LEUBA: I may have missed it.
11 Was Chapter 15 updated with this new calculation, or
12 at least a mention to it? Because I missed it. So
13 your Chapter 15 has been LOCA, the reference has been
14 LOCA, it still assumes the SRS not working?

15 MR. BRISTOL: That's correct.

16 MEMBER MARCH-LEUBA: But for to
17 demonstrate your new 252H level, you have to form a
18 new calculation?

19 MR. BRISTOL: Yes, that's right.

20 MEMBER MARCH-LEUBA: And that -- at least
21 on one line, according to the fact that this is the
22 case, because if I look at Chapter 15 SVA, I see that
23 I don't really open the valve or something until the
24 pressure drops below IAV.

25 MR. BRISTOL: Mm-hmm.

1 MEMBER MARCH-LEUBA: Obviously, that's not
2 the case. I guess it merits some explanation, a one
3 liner. I don't want to see the plots, understand what
4 you're saying.

5 MR. BRISTOL: Okay.

6 MEMBER MARCH-LEUBA: I didn't miss it.

7 MR. BRISTOL: So slide 10, Mike? Okay, so
8 the riser holds. As we discussed previously, under
9 DHR cooling shrinkage conditions the top of the riser
10 there, the inventory can shrink to the point where
11 that uncovers.

12 And what we see under those conditions is
13 that the temperature gradient between the riser and
14 downcomer starts to increase with the downcomer
15 becoming cooler and continuing to shrink while the
16 riser remains hot until the point at which the heat
17 removal for the delta T is sufficient to push the
18 decay through the riser wall itself. When we were
19 evaluating that phenomena, it was identified that
20 that's actually a good driving force for fluid from
21 the riser to the downcomer if there was a flow path.

22 And because of the very small margin or
23 with the very low allowable boron gradient between the
24 downcomer and riser under cold conditions, where, you
25 know, xenon has burned out and DHR, if we're

1 postulating DHR cooling for a great deal of time
2 beyond the 24-hour timeframe, the amount of condensate
3 while very slow in accumulating and developing, it
4 still could become somewhat challenging from the
5 allowable critical boron concentration with analysis
6 uncertainties and, you know, the worst, rod stuck out
7 of the core.

8 So with that in consideration, rather than
9 maintaining analysis basis that was fairly tight from
10 margin perspective, we went ahead and decided to add
11 the riser holes. And we also recognized that this
12 provided a much more robust design solution and
13 simplified potential event recovery considerations for
14 the more probable events where DHR, extended DHR
15 cooling had occurred and that the potential
16 complexities were around ensuring that the downcomer
17 concentration hadn't dropped to a point that was
18 challenging.

19 With riser holes we've sized them such
20 that again they had a very small impact on the normal
21 circulating loop, a very small impact on any of the
22 analyses supporting the original SR, and yet providing
23 upflow to ensure that the concentration that develops
24 between the gradient between the downcomer and riser
25 remains quite small.

1 (Telephonic interference.)

2 MEMBER MARCH-LEUBA: --- and fixing the
3 problem is always the best thing to do. Keep going.

4 MR. BRISTOL: So I think that's the end of
5 my presentation. I'm going to pass it over to Paul
6 who's going to talk a little bit about much of the
7 rest of this presentation's focus is on the impacts of
8 these design changes. So if there's no more
9 questions, I'll turn it over to Paul.

10 MEMBER KIRCHNER: Ben, just that when we
11 get to the closed session -- this is Walt Kirchner.

12 MR. BRISTOL: Yeah.

13 MEMBER KIRCHNER: Will you just go over
14 how you chose the level for the location of the holes?
15 Could you talk a little bit about that? I don't want
16 to postulate what I would have done, but I'd just like
17 to hear more detail, i.e., the scenarios that you used
18 to decide where to make the actual penetration, so to
19 speak. The elevation is of interest. Thank you.

20 MR. BRISTOL: Sure. And I can actually
21 cover some of that in the open session here. What we
22 were looking at was as I mentioned the extended DHR
23 cooling scenarios. One of the things we observe about
24 the normal circulation of the loop is that a good
25 portion of the heat transfer occurs in the bottom half

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1 of the steam generator, so any of the bypass flow that
2 occurred from the midpoints and above doesn't actually
3 present a net thermal efficiency loss.

4 So that was one of the reasons for putting
5 the riser holes at that low elevation was the normal
6 operating consideration, in fact. In addition,
7 they're low enough that even the most severe non-LOCA
8 events where, you know, potentially we have a loss of
9 inventory to initiate the events and then shrink from
10 there, the holes will never uncover during normal DHR
11 cooling scenarios. So those were kind of the two
12 primary considerations that went into that location.

13 MEMBER KIRCHNER: Okay. Thank you.

14 MR. BRISTOL: Sure. Go ahead, Paul.

15 MR. INFANGER: Okay. Can you hear me? Is
16 my mic --

17 MEMBER KIRCHNER: Yes, Paul. Go ahead.

18 MR. INFANGER: Okay.

19 (Telephonic interference.)

20 MEMBER KIRCHNER: Paul, you're garbled
21 somewhat. Can you speak more directly to your
22 microphone?

23 MR. INFANGER: Yeah, let me see if I can
24 get closer here. Better. Is that better?

25 MEMBER KIRCHNER: That's much better.

1 MR. INFANGER: Okay. So the next section
2 of the presentation is to talk about the FSAR and
3 analysis changes. Okay. So -- and for Chapter 15,
4 we've looked at all of the analyses and looked at what
5 needed to change based on the design changes.

6 So we looked at the return to power
7 calculation that's in FSAR 15.0.6 and the end of cycle
8 conditions are still limiting for the return to power
9 event. So there's no change to the limiting event.

10 So the flows through the riser hole will
11 maintain the downcomer greater than the critical boron
12 concentration for events that occur earlier in the
13 cycle, so those became even a less of a concern
14 because all of the events with the DHS and potential
15 return to power, all of those now have the mixing from
16 the circulation flow that goes through the holes and
17 back through to the core.

18 So the 15.0.6 there was no impact with the
19 results in the FSAR.

20 MEMBER MARCH-LEUBA: So I'm going to
21 summarize. The boron will return to power is very
22 high sequence activity, which happens at the end of
23 power where you don't have boron in the vessel. So
24 boron solution when you have no boron to start with is
25 not an issue. So absolutely, I second your opinion.

1 MR. INFANGER: Okay. So -- and also we
2 presented our boron redistribution methodology in
3 response to a request for additional information in
4 RAI 8930. And in that we had done like simple
5 grouping of boron concentration levels in the -- like
6 for three simple groups.

7 And what the modifications do is they with
8 the ECCS modifications they assure that early
9 actuation of ECCS has flow out of the reactor vessel
10 and into containment, and therefore we get a mixing in
11 containment.

12 And then when you do have return flow it's
13 very slow flow because the pressure equalizes, and
14 then as level builds in containment you get a slow
15 flow back into the core, into the reactor vessel from
16 the containment, and then you don't run into the same
17 boron mixing concerns you have with getting a large
18 slug from the downcomer or the containment.

19 So the modifications that we made, the
20 combination of the holes and the revised ECCS
21 actuation set point maintained all of the assumptions
22 that we had in our boron redistribution analysis. We
23 submitted an update to that RAI response documenting
24 the changes and that the -- so what the results are.

25 I'm moving the screen here. I don't know

1 if we're -- the -- let's go off of another slide on
2 the computer because the -- my WebEx, mine has -- it's
3 disappeared.

4 The LOCA analysis was redone, and there
5 were some postulated events that actuate on low RCS
6 posture. Most of the steam space LOCAs will now go on
7 low RCS pressure actuation and from the liquid space
8 LOCA.

9 So there was no change to the limiting end
10 state to power request liquid level events, because
11 the MCHFR events are inadvertent opening of an ECCS
12 valve, either the RVV or the RRV. And in those events
13 the MCHFR occurs in like the first half a second.

14 So those events are very, very quick so
15 the progression to -- was not significant. And the
16 actuation on the low RCS pressure occurs in the events
17 that still have power available.

18 For the limiting events, we go on the IAVs
19 or loss of AC power and loss of DC power and the ECCS
20 valves actuate on the inadvertent actuation block
21 release point. So the -- and plus liquid level is
22 mostly the limit is the very small liquid space
23 breaks. So the limiting events I did not change so
24 that the minimum class liquid level didn't change or
25 either did the lowest MCHFR.

1 Some of the non-limiting events did change
2 in that a handful of tables in 15.6.5 were revised and
3 some because a number of the -- particularly the steam
4 space breaks now go on low RCS pressure, and the
5 sequence of events changes, they go ECCS earlier than
6 previous. So we do update the FSAR, but no limiting
7 results changed in any part of the FSAR. You can go
8 to the next --

9 MEMBER KIRCHNER: Paul?

10 MR. INFANGER: Yeah.

11 MEMBER KIRCHNER: Did you see any
12 significant change in your containment analysis?

13 MR. INFANGER: No. The limiting case for
14 containment pressure is the inadvertent reactor
15 circulation valve opening, and that entire scenario
16 was not affected by this event. So both on
17 containment level, ECCS on -- well, first, you get the
18 -- you go on AIV. With loss of DC power you go on a
19 loss of on the AIV set point. And --

20 MEMBER KIRCHNER: Thank you.

21 MR. INFANGER: And we also -- we looked at
22 the inadvertent opening of the ECCS valves. These had
23 no impact on the limiting event, the RVV opening with
24 power available. The remaining valves will open on
25 low RCS pressure, or in a couple of cases there is a

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1 non-safety opening of the valves on low delta P.

2 As the very fast depressurization,
3 sometimes that can come in before we hit the low RCS
4 pressure set points if they occur around the same
5 pressure range. The RRV was not affected, so the
6 remaining valves open on containment level, and the
7 reactor safety valve of opening events are still
8 bounded by the ECCS valve opening event.

9 So overall the Chapter 15 changes were
10 relatively minor. We did put in some discussion about
11 how the -- there's with the new signal that the steam
12 space breaks and the larger liquid space breaks open
13 on the new RCS low pressure set point.

14 That does affect a large number of events,
15 but mostly in the accident progression and as they
16 transition to ECCS earlier than they did before on
17 containment level. So that's the primary changes to
18 Chapter 15. In fact, the mechanical analysis, I'll
19 turn it over to --

20 MR. PRESSON: And we'll pass that off to
21 Hannah Rooks.

22 MR. INFANGER: Is Hannah available? Okay,
23 thanks.

24 MS. ROOKS: Yes, this is Hannah. Can you
25 hear me?

1 MEMBER KIRCHNER: Hannah, just a little
2 bit louder and closer to your microphone?

3 MS. ROOKS: Yes.

4 MEMBER KIRCHNER: And somebody else
5 probably has -- needs to mute their phone. We're
6 getting feedback.

7 MS. ROOKS: Okay. That there?

8 MEMBER KIRCHNER: A little more please.

9 MS. ROOKS: Okay. All right, so this is
10 Hannah Rooks. I'm the supervisor of the NSSS System
11 Analysis group, so I'm going to talk about the
12 evaluations that we performed for mechanical design
13 and analysis impact of the riser hole design addition.

14 So as Ben touched on already, the holes
15 are located at about the mid-height of the steam
16 generator, and since the majority of the heat transfer
17 occurs in that bottom half of the steam generator, the
18 flow through the riser holes still get most of the
19 cooling across the tubes and therefore it has
20 negligible impact on the normal RCS flow rate.

21 The holes also do not introduce any
22 structural integrity concerns due to swelling due to
23 vibration, and there's no need to update the
24 comprehensive vibration assessment program technical
25 report. And I have more detail on the SIV evaluations

1 that we performed on the next slide.

2 And also the holes don't have any impact
3 on the normal DHRS cooldown, and the cooldown curves
4 and the conclusions about DHRS performance that we
5 have presented in section 5.4 of the FSAR do not need
6 to be updated.

7 MEMBER MARCH-LEUBA: I wanted to ask about
8 that one because we used to have, for a few years,
9 5.4.11, I believe, and then it was where you can see
10 that they had a separating after two or three hours.

11 But this is a number, it's two kilos per
12 second flowing through the DHRS, it doesn't cool well.
13 I mean DHRS has improved, which is pretty good, but
14 does it have any like on the final temperature, does
15 that being colder, anything that shouldn't do? Did
16 you look at that?

17 My point is two kilos per second doesn't
18 sound like much, but a lot greater than zero. And I
19 can tell you DHRS works better with the holes than
20 without the holes. I don't know if it's one degree or
21 10 or 100, but it's better.

22 And the question is, with the final
23 temperature and does that affect something else like
24 in terms of practicality, which it won't, and forget
25 about -- so -- but over to you.

1 MEMBER KIRCHNER: Jose, this is Walt.
2 What you're saying is, it supplements the DHRS. It
3 doesn't actually change the DHRS performance.

4 MEMBER MARCH-LEUBA: No, it's increasing
5 the heat transfer coefficient outside the tubes of the
6 steam generator, which therefore makes DHRS move more
7 heat.

8 MEMBER KIRCHNER: But if the flow is from
9 the riser to the down-comer, it's hotter fluid than
10 in ---

11 MR. BRISTOL: Walt, this is Ben Bristol.
12 So I'll maybe add something here to help a little bit.
13 The normal cooldown curve, the RCS flow rate is around
14 200 kilograms per second. And that's when the delta
15 T is fairly low. As the riser starts to uncover,
16 obviously then the resistance becomes higher and the
17 flow rate starts to drop.

18 MEMBER KIRCHNER: Right.

19 MR. BRISTOL: The two KG per second
20 doesn't characteristically change that temperature
21 gradient increase. Because even though, yes, there is
22 some additional flow circulating, it's too small to
23 really characteristically change that DHR cooldown
24 curve as a function of time.

25 MEMBER KIRCHNER: Okay.

1 MEMBER MARCH-LEUBA: My real question is
2 have you calculated it, or I mean it's okay. It's not
3 going to affect anything, because if you cooldown,
4 cooling the temperature like 10 degrees, because
5 mostly we do 10 degrees, I don't see the impact of
6 that.

7 MR. BRISTOL: Right.

8 MEMBER MARCH-LEUBA: Okay, continue.

9 (Pause.)

10 CHAIR SUNSERI: Please unmute.

11 MEMBER KIRCHNER: Yes, Ben are you, or did
12 we lose Hannah, or has she turned it over to you, Ben?

13 MS. ROOKS: No, somehow I got muted. Can
14 you hear me now?

15 MEMBER KIRCHNER: Yes. Go ahead, Hannah.

16 MS. ROOKS: Okay. So I was just saying
17 that we did run, with our RELAP analysis, the
18 comparison of the DHR cooldown with and without the
19 holes. And we basically kind of plotted the cooldown
20 curve and compared them. And there's a pretty
21 indistinguishable difference between the two cooldown
22 progressions.

23 MEMBER MARCH-LEUBA: See, that's the
24 perfect answer.

25 MS. ROOKS: Okay. So moving on to the

1 next slide, I guess, 14, so this is some detail, a
2 little more detail about the evaluations that we did
3 for the riser holes. So we looked at particularly
4 turbine buffeting and vortex shedding.

5 So the holes are, they're part of the
6 upper riser which feeds turbine flow. And therefore,
7 we've already evaluated the riser assemblies for
8 turbine buffeting. And the holes are just a very
9 small volume reduction to the upper riser. So they
10 have really no impact on the structural properties of
11 the riser, and there's no impact to the turbine
12 buffeting evaluations that have already been
13 performed.

14 And then because there's continuous flow
15 through the holes, any generation of vortices at the
16 leading edge of the holes would be suppressed by that
17 flow. But if vortices were to form, their frequency
18 would not be coincident with any relevant modes of the
19 riser.

20 And lastly, we reviewed the operating
21 experience, some valid -- there was some vibration
22 damage that occurred with fuel pins due to some cross
23 flow through gaps that developed between baffle
24 plates.

25 So the riser holes, they would induce a

1 cross-flow path from the riser to the downcomer
2 region. However, we evaluated the force due to normal
3 flow through the holes, and it's very minimal. And
4 the frequency of that flow would not result in any
5 resonance with nearby components.

6 So if there are no questions on that, I
7 think I will turn it over to Sarah to talk about PRA.

8 MS. BRISTOL: This is Sarah Bristol. Can
9 you hear me?

10 MEMBER KIRCHNER: Yes, Sarah.

11 MS. BRISTOL: All right. The PRA was part
12 of the team to develop the design solution. It was a
13 collaborative effort with safety analysis, design
14 engineering, I&C, ops. And once finalized, we
15 evaluated the design changes in the PRA. We looked at
16 our thermal-hydraulic models as well as our logic
17 models.

18 Next slide please. We incorporated the
19 design changes with the riser holes and the ECCS
20 actuation logic into the best estimate NRELAP5 PRA
21 thermal hydraulics model.

22 The changes to the ECCS actuation logic
23 had the potential to affect the accident sequence
24 prevention as well as the end states. So we have re-
25 evaluated the PRA from a hydraulic calculation to

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1 confirm the impact of the change on the Level 1 PRA
2 criteria and accident progression.

3 The results of the evaluations concluded
4 that cycling reactor safety valve sequences, which are
5 typically modeled following failure of flow trains of
6 the safety related decay heat removal system would now
7 reach this new low RCS pressure ECCS actuation set
8 point.

9 So in different instances, reactor safety
10 valves cycled through early pressure or stuck open.
11 Also those accident scenarios would now result in this
12 new ECCS actuation.

13 The additional impact we saw was that, in
14 the low likelihood scenario of an un-isolated chemical
15 and volume controlled system, injection running pipe
16 breaks often continued.

17 The earlier actuation of ECCS has the
18 potential of increasing the amount of coolant lost
19 from that break from the reactor pressure vessel prior
20 to isolation. So we are now crediting that safety
21 related decay heat removal system to delay the
22 potential event progression, which at times has
23 provided to the operators to provide coolant
24 injections. So we updated the event tree to reflect
25 those two new insights from the design changes.

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1 MEMBER MARCH-LEUBA: Let me interrupt here
2 and go back to my new favorite topic which you'll hear
3 as long as I have a microphone that works, yes. The
4 sequence I'm concerned about is any LOCA that returns
5 the salts in ECCS actuation.

6 You see a week or two before the NRC
7 inspection team to make up their minds and let you do
8 something, and then operate CFDS. The way I'm reading
9 this, they approve the design, the certified design,
10 it's still on the operator, valves shall use CFDS in
11 those conditions?

12 If the POL responsible civil engineer says
13 that's crazy, if I turn CFDS, I'm going to push all
14 that operator outcome, and it's the core. So the only
15 recourse would be to take an exception from the
16 approved design.

17 And you can go to this particular sequence
18 on Chapter 19 and say this is a success sequence
19 because we put water in the core. Yes, you pull up
20 water to get water in the core.

21 So I still have a hangup here. We have to
22 do something about this. I don't know what to do, but
23 I think this is a hole in the system. I think it's a
24 serious hole in the system actually. Just putting it
25 out there. It'll probably be on here later.

1 Certainly I know the staff is listening.
2 The staff will do the math and see what all the
3 differences of the program. But it can be a 50/50
4 chance if you operate ECCS a week or two for the teams
5 to go away and let you do your job, and then you turn
6 CFDS, that is a bad scenario. I put it on the record,
7 and I will repeat it again over, and over, and over.

8 MEMBER BLEY: Excuse me, this is Dennis.
9 I got knocked off the line just as soon as Jose
10 started speaking. And I don't know if there was an
11 answer in between, or you're on your second round.
12 It's really hard to hear what happened during that
13 time, if somebody could summarize it.

14 MEMBER MARCH-LEUBA: This is Jose. I did
15 not hear an answer. I placed on the record the
16 scenario, they at NuScale, the Applicant, has fixed
17 the high frequency events by putting those two holes.
18 I applaud them for that. They have done the right
19 thing.

20 In my opinion, they left a hole on this
21 system. ECCS actuates because of all the inspections,
22 and analysis, and everything that needs to be done.
23 You stay there for a week or two. I mean I don't
24 guarantee. And then when you're ready to transfer
25 that module to the refueling station to work on it and

1 fix the break, you flood it with CFDS ---

2 (Simultaneous speaking.)

3 MEMBER KIRCHNER: Jose, I would submit
4 that that's a long time span. And that's not how you
5 operate a power plant. There are ways for them to
6 address this in tech specs phase and operating
7 procedures so that they do not allow the system to sit
8 there for weeks as you're postulating before this core
9 flood and drain system is actuated.

10 MEMBER MARCH-LEUBA: Can you point me to
11 the tech spec section that says that?

12 MEMBER KIRCHNER: I'm just proposing to
13 you that there is a fix for that.

14 MEMBER MARCH-LEUBA: I know there is a fix
15 for that. But what I'm saying is the fix is not in
16 the current FSAR or certified as an application.

17 MEMBER KIRCHNER: Yes, so we should take
18 that up.

19 MEMBER MARCH-LEUBA: Yes. It should be.
20 I think the consequences are piling up. And if you
21 look through, I mean even on this slide, we instruct
22 the operator to recover the CFDS.

23 MEMBER BLEY: Yes. Thanks for giving the
24 reprieves. I figured that's where you were going.
25 I'm very interested in your answer, but I really agree

1 with Jose on this, that if it fits without an answer
2 at this point in time, just putting it in the tech
3 specs will require an exception next time around. And
4 this is all part of one piece and ought to be
5 addressed at this time.

6 MEMBER MARCH-LEUBA: Yes.

7 (Simultaneous speaking.)

8 MEMBER MARCH-LEUBA: The Applicant will --

9 -

10 MEMBER KIRCHNER: Yes.

11 MEMBER MARCH-LEUBA: -- will need an
12 answer tomorrow. We have the whole morning tomorrow
13 to think about it. I know this comes cold, the
14 concept, so I don't want you to think on your feet and
15 make commitments in five minutes. Think about it, and
16 leave it for tomorrow.

17 MR. PREESON: Yes, we'll certainly think
18 about that and come back with any more details
19 tomorrow, Jose. But I think for the NuScale position
20 on that more extreme scenario is that we did provide
21 those updates to the language in Chapter 4 and Chapter
22 15 to identify those extended ECCS operating
23 conditions so that operators would have the
24 information they need to know that that is something
25 to consider.

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1 MEMBER MARCH-LEUBA: And you won't be
2 surprised that we write a letter, maybe something,
3 some recipes, that the design is incomplete. So
4 that's the way I see it. It can be fixed if you put
5 your heads to it. The same way you fixed the holes,
6 you can fix this too.

7 But at the moment, the consequences are so
8 bad. And this is not such an incredibly low frequency
9 event. It's any LOCA of any type, that's the same,
10 one gallon per minute leak from an SRV. We get you
11 there. We bring you an inspection team that won't let
12 you fix it for two weeks.

13 You will completely liberate the
14 downcomer. And as Walt says, what you have to do is
15 the moment you have uneasy situation, flood, we can
16 help, don't wait for whatever you want to do.

17 But in my opinion, the design is
18 incomplete. This is a sequence, which if you put it
19 on your PRA, this will be a dominant sequence for core
20 average. It won't be 10 to the minus 11.

21 MEMBER PETTI: Jose, can you help me here?
22 I seem to have lost the sequence of events. You have
23 some sort of a LOCA that actuates ECCS. You somehow
24 assume that the level is below the holes, so they
25 don't work?

1 MEMBER MARCH-LEUBA: It's got to be below
2 the holes, yes. It's designed to be below the holes.

3 MEMBER KIRCHNER: It would shrink it,
4 Dave, down, below that --

5 (Simultaneous speaking.)

6 MEMBER KIRCHNER: But that's a question we
7 can take up in the closed session meeting.

8 MEMBER PETTI: Sure, yes.

9 MEMBER KIRCHNER: That's where I was going
10 --

11 (Simultaneous speaking.)

12 MEMBER MARCH-LEUBA: -- containment.

13 MR. CORRADINI: I think I'd like to take
14 it up in the closed session. Because I'm confused
15 also, just as Dave is.

16 MEMBER KIRCHNER: Yes.

17 VICE CHAIR REMPE: So I have a question
18 about the process. We're kind of at a process. The
19 staff is still reviewing this, but if the staff
20 decides, I mean we've heard NuScale say, well we think
21 we've done enough, but we're reviewing what the staff
22 gives us.

23 The staff may say, hey, what they provided
24 is incomplete. And so I'm not sure, I mean it's good
25 for us to learn what NuScale's proposing and to make

1 comments. But I don't know, I think we're at a
2 process here, and it'll be interesting to see what
3 happens in the future. But I guess I'd kind of hold
4 back on any substantial conclusions on all this.

5 MEMBER KIRCHNER: Yes. We still are, we
6 are a little bit ahead of the staff. Joy, you're
7 correct. It's where we are today.

8 So I think Jose's point's been made
9 strongly, and NuScale I know, of course, the staff can
10 take notice of it. We are not in a position to draw
11 out the Applicant's design fixes. We only can make
12 our observations known at this point. And we should
13 reserve judgement until the process, as you point out,
14 is complete when the staff issues its SER, which we
15 will do.

16 MEMBER BLEY: Right. I'd ask NuScale for
17 tomorrow just to point out the specific language in
18 Chapters 4 and 15 that you think covers this so that
19 there's not a gap. But if you'd be real specific
20 about that tomorrow, I'd appreciate it.

21 MR. BRISTOL: So one point of
22 clarification, this is Ben Bristol, the event that
23 we're talking about here doesn't include an ECCS
24 actuation. It's an RSP that's cycling, and what PRA
25 has identified is that CFDS can be used to flood

1 containment and provide cooling to avoid the ECCS
2 actuation. And eventually as the level increases,
3 ECCS could be actuated on the containment level
4 actuation. But this is prior to ECCS actuation.

5 MEMBER MARCH-LEUBA: Are you sure about
6 that? Because the one, I mean maybe this, I'm at this
7 slide is what you say. But there are three or four
8 instances of this in Chapter 19. And one of them, the
9 first one, is CVC has lined LOCA. So you have an
10 isolated, the CVC has ejection line. Instead you lose
11 inventory, and still you will open ECCS before you can
12 find to turn CFDS. So maybe it's not this bullet was
13 referring to all the other instances of the six like
14 this in Chapter 19.

15 (Simultaneous speaking.)

16 MR. MELTON: Can you guys hear me okay?

17 MEMBER MARCH-LEUBA: Yes.

18 MR. MELTON: Okay, great. So we can
19 address this further in the proprietary section. We
20 have heard Jose's comments. We don't agree that the
21 design is incomplete. And we think we have this
22 covered pretty well. So we'll get to the proprietary
23 section, but I think it would be fair to wait for that
24 section so we can add some more detail and elaborate
25 a little bit more. Maybe the design is complete.

1 MEMBER MARCH-LEUBA: Sounds like a plan.

2 MR. MELTON: Yes, that'll be our plan to
3 carry this case a little bit further.

4 MR. BRISTOL: Okay.

5 MR. MELTON: Thank you, guys.

6 MEMBER KIRCHNER: Let's see, Matthew, are
7 we back to you? Or are we still with --

8 MS. BRISTOL: This is Sarah, still going
9 forward to Slide 16. And just to --

10 MEMBER KIRCHNER: Okay.

11 MS. BRISTOL: -- to clarify, I believe
12 that we are talking about two different events. This
13 event we're looking at in the PRA here is a beyond
14 design basis event. It's an un-isolated containment.

15 And so, you know, we have common cause
16 failure of things related to isolation valves to fail.
17 So again, this is a beyond design basis event. We in
18 the hearing credit power and credit operator actions,
19 and so again, this is crediting the DHRS in order to
20 give us more time to respond to the events. And that
21 was one of the insights we got out of the updated
22 thermal hydraulic runs.

23 MEMBER MARCH-LEUBA: Just talk about this
24 in the process, okay?

25 MS. BRISTOL: Understood. Thank you.

1 Next slide please. With the PRA model we looked at,
2 the ECCS fault tree model was reviewed to evaluate the
3 potential impacts of the new ECCS actuation changes.
4 So while there are numerous signals that actuate the
5 safety logic, as in modeling simplifications, the
6 fault tree logic does not credit all sensors and
7 signals that may actuate ECCS. And so the existing
8 credited sensor still remains adequate in that fault
9 tree model.

10 In the initiating event evaluations, the
11 PRA includes spurious openings of an ECCS valve as an
12 initiating event. And since this new ECCS actuation
13 signal would require three sets of sensors to
14 spuriously actuate, the design change has negligible
15 impact on that spurious ECCS initiating event
16 frequency.

17 MEMBER MARCH-LEUBA: Sarah, I'm sorry to
18 be the bad guy, but over a half an hour ago we heard
19 that for the lower containment elevation set point of
20 252 inches to work, you needed to have credit for DHRS
21 being on. Whereas in the previous calculations, any
22 prior calculation, DHRS was not required to be
23 activated. Do you update the sequence?

24 MS. BRISTOL: We did look at those in the
25 PRA. We did update the levels and in the new

1 actuation. So we did re-evaluate those sequences.

2 MEMBER MARCH-LEUBA: Yes, but you need to
3 also require DHRS to be active. And I didn't see that
4 change in Chapter 19. So what we were told, I mean
5 what I asked is in the previous design SB LOCA
6 calculation of the core, the actual level set point
7 reference, what really triggered it was the IAB
8 pressure.

9 And we're told that, well yes, that's
10 because we didn't have any consent of the calculation,
11 and we assumed DHRS was not working. But now, for 252
12 inches to work, DHRS must work. And that changes the
13 sequences you may now have unaffected. But you do
14 need to change it. Another thing to talk to in that
15 conversation tomorrow, okay. Think about it.

16 MR. BRISTOL: Yes. And just to clarify,
17 this is Ben Bristol, the LOCA progression we're
18 talking about is a very small break where DHR is not
19 a thing to function and ECCS actuates on the IAB
20 release. So the actuation signal is generated, but
21 the IAB has repositioned to block the actuation until
22 the system depressurizes enough for the IAB release.

23 MEMBER MARCH-LEUBA: All right. And my
24 question is that given the concern about liberating
25 the downcomer and actuating ECCS RRV valves too late,

1 have those sequences been incorporated into the PRA?
2 You guys look at it, and tell me tomorrow.

3 MS. BRISTOL: Okay. Thank you. With
4 respect to the success criteria, the event trees were
5 updated to reflect the thermal hydraulic calculation
6 results of the cycling reactor safety valves resulting
7 in ECCS actuation, as well as the consideration of the
8 containment removal system's delayed event progression
9 to credit injection for those non-design basis un-
10 isolated pipe breaks outside of containment.

11 We looked at the model queued for operator
12 actions, and the time for operators to take actions
13 remains unchanged such that the operator actions
14 credited in the PRA were not impacted. Next slide
15 please. The impact of the design change is limited to
16 low likelihood sequences resulting in negligible
17 change to the core damage frequencies, the large
18 release frequencies. These design changes were seen
19 well below the significant contributors to core damage
20 and large release pressure. There was negligible
21 change in the overall values presented in the FSAR.

22 MEMBER MARCH-LEUBA: I'd like to --

23 MS. BRISTOL: Yes.

24 MEMBER MARCH-LEUBA: -- go over those
25 issues here. It's the bad guy again. I will say that

1 it's not negligible change in the reporting for damage
2 frequencies.

3 So Revision 4 reported a core damage
4 frequency. And now we know that we require some
5 modifications, because there could have been a
6 problem. And we also know that the program was never
7 evaluated. So we don't really know what the core
8 damage frequency was for Rev --- we know what it is
9 for Rev. 5.

10 So the numbers that we're reporting in
11 Rev. 4 now do apply to Rev. 5 to fix this issue with
12 ECCS. But probably the Rev. 4 PDF is certainly not 10
13 to the minus 11. And yes, putting it on the record,
14 I would have liked to see the evaluation of the risk,
15 because we always talk about risk in our evaluations
16 and never do it. Keep going.

17 MS. BRISTOL: Okay. We did not have any
18 additional candidate for risk significant structures,
19 systems, components, initiating events, human action.
20 And we were just discussing no change in significant
21 core damage or large release.

22 These impacts, the impacts of the design
23 changes in those subset of results were very low
24 likelihood sequences, such that the first impacted
25 subset was around tested 75, and it includes

1 combinations of common cause failures with multiple
2 data systems. And so these changes were, again, it's
3 a low likelihood scenario.

4 There was negligible effect on the
5 external events as well as zero power in shutdowns.
6 And in these cases where the NuScale power module was
7 manually shut down, for example, a refueling outage on
8 a manual trip, the chemical volume control system
9 remained available for cool down. We have power, we
10 have operator actions, we have procedures, and we
11 credit the operators to operate the plant, how they
12 are required for tech specs and for their license.

13 And as the reactor coolant system volume
14 shrinks, the operators adjust makeup and let down to
15 maintaining natural circulation and shutdown margin
16 with CVCS. And that is, you know, credited in the
17 PRA.

18 And then in the postulated long-term
19 cooling shutdown scenarios, there was a whole design
20 change, maintains that re-circulation independent of
21 operator action. So we evaluated that and did a low
22 power shutdown as well. Next slide please.

23 MEMBER KIRCHNER: Sarah, did you look at
24 the effect of not having availability of CVCS in that
25 last set of scenarios?

1 MS. BRISTOL: On low power and shutdown?

2 MEMBER KIRCHNER: Yes.

3 MS. BRISTOL: In the various scenarios, we
4 would look at CVCS not being available, yes, we
5 evaluated that in the low power and shutdown.

6 MEMBER KIRCHNER: And did you see any
7 marginal or market difference in results?

8 MS. BRISTOL: Again, with respect to
9 crediting CVCS, it mainly used to, would end the PRA
10 low power and shutdown to mitigate the incomplete ECCS
11 actuation, such that if ECCS were to actuate we would
12 have that natural circulation. And so it's scenario-
13 dependent, you know, depending on the initiator if
14 ECCS would be required or not. But CVCS is nominally
15 available in the low power and shutdown PRA.

16 MEMBER KIRCHNER: Yes, we know that it is
17 nominally available, but it's not implausible that
18 it's out of service. It's a complicated system.
19 There's a problem with a valve position. And since it
20 didn't make the DRAP list, I'm just curious how you'd
21 assign its availability or unavailability.

22 MS. BRISTOL: And I guess we would assess
23 the reliability of the system, the two trains, the
24 injection capabilities, the components in the
25 injection line, and evaluated that in response to the

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1 event, and while that, again, makes the thresholds for
2 candidates for risk significance, the importance of
3 the operators to operate the system was important.

4 And so again, that action, you know, and
5 that process of CVCS injection is evaluated in lower
6 power and shutdown.

7 MEMBER KIRCHNER: Okay. This is just
8 perhaps a personal observation from one member. I
9 don't understand how it cannot be risk significant.
10 It's such an important system in bringing the module
11 to safe shutdown configuration that I'm a little
12 nonplussed. You just said a moment ago that the
13 importance of the operator intervention in the
14 sequence, but the operator has to have a system that
15 functions for him or her. Just one member's
16 observation. Thank you.

17 MS. BRISTOL: Right. And in our analysis,
18 we would see that the system is reliable. It's a very
19 reliable system. However, the operator would be less
20 reliable compared to the reliability of the CVCS. And
21 again, it's an active backup system to the passive
22 safety systems. You have to -- it's not required for
23 safe shutdown of the module --

24 MEMBER KIRCHNER: Sarah?

25 MS. BRISTOL: -- in reactor sequences.

1 Yes?

2 MEMBER BLEY: This is Dennis.

3 MEMBER BLEY: Am I on? I guess I am. The
4 last time I tried, I got a notice saying I'd been
5 turned off.

6 CHAIR SUNSERI: No, you're on Dennis. I
7 can hear you.

8 MEMBER BLEY: Okay. But three things I
9 want to talk about. The first one is, I think it's
10 more than a myth.

11 The language used in talking about these
12 things, you know, is Chapter 15 kind of language. The
13 PRA doesn't credit operators or credit systems, it
14 includes the new model along with the evaluation of
15 how likely they are to work under the situation we're
16 looking at, number one.

17 Number two, I really agree with Jose on
18 this one. This presentation keeps saying there was no
19 change. That's very deceptive. What it really says
20 is with this change in place, you find that the
21 answers are about the same as they were when you
22 didn't consider this scenario at all. That's a very
23 different kind if, situation.

24 And third, I want to ask you about CVCS
25 because it's been a while since I've read through

1 details in the PRA. But we didn't get to see fault
2 trees and talk about that.

3 With regard to Walt's questions, two
4 things, is there a fault tree model for CVCS that is
5 included in the PRA, number one?

6 And number two, if you had said the
7 operator is important to initiate, was that just a
8 single number stuck in for initiate? Or did you look
9 at the sequence of things the operator has to do to
10 align that system for different scenarios?

11 That's the end of my question.

12 MS. BRISTOL: Okay. Yes. So we -- it is
13 correct, we have a fault tree model of the CVCS. And
14 that includes operator action is in that fault tree
15 model.

16 We do have that.

17 MEMBER BLEY: So, what is your action or
18 is that a situation where you look at whatever valve
19 line ups are required to be done for different
20 scenarios of its use, and evaluate those differently?

21 MS. BRISTOL: We looked at the operator to
22 start CVCS, and the higher level operator action. The
23 valve where we did locate the design engineers, that's
24 the valve in the path, the flow path.

25 Either, you know, failed as is. Or failed

1 in the open position such that we could always have an
2 injection path available to get inventory to the
3 module.

4 And so, the operators in response to an
5 event, do not, you know, need to do special actions in
6 order to open up the line outside of potentially
7 unisolating the module if it's an active injection,
8 action isolation signal.

9 So, we credit the operator to unisolate
10 and inject in that operator action.

11 MEMBER BLEY: As you talked earlier, you
12 can inject into at least two places in the module that
13 have different impacts on what's going on in some of
14 these scenarios.

15 You didn't make that distinction. And
16 that would require a different valve line up to switch
17 where the injections go.

18 MS. BRISTOL: That's correct. And we did
19 look at the different injection potentials from the
20 PRA thermal hydraulic line.

21 If we had, you know, a break of the
22 charging line alongside a continuum, we would credit
23 the pressurizer spray line. And again, in the thermal
24 hydraulic line, we potentially, you know, had a delay
25 between transitioning from one to the other if one

1 were unavailable.

2 And so we credit, you know, either path.
3 And then again, the flow paths remain open, and then
4 the operators in the control room are able to
5 unisolate those isolation valves for whichever line
6 they are planning to inject from.

7 MEMBER BLEY: Yeah. And this is a little
8 more complex than the way it's modeled. But, that has
9 to be at this point since you don't even have a
10 procedure.

11 So, later on that should be, you know,
12 have a little more detail on it by then.

13 MS. BRISTOL: Okay.

14 MEMBER MARCH-LEUBA: Yeah. In the defense
15 of the applicant, these types of scenarios are based
16 weeks the time cost, if not minutes. If not except
17 for the plans positioned by an operator.

18 I will state that if any of these things
19 happen in your committee, then we review worksheet and
20 want to go out there. They might even have a walk
21 through of the valves before they, to see if they line
22 up properly. That will do it.

23 There really is on topic, and you heard
24 Walt's every for the CVCS. Mine is CFDS. In the PRA,
25 the person that's the DS is a backup for CFDS number

1 one failure

2 MS. BRISTOL: In certain scenarios we do
3 credit the containment flooding and drain system as a
4 back up to CVCS.

5 MEMBER MARCH-LEUBA: When the staff is
6 looking at your FSAR, try to remember how thoroughly
7 we asked them if they checked those views. And they
8 will have the issue of restarting CVCS -- because it's
9 the ETS more for a week.

10 So, some things to look at. Is the only
11 thing that's left. Okay. Everything else was fixed.
12 The only thing that's still -- is in my mind, is that.

13 Everything else, we can think -- so, if
14 you -- you know what I said. CFDS is my favorite one,
15 and you will be on it.

16 MS. BRISTOL: Okay. Thank you. Next
17 slide.

18 (Simultaneous speaking)

19 MS. BRISTOL: Okay. Thanks. Thank you.
20 In summary, these design changes reflect the PRA
21 results that we have in the FSAR.

22 We have updated event tree logic to
23 reflect the new event progressions based on the design
24 changes of the ECCS actuation and the event
25 progressions for those effects.

1 And that's all I had. I think the --

2 MEMBER DIMITRIJEVIC: Sarah?

3 MS. BRISTOL: Yes? Hi Vesna.

4 MEMBER DIMITRIJEVIC: Hi. I was patiently
5 waiting for time in here. But I've been patient, but
6 so I have a very important question, but before that,
7 I want to make a couple of statements to see do you
8 agree with me.

9 Okay. The first statement, these boron
10 scenarios have never been considered in the PRA. Not
11 in the previous version of aspect, not in this version
12 of aspect.

13 Is that a true statement?

14 MS. BRISTOL: Well, I --

15 MEMBER DIMITRIJEVIC: That doesn't say you
16 have never had a failure to prevent, you know, the
17 timely ECCS actuation, or what's happened after the
18 wrong ECCS actuation.

19 Or what may happen when you're recovering
20 from failure of ECCS, you have no any sequence in the
21 PRA that addresses this problem. You did not have it
22 before. And it's not now.

23 The changes which are made are just based
24 on the change in ECCS actuation. Right?

25 MS. BRISTOL: That's correct. And then

1 the holes when --

2 MEMBER DIMITRIJEVIC: That is enter also.
3 Or maybe -- or you also say that. But you have never
4 considered boron an issue in the success criteria.

5 MS. BRISTOL: Correct. It does not lead
6 to a core damage in the PRA evaluation.

7 MEMBER DIMITRIJEVIC: Basically you just
8 assume that this is, the problem is improvement and
9 it's not going to occur. Right?

10 MS. BRISTOL: Yes. We have addressed --
11 yes. With the holes we do believe that this boron
12 redistribution issue is precluded.

13 MEMBER DIMITRIJEVIC: Okay. So, you have
14 never looked in the small piece. And you have never
15 looked in this, but it's also best to say you haven't
16 addressed this issue in the PRA.

17 MS. BRISTOL: We looked at ATWS scenarios
18 which have evaluated reactivity. So, it comes in the
19 overall holistic.

20 We looked at, you know, the reactivity
21 evaluations. Not necessarily from this, you know,
22 specific scenario.

23 But, holistically, we looked at potential
24 impacts.

25 MEMBER DIMITRIJEVIC: So, if this is why

1 you choose now not to look in this scenario after all
2 of this come out, and you know, design changes are
3 made. The reason you decide not to look in those
4 scenarios at this moment is because you think that
5 those holes, arise the holes totally for the vent in
6 this event.

7 The many initiating events, the many
8 situation that you have in the PRA. Is that a true
9 statement?

10 Because if you are not -- if you think the
11 ECCS actuates, you know, if you're not considering
12 failure of the timing of ECCS actuation or the
13 prolonged uses of recovery from ECCS failure, you
14 think that recovery is addressed and it doesn't need
15 to be part of the PRA.

16 Is that a true statement?

17 MS. BRISTOL: That is correct. We believe
18 the design change addresses it. And we do not
19 believe, we have no indication that the small amount
20 would lead to a core damage.

21 MEMBER DIMITRIJEVIC: Okay. All right.
22 So, that's I just wanted you, want you to state this
23 on the record. That that has not been analyzed in the
24 PRA.

25 And you don't see any failure mode which

1 could lead to this issue. So, we can have a
2 discussion because Walt brought in the beginning are
3 you discussing the mitigation of conclusion?

4 And the thing that he asked is the sort of
5 conclusion is considered not ending with mitigation on
6 the way to fail is considering the PRA, right?

7 (No response)

8 MEMBER DIMITRIJEVIC: Okay. Now my other
9 question is that the CVCS, the -- and I mean, I will
10 come back with these questions, because I want to
11 understand that what you are saying is true. And that
12 there is no way we can get into this situation.

13 Now, the whole failure is prolonged ECCS
14 actuation, right? And that did you guys ever look in
15 the timing?

16 Did you actually look in any timing of the
17 ECCS operation, either in the timing that doesn't
18 actuate on time? Or the timing that operates for too
19 long?

20 (No response)

21 MEMBER DIMITRIJEVIC: And what was the
22 timing for the actuation when you put even the human
23 actions for the actuator either charging or
24 containment flood, what was the timing, how is the
25 timing for these actions determined?

1 MS. BRISTOL: Depending on the events, we
2 looked at various thermal hydraulic sequences. And
3 then we would, you know, having different timings
4 based on the plant site response unit to address that
5 scenario.

6 MEMBER DIMITRIJEVIC: How about for best
7 actions, you know, human error involved in the
8 probabilities always the same, right? Because you
9 assume that he has enough timing, or the timing is --
10 I was just wondering if this calculation of these
11 humans, and what was the timing scale?

12 MS. BRISTOL: Yes. That's more of a
13 numeric operator or higher probability for the
14 operator action. We have a bounding approach to
15 calculate those.

16 And so the timing was such that it was
17 included in the calculations for that operator action
18 at a higher level.

19 MEMBER DIMITRIJEVIC: What was the base,
20 what was base for this timing? That's what I'm asking
21 you. What was that based on?

22 MS. BRISTOL: We looked at the thermal
23 hydraulic runs and looked at, you know, did we have
24 enough time for operators to respond to the event to
25 mitigate it.

1 And so --

2 MEMBER DIMITRIJEVIC: So you all had --
3 you have your own time of really, for example for
4 LOCAs. Not the ones which assume that loss of offsite
5 power is there.

6 So, ECCS will actuate in 24 hours or some.
7 I mean, you have your own thermal hydraulic runs,
8 right? Assuming there are offsite power is
9 available. You know, things like that?

10 MS. BRISTOL: Yes. And we took a
11 simplistic approach to modeling the human error
12 probability in the PRA. Such that we put our most
13 limiting times of 30 minutes, and just applying it
14 across all of the events.

15 And we assigned that max human error
16 probability for the shortest amount of time to all
17 operator actions. Such that if there's an operator
18 action and it cuts it, we just defined it the binding
19 operator, the limiting bounding operator action timing
20 and value, human error probabilities.

21 MEMBER DIMITRIJEVIC: And then let me ask
22 you. And I mean, and I'm going to go and check for
23 your importance of suggestion shutdown, because the
24 low flow has happened. I don't remember how was this.

25 But when you determined importance of the

1 systems and components, did you base this on the
2 thought of CVCS? Or anything important in the shut
3 down or for external events, or something valuable to
4 be considered important?

5 What was -- how was importance based on
6 the total CVCS? Or if any of the sections of CVCS is
7 important it will be considered important? Like if
8 it's important in shutdown.

9 MS. BRISTOL: Yes. We looked at each
10 independent PRA and evaluated risk significant
11 candidates for each PRA.

12 Such that it wasn't the overall CVS of
13 everything. It was, you know, internal events we
14 looked at, typically for suitability.

15 We looked at the shutdown. We looked at
16 certain events --

17 MEMBER DIMITRIJEVIC: And you looked in
18 the shutdown, you did not consider this, you know, the
19 movement? Because that don't mean it's shutdown and
20 maybe because of that, you know, maybe because of that
21 nothing else was important in shutdown.

22 MS. BRISTOL: Well, we didn't actually
23 take that approach. We did look at the internal
24 events, low power and shutdown as well.

25 We kept the cranes separate. And we do

1 have risk significant candidates for low power and
2 shut down in the FSAR. And CVCS and CFDS operator
3 actions are candidates in that low power and shutdown
4 table.

5 MEMBER DIMITRIJEVIC: All right. And if
6 there were many, the important question for you, do
7 you personally think that these events should be
8 discussed in the PRA and addressed in PRA?

9 For example, if you have a vent which is
10 very small, I think, you know, it's above your tech
11 spec, but he fails to follow the tech spec, so you
12 have a small leakage very likely, and no operator
13 notices this for a long time, you can have a very, you
14 know, specific event related to that.

15 Did you guys decided that this is events,
16 you know, you are not planning to consider this event
17 in the PRA?

18 MS. BRISTOL: I would say that we looked
19 at this event through the issue of these small line
20 breaks. We looked at tech specs. We looked at all of
21 the operator actions that could be accomplished to
22 mitigate these events.

23 You know, in you know, there's power,
24 there's time, there's multiple systems. There's
25 redundancy in the face of gaps in responding to this

1 event.

2 And if you -- it does not seem feasible
3 that, you know, and that's not how we're planning to
4 operate the plant. To, you know, just let this event
5 progress, you know, while we have numerous indications
6 that there's something occurring.

7 You know, the PRA's best estimate and it's
8 not using our model to, you know, look at --

9 MEMBER DIMITRIJEVIC: Yeah, I know all
10 that too. Well, I just want to say that based on your
11 CVCS out there, that is your first sequence. There is
12 a million events in this PRA which are not very likely
13 and satisfy everything which you cannot say.

14 And this is one very specific event,
15 which in my opinion, exactly warrants consideration.
16 Not maybe just for leakages, but for every situation
17 when this, you know, the prevention may not work.

18 So, definitely you know, we are late now
19 in the design specification. But definitely those
20 events, someplace has to be designed for this in the
21 PRA in my opinion.

22 But, okay. That's all from me.

23 CHAIR SUNSERI: Hey Walt, are we at a good
24 breaking point here?

25 MEMBER KIRCHNER: I think you know, I'm

1 trying to remember how many more slides NuScale has.
2 These are the changes. That's it.

3 Why don't we let them finish. And then
4 take a break, Matt. I think we have to let people
5 know that the staff is going to speak in an open
6 session next.

7 And then the closed session is going to
8 have to be pushed back. I understand that there are
9 other staff members that need to be informed of when
10 we would start that.

11 But, I would -- I would propose we have --

12 CHAIR SUNSERI: Well, Walt --

13 MEMBER KIRCHNER: On the open session of
14 the staff's plans and public comment before we go to
15 closed session.

16 CHAIR SUNSERI: So, let me just ask
17 NuScale, how much longer are you going to need to
18 finish this part?

19 MR. PRESSON: So, the next three slides,
20 that's 21 and 22, are a summary of the design changes
21 that we made and where they are captured in our
22 licensing documents.

23 Then we have a conclusion on slide 23.
24 So, I'd say maybe another ten minutes, plus questions.

25 CHAIR SUNSERI: Okay. So, let's take a

1 ten minute break here. Because nothing is going to
2 happen in ten minutes the way we ask questions.

3 So, we're going to take a ten minute break
4 until five after 4:00. So we'll reconvene at five
5 after 4:00.

6 (Whereupon, the above-entitled matter
7 went off the record at 3:56 p.m. and
8 resumed at 4:05 p.m.)

9 CHAIR SUNSERI: Okay. This is Matt.
10 We're going to reconvene. It's five after 4:00. I'll
11 start with a roll call. Ron Ballinger?

12 MEMBER BALLINGER: Here.

13 CHAIR SUNSERI: Dennis Bley?

14 (No response)

15 CHAIR SUNSERI: Charles Brown?

16 (No response)

17 CHAIR SUNSERI: Vesna Dimitrijevic?

18 MEMBER DIMITRIJEVIC: Yes.

19 CHAIR SUNSERI: Walt Kirchner?

20 MEMBER KIRCHNER: Here.

21 CHAIR SUNSERI: Jose March-Leuba?

22 (No response)

23 CHAIR SUNSERI: Dave Petti?

24 (No response)

25 CHAIR SUNSERI: Joy Rempe?

1 VICE CHAIR REMPE: Here.

2 CHAIR SUNSERI: Pete Riccardella?

3 (No response)

4 CHAIR SUNSERI: Matt Sunseri. Okay, so --

5 MEMBER RICCARDELLA: Matt, I'm here. This
6 is Pete.

7 CHAIR SUNSERI: Okay, Pete. You're back.
8 So, one, two, three, four. All right. We barely have
9 a quorum. So, let me just give us some remarks here
10 and then we'll see if the others can join in here.

11 So, I know we have a lot of new
12 information before the Committee. And therefore,
13 we're asking a lot of questions. And that's inherent
14 in our process, and we need to allow members to ask
15 their questions and get their answers.

16 So, I was looking for an opportunity to
17 take more time for breaks during that. But, I did not
18 want to discriminate against any member and give them
19 their fair time to ask all their questions.

20 However, saying that, we really need to
21 look for an opportunity about every hour or hour and
22 a half or so, to have a break. It's just too long to
23 go two hours on these Skype sessions without being
24 able to stand up and get up and refresh our brains.

25 So, I ask all the members and participants

1 to help me with that, to look for these opportunities.
2 So, before we just go on then, I'll just check with
3 the others.

4 So, Dennis Bley, have you joined us?

5 (No response)

6 CHAIR SUNSERI: Charles Brown?

7 (No response)

8 MEMBER MARCH-LEUBA: Jose is here.

9 CHAIR SUNSERI: And Jose is here. Okay.
10 How about Dave Petti?

11 MEMBER PETTI: Yep. I got knocked out
12 right at 2:05. And I'm back.

13 CHAIR SUNSERI: Okay. So, we're just
14 missing Charles and Dennis.

15 MEMBER PETTI: I think what's happening is
16 that when I go to the Microsoft portal, and you don't
17 do anything for a while, it automatically logs you
18 out. And then it kills Skype for Business as well.

19 I'd like the staff to think about that.

20 MEMBER KIRCHNER: Well Dave, one thing
21 I've been doing that has worked very well, whereas I
22 know some of our colleagues have been knocked off
23 frequently, and that is I'm going through the normal
24 VPN connection. To Skype on my NRC computer.

25 And I actually, it's been pretty much

1 faultless. I've only been dropped once, I think, in
2 the last several meetings.

3 And even though it's inactive during the
4 lunch break today, it stayed on. It didn't sign me
5 off or break the Skype connection. Just an
6 observation.

7 CHAIR SUNSERI: Yeah. Okay. So, is
8 Dennis back with us yet?

9 (No response)

10 CHAIR SUNSERI: How about Charlie Brown?

11 (No response)

12 CHAIR SUNSERI: Okay. Well, we have eight
13 out of the ten. So, I'm going to turn it back to
14 Walt. But, before I release it, I mean to impose a
15 hard stop here at 5:45.

16 And that's if we make it to the closed
17 session, fine. If we don't, then at 9:30 tomorrow, we
18 will resume the foundation discussion per our agenda.

19 At 5:45 though, I need to stop. And we
20 need to move on with the finalizing our comments on
21 the Reg Guide 1.236 report.

22 So, that gives us about an hour left at
23 the very end of this day to do that. So, we will end
24 this NuScale, we will recess with the discussion on
25 NuScale at 5:45.

1 So Walt, take it from here.

2 MEMBER KIRCHNER: Okay. I think we're
3 back to Matthew Presson. And I think they have about
4 three slides left if I remember correctly.

5 So NuScale, go ahead. Whoever is going to
6 take this next session.

7 MR. PRESSON: Thanks Walt. I appreciate
8 it. This is Matthew Presson. And we will be starting
9 back on slide 20, where we cover DCA and conforming
10 changes.

11 Essentially describing the three very
12 focused changes that we had. But since the FSAR and
13 the rest of the DCA are very involved licensing basis,
14 there are a number of places where those changes
15 showed up.

16 So, to help us go through that summary,
17 Paul Infanger will be presenting on these slides.

18 MR. INFANGER: Okay. Checking my
19 microphone is unmuted.

20 MEMBER MARCH-LEUBA: It is unmuted, Paul.
21 Can I ask a question about process? So, we have
22 issued or you have issued an errata two.

23 So, the process would be the staff reviews
24 all these, all these on these pages. And then they
25 issue an SER, at which point you then will issue

1 revision five?

2 MR. INFANGER: Yeah. That's correct.

3 MEMBER MARCH-LEUBA: All right. Thanks.

4 MR. INFANGER: So, we made the whole
5 middle to document and update the application for the
6 design changes and the analysis changes that we've
7 made.

8 We submitted the DCA Revision Four, errata
9 two on May 20. And it would affect a number of
10 various, so we just kind of are summarizing the
11 various sections and what changed.

12 For example, in Tier One, Chapter Two, it
13 lists the ECCS actuations. So, since we added a new
14 actuation spindle and set point, that was added to
15 this at Tier One, Chapter Two.

16 In the FSAR itself, there were a number of
17 changes where we were describing the modifications
18 themselves. And then did some conforming changes to
19 document the interrelation between some of the
20 sections now.

21 So, the rise in all and structural
22 evaluations itself were in Section 3.9 and 5.4. And
23 the new ECCS actuation, the data box, which contains
24 the pressure and the YAR, I mean, the YAP, any of
25 those if this point changes, both the new part ECCS

1 actuation signal and the containment level revision.

2 And the passive valve opening, I would
3 feature that was, it's always been there with the
4 valve, but we add it to the description section in 4B
5 and for the 15 fix.

6 And then also the, there's a change in the
7 RCS wide rate pressure instrumentation, because we are
8 now using that for an ECCS signal. So, it was
9 upgraded in the DROC program.

10 But, that affected the Chapter 2.2,
11 6.2, 6.3, 7.1, 7.2, 15, 15.6, and 17.4. So, that was
12 pretty wide, widespread throughout the FSAR.

13 We added the, to Jose's point about the
14 mechanisms of the solution in the downcomer. Since
15 that was a new phenomenon, we described that in
16 Chapter 4 as a potential issue for boron dilution.

17 And so we described how the -- that
18 there's a potential either from containment, because
19 you -- in any steam place break, you're going to end
20 up with unborated water in containment.

21 And then there's a couple of mechanisms
22 for getting, either in LOCAs or DHRS events, when the
23 riser becomes uncovered, or goes to the levels below
24 the top of the riser, you can start to get
25 condensation in the downcomer.

1 So, those phenomena were described in
2 Chapter 4. And then in Chapter 15 we put a reference
3 to the sections that say that the --that the potential
4 for solution during restoration needs to be
5 considered.

6 And there is a section, in Chapter 13 we
7 have procedures that are required to implement the
8 requirement of Reg Guide 1.206, which includes details
9 on what you have to be in operative three that's
10 including restoration from a severe event.

11 The LOCA analysis was changed to mention
12 that earlier in 16.65. Some tables and sequence of
13 events and some minor changes to results.

14 And then we updated the PRA event
15 sequences to the new actuation signal. And
16 descriptions of the riser holes in Section 19.1.

17 The ECCS signal is a stipulated actuation.
18 It is a separate item in the technical specifications.
19 And then we added information in the instrumentation
20 section and in the ECCS section and the associated
21 basis for those tech specs.

22 The next slide. We also stated the number
23 of technical supports, the instrumentation step point
24 methodology, we added the ECCS signal and the
25 actuation range discussion.

1 The advanced sensor technical report, we
2 added the same information. For the containment it
3 was part analysis. We did the evaluation of -- we
4 verified that the limiting cases for containment of
5 peak pressure and peak temperature will remain
6 unchanged.

7 And we noted that there were some minor
8 changes to the nonlimiting cases. But we verified
9 that they remained nonlimiting and that we didn't
10 update the nonlimiting cases in the containment
11 technical report. But did document that they were
12 evaluated and will remain nonlimiting.

13 And the alternate cooling methodology, we
14 added the new ECCS signal. And discussed that the
15 long term cooling evaluation will remain acceptable.

16 It did not change the limiting cases for
17 the limiting, or for the long term cooling. And then
18 there was just minor change in the tech spec technical
19 report to document the change to the ECCS.

20 And just one other item we're just
21 noticing there will be probably for discussion more
22 throughout the meeting of most of the changes that
23 we've been in discussion with the staff were complete.

24 And we submitted in our FSAR update on May
25 20, and they were admitted and there were just a few

1 topical reports we updated that we sent a week later.

2 But there's still one issue we're
3 discussing with them, and that's the basis of our GDC
4 33 exemption and makeup. We'll have a thorough
5 discussion so we don't have anything to report on
6 that. So, I just wanted to mention that for
7 completeness.

8 And next slide. And then on the topical
9 reports. Similar to the containment section report,
10 with LOCA we evaluated the limiting cases.

11 The new ECCS actuation set point did not
12 affect any of the limiting cases. So, we added the
13 information that that set point is there.

14 But that we didn't have to revise the
15 limiting analysis or the limiting case selection. So,
16 there's no change to the MCHFR limiting case or the
17 class liquid level above that active fuel case.

18 So, those things are noted in the
19 methodology. And then we verified that all the
20 nominating cases remain nominal.

21 And the LOCA is non-LOCA topical. We
22 really just added a note saying that the ECCS
23 actuation signal was in the riser holes, had been
24 added.

25 But, this, in the non-LOCA topical,

1 there's no actuation of ECCS. So, that was a pretty
2 minor change.

3 And the riser holes simply maintain a
4 function that we were making previously on boron
5 distribution.

6 MEMBER MARCH-LEUBA: Hey Paul, can we go
7 back to GDC 33? Are we going to be hearing any more
8 details about that?

9 MR. INFANGER: Not in this presentation.
10 We were still, I'd say it's all predecisional. We --
11 one thing that's a little different in the revision we
12 sent on May 20, and then the topical on May 27, is we
13 discussed the changes with the NRC staff in detail
14 prior to making the submittal.

15 Because, it would be a compressed, the
16 time schedule. You know, they can't do preapproval
17 obviously.

18 MEMBER MARCH-LEUBA: Sure.

19 MR. INFANGER: But the changes we made to
20 the FSAR were all discussed with the staff in the
21 audit. This current audit was --

22 MEMBER MARCH-LEUBA: This wasn't the --

23 MR. INFANGER: Going on since that and
24 just daily meetings. So, we've been putting
25 information in, in an electronic reading room.

1 And this relates, we don't want to have to
2 iterate with the staff. But, there were a couple of
3 things that we're still finalizing with the staff.
4 And this is the GDC 33 content is one of them.

5 And we're going to be proposing another
6 small addition to the FSAR. But again, we don't -- we
7 haven't -- everything else we are presenting here has
8 at least been discussed in detail with the staff.

9 And then that part is, I would say, still,
10 is still an active subject.

11 MEMBER MARCH-LEUBA: Is there any serious
12 technical issue? Or are we just trying to document
13 what we agree on?

14 MR. INFANGER: Yeah. The essential issue
15 is simply that we don't rely on makeup to meet GDC 33,
16 which is, most plants use the normal makeup system.

17 And we credit the ECCS system to handle
18 RCS leakage. And we're just talking about where we
19 defined the difference between an RCS leak and the
20 LOCA design basis spectrum.

21 And how we handle the analysis in those
22 two different regions.

23 MEMBER MARCH-LEUBA: We're looking more as
24 a combination then as a real approach.

25 MR. INFANGER: Yeah. It's not going to

1 require any other changes. It's simply how we
2 document the basis for the exemption to GDC 33.

3 MEMBER MARCH-LEUBA: Yeah. I mean,
4 because a tech spec leak geek, less than .5 pounds per
5 minute, you handle it with CVCS with no problem.

6 And but if you don't have power because
7 it's not safety grade, then how will the containment
8 handle it with ECCS?

9 I don't see -- you just have to
10 demonstrate and run the calculation and make sure that
11 you satisfy all the requirements, all the conditions.

12 All right. Keep going.

13 MR. INFANGER: Okay. With that, I think
14 I'm done. Matt, do you want to go live?

15 MR. PRESSON: Yeah. So yeah. For the
16 summary and conclusions. I wanted to cover that our
17 design changes were selected and chosen specifically
18 that were on redistribution for those postulated
19 design basis and beyond design basis events.

20 And focusing on those design changes, we
21 adjusted our ECCS actuation to, well, we added a new
22 ECCS actuation signal on low RCS pressure. And
23 adjusted our high containment level set point.

24 And with the combination of those two, we
25 assure that the initial flow out of our reactor

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1 pressure vessel would preclude an influx of unborated
2 water from the containment or downcomer.

3 The third design change that we
4 incorporated was the addition of riser holes. In
5 order to assure boron mixing in the downcomer and
6 core, and the specific cases that we looked at there
7 are when, for when PSRS cools and shrinks the RCS
8 level below the riser.

9 And for those smaller LOCAs and RCS leaks,
10 while the RCS level is above the holes. So,
11 throughout that work, our analysis has demonstrated
12 that no significant changes to the results that we see
13 in the previous, well, the January 4, January Rev. 4
14 and that our acceptance criteria continue to be met.

15 And the last bullet on this is simply
16 covering that while we did look to select and stayed
17 very focused with those design changes, the evaluation
18 and resolution of this topic has involved an
19 evaluation of a large scale-postulated scenario, along
20 with a sense of calculations, reviews, analysis, and
21 related document changes that were all developed to
22 implement the -- implement these design changes.

23 Essentially looking to ensure that while
24 these are three quote/unquote small design changes,
25 that they are effective at what they do. And that we

1 have a broad enough evaluation of those changes to
2 ensure that nothing else would result from making
3 them.

4 So, --

5 MEMBER DIMITRIJEVIC: I have a question.

6 MR. PRESSON: Yes?

7 MEMBER DIMITRIJEVIC: Are these diag --
8 these ECCS concentration and riser holes, are those
9 design changes all or ending? Are they both
10 necessary? Or either one of them will preclude this
11 influx of unborated water?

12 MR. PRESSON: For the couple up there?

13 MEMBER DIMITRIJEVIC: Yes. Yes, my
14 question is, if you made the two major changes, why do
15 you think ECCS actuation set points and another is
16 riser holes, right?

17 MR. PRESSON: Um-hum.

18 MEMBER DIMITRIJEVIC: So, my question is,
19 are the both of those design changes necessary to
20 prevent the influx of the unborated water? Or either
21 one of them is enough?

22 MR. PRESSON: So, to answer that, those
23 first set of changes for ECCS actuation were the kind
24 of primary lead in design changes that were targeted
25 as resulting in these postulated events.

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1 And then we looked at riser holes in order
2 to increase the margin that we saw for DHRS operation.
3 So the riser holes are more based on ensuring that we
4 have adequate margin for all those postulated events.
5 While the ECCS actuations were targeted at actually
6 precluding them.

7 MEMBER DIMITRIJEVIC: Well, I don't --

8 MS. BRISTOL: So, to answer your question
9 Vesna, both are needed. Both changes are needed in
10 the design.

11 MEMBER DIMITRIJEVIC: Because I just
12 discussed it better that which one was adjusted. I
13 make the call provided not missing to preclude this
14 influx.

15 So, because ECCS actuation, you know, will
16 fail, can fail. And you know, can occur in wrong
17 timing.

18 So, therefore, my question is, if we don't
19 have an ECCS actuation in the right time, do we still
20 have a problem? Even if we do have the riser holes?

21 So, my question is, if ECCS doesn't
22 actuate on the right time, which we don't know about
23 these things exactly. But let's say if ECCS doesn't
24 actuate on the right time, do we still have an issue
25 with this influx of unborated water?

1 MS. BRISTOL: When we looked at the
2 different ECCS actuations before this new proposed
3 actuation and reflected that in the PRA, you know, in
4 the historic runs as well as the new set points now in
5 the TH run.

6 And so, we can discuss the specifics of
7 those PRA, TH results in the closed session, if we can
8 bring that back up, Vesna.

9 MEMBER DIMITRIJEVIC: All right. Okay.
10 But my question was simply enough. You know. My
11 question was, if the ECCS doesn't actuate, with the
12 PRA in the event, would those holes prevent this
13 event? That's a simple question.

14 MEMBER BLEY: Well, it's probably not so
15 simple Vesna, as that. Earlier, and I forget which of
16 the gentlemen in the first presentation, said they'd
17 done some calculations of, thermal hydraulic
18 calculations best estimate with uncertainty.

19 And I'm guessing that's something like a
20 CSAU approach. And most of the times things are okay.
21 But not all of the time.

22 So, I don't think they can answer that
23 definitively. Or haven't tried to. If NuScale
24 disagrees with that, step up.

25 MR. BRISTOL: This is Ben Bristol. I

1 would say that the riser holes actually are quite
2 effective for mitigating the redistribution for both
3 the DHR cool down scenarios and the slower LOCA event
4 such that the timing of ECCS, if the holes were to
5 uncover that's when we would postulate that the
6 redistribution would start to occur.

7 And the ECCS actuation at that time is
8 much more preferential for precluding a core in surge
9 type phenomena, or at least the phenomena we were
10 looking at.

11 MEMBER BALLINGER: Yeah. This is Ron
12 Ballinger. So, there is no scenario in which the
13 riser holes do come uncovered?

14 MR. BRISTOL: Yes. Normal ECCS operation,
15 the riser holes are well in the steam space.

16 MEMBER BALLINGER: Okay.

17 MR. BRISTOL: So, they're not relevant
18 once we get to normal ECCS cooling conditions.

19 MEMBER BALLINGER: Okay. Thank you.

20 MR. BRISTOL: Sure. One other
21 clarification. I think, with respect to the credit of
22 CFDS in the PRA, I think it's important to understand
23 that those are event sequences where we would expect
24 the core inventory is unmit - the inventory loss is
25 unmitigated. And we're progressing toward a full on

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1 recovery condition.

2 So, the credit of CFDS is -- and the
3 inventory addition, is definitely more beneficial for
4 the core, with the acknowledgments of the challenges
5 of where the boron is, and how CFDS impacts that.
6 Keeping the core cooled is the primary consideration
7 for those extreme beyond design basis events.

8 And that's a lot different than what our
9 restart procedures might be. And again, we don't have
10 those, and they're not developed at this stage. It's
11 a design certification.

12 The restart procedures will all ensure
13 that CVCS is used in order to reestablish a safe boron
14 concentration in the system when coming out of, or
15 restarting from an extended ECCS operating condition,
16 core event.

17 MEMBER MARCH-LEUBA: Yeah. My point is
18 that you have to also do scenarios and analyze each
19 one. There's always one outlier.

20 And this if your core is getting
21 uncovered, you want to put water. But you don't want
22 to put unborated water.

23 So, my point is, somebody has to think
24 about it, and analyze it. And figure out if it's good
25 or bad.

1 MR. BRISTOL: Sure. And we definitely
2 would prefer to put unbor -- to put borated water at
3 all times in the PRA because of the failure sequences.

4 There are times at which that is not
5 possible, right. And that's where the analysis of
6 CFDS comes into play.

7 MEMBER MARCH-LEUBA: Okay. Let you go.

8 MEMBER KIRCHNER: Okay. Matthew, is that
9 it for your open presentation?

10 MR. PRESSON: Yeah. That's it for the
11 presentation. I did want to capture a quick follow up
12 from one of your requests earlier on kind of the
13 diagrams for CVCS.

14 I wanted to point you towards Table 7.1-5
15 with the description of containment through dash 1
16 overrides. That kind of covering some of that
17 information, as well as figure 7.1-1k.

18 And then also figure 9.3.4-1. Actually it
19 shows the three distinct lines into containment that
20 are provided by CVCS and the valves that are attached
21 to that.

22 MEMBER KIRCHNER: Okay. Thank you.

23 MR. PRESSON: Yeah.

24 MEMBER KIRCHNER: Okay. Members, any
25 other questions that -- hopefully we could defer

1 further questions at this point to the closed session.
2 So that we can transition to the staff.

3 But, I don't want to silence anyone. I'm
4 going to use the 15 second rule.

5 (No response)

6 MEMBER KIRCHNER: Okay. Hearing no
7 further questions, thank you, Matthew and your staff
8 for the presentation.

9 And we'll need a few moments here now to
10 make a transition to the staff. And Mike Snodderly,
11 would this be Bruce Baval, or --

12 MR. SNODDERLY: Yes. Yes.

13 MEMBER KIRCHNER: Right now would --
14 you're going to make an introductory comment.

15 MR. SNODDERLY: All right. What we're
16 asking if Bob Caldwell or Rob Taylor, if they want to
17 make an opening statement. But I know Bruce Baval
18 will be the presenter.

19 So, please Bruce, request to share your
20 screen. So we'll get started.

21 MEMBER KIRCHNER: Yeah. Bruce, I'm just
22 going to turn right to you.

23 MR. BAVOL: Understand. I'm ready to go.
24 But, if management needed to say a few words?

25 MEMBER KIRCHNER: Okay.

1 MR. CALDWELL: Hi, this is Bob Caldwell.
2 And I think we're ready to get started. And let's go.

3 MEMBER KIRCHNER: Okay. Thank you, Bob.

4 MR. BAVOL: Okay. Again, this is Bruce
5 Baval. I'm a project manager for the NRC. I'm
6 currently working on the NuScale design certification.

7 This is a project presentation. It will
8 go very quickly. All on the open item update and what
9 staff has been up to over the last several months.

10 On slide two I have a short agenda here.
11 Talk a little bit about the April 29, ACRS full
12 Committee letter, which led us to set up these
13 meetings and a future July full Committee meeting for
14 staff.

15 We'll give you a little background on what
16 got us to this point. The design changes, I won't
17 spend much time, because NuScale did a good job in
18 explaining those.

19 Impacted Chapter SCRs, along with
20 technical topical reports, again, NuScale provided
21 that information. And of course the next step in what
22 staff is going to be doing here in the near future.

23 Slide number three. I think the key point
24 here for the ACRS full Committee letter, our response
25 back was that there were two bullets on number two.

1 They're trying to put a criticality
2 maintaining that item throughout the audit. And our
3 future description, or our future presentation with
4 the boron redistribution and the issue that remains
5 open.

6 That's really why we're here today. And
7 then again, in July for the staff presentation.

8 Slide number four. A little bit about the
9 background. February 27 the error in the boron
10 redistribution analysis was pro -- that information
11 was provided to us.

12 On March 2 staff initiated an audit plan.
13 We got things going pretty fast. On March 4 we held
14 an audit entrance. So, as you can see, we've been at
15 it for quite some time.

16 And the first staff sent the letter,
17 schedule letter to NuScale. And this is because some
18 of the items were going to be interrupted. Some of
19 the milestones, mainly the ACRS schedule.

20 But, what we're looking at once we get the
21 full Committee presentation, we'll be able to proceed
22 with the letter writing and the DCA Rev. 5. And then
23 we're also shooting for that phase six milestone in
24 September.

25 On May 20 as was presented by NuScale,

1 that second update to DCA Rev. 4. There are a number
2 of items were put on the docket.

3 I'd also like to make mention that we've
4 done pretty much daily audit briefings, status
5 briefings. And we've held multiple public meetings.

6 In fact, the last public meeting we held
7 was Monday, June 1. All this information is,
8 summaries are being put together. But, we have
9 information from -- that's being placed into ADAMS.

10 So, moving on to slide number five. These
11 were the design changes that NuScale provided the
12 technical, all nonproprietary discussion.

13 But also, I'd like to make mention that we
14 applied the chapters that were impacted by the
15 specific design changes, which we need to make sure
16 that the technical dif -- or technical disciplines are
17 involved.

18 And we coordinate all that information to
19 make sure we don't miss something as we go along. And
20 something doesn't drop through the cracks based on
21 what we've been provided.

22 On slide number six here's a list of the
23 chapters that staff have gone through. Either that a
24 change was made, it was provided, the change, the
25 redline strike out was provided by the electronic

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1 reading room.

2 This is our audit base for all documents
3 and calculations and such that the staff is using for
4 the audit, along with various Skype meetings and audit
5 status meetings.

6 And again, the impact that the topical
7 technical reports that were again mentioned by
8 NuScale. And the technical reports of course support
9 the chapter, specific chapters, if there were changes
10 there they were written about in the safety
11 evaluations of the specific chapters.

12 Again, this is it. This is the last slide
13 here. We're currently completing analysis. And we
14 want to, we will be engaging the ACRS in a technical
15 briefing of the staff findings in July.

16 I believe July 8 is what I've been
17 hearing. But, I'll wait for ACRS staff to give us a
18 final.

19 But, what I'd also like at this point is,
20 since this is a little different where staff isn't
21 going to be briefing until July, if there's anything
22 from the ACRS members that came up during the NuScale
23 briefing that you would like to inquire about from our
24 technical staff, I'd like that to be, you know,
25 discussed either here or in closed session as needed.

1 So that our staff, who most of them are on
2 the line, can hear and prepare a better presentation.
3 And that's all I have.

4 MEMBER KIRCHNER: Thank you, Bruce. Let
5 me turn to members then. Do you have any questions or
6 requests of the staff that you would like to air at
7 this point?

8 MEMBER MARCH-LEUBA: Yes. More of a
9 response to the last comment. Often we've written a
10 white paper with our concerns.

11 And maybe the Committee will do something
12 like this and give you some topics in writing for you
13 to address in that presentation.

14 MR. BAVOL: Okay. Thank you.

15 MEMBER KIRCHNER: Bruce, this is Walt
16 Kirchner. I have one item. With regard to the
17 topical reports on methodologies. I'm just going to
18 ask a leading question. I don't require or need an
19 answer at this point.

20 Are you going to, the staff, are you going
21 to look at the applicability of the RELAP code for
22 analyzing the flow through the holes that now have
23 been put in the riser design to mitigate the boron
24 dilution problem and the downcomer?

25 And I'll just make one observation from my

1 own experience with these kind of numerical methods
2 that one often has a problem with numerical defusion
3 exceeding natural physical diffusion.

4 So, I would be interested in the staff's
5 review of the applicability, the methods for analyzing
6 that particular phenomenon in the downcomer. The
7 mixing from the riser to the downcomer.

8 MR. BAVOL: I understand those questions.
9 That's exactly what we were looking for. We have
10 Reactor Systems staff observing today's session.

11 So, I'm sure they're, you know, taking
12 that information down.

13 MS. PATTON: Yes. This is Becky Patton
14 from Reactor Systems. And we'll be sure to address
15 that when we come in July.

16 I think some of the details for how they
17 do that are likely proprietary. So, and the staff is
18 still also currently reviewing how they performed that
19 analysis.

20 MEMBER KIRCHNER: Thank you, Becky. Yes,
21 and then obviously the methodology and then the actual
22 analysis, the bounding analysis so that we can
23 demonstrate confidence that the dilution problem is
24 actually physically solved. Thank you.

25 VICE CHAIR REMPE: Walt, this is Joy. I

1 had a couple of questions. One, has the staff gone
2 through the review enough to say that the middle is
3 complete? Where exactly are you in this review?

4 And then secondly, could I ask for some
5 elaboration on what's going on with GDC 33? Some more
6 to the question that Jose asked? Because I'd like a
7 little more understanding of what's going on in that
8 topic.

9 MS. PATTON: So, this is Becky Patton
10 again. So, as to where we are in the review, we are
11 partially through the calculations.

12 So, it's really premature for me to report
13 back on aspects of that review. And I also, as I
14 think NuScale may have stated in their presentation,
15 we are still discussing some aspects of GDC 33 with
16 them, and their exemption request, and the analysis
17 they perform for that.

18 So, I guess I would prefer to report back
19 on that when the staff provides its detailed
20 presentation in July. But, we are planning on having
21 a presentation of those aspects.

22 VICE CHAIR REMPE: So, with respect to
23 schedule, do you have a feel for when we're going to
24 receive all this information? The draft SE from you,
25 et cetera?

1 MR. DUDEK: Yes. This is Michael Dudek.
2 So, I think with respect to that and our coordination
3 and collaboration with Mike Snodderly and Scott Moore,
4 I think preliminarily we have discussed giving you the
5 completed SER and the final products by June 26.

6 MEMBER KIRCHNER: Joy, that's my -- this
7 is Walt. That's our understanding, Joy, on the --

8 VICE CHAIR REMPE: Okay. I just wanted to
9 check again. But, thank you.

10 MEMBER PETTI: Walt, I have a question.

11 MEMBER KIRCHNER: Go ahead, Dave.

12 MEMBER PETTI: Can I ask the staff about,
13 and if they can't answer now, certainly when they come
14 to us in complete, in July.

15 How does this information that we're going
16 to hear in closed session, get documented? Where does
17 it get documented in the process?

18 Because nothing that we've been given so
19 far has any of the details except these slides that
20 we're going to hear about in closed session.

21 Does the process require that they be
22 documented in some other way then what we've received
23 so far?

24 MR. BAVOL: This is Bruce Bavol, the
25 Project Manager. Currently, as the audit progresses,

1 our process requires that we generate an audit
2 summary. Which is going to be an extremely detailed
3 review of what the staff has looked at, broken down by
4 technical disciplines.

5 And we've been maintaining an ongoing
6 summary. And staff has been adding to that as we've
7 been going along.

8 So, yes. The goal is to get a summary
9 generated that would complement the completion of the
10 review.

11 MEMBER PETTI: But there's not a NuScale
12 document beyond this level of slides that we're going
13 to see?

14 MEMBER MARCH-LEUBA: Bruce, do they have
15 a reading room where all the general calculation
16 sheets and documents are available to you? For the
17 audit?

18 MR. BAVOL: Yes. So, currently in the
19 audit process we've got an electronic audit reading
20 room. And applicable documents are placed in that
21 room, just like a regular audit, calculations and so
22 on.

23 And staff have access to that. So, that's
24 really the interaction we have with the audit process.
25 And of course, if a document is changed in the DCA, a

1 chapter is changed or a technical report, topical
2 report, that information is provided, will be
3 submitted with that change, ultimate change intact
4 when the audit is complete.

5 MEMBER KIRCHNER: I think our issue,
6 Bruce, has been that the FSAR is more description than
7 rationale of changes that they've effected to the
8 design.

9 It's -- probably of more underlying
10 interest is the analytical support for these design
11 changes. That's of interest.

12 So, I think that's the, at least the
13 spirit of our questions.

14 MEMBER MARCH-LEUBA: Yeah. But all that
15 information is contained in the electronic reading
16 room on our internal engineering data files for, from
17 provided from NuScale.

18 And they're made available to the audit
19 team. But, they are not part of submittal. They
20 don't go to ADAMS.

21 Now, ACRS can beg and ask the question
22 with immediately go to the reading room. But, be
23 careful what you ask for. Those things tend to be
24 hundreds of pages long. I would love to.

25 MEMBER PETTI: Jose, I just found it

1 interesting that the topical reports were incredibly
2 detailed and calculated every sequence noted, as just
3 demonstration of how many of them were exactly what is
4 reported in the FSAR.

5 And so I was surprised that something as
6 important as this doesn't rise to the level of another
7 appendix in one of the topical reports. It's just --

8 MEMBER MARCH-LEUBA: It should have been
9 a topical report for review independently. We just
10 didn't have the time.

11 But, this is something --

12 MEMBER PETTI: I'm just wondering if it's
13 in the software.

14 MEMBER MARCH-LEUBA: It's not unusual.
15 They -- NuScale works under Appendix B. And
16 everything that calculates has to have a report
17 underneath, signed by two people.

18 And they make all those papers available.
19 And they're hundreds of pages long. And that's how
20 the staff does audits.

21 Unfortunately we at ACRS have to read the
22 FSAR which says, we put some holes. And believe me,
23 it looks good. That's all they give this.

24 But, I have good confidence that, I mean,
25 there are hundreds if not thousands of pages in that

1 reading room with all these calculations.

2 And hopefully the staff is looking at
3 them.

4 MEMBER PETTI: Okay. I stand corrected.

5 MEMBER KIRCHNER: Other members,
6 questions, comments, suggestions for the staff?

7 (No response)

8 MEMBER KIRCHNER: I guess I had one that
9 I'll suggest. And it goes back to the very beginning
10 of the NuScale presentation and then again at the end
11 with Vesna's comments on PRA.

12 The whole approach is one of precluding
13 the event sequences that we're worried about. And
14 that's to be complimented.

15 The question though is, if one is not
16 successful, what are the consequences? I don't know
17 that we've seen any analyses showing if you do indeed
18 have a diluted slug of cold water injected in the
19 core, what are the chance or consequences in terms of
20 core damage?

21 MEMBER BALLINGER: Hey Walt, this is Ron.
22 That goes to the point where I asked about the why
23 question.

24 And that's something that I think you
25 asked as well, right? With the holes for example.

1 MEMBER MARCH-LEUBA: Well, they showed us
2 -- they showed us last month an AMC and P calculation
3 of a front, or they're worried if I'm moving into the
4 core, at which point does it get to criticality?

5 And probably the results are not
6 proprietary. And I cannot tell you what elevation.
7 But, it showed that you risk criticality with plenty
8 of room to spare.

9 So, the calculation is not difficult to do
10 in your head. If you're able --

11 MEMBER KIRCHNER: Yes. But that's an
12 idealistic calculation as well. Maybe this is a
13 conversation to be held with the staff offline.

14 MEMBER MARCH-LEUBA: Or on the question
15 of --

16 MEMBER DIMITRIJEVIC: This plans to the
17 whole thing. What I was trying to reach with the PRA.
18 What the sig -- what if we have scenario, a simple
19 scenario, then you have a look and we discuss the
20 size.

21 And then we have a failure of delayed ECCS
22 actuation. Where that would lead? So we have to
23 define, what is the delay?

24 How long is the rack, has to be uncovered
25 to bring to the problem? And things like that. This

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1 analyzing doesn't exist anywhere.

2 So it's a simple scenario, LOCA and
3 failure of delay in ECCS actuation. That's it.
4 What's happening with this?

5 MEMBER MARCH-LEUBA: It also depends on
6 the size of the LOCA and how long it took to get that
7 there.

8 And there are thousands of scenarios or
9 combinations.

10 MEMBER DIMITRIJEVIC: Right. Right.
11 Well, you know, the delay is defined differently for
12 different size of the LOCA.

13 But the question is that my impression was
14 that this manual would never lead to problems if we
15 had the whole rise. Of course this is definition of
16 the failure of the ECCS penetration, which is easy to
17 understand how it fails.

18 Now, we cannot really look in the failure
19 of the holes, right? So, that's not the questionable.
20 But, I think that --

21 MEMBER MARCH-LEUBA: Yeah, NuScale --
22 NuScale answered that question for you half an hour
23 ago.

24 If you have a LOCA, for the first six
25 seconds or minutes, you are -- your level is higher

1 than the holes. And the holes are effective in mixing
2 boron.

3 Eventually you're going to drop your level
4 below the holes. And continue to drop it. At that
5 point, you're starting ready.

6 The question is, how long are you going to
7 be before you open the ECCS valves? So, you have to
8 do a balance of is the ECCS working or not working?

9 How large is the break? There are so many
10 combinations. But, the holes are in the middle of the
11 steam generator. It's roughly 10 to 15 feet above the
12 level that you reach when you open the risk, so.

13 MEMBER DIMITRIJEVIC: Yeah. But my point
14 is that these calculations have not been performed.
15 That those calculations, how long, lots of situations
16 has not been performed.

17 Even staff assumed that these preventions
18 will not fail. And then we are fine.

19 MEMBER MARCH-LEUBA: No. They have not
20 been performed. I assume, I haven't seen the PRA.
21 But I assume that if this fails, if the ECCS opens
22 late, you can see that it fails.

23 MEMBER DIMITRIJEVIC: Yes. But then you
24 know that there was just from some reason the PM
25 didn't analyze any of those failures. There was no

1 risk involved in applications.

2 So, then these risk scenarios are not in
3 the PRA. So, they're not in Chapter 15. They're
4 nowhere.

5 MEMBER MARCH-LEUBA: No, but this is a
6 LOCA scenario. Anyway, I agree with you, the
7 calculations were not performed. And that's how we've
8 seen them.

9 MEMBER KIRCHNER: Okay. Any further
10 comments from members?

11 (No response)

12 MEMBER KIRCHNER: Okay. Mr. Chairman,
13 it's about four minutes before five o'clock Eastern
14 daylight time. We can take a quick break.

15 Would you -- and then --

16 PARTICIPANT: Public comments, please?

17 CHAIR SUNSERI: Yes. Please, we're
18 controlling the meeting. Yep. Go ahead Walt.

19 MEMBER KIRCHNER: And we can start on the
20 closed session. And you've declared a hard break at
21 5:45.

22 And so, I think it's -- we'll have to sign
23 off this open Skype line.

24 CHAIR SUNSERI: I think before we do that,
25 --

1 PARTICIPANT: Public comment, please.

2 CHAIR SUNSERI: Yes. We've got it
3 covered, please. Before we do that Walt, we're going
4 to have to -- we're going to offer the public to --

5 MEMBER KIRCHNER: Yeah. Public comments.
6 Thank you for the prompt. Thanks.

7 CHAIR SUNSERI: And I would ask for the
8 public line to be open.

9 MEMBER KIRCHNER: Open the public line,
10 please.

11 OPERATOR: The public line is open for
12 comments.

13 MEMBER KIRCHNER: Okay.

14 MR. LEWIS: Yes. My name is Marvin Lewis.
15 And I demand to have a question now.

16 MEMBER KIRCHNER: Go ahead, Marvin.

17 MR. LEWIS: Hello?

18 MEMBER KIRCHNER: Hello.

19 MR. LEWIS: Oh, thank you.

20 MEMBER KIRCHNER: Go ahead.

21 MR. LEWIS: Okay. So, here's a simple
22 question. The question I have had for 30 or 40 years
23 presented to the staff, Commission, what have you,
24 again and again.

25 Say you have a LOOP, a loss of offsite

1 power. And the whole place is without power, so you
2 can't heat up any of your borated water tanks or
3 anything like that.

4 And it actually gets to the point where
5 the flow rate precipitates from the water. Which
6 happens when the water gets cold.

7 And once it's precipitated there, it's a
8 bugger to get back in. It doesn't go back in easy.
9 Have you looked at that situation?

10 Again and again I've asked if this
11 situation has been looked at. And I've got a very
12 limited answer. Thank you.

13 MR. KIRCHNER: Thank you, Marvin. Any
14 other members of the public wish to make a comment,
15 please --

16 MS. FIELDS: Yes.

17 MEMBER KIRCHNER: Go ahead.

18 MS. FIELDS: This is Sarah Fields.
19 Throughout the numerous discussions around the NuScale
20 design, you go to various scenarios that will need
21 operator attention and options.

22 And some of these options have not even
23 been identified yet. However, NuScale is in the
24 process of developing a topical report where they're
25 requesting a -- the possibility of the use of operator

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1 workers in the control room.

2 So you would have one operator and a
3 couple of senior operators. So, already, even though
4 the SCS is, this is in anticipation of a standard
5 design approval application.

6 Which will really supplement this ST. I
7 mean, yeah, the design certification. So, considering
8 the unresolved issues related to this current
9 application, I am very surprised that NuScale would
10 want to reduce the number of control room operators
11 who would be responding to these types of LOCAs or
12 non-LOCA events.

13 So, that's my comment. And thank you very
14 much for the staff and ACRS' hard work and
15 consideration of these issues.

16 MEMBER KIRCHNER: Thank you, Sarah. Is
17 there anyone else out there who would like to make a
18 comment? Please state your name and comment.

19 (No response)

20 MEMBER KIRCHNER: Okay. Mr. Chairman, I
21 think that was 15 seconds. I hope that was adequate
22 for any other additional public comments.

23 I haven't heard --

24 CHAIR SUNSERI: Okay. Thank you, Walt.
25 And thanks to the public for providing your thoughts

1 on this matter.

2 Mike Snodderly, is this still the case
3 that we need 15 minutes to transition into the closed
4 session?

5 MR. SNODDERLY: No, Matt. I don't think
6 so. I think we just end this call. And hopefully
7 everyone has an invitation from me from 3:00 to 6:00
8 p.m.

9 And just go accept that invitation and
10 we'll get started as soon as you have a quorum and we
11 have the NuScale and the staff on the line.

12 So, why don't we give it a shot?

13 CHAIR SUNSERI: Yeah. Okay. So, let's
14 transition over. And everybody get their Skype line
15 up and we'll reconvene on the closed session at 15
16 after the hour. So, 5:15.

17 MR. SNODDERLY: Thanks.

18 CHAIR SUNSERI: All right. Thank you all.
19 And so we are recessed to the closed session, moving
20 into the closed session. Thank you.

21 (Whereupon, the above-entitled matter went
22 off the record at 5:02 p.m.)

23

24

25



U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Regulatory Guide 1.236 PWR Control Rod Ejection and BWR Control Rod Drop Accidents

ACRS Full Committee

June 3, 2020

Paul M. Clifford

Division of Safety Systems
Nuclear Reactor Regulation

Agenda

U.S. NUCLEAR REGULATORY COMMISSION
REGULATORY GUIDE RG 1.236



Issue Date: May 2020
Technical Lead: Paul Clifford

**PRESSURIZED-WATER REACTOR CONTROL ROD
EJECTION AND BOILING-WATER REACTOR
CONTROL ROD DROP ACCIDENTS**

A. INTRODUCTION

Purpose

This regulatory guide (RG) describes methods and procedures that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable when analyzing the nuclear reactor's initial response to a postulated control rod ejection (CRE) accident for pressurized-water reactors (PWRs) and a postulated control rod drop (CRD) accident for boiling-water reactors (BWRs). It describes analytical limits and guidance for analyzing the short-term reactivity insertion and demonstrating compliance to 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 28, "Reactivity Limits." It also defines fuel cladding failure thresholds, including ductile failure, brittle failure, and pellet-clad mechanical interaction (PCMI), to support radiological consequence assessments. To facilitate implementation, this guide also provides acceptable analytical models for cladding hydrogen uptake and transient fission gas release (FGR).

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1. Regulatory Requirements
2. Guidance Summary
3. Timeline and Stakeholder Comments
3. Guidance Updates
 - a. Damaged Core Coolability
 - b. Radiological Consequences
 - c. Cladding Hydrogen Models
 - d. BU Extension

Reason for Concern

LEST WE FORGET



SL-1 1-3-61

- Fatal accident at Army's prototype modular reactor – Stationary Low Power Reactor (SL-1)
- Improper withdrawal of central control rod resulted in prompt critical power excursion and steam explosion

**Protection Against Violent
Explosion and Loss of
Pressure Boundary**

Regulatory Requirements

- 10 CFR 50, Appendix A GDC 28 requires reactivity control systems to be designed with appropriate **limits** on potential **amount** and **rate** of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in **damage to the reactor coolant pressure boundary greater than local yielding** nor (2) sufficiently disturb the core, its support structures, or other reactor pressure vessel internals to **impair significantly the capability to cool the core**.
- 10 CFR 100.11 and 10 CFR 50.67 establish **radiation dose limits** for individuals at the boundary of the exclusion area and at the outer boundary of the low population zone.

RG 1.236 provides an acceptable means to meet requirements

Reactivity Insertion Accidents

- Reactivity insertion accidents are safety significant because of their potential ability to challenge fuel rod integrity, fuel bundle geometry, and the integrity of the reactor pressure boundary
- The uncontrolled movement of a single control rod out of the core results in a positive reactivity insertion that promptly increases local core power
 - Considered the limiting reactivity insertion accident
- Of the various postulated single failures of the CRD system which may initiate an uncontrolled movement of a single control rod, PWR CRE and BWR CRD are considered the most limiting scenarios for the current operating fleet

Guidance Summary

- Building upon latest research data, RG 1.236 represents a significant advancement in guidance
- Separately captures fabrication-, burnup-, and corrosion-effects on fuel rod performance under RIA conditions

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APPENDIX A: ACRONYMS AND ABBREVIATIONS

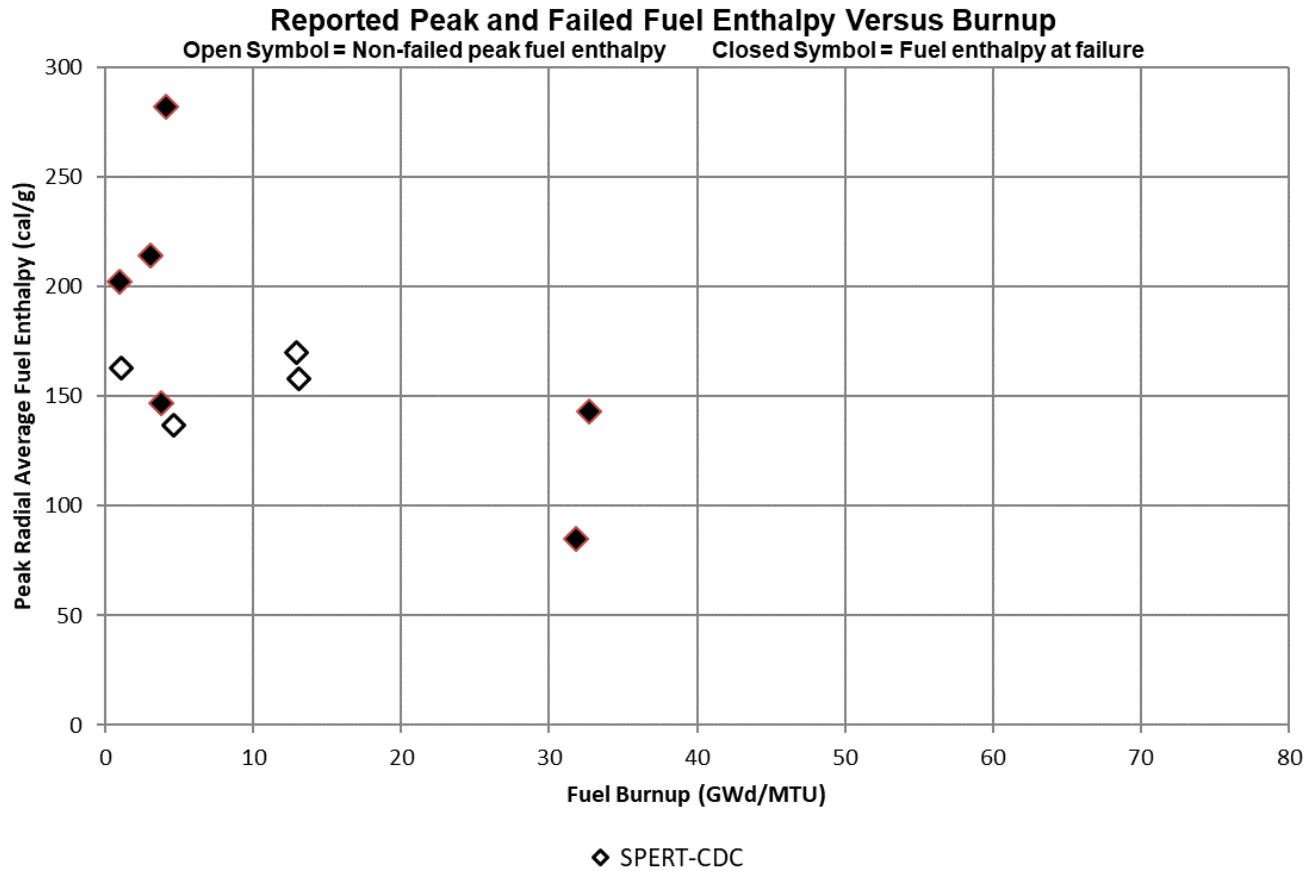
APPENDIX B: TRANSIENT FISSION GAS RELEASE

APPENDIX C: HYDROGEN UPTAKE MODELS FOR FUEL ROD CLADDING

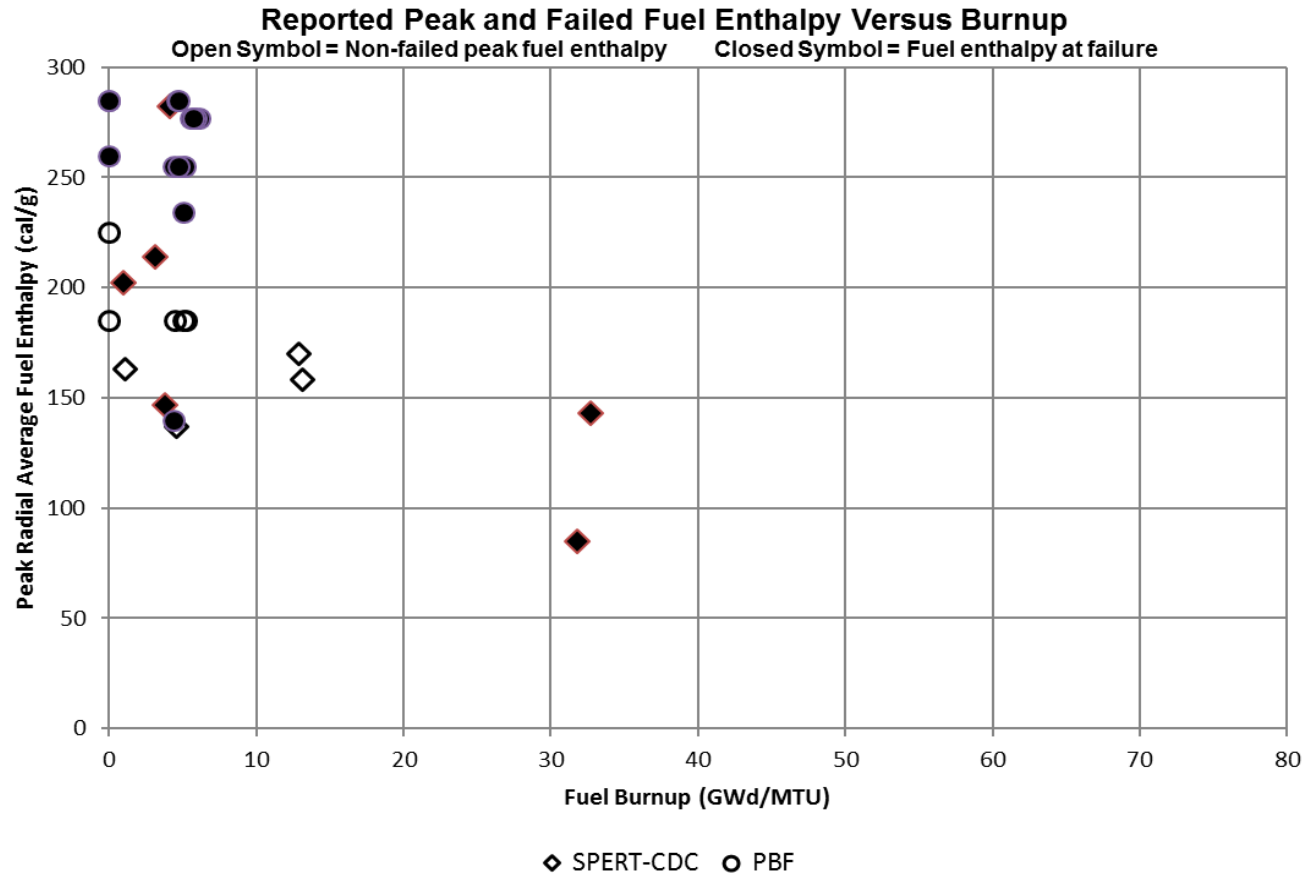
Timeline

- 1974 RG 1.77, Assumptions used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors
- 1980 *Nuclear Safety* article (MacDonald et.al.) suggests need for new analytical limits for coolable geometry and failure threshold
- 2004 RIL-0401, An Assessment of Postulated Reactivity-Initiated Accidents (RIAs) for Operating Reactors in the U.S.
- 2007 SRP 4.2, Appendix B, Interim Acceptance Criteria and Guidance for the Reactivity Initiated Accidents
- 2017 DG-1327 1st public comment period
- 2019 DG-1327 2nd public comment period

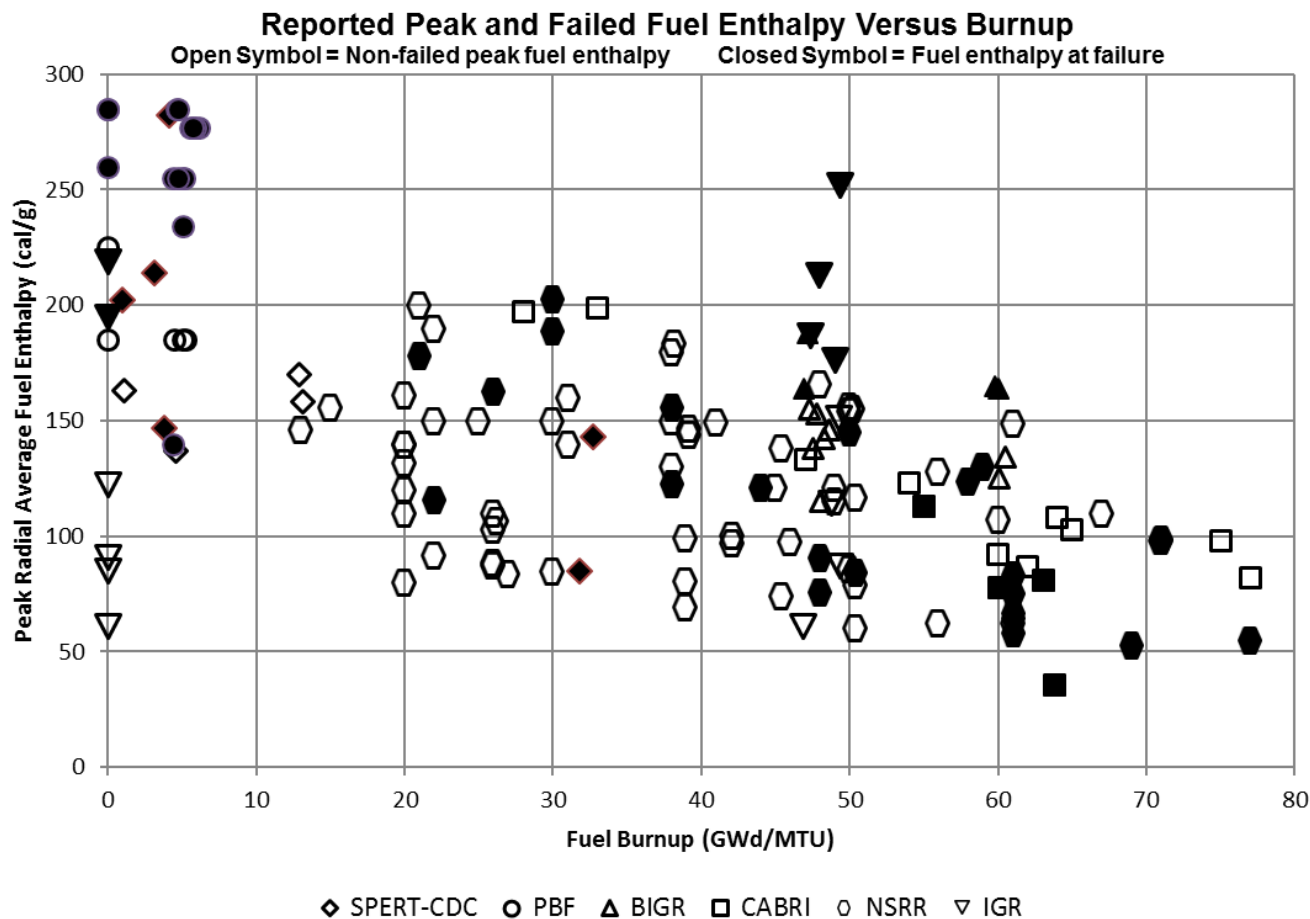
Timeline - 1974



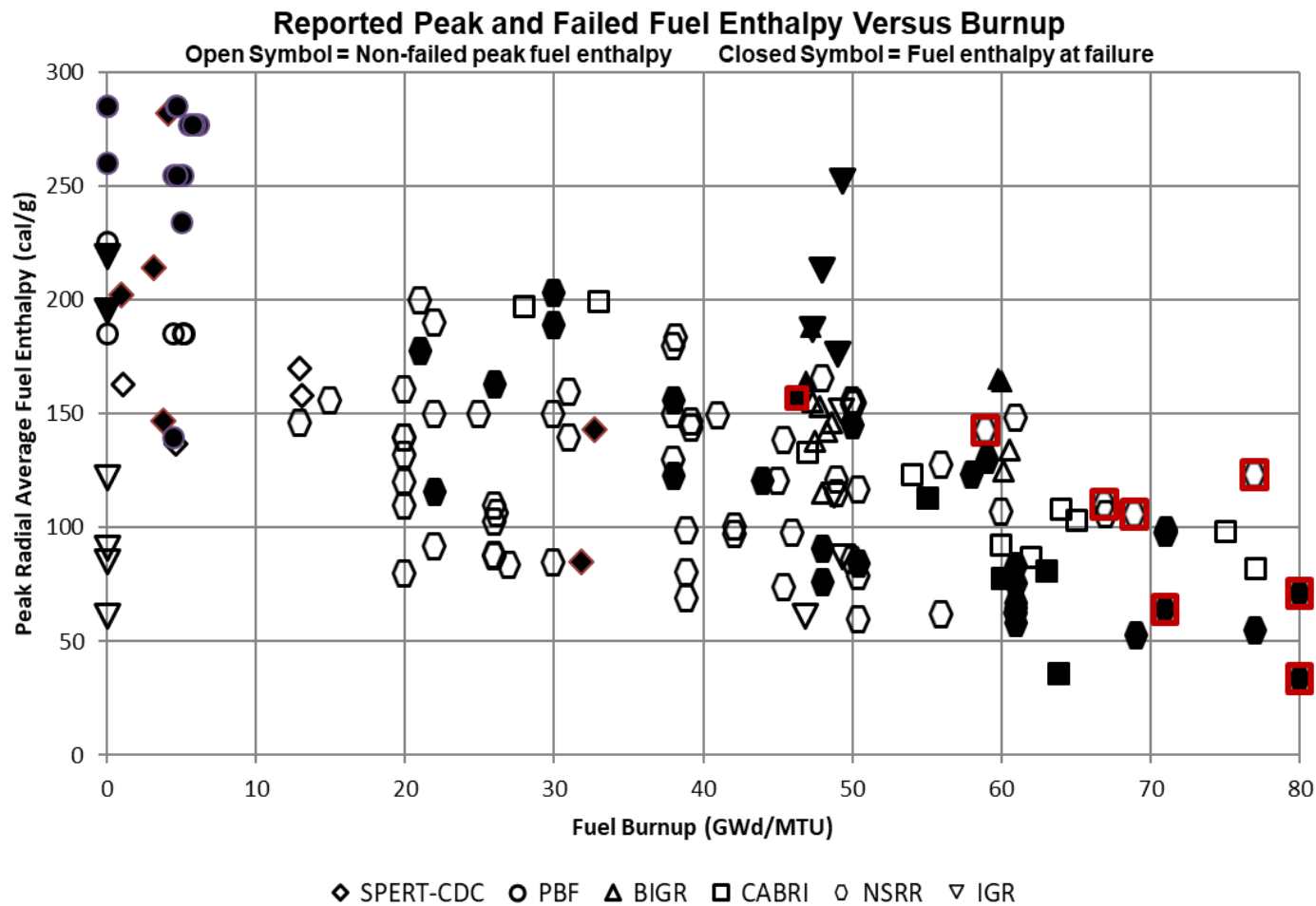
Timeline - 1980



Timeline - 2004

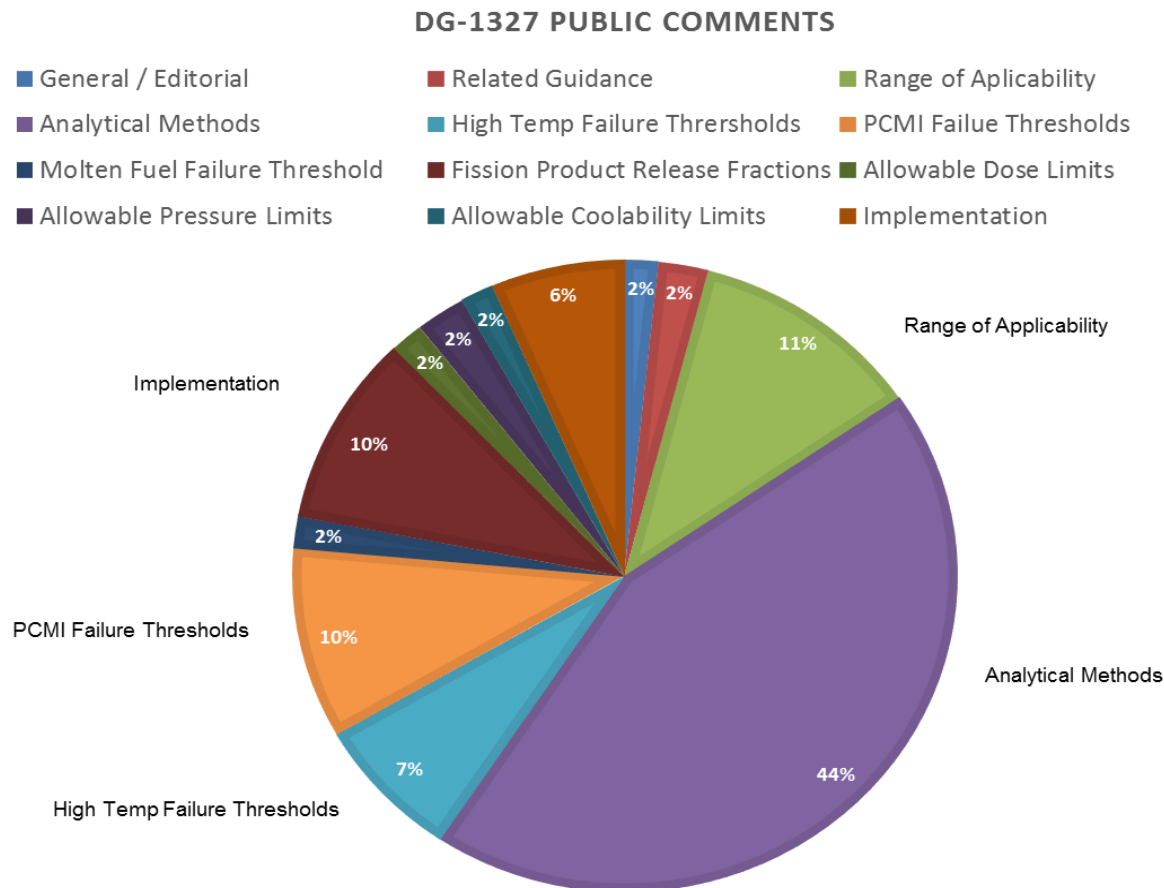


Timeline - 2020



Public Comment - 2017

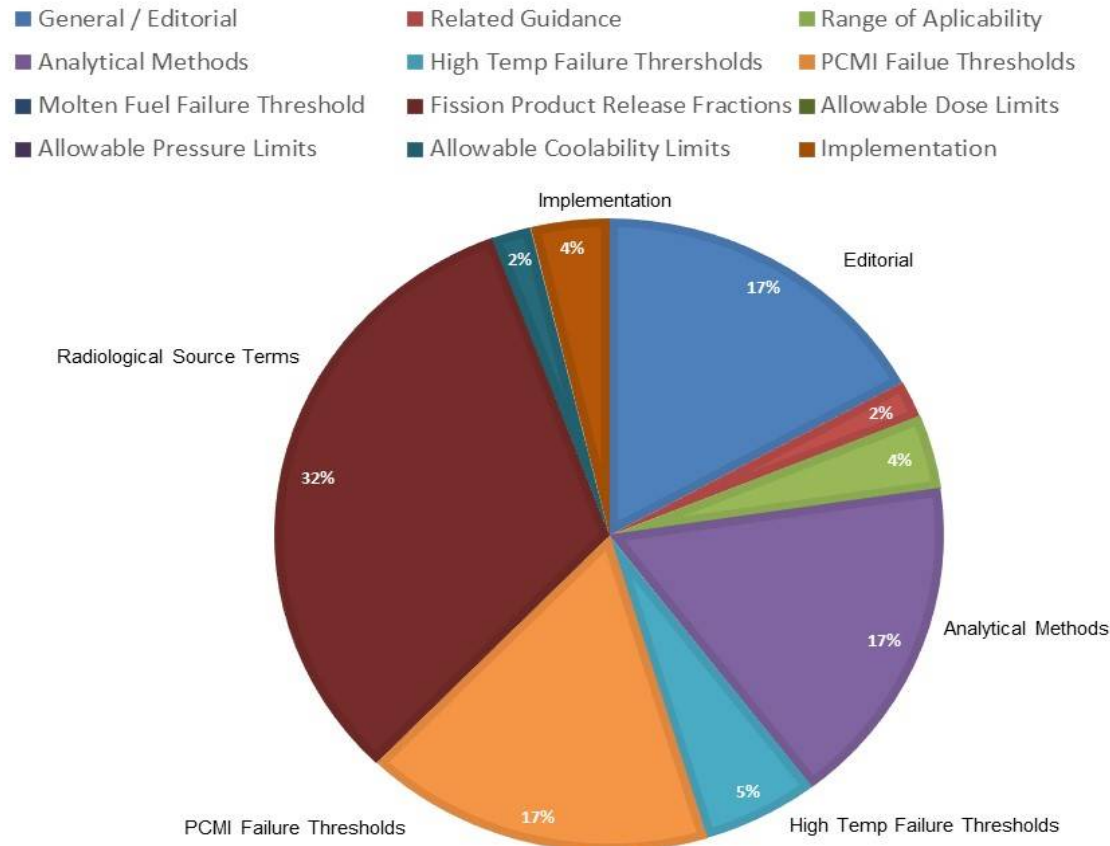
- **Comment submissions received from 12 stakeholders with a total 124 comments**
 - **Over 100 comments were accepted**



Public Comment - 2019

- **Comment submissions received from 7 stakeholders with a total 54 comments**
 - **Over 30 comments were accepted**

DG-1327 PUBLIC COMMENTS - 2019



Major Changes

- Expanded fuel burnup range to 68 GWd/MTU (Section C.1)
- Improved analytical requirements (Section C.2)
- Revised PCMI cladding failure threshold curves (Section C.3)
- Removed radiological source term information (Section C.4)
 - Analytical requirements
 - Fission product gap release fractions → [Future revision to RG 1.183](#)
 - Analytical procedure
- Amended implementation to reflect revised Backfit guidance (Section D)
- Added cladding hydrogen uptake models (Appendix C)

Agenda

U.S. NUCLEAR REGULATORY COMMISSION
REGULATORY GUIDE RG 1.236



Issue Date: May 2020
Technical Lead: Paul Clifford

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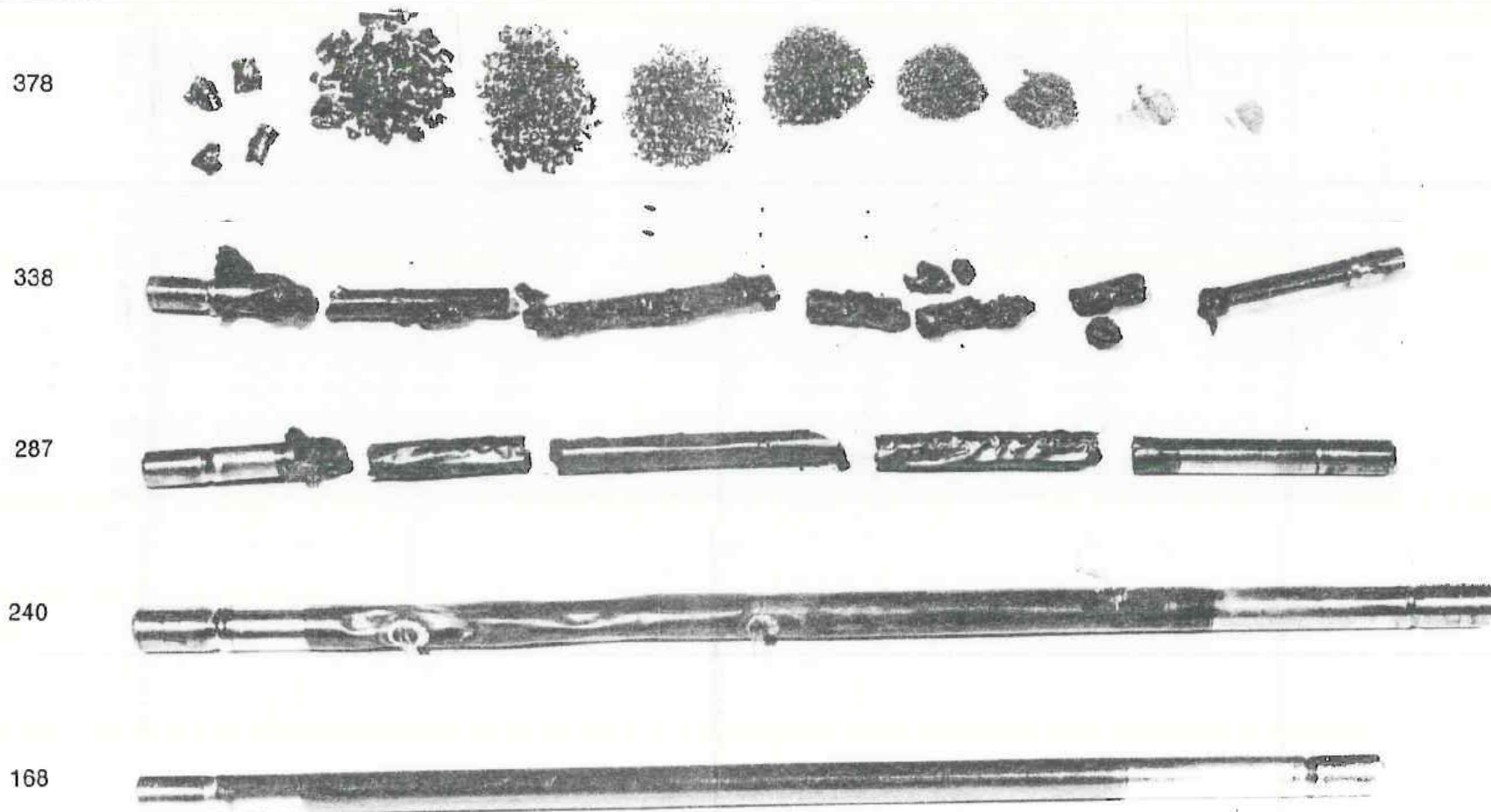
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Protect Against Loss of Fuel Bundle Geometry

Energy deposition
(cal/g UO₂)



69-6057

Fig. 3 Posttest photographs of SPXM rods tested in the CDC.

Coolability Analytical Limits

6. Allowable Limits on Damaged Core Coolability

Limiting peak radial average fuel enthalpy to prevent catastrophic fuel rod failure and avoiding molten fuel-coolant interaction is an acceptable metric to demonstrate that there is limited damage to core geometry and that the core remains amenable to cooling. The following restrictions should be met:

- a. Peak radial average fuel enthalpy should remain below 230 cal/g.
 - b. A limited amount of fuel melting is acceptable provided that it is less than 10 percent of fuel volume. If fuel melting occurs, the peak fuel temperature in the outer 90 percent of the fuel volume should remain below incipient fuel melting conditions.
- Loss of fuel rod geometry limit (230 cal/g) based on earlier SPERT, PBF and NSRR prompt critical experiments
 - Limited centerline melt (current license bases) avoids molten FCI
 - Fuel melt becomes more limiting at ~30 GWd/MTU
 - Preserves coolable geometry - satisfies GDC-28

Radiological Consequences

1. Requires a conservative estimate of the total number of failed fuel pins from all failure modes
 - Prompt critical high temperature cladding failure
 - Non-prompt DNB/CPR cladding failure
 - PCMI cladding failure
 - Centerline fuel melt cladding failure

2. Requires a conservative estimate of fission product release fractions
 - Steady-state gap inventories
 - Transient fission gas release
 - Fuel melt fission gas release

→ Future revision to RG 1.183

HT Cladding Failure Threshold

3.1 High-Temperature Cladding Failure Threshold

Figure 1 shows the empirically based high-temperature cladding failure threshold. This composite failure threshold encompasses both brittle and ductile failure modes and should be applied for events with prompt critical excursions (i.e. ejected rod worth or drop rod worth greater than or equal to \$1.0). Because ductile failure depends on cladding temperature and differential pressure (i.e., rod internal pressure minus reactor pressure), the composite failure threshold is expressed in peak radial average fuel enthalpy (calories per gram (cal/g)) versus fuel cladding differential pressure (megapascals (MPa)).

For prompt critical scenarios which experience a prolonged power level following the prompt pulse, fuel cladding failure is presumed if local heat flux exceeds thermal design limits (e.g., departure from nucleate boiling and critical power ratios).

For non-prompt critical excursions, fuel cladding failure is presumed if local heat flux exceeds thermal design limits.

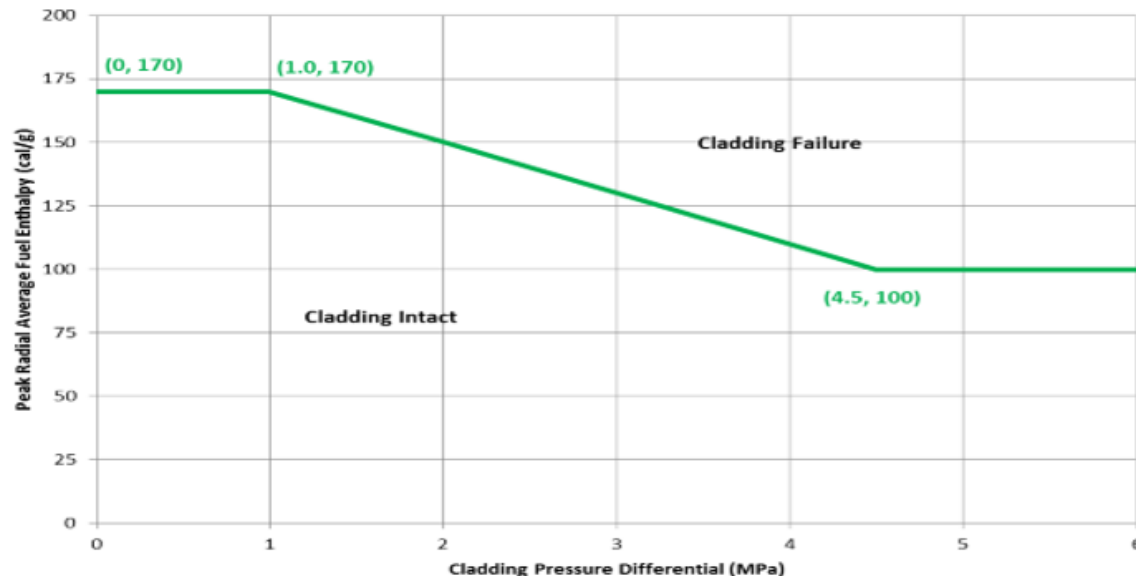


Figure 1. High-Temperature Cladding Failure Threshold

PCMI Cladding Failure

3.2 PCMI Cladding Failure Threshold

Figures 2 through 5 show the empirically based PCMI cladding failure thresholds. Because fuel cladding ductility is sensitive to hydrogen content, zirconium hydride orientation, and initial temperature, separate PCMI failure curves are provided for RXA and SRA cladding types at both low initial cladding temperature conditions (i.e., below 500 degrees F down to BWR cold startup) and high initial cladding temperature conditions (i.e., at or above 500 degrees F). The RXA cladding failure threshold is further refined for cladding designs with and without a barrier liner (e.g., sponge or low allow cladding inside diameter liner). The SRA cladding failure threshold is applicable regardless of the presence of a barrier liner. The PCMI cladding failure threshold is expressed in peak radial average fuel enthalpy rise ($\Delta\text{cal/g}$) versus excess cladding hydrogen content (wppm). Excess cladding hydrogen content refers to the portion of total hydrogen content in the form of zirconium hydrides (i.e., it does not include hydrogen in solution).

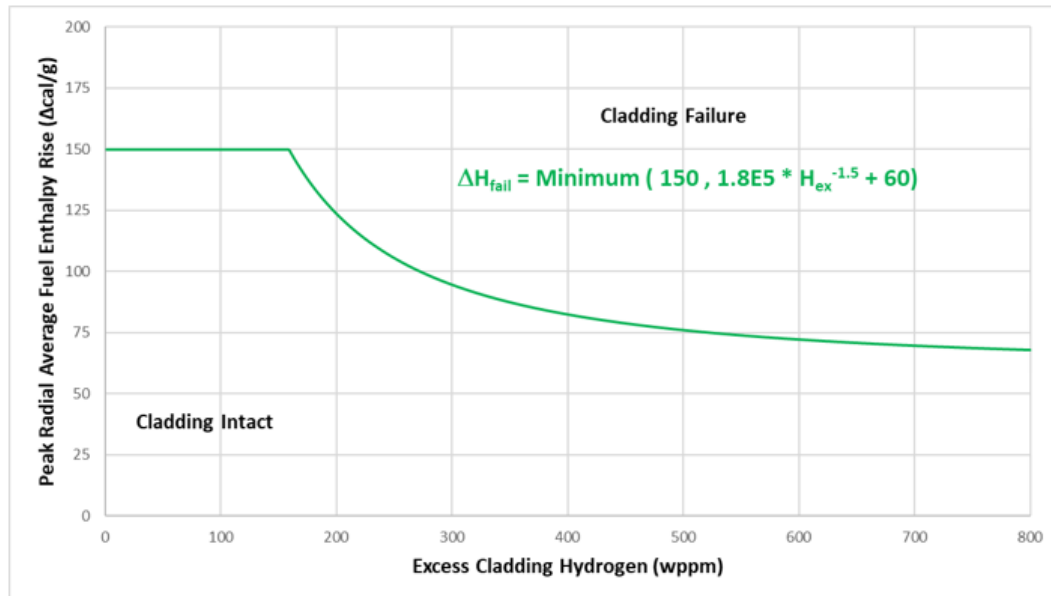
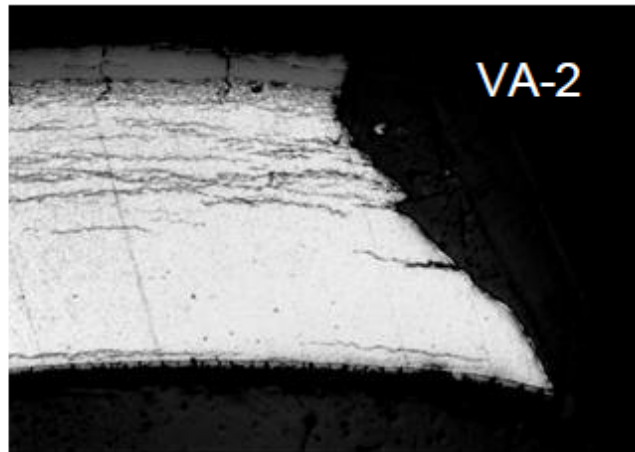


Figure 3. PCMI Cladding Failure Threshold—SRA Cladding at or above 500 Degrees F

Hydride Orientation

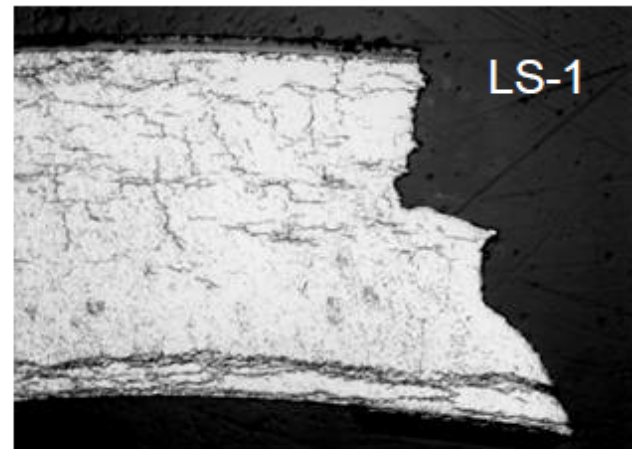
- Besides overall concentration, PCMI sensitive to hydride distribution and orientation which are influenced by:
 - Thermal and mechanical treatment during manufacturing
 - Stress state prevailing during hydride precipitation

PWR cladding
(stress-relieve annealed)



Burnup: 79 GWd/t
H content: 760 ppm
Failure at 55 cal/g

BWR cladding
(recrystallization annealed)

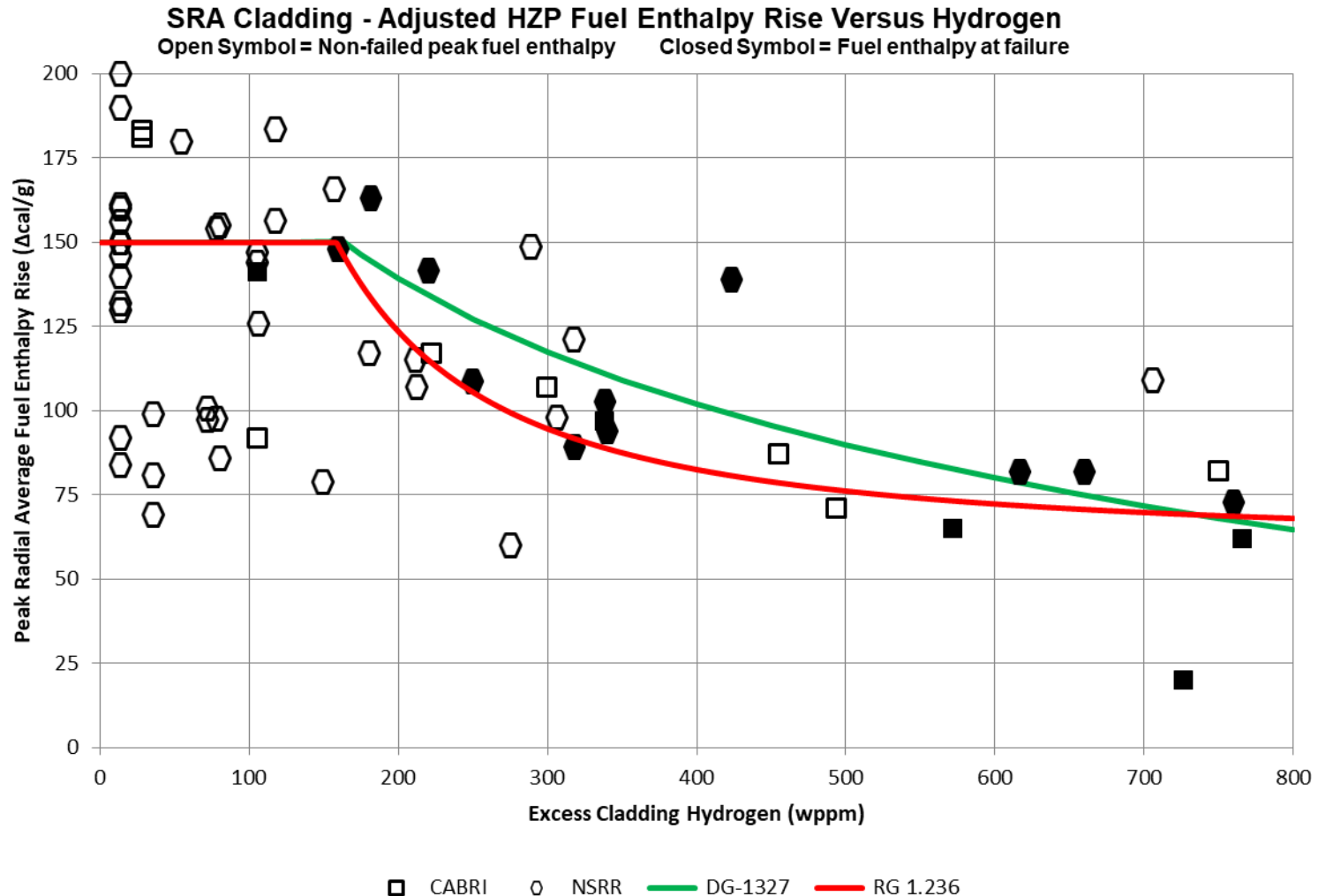


Burnup: 69 GWd/t
H content: ~300 ppm
Failure at 60 cal/g

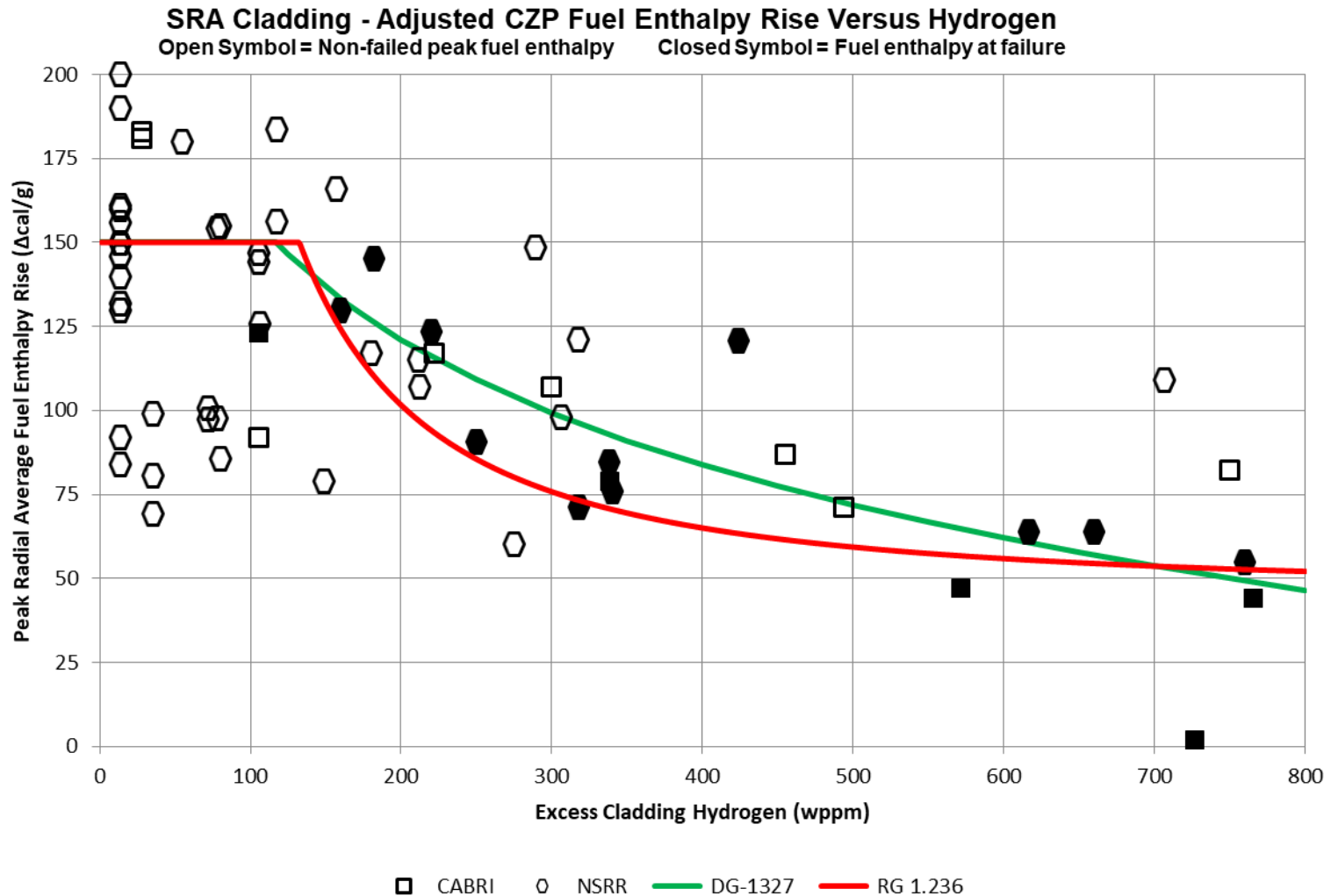
Separate PCMI Failure Thresholds

- Separate PCMI cladding failure threshold lines established which account for impacts associated with initial RCS temperature, excess hydrogen, and hydride sensitivity
 1. SRA cladding at high RCS coolant temperature
 2. SRA cladding at low RCS coolant temperature
 3. RXA cladding at high RCS coolant temperature
 4. RXA cladding at low RCS coolant temperature

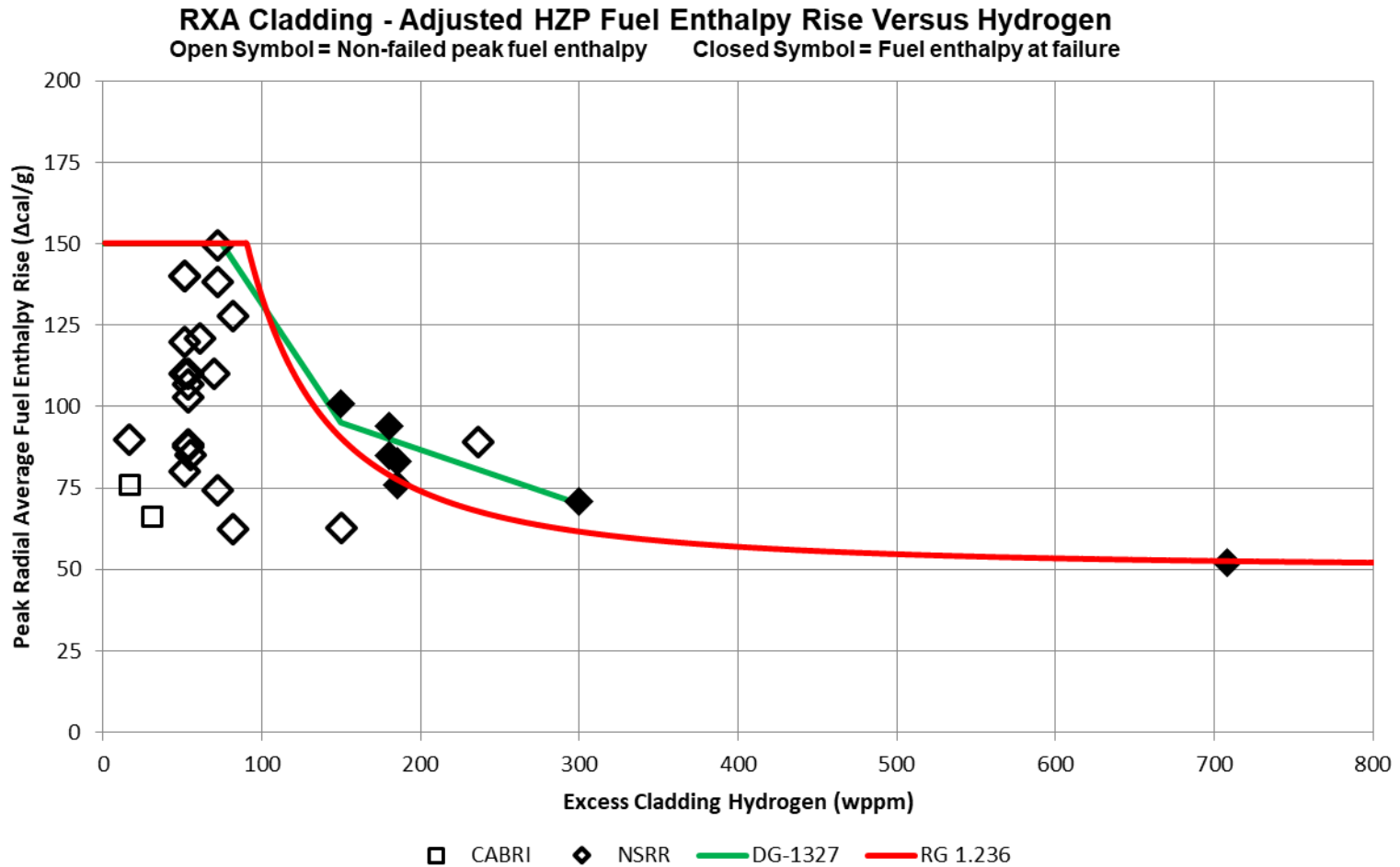
SRA Hot PCMI Failure Threshold



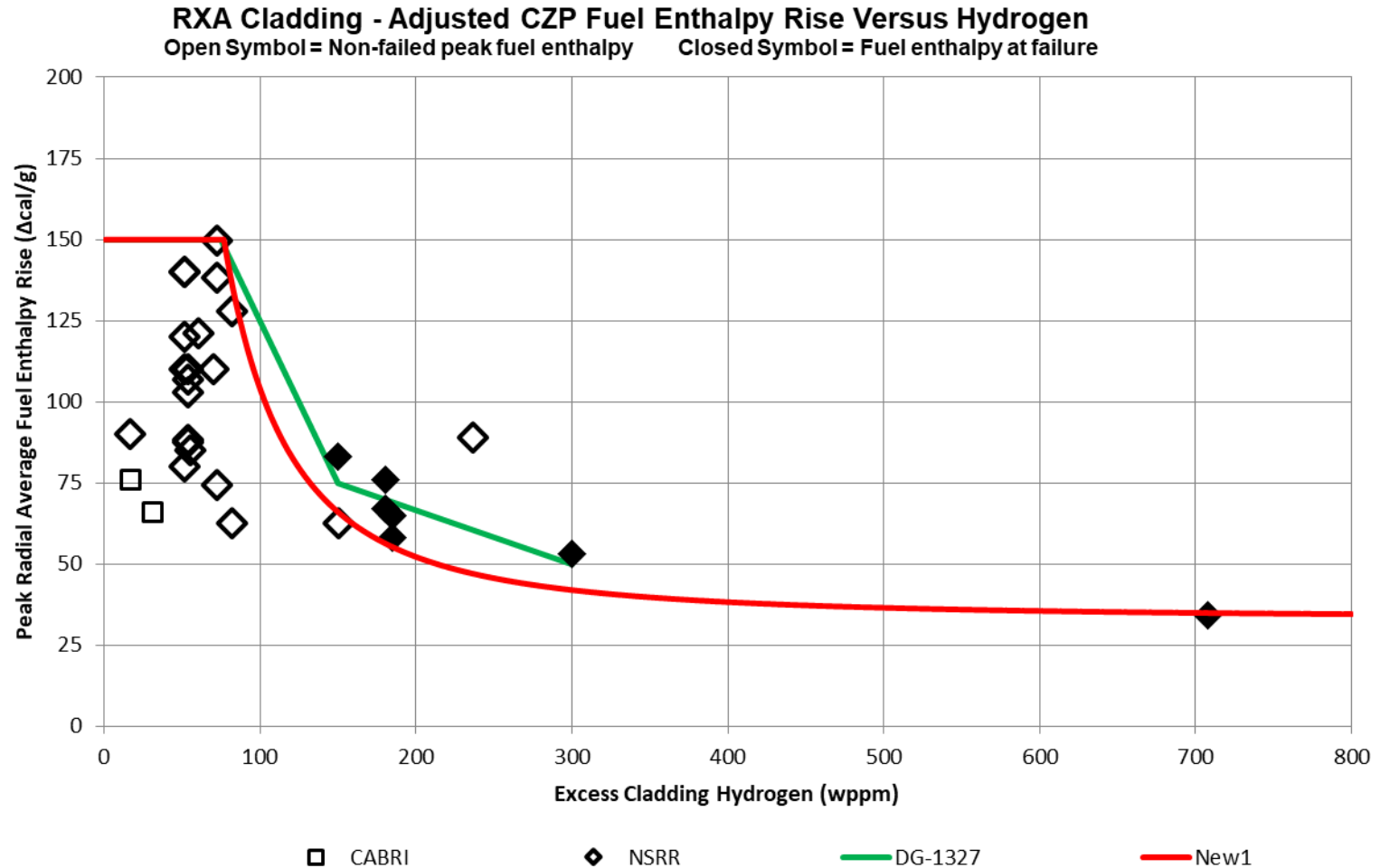
SRA Cold PCMI Failure Threshold



RXA Hot PCMI Failure Threshold

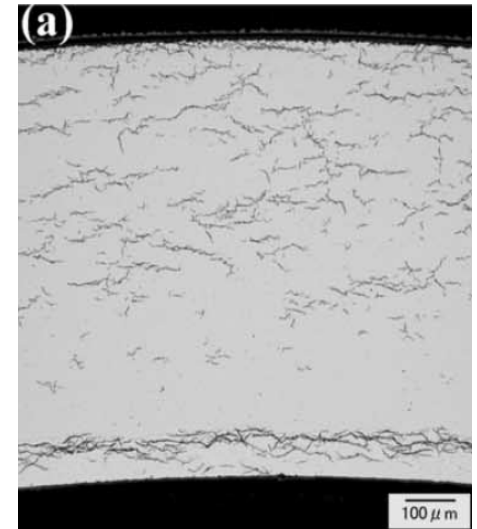
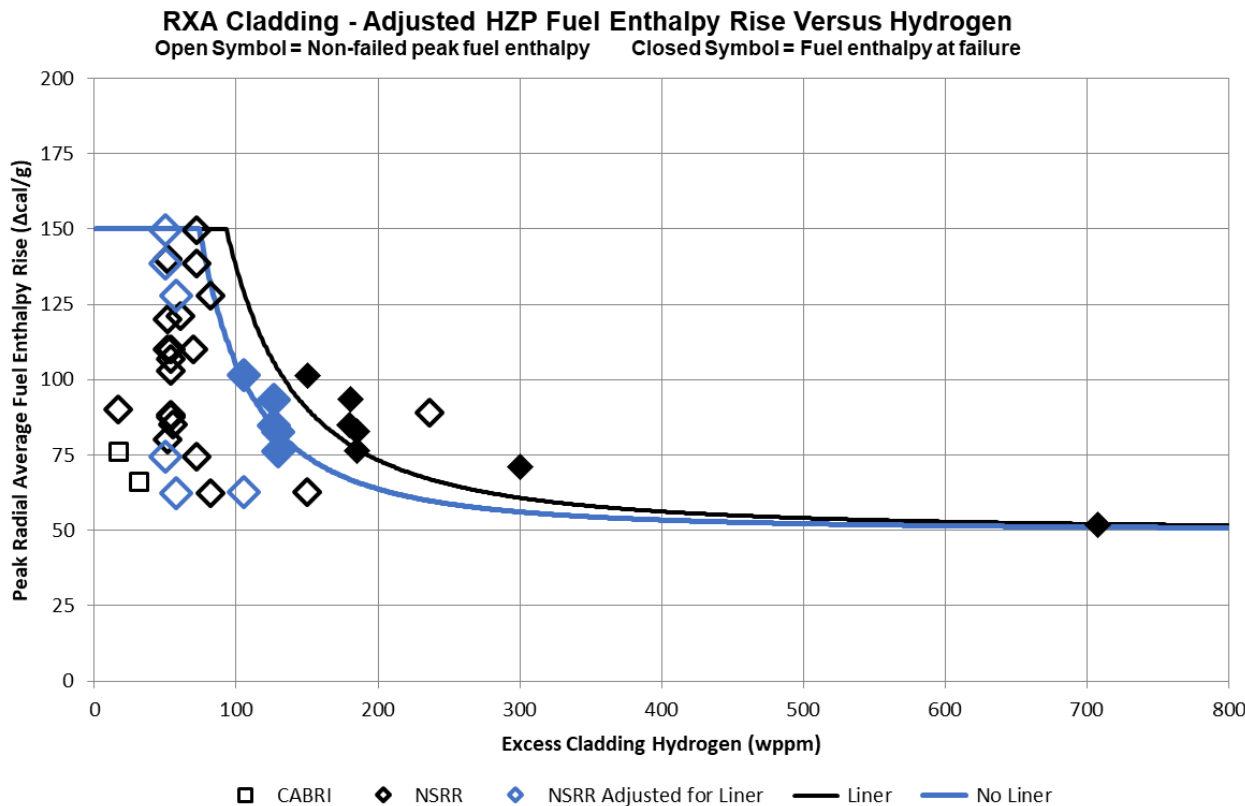


RXA Cold PCMI Failure Threshold



Impact of Barrier Liner

- In BWR liner (i.e., barrier) fuel, the natural or low alloy zirconium liner acts as a sponge for hydrogen.
 - Depletes base metal of detrimental effects of hydrides
 - Liner remains ductile even with high concentration of hydrides



Hydrogen Uptake Models

- Originally published in draft RG 1.224 (2015) in support of 50.46c rule
 - DG-1263 public comment period in 2014

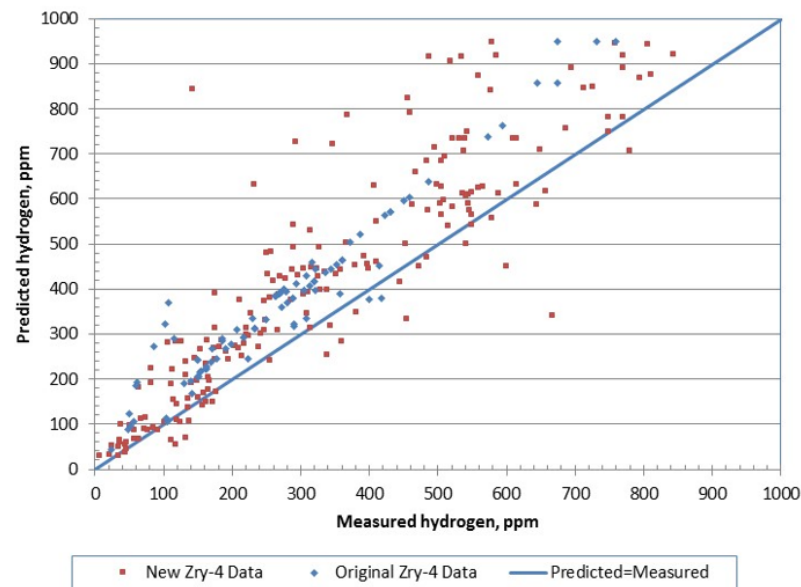
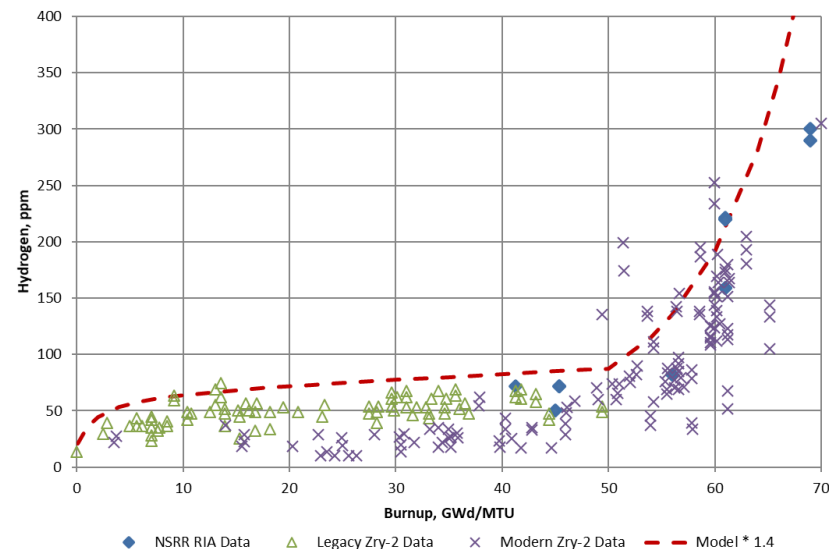
C-1. Zirconium Cladding Alloys in Pressurized-Water Reactors

Corrosion rates and the amount of corrosion at fuel discharge vary widely across the pressurized-water reactor (PWR) fleet because of alloy composition, operating conditions, and residence time (i.e., effective full-power days). Fuel vendors have approved fuel performance analytical tools along with corrosion models. In general, these corrosion models can predict a best estimate corrosion thickness as a function of effective full-power days and local operating conditions (fuel duty).

An examination of the empirical database of measured cladding hydrogen content for the current commercial zirconium alloys reveals that PWR cladding alloys do not exhibit the same breakaway hydrogen uptake at higher fluence levels as observed in Zircaloy-2 data for boiling-water reactors (BWRs). However, the pickup fraction does appear to be alloy specific. With consideration of the extent, uncertainty, and variability of the supporting database, the staff developed the following upper bound pickup fractions:

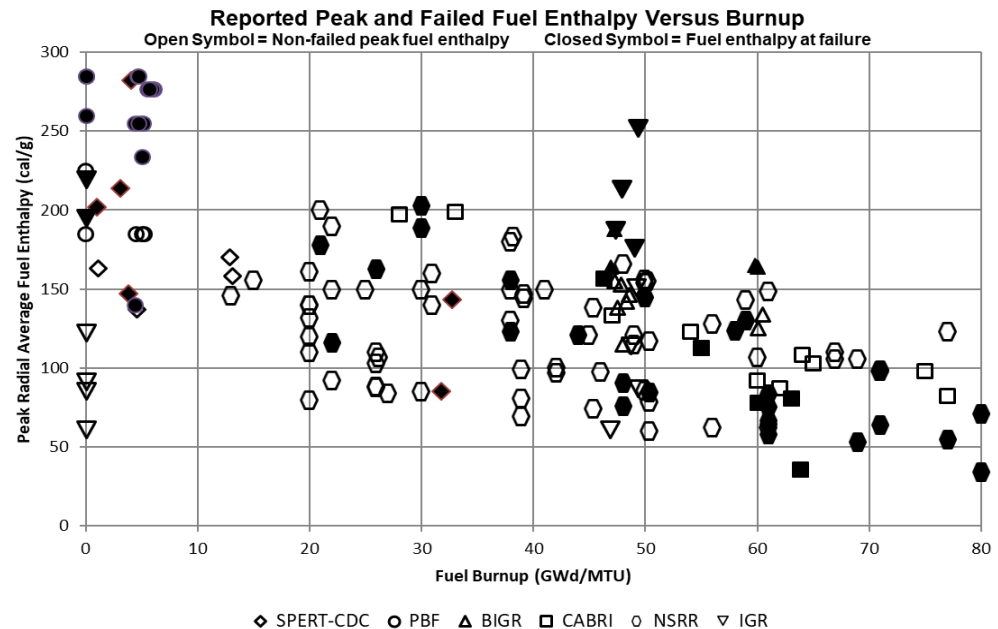
Zircaloy-4	20% hydrogen absorption
ZIRLO®	25% hydrogen absorption
Optimized ZIRLO™	25% hydrogen absorption
M5®	15% hydrogen absorption

These hydrogen pickup fractions should be used, along with a best estimate prediction of the peak oxide thickness using an approved fuel rod thermal-mechanical model, to estimate the cladding hydrogen content.



Burnup Extension

- In support of near-term licensing actions to extend allowable fuel rod average burnup to 68 GWd/MTU*, staff completed a critical assessment of the empirical database supporting RG 1.236 guidance (ML20090A308)
- For each portion of the guidance, the staff (1) investigated sensitivity with burnup and (2) assessed the extent of empirical database
- Based on this work the applicability of RG 1.236 was expanded up to 68 GWd/MTU



* Empirical database reports test segment (i.e., local) burnup. Rod average 68 GWd/MTU equivalent to approximately 75 GWd/MTU test segment burnup.

Conclusions

- Based upon latest research data, revised research data, new analysis, and international perspectives, the NRC staff has developed CRE/CRD guidance in RG 1.236
 - Represents a significant advancement in guidance
 - Separately captures fabrication-, burnup-, and corrosion-effects on fuel rod performance under RIA conditions
- ACRS and stakeholder involvement starting prior to 2007
 - Several ACRS briefings beginning prior to Interim Guidance
 - Numerous public workshops and 3 rounds of public comments

May 29, 2020

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Submittal of Presentation Materials Entitled "ACRS Full Committee Presentation: NuScale Topic – Boron Redistribution and Associated Design and DCA Changes," PM-0620-70244, Revision 0

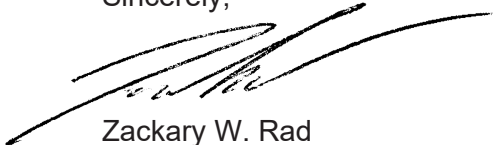
The purpose of this submittal is to provide presentation materials to the NRC for use during the upcoming Advisory Committee on Reactor Safeguards (ACRS) NuScale Full Committee Meeting on June 3, 2020. The materials support NuScale's presentation of boron redistribution and associated design changes in the NuScale Design Certification Application.

The enclosure to this letter is the nonproprietary presentation entitled "ACRS Full Committee Presentation: NuScale Topic – Boron Redistribution and Associated Design and DCA Changes," PM-0620-70244, Revision 0.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions, please contact Matthew Presson at 541-452-7531 or at mpresson@nuscalepower.com.

Sincerely,



Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Robert Taylor, NRC
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Enclosure: "ACRS Full Committee Presentation: NuScale Topic – Boron Redistribution and Associated Design and DCA," PM-0620-70244, Revision 0

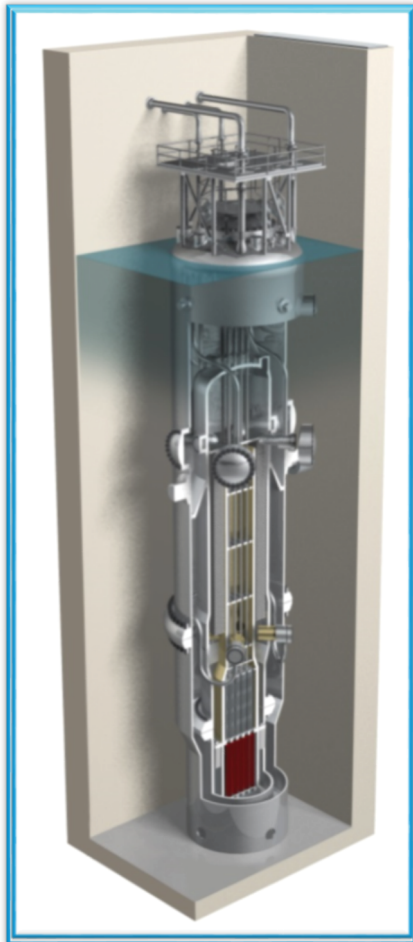
Enclosure:

“ACRS Full Committee Presentation: NuScale Topic – Boron Redistribution and Associated Design and DCA Changes,” PM-0620-70244, Revision 0

ACRS Full Committee Presentation

NuScale Topic Boron Redistribution and Associated Design and DCA Changes

June 3, 2020



Presenters

Matthew Presson

Licensing Project Manager

Paul Infanger

Licensing Specialist

Ben Bristol

Supervisor, System Thermal-Hydraulics

Hannah Rooks

Supervisor, NSSS Systems Analysis

Sarah Bristol

Supervisor, Probabilistic Risk Assessment

Agenda

- Boron Redistribution Background
- Boron Dilution Analysis
- Event Scenarios
- Design Changes
- Safety Analysis
- Mechanical Analysis
- Probabilistic Risk Assessment
- DCA and Conforming Changes
- Conclusions

Boron Redistribution Background

- During ACRS subcommittee meetings in February 2020, scenarios were discussed that could lead to dilution of fluid in reactor pressure vessel (RPV) downcomer
 - Under certain conditions, ECCS actuation or restoration of natural circulation flow could transport diluted coolant to the reactor core
 - Postulated reactivity event could be outside those previously evaluated
 - Return to power (FSAR 15.0.6)
 - Boron dilution (FSAR 15.4.6)
 - Boron redistribution (RAI 8930)
 - NuScale initiated an evaluation of the postulated scenarios in accordance with Corrective Action Program
-

Boron Dilution Analysis

Existing methods used bounding assumptions or assumed perfect mixing

- Large analysis conservatisms lead to unrealistic results
 - » Large boron loss term for fluid in containment (CNV) below reactor recirculation valves (RRVs)
 - » Boron lost in vapor through reactor vent valves (RVVs) due to volatility
 - » No mechanism for boron recovery
- No methodology approved by the NRC exists for detailed boron mixing in downcomer or core
- Determined that the postulated boron redistribution scenarios could be eliminated through several minor design changes
- NRC initiated an audit (ML20059N687) to review the resolution of the postulated boron redistribution scenarios and associated changes to the NuScale Design Certification Application (DCA)
 - » Daily interactions to support NRC staff review

Event Scenarios

- Potential events that required further evaluation for boron dilution
 - LOCAs
 - Condensation of water in CNV from RVVs
 - Condensation of unborated water in downcomer
 - ECCS actuation can transport unborated water to core
 - DHRS operation can shrink RCS inventory below top of riser
 - Condensation of unborated water in downcomer
 - Unborated water can enter core when restoring natural circulation or after ECCS actuation (24-hour timer on loss of AC power)
 - Anticipated Transient Without Scram (ATWS)
 - Condensation of unborated water in downcomer and CNV after RCS fluid lost through reactor safety valves (RSVs)
 - Unborated water can enter core when restoring natural circulation or opening ECCS valves

Design Changes

- Design Considerations
 - Ensure early actuation of ECCS for postulated LOCA events
 - Actuates ECCS while pressure and level in RPV are higher than CNV establishes flow out of RPV when ECCS valves open
 - After outflow, flow stagnates and slowly reverses through RRVs so that no large influx of unborated water can occur
 - Provide mechanism for boron mixing in the unlikely event that RCS level drops below riser
 - Eliminates potential dilution from restored natural circulation following analyzed DHRS cooldown scenarios or ATWS events
 - Eliminates potential dilution from operator action to restore natural circulation or manual ECCS actuation

Design Changes (continued)

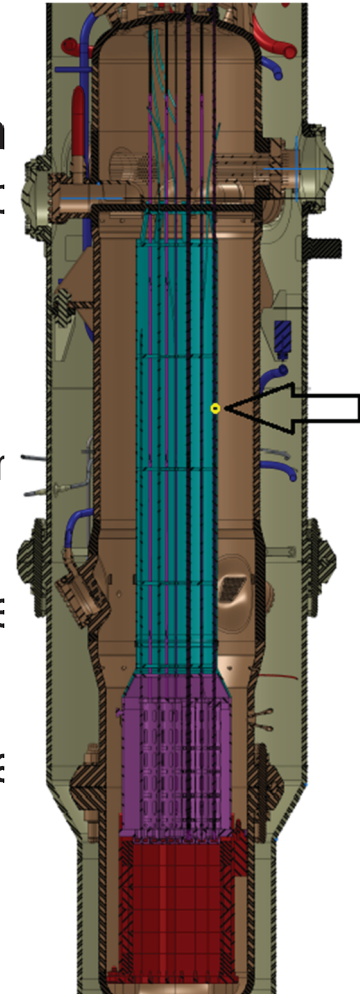
- Addition of ECCS actuation signal on low RCS pressure (less than 800 psia +/- 100 psi)
 - ECCS actuation prevented by either of following interlocks
 - CNV pressure less than 1 psia
 - RCS T_{hot} less than 475 °F
- Interlocks prevent ECCS actuation for Non-LOCA events
 - RCS is subcooled in DHRS cooldown events (lower than 475 °F) and have no increase in CNV pressure
 - Main steam line breaks and feedwater line breaks
 - RCS pressure remains above ECCS actuation pressure range during initial transient response
 - RCS is subcooled below 475 °F T_{hot} interlock before RCS depressurizes to ECCS actuation range

Design Changes (continued)

- Lowered ECCS CNV level actuation setpoint
 - 252 inches (from 282 inches)
 - Level setpoint range remains above RRV
 - Actuates ECCS while RCS level and pressure greater than CNV level and pressure
 - Ensures initial flow out of RPV into CNV
 - Establishes boron mixing before ECCS flow into RPV

Design Changes (continued)

- Diverse flowpaths added to RPV riser
 - Provide a flow path from riser through the downcomer to ensure boron mixing even if level drops below top
 - Four ¾ inch holes located at midpoint of SG
 - Impact to normal operation is minimal
 - Flow through holes is small (2 kg/s) compared to minimum (535 kg/s)
 - Holes located below RCS contracted level from extended cooldown
 - Holes are above equilibrium riser level after ECCS action (impact on LOCA cooling)
 - Additional detail about this design change included closed presentation



Safety Analysis

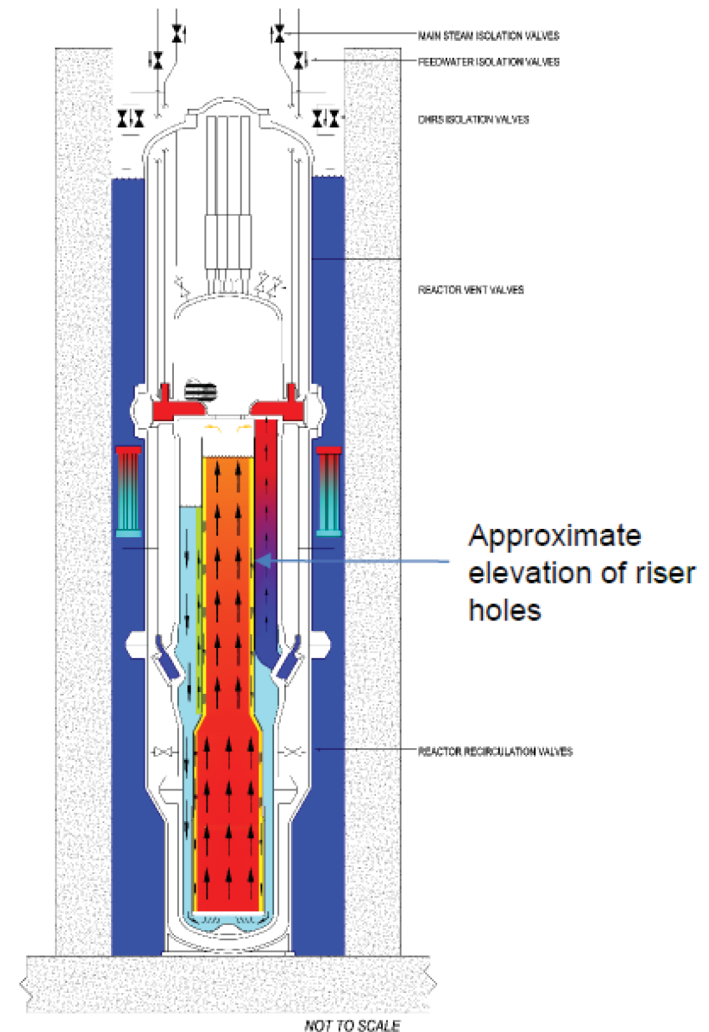
- Return to Power (FSAR 15.0.6)
 - End of cycle conditions remain limiting
 - No impact to the postulated limiting return to power scenario
 - Flow through riser holes maintains downcomer greater than critical boron concentration for events earlier in cycle
- Boron redistribution (RAI 8930)
 - Modifications maintain assumptions in redistribution analysis
- LOCA (FSAR 15.6.5)
 - Some postulated events would actuate ECCS on low RCS pressure (most steam space LOCAs and some liquid space LOCAs)
 - No change to limiting event MCHFR or collapsed liquid level
 - Minor changes to some non-limiting events

Safety Analysis (continued)

- Inadvertent RPV valve opening (FSAR 15.6.6)
 - No impact to limiting events (Loss of DC power events actuate ECCS on IAB threshold)
 - RVV opening events with power available, remaining ECCS valves open on RCS pressure or low valve ΔP
 - RRV events not affected (remaining valves open on CNV level)
 - RSV events remain bounded by inadvertent ECCS valve opening

Mechanical Analysis

- Mechanical design and analysis impacts of the riser holes
 - Negligible impact on full power RCS flow rate (approximately 0.1 kg/s)
 - Does not introduce structural integrity concerns due to flow-induced vibration
 - No update needed to CVAP Technical Report
 - Negligible impact to DHRS cooldowns



Mechanical Analysis (Continued)

- Flow Induced Vibration (FIV) Evaluation
 - The riser holes have been evaluated for FIV mechanisms
 - turbulent buffeting (TB)
 - » Holes are small (volume reduction of upper riser approximately 1/26,000) – no impact to riser structural properties and TB evaluations not affected
 - vortex shedding (VS)
 - » Riser holes not expected to generate vortices due to continuous flow through the holes
 - » If vortices did form, would not be coincident with riser acoustic modes
 - Reviewed Operating Experience for fuel pin vibration due to baffle gap cross-flow
 - » Normal flow through holes produces minimal force and no resonance with nearby components

Probabilistic Risk Assessment

- PRA Evaluation
 - Thermal hydraulic evaluation
 - PRA models
 - Risk significance and results

Beyond Design Basis Thermal Hydraulic Impacts

- Design changes incorporated into best estimate NRELAP5 PRA thermal hydraulics model
 - riser holes credited for preventing significant boron redistribution (per Chapter 15 analyses)
 - new ECCS actuation logic modeled
- Impact to postulated event progression
 - cycling RSV sequences now reach the new low RCS pressure ECCS actuation
 - DHRS credit to reduce rate of coolant loss of unisolated injection line pipe breaks outside containment mitigated with core flood and drain system (CFDS)
 - no impact to remaining sequences or assessments

PRA Model Impacts

- Negligible effect on ECCS fault tree model
 - fault tree does not credit all sensors/signals
- Negligible effect on ECCS initiating events
 - requires three sensors to spuriously actuate
- Success criteria
 - RSV cycling
 - DHRS credited to mitigate unisolated injection line pipe break
- Negligible effect on operator actions
 - modeled cues are unchanged

PRA Results

- Internal events
 - negligible change in the core damage frequency (CDF) and large release frequency (LRF)
 - negligible change in the conditional containment failure probability (CCFP)
 - no change in candidate risk-significant structures, systems, or components (SSCs)
 - no change in candidate risk-significant initiating events or human actions
 - no change in the significant core damage cutsets (FSAR Table 19.1-18)
 - no change in the significant large release cutsets (FSAR Table 19.1-26)
- External events
 - negligible effect
- Low power and shutdown
 - negligible effect
 - CVCS remains available during the plant cooldown to respond to RCS volume changes, as well as maintain adequate shutdown margin
 - holes in the riser will maintain RCS recirculation independent of operator action

PRA Summary

- Implementing the design changes to ECCS actuation, and the addition of riser bypass flow holes have a negligible effect on PRA results and insights
 - some PRA sequences that involve cycling the RSV will now result in ECCS actuation
 - riser holes credited to prevent significant boron redistribution
- Event tree logic has been updated to reflect the new event progressions for affected sequences.

DCA and Conforming Changes

- DCA Revision 4, Errata 2, submitted May 20, 2020
- Tier 1 Chapter 2
 - add new ECCS signal on low RCS Pressure
- FSAR Chapters
 - riser holes and structural evaluations (Sections 3.9, 5.4)
 - new ECCS actuation, interlocks and setpoint changes, passive ECCS valve opening, RCS wide range pressure instrumentation (Sections 3.2, 6.2, 6.3, 7.1, 7.2, 15.0, 15.6, 17.4)
 - downcomer boron dilution mechanism (Sections 4.3, 15.0)
 - LOCA analysis changes, sequence of events (Section 15.6.5)
 - PRA event sequences for new ECCS actuation and riser holes (Section 19.1)
- Technical Specifications and Bases
 - LCOs 3.3 Instrumentation and 3.5 ECCS

DCA and Conforming Changes (continued)

- *Technical Reports (submitted May 20, 2020)*
 - Instrument Setpoint Methodology (TR-0616-49121) – added ECCS Setpoint and Actuation range design changes
 - NSSS Advanced Sensor (TR-0316-22048) – added ECCS Setpoint and Actuation range design changes
 - Containment Response (TR-0516-49084) – added ECCS Setpoint and Actuation range design changes
 - Long-Term Cooling Methodology (TR-0916-51299) – added ECCS Setpoint and Actuation range design changes
 - Technical Specification Regulatory Conformance and Development (TR-1116-52011) – incorporated associated changes in instrumentation and bases
- GDC 33 Exemption – Possible revision to exemption basis being discussed with NRC staff. Not included in DCA Revision 4, Errata 2.

DCA Conforming Changes

- Topical Reports (submitted May 27, 2020)
 - LOCA Methodology (TR-0516-49422) – added ECCS Setpoint and Actuation range design changes. Added the Riser Hole design change.
 - No change to limiting cases for MCHFR and collapsed liquid level above TAF
 - Non-limiting cases remain non-limiting
 - Non-LOCA Methodology (TR-0516-49416) – added ECCS Setpoint and Actuation range and the Riser Hole design changes
 - Results for RCS pressure, core inlet temperature, RCS flow, and steam generator pressure confirmed to have negligible differences under DHRS cooling

Summary and Conclusions

- Design changes preclude boron redistribution for postulated design basis and beyond design basis events
 - ECCS actuation on low RCS pressure or high CNV level
 - Assures initial flow out of RPV to preclude influx of unborated water from CNV or downcomer
 - Riser holes assure boron mixing in downcomer and core
 - when DHRS cools and shrinks RCS level below the riser
 - smaller LOCAs/RCS leaks while RCS level is above holes
- Analyses demonstrate no significant changes to results and that acceptance criteria continue to be met
- The evaluation and resolution of this topic involved the evaluation of a broad scope of postulated scenarios, extensive calculations, analyses and related document changes to develop and implement the design changes

Acronyms

AC – alternating current
ACRS – Advisory Committee on Reactor Safeguards
AOO – Anticipated Operational Occurrences
ATWS – anticipated transient without scram
CCFP – conditional containment failure probability
CDF - core damage frequency
CFDS – core flood and drain system
CHF – Critical Heat Flux
CNV – containment vessel
COL – Combined License
CVAP – Comprehensive Vibration Assessment Program
CVCS – chemical and volume control system
DCA - Design Certification Application
DHRS – decay heat removal system
ECCS – emergency core cooling system
EOC – end of cycle
°F – degree Fahrenheit scale
FIV – flow induced vibration
FSAR - Final Safety Analysis Report
GDC – General Design Criteria
IAB – inadvertent actuation block
kg - kilogram
LCO – Limiting Condition for Operation
LOCA – loss-of-coolant accident
LRF – large release frequency

MCHFR – minimum critical heat flux ratio
NPM – NuScale Power Module
 ΔP – differential pressure
Psia – pounds per square inch absolute
RAI – Request for Additional Information
RCS – reactor coolant system
RPV – reactor pressure vessel
RRV – reactor recirculation valve
RSV – reactor safety valve
RTP – return to power
RVV – reactor vent valve
/s – per second
SAFDL – specified acceptable fuel design limits
SDM – shutdown margin
SG – steam generator
TB – turbulent buffering
TAF – top of active fuel
VS – vortex shedding

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Chapter 15, “Transient and Accident Analyses”

Open Item Update: Audit of Boron Redistribution/Applicable Design Changes NuScale Design Certification Application

ACRS Full Committee Meeting
June 3, 2020

Agenda

- April 29, 2020, ACRS FC Letter
- Background
- Design Changes
- Impacted Chapter SERs
- Next Step

ACRS FC Letter

The April 29, 2020, ACRS FC letter contained the following two conclusions and recommendations:

1. We concur with the staff's conclusions in Chapter 15 of their Advanced SE Report: all open items, including those unresolved from the earlier SE, have been resolved. However, a new issue related to boron redistribution remains open.
2. Major conclusions from our focus areas are the following:
 - Return to Criticality – The low risk of event sequences associated with return to criticality makes the General Design Criterion (GDC) 27 exemption acceptable.
 - Boron Redistribution – The issue remains open. The Applicant and the staff are working on its resolution. We will review the final staff evaluation.

Background

- February 27, 2020, NuScale notified NRC staff of an error in their boron redistribution analysis and informed that they are following their corrective action program. On March 2, 2020, staff issued an audit plan in anticipation of NuScale generating corrected calculations. Staff held an audit entrance on March 4, 2020, and since then, has held multiple public meetings to discuss relevant design change issues.
- On May 1, 2020, staff sent a schedule letter (ML20112F455) to NuScale. The purpose of this letter was to communicate the status of the NRC staff's review of the NuScale design certification application given the current schedule and the need for additional design changes.
- On May 20, 2020, NuScale submitted, "Second Updates to DCA Rev 4," that includes final design change documents for NRC review (ML20141L787).

Design Changes

NuScale Design Changes Under Review (w/Impacted DCA Chapters):

- **High containment level change** (I&C-Chapter 7, Reactor Systems-Chapter 15, Containment-Chapter 6)
 - ECCS actuation range is adjusted down to mitigate the accumulation of condensate in containment prior to an actuation signal. The new analytical limit ranges from 240"-264" (previously 264"-300").
- **New ECCS actuation signal** (I&C-Chapter 7, Reactor Systems-Chapter 15, Containment-Chapter 6, PRA-Chapter 19, TS-Chapter 16, Operations-Chapter 13)
 - A new actuation signal has been added to the design, based on a low Wide Range Reactor Coolant System Pressure signal of less than 800 psia. This signal allows for a faster ECCS response in small-break LOCA scenarios, and mitigates the accumulation of condensate in the downcomer.
 - Associated bypass signals include $Thot < 475^{\circ}F$, or containment pressure < 1 psia. Actuation based on a low Wide Range RCS signal will only occur when both $Thot > 475^{\circ}F$ and containment pressure > 1 psia (i.e. LOCA conditions)
- **Addition of riser holes** (Reactor Systems-Chapter 15, Containment-Chapter 6, PRA-Chapter 19, TS-Chapter 16, Operations-Chapter 13, Mechanical-Chapter 3)
 - Several small flow paths were added to the upper riser, allowing a limited flow of reactor coolant into the steam generator tube region. This allows for sufficient boron concentrations to remain in the reactor coolant under postulated extended riser uncover conditions.

Impacted Chapter SERs

- Chapter 3 - Design of Structures, Components, Equipment, and Systems
- Chapter 4 - Reactor
- Chapter 5 - Reactor Coolant System and Connecting Systems
- Chapter 6 - Engineered Safety Features
- Chapter 7 - Instrumentation and Controls
- Chapter 9 - Auxiliary Systems
- Chapter 13 - Conduct of Operations
- Chapter 15 - Transient and Accident Analyses
- Chapter 16 - Technical Specifications
- Chapter 19 - Probabilistic Risk Assessment and Severe Accident Evaluation

Impacted Topical & Technical Reports

Impact – 5 Technical Reports (support various chapters/SERs):

- TR-0616-49121, Setpoint Methodology
- TR-0316-22048, Advanced Sensor
- TR-0516-49084, Containment Response
- TR-0916-51299, Long Term Cooling
- TR-1116-52011, Technical Specifications Regulatory Conformance and Development

Impact – 2 Topical Reports:

- TR-0516-49416, Non-LOCA – (Non-Loss-of-Coolant Accident Analysis Methodology)
- TR-0516-49422, LOCA – (Loss-of-Coolant Accident Evaluation Model)

Next Step

The NRC Staff is currently completing its analyses and will engage with the ACRS in a technical briefing of their findings in July.

Questions?

[illegible]

PARTICIPANTS

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Caldwell, Bob	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
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Cell Phone VA Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
CINDY WILLIAMS Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
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Daniel Lassiter Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
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Dennis Bley Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
Donoghue, Joseph	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
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Fields John Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
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Gary Becker (NuScale) Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
Glubok Carolyn Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
GROSS KARL Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]
Hannah Rooks Guest	[Icon]	[Icon]	[Icon]	[Icon]	[Icon]

[Invite More People](#) [Participant Actions](#)

1:59 PM
Wednesday
6/3/2020

AC

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Hayley Keppen, NuSc...	Guest				
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JAMES CURRY	Guest				
Jeffrey Zhou (NuScale)	Guest				
Johnson, Joanne					
Johnson, Marieliz					
Jose Reyes	Guest				
Karl Gross	Guest				
Liz English, NuScale	Guest				
Lu, Shanlai					
Luchsinger D	Guest				
March-Leuba, Jose					
Mark Chitty (NuScale)	Guest				
Marty Bryan	Guest				
Meghan McCloskey	Guest				
Michael Co... - External Network					
MICHAEL MELTON	Guest				
mike melton NuScale	Guest				
Montgomery, Shandeth					
Moore, Scott					
Nakanishi, Tony					
NUSCALE POWER	Guest				
NUSCALE POWER	Guest				
Olivia Hand	Guest				
Patton, Rebecca					

Invite More People

Participant Actions

105 Par

2:01 PM
Wednesday
6/3/2020

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Rebecca Norris (NuSc... Guest					
Riccardella,... - External Network					
Riner, Janet					
RNT G Guest					
Robert Gamble Guest					
Ron Ballinger Guest					
Sarah Bristol Guest					
Schultz, Stephen					
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Skov, Tammy					
Snodderly, Michael					
Stephanie Terwilliger (... Guest					
Steve Pope (NuScale) Guest					
Tabatabai, Omid					
Taneja, Dinesh					
Taylor Coddington Guest					
Taylor, Robert					
Tim Tovar, NuScale Pl... Guest					
TOM BERGMAN Guest					
Tom Bergman Guest					
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Walker, Sandra					
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NEI 96-07 Appendix D and RG 1.187

Revision 2

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Advisory Committee on Reactor Safeguards Meeting
June 3, 2020

Purpose

- Brief ACRS on:
 - The final versions of NEI 96-07 Appendix D and RG 1.187 Revision 2 (Recommendation 4)
 - How the exception in the draft RG on section 4.3.6 in NEI 96-07 Appendix D was resolved (Recommendation 3)
- * Recommendations are from ACRS letter dated June 20, 2019, “Review of Nuclear Energy Institute (NEI) 96-07, Appendix D, “Supplemental Guidance for Application of 10 CFR 50.59 to Digital Modifications,” dated November 2018, and the NRC’s Associated Draft Revision 2 to Regulatory Guide 1.187, “Guidance for Implementation of 10 CFR 50.59 Changes, Tests and Experiments” (ML19171A323)

NEI 96-07, Appendix D

Timeline After ACRS Full Committee Meeting:

- 06/25/19: Public meeting to conduct table-top exercises of digital I&C upgrades on applying Appendix D, Section 4.3.6 guidance (45-day RG 1.187 Public Comment period still open)
- 09/18/19: Public meeting on the comments received on RG 1.187, Revision 2. In addition, NRC offered draft wording to resolve the section 4.3.6 exception
- On 10/15/19 NEI provided revised section 4.3.6 wording
- From November 2019 to April 2020: Staff discussion on section 4.3.6 wording.
- On 4/22/20 NEI submitted final version of section 4.3.6 wording
- On 4/27/20 there was a public meeting to discuss NRC comments and suggestions on section 4.3.6 examples
- On 5/13/20 NEI submitted by letter the final version of Appendix D and requesting endorsement

50.59 Evaluation Criteria

- Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the FSAR (50.59(c)(2)(i))
- Result in more than a minimal increase the likelihood of occurrence of malfunction of a structure, system, and component (SSC) important to safety previously evaluated in the FSAR (50.59(c)(2)(ii))
- Result in more than a minimal increase in the consequences of an accident previously evaluated in the FSAR (50.59(c)(2)(iii))
- Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety accident previously evaluated in the FSAR (50.59(c)(2)(iv))
- Create the possibility of an accident of a different type than any previously evaluated in the FSAR (50.59(c)(2)(v))
- **Create the possibility for a malfunction of an SSC with a different result than any previously evaluated in the FSAR (50.59(c)(2)(vi))**
- Result in a design basis limit for a fission product barrier as described in the FSAR being exceeded or altered (50.59(c)(2)(vii))
- Result in a departure from a method of evaluation described in the FSAR used in evaluating the design basis or in the safety analysis (50.59(c)(2)(viii))

NEI 96-07, Appendix D (Rev. 0) Draft RG Exception

e. **Section 4.3.6 of NEI 96-07, Appendix D**

The NRC staff takes exception to the application of the term “safety analysis” to the criterion in section 10 CFR 50.59(c)(2)(vi) in lieu of the term “FSAR (as updated)” throughout NEI 96-07, Appendix D, Section 4.3.6. This exception includes the Introduction to Section 4.3.6 of NEI 96-07, Appendix D, which does not itself provide guidance on the application of 10 CFR 50.59(c)(2)(vi) to a DI&C modification. Nonetheless, the NRC staff takes exception to the rationale set forth in the Introduction for

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limiting the matters considered under that criterion to safety analyses. In particular, the NRC staff takes exception to steps 5 and 6 in “Determination of Safety Analysis Result Impact,” Section 4.3.6 of NEI 96-07, Appendix D, because the determination of the safety analysis result impact is only made against the safety analysis sections of the FSAR (as updated) and not against the entire FSAR (as updated). The NRC staff’s position is that where the criteria in 10 CFR 50.59 uses the term “previously evaluated in the final safety analysis report,” it means the whole FSAR (as updated). Therefore, when applying the guidance in Appendix D, licenses should not limit their examination of the FSAR (as updated) to particular sections. For example, Section 4.3.6 of Appendix D instructs the licensee to consider malfunctions previously evaluated in the safety analysis in their FSAR (as updated). Licensees should instead consider malfunctions previously evaluated in any section of their FSAR (as updated).

The text in Section 4.3.6 of NEI 96-07, Appendix D, allows the user to answer the question: “Does the Activity Create a Possibility for a Malfunction of an SSC Important to Safety with a Different Result?” However, contrary to NRC staff’s interpretation of the guidance in NEI 96-07 and of 10 CFR 50.59, Section 4.3.6 of NEI 96-07, Appendix D, generally focuses on the impact of a malfunction on the results of the safety analysis rather than the impact on the results of the FSAR (as updated).

The NRC staff’s position is that Section 4.3.6 of NEI 96-07, Appendix D, should determine whether the impact of the “SSC malfunction” has a different result than any previously evaluated in the FSAR (as updated), instead of a different result than previously evaluated in the “safety analysis” (Appendix D expresses the latter concept as “safety analysis results impact.”). Therefore, Step 5 in Section 4.3.6 should be used to identify malfunctions previously evaluated in the FSAR (as updated) and the results of these malfunctions. Step 6 in Section 4.3.6 should be used to compare the projected/postulated results with the previously evaluated results to determine whether the effects are bounded by the results in the FSAR (as updated).

Examples 4-17 through 4-23 of NEI 96-07, Appendix D, use the term “safety analysis” based on the explanation in the introduction of NEI 96-07, Appendix D, Section 4.3.6, rather than using the UFSAR. This can result in an incorrect 10 CFR 50.59 evaluation. For instance, in example 4-19, which discusses an upgrade of area radiation monitors, the NRC staff takes exception to the text: “There are no safety analyses that directly or indirectly credit this design basis function. Namely, there are no considerations of malfunctions of single or multiple radiation monitors, or expected responses of the radiation monitors, in any safety analysis.” The NRC staff’s position on example 4-19 is that the user should identify area radiation monitor malfunctions previously evaluated in the FSAR (as updated) and the results of these malfunctions. The results should be compared with previously evaluated results to determine whether the effects are bounded by the results in the FSAR (as updated), and not solely the results in the safety analysis. Stating that there cannot be a different result when comparing to a preexisting safety analysis because none exists is not adequate to meet 10 CFR 50.59.

NEI 96-07, Appendix D Path to Resolution

Public Meeting Conducted on 6/25/19:

Purpose was to conduct a table-top exercises of digital I&C upgrades in which applying NEI 96-07, Appendix D, Criterion 6 guidance was met.

Public Meeting Conducted on 9/18/19:

Purpose was to discuss the public comments received on the draft RG.

NEI 96-07, Appendix D

Section 4.3.6 (Revision 1)

- Six Step Process in Section 4.3.6 **Revised Wording**
 1. Identify the functions directly or indirectly related to the proposed modification
 2. Identify which of the functions from Step 1 are Design Functions and/or Design Basis Functions
 3. Determine if a new Failure Modes and Analysis (FMEA) needs to be generated
 4. Determine if each design bases function continues to be performed/satisfied
 5. **Identify all ~~safety analyses~~ involved malfunctions of an SSC important to safety previously evaluated in the UFSAR**
 6. **For each ~~safety analyses~~ involved malfunction of an SSC important to safety, compare the projected/postulated results with the previously evaluated results**

Clarifications

RG 1.187 Revision 2 endorses NEI 96-07 Appendix D with clarifications

Relationship to NEI 01-01: the NRC continues to find NEI 01-01 acceptable for use by NRC licensees. Licensees have the option to use the 10 CFR 50.59 guidance provided in either NEI 01-01 or in NEI 96-07, Appendix D, Revision 1. However, NEI 96-07, Appendix D, Revision 1 does not describe, and this revision to RG 1.187 (Revision 2) does not endorse, applying select portions from both NEI 96-07, Appendix D, Revision 1 and 10 CFR 50.59 guidance of NEI 01-01. In addition, NEI 96-07, Appendix D, Revision 1 is applicable to digital modifications only and is not generically applicable to the 10 CFR 50.59 process. **(Reworded slightly from the draft RG)**

Clarifications

Human-System Interface:

- In NEI 96-07, Revision 1 changes to HSI automatically screened in.
- NRC has endorsed contradicting guidance in NEI 01-01, which states, “not all changes to the human-system interface fundamentally alter the means of performing or controlling design functions,” and therefore NEI 01-01 advises that not all changes to HSI should automatically screen in.
- NEI included similar guidance on screening for HSI in Appendix D.
- The NRC staff acknowledges that Appendix D is thus not a change from existing guidance on digital interfaces, but notes that it is a change from the guidance in NEI 96-07, Revision 1. The NRC staff agrees that changes to HSI may be screened as described in NEI 96-07, Appendix D, Revision 1. (**Reworded from the draft RG**)

Clarifications

Software Failure

- RIS 2002-22 Supplement 1 is currently the only guidance the NRC has reviewed or endorsed as providing an acceptable technical basis to determine that the likelihood of software CCF is sufficiently low for the purpose of 10 CFR 50.59 evaluations and may be used in conjunction with NEI 96-07, Appendix D, Revision 1.

Clarifications

Use of Acceptance Criteria as Evaluation Results:

- NEI 96-07, Revision 1, Section 4.3.6, in contrast to Appendix D, does not refer to “acceptance criteria”
- NEI 96-07, Revision 1, provided that licensees should consider changes to SSCs at the same level at which malfunctions of the affected SSCs were previously evaluated in the FSAR (i.e., component- or system-level).
- The NRC has now determined that, in addition to the existing guidance in NEI 96-07, Revision 1, licensees may consider whether all applicable acceptance criteria are satisfied after a proposed change to demonstrate that no possibility for a malfunction with a different result has been created.
(New Clarification)

Clarifications

Step 6: Basic Assumptions and Acceptance Criteria

“For those design functions placed into [categories 1.b, 2.b, or 3 in Step 2], if any of the previous evaluations of involved malfunctions of an SSC important to safety have become invalid due to their basic assumptions no longer being valid (e.g., single failure assumption is not maintained), or if any existing safety analysis is no longer bounding (e.g., the revised safety analysis no longer satisfies the acceptance criteria identified in the associated safety analysis), then the proposed activity creates the possibility for a malfunction of an SSC important to safety with a different result. [Emphasis added.] “

(New Clarification)

NEI Comments on RG 1.187 Rev 2 (From ACRS Subcommittee Mtg)

- Appears to unnecessarily insert the purpose of Criterion 8 in the consideration of Criterion 6. **Resolution: Clarification 2.d was revised to remove Criterion 8 language.**
- May not fully account for revised Section 4.3.6 guidance. **Resolution: Clarifications 2.d was revised.**
- May imply that RIS 2002-22, Supplement 1 must be used in a broader population of DI&C activities than intended. **Resolution: Clarification 2.c was revised.**
- The two-prong test has been the way that licensees having been doing 50.59 evaluations even though it is not stated in NEI 96-07, Revision 1. **Resolution: Clarification 2.c retains this language, but it is slightly modified.**

Questions ?

Back-Up Slides

NEI 96-07, Appendix D

Timeline Through ACRS Full Committee Meeting:

- In July 2018, NEI provided an update to NEI 96-07, Appendix D
- In August 2018, the NRC staff provided a set of comprehensive comments (85 total) to NEI, and began a disciplined process for cataloging and tracking comments for resolution
- Public meetings were held with industry on 8/30/18, 9/11/18, 10/11/18, and 11/14/18 to resolve these comments. Over 90% of the comments were resolved using this process
- NEI submitted its final revision of NEI 96-07, Appendix D to the NRC on 11/30/18. Letter requesting endorsement submitted 1/08/19
- ACRS Digital I&C Subcommittee meeting on 4/16/19
- Draft RG 1.187 Rev. 2 was issued for public comment on 5/30/19
- ACRS Full committee meeting on 6/5/19

NEI 96-07, Appendix D, Section 4.3.6 (Rev 1)

Acceptance Criteria Language in Step 6 Changed:

- For those design functions placed into any other category or combination of categories, if any of the previous evaluations of involved malfunctions of an SSC important to safety have become invalid due to their basic assumptions no longer being valid (e.g., single failure assumption is not maintained), or if any **existing** safety analysis **is** no longer **bounding** (e.g., the **revised** safety analysis **no longer satisfies the acceptance criteria identified in the associated safety analysis**), then the proposed activity creates the possibility for a malfunction of an SSC important to safety with a different result. **If the acceptance criteria are still satisfied and the basic assumptions remain valid, there is no different result even if the malfunction of an SSC important to safety would otherwise cause changes to input parameters described in the USFAR.**

NEI 96-07, Appendix D Path to Resolution

Example of Acceptance Criteria: (Example 4-18)

- Previously, only one of four feedwater flow control valves was assumed to fail open as part of the initiation of the Excess Feedwater event. Now, as a result of this change, all four feedwater flow control valves could simultaneously fail open following a software CCF.
- Step 6: The severity of the initiating failure has increased due to four valves supplying flow as compared to one valve prior to the change.
- The minimum acceptable departure from nucleate boiling ratio (DNBR), i.e., the [acceptance criteria identified in the associated](#) safety analysis, is 1.30. The current safety analysis [documents](#) a minimum DNBR value equal to 1.42. After using the increased value for the new feedwater flow (to represent the increase in feedwater flow caused by the opening of the four feedwater flow control valves) in a revision to the Excess Feedwater accident analysis, the new safety analysis [documents](#) a minimum DNBR value equal to 1.33.
- Conclusion: Although the software CCF likelihood was determined to be **not sufficiently low** and the severity of the initiating failure has increased, a comparison of the minimum DNBR values shows that the [safety analysis](#) remains bounded [by the associated acceptance criteria](#). Therefore, the proposed activity does NOT create the possibility for a malfunction of an SSC important to safety with a different result.

NEI 96-07, Appendix D

- RIS 2002-22, Supplement 1 gives guidance on the technical aspect of digital I&C modifications, not the 50.59 process
- Appendix D gives digital I&C modification screening and evaluation guidance
- The format of Appendix D is aligned with NEI 96-07, Rev. 1 text for ease of use
- Some of the guidance in Appendix D is not digital specific
- NEI 96-07, Appendix D does incorporate some RIS 2002-22, Supplement 1 guidance on qualitative assessments

RIS 2002-22, Supplement 1

- NRC issues RIS 2002-22, Supplement 1 in May 2018 to clarify RIS 2002-22
- NRC continues to endorse NEI 01-01
- RIS 2002-22, Supplement 1, clarifies guidance for preparing and documenting “Qualitative Assessments”
- Not for Replacement of:
 - Reactor Protection System (wholesale)
 - Engineered Safety Features Actuation System (wholesale)
 - Modification/Replacement of the Internal Logic Portions of These Systems
- Licensees can currently performed digital modifications using RIS 2002-22, Supplement 1 guidance (without an NRC endorsed NEI 96-07, Appendix D)

NEI 96-07, Appendix D

Screening Section

- Scope of digital modifications:
 - Software-related activities
 - Hardware-related activities
 - Human-System Interface-related activities
- To reach screen conclusion of non-adverse:
 - Physical characteristics of the digital modification
 - Change has limited scope
 - Relatively simple digital architecture
 - Limited functionality
 - Can be comprehensively tested
 - Engineering Evaluation Assessments
 - Quality of the design process
 - Single failures encompassed by existing failures of the analog device
 - Has extensive operating history

NEI 96-07, Appendix D

Screening Section

- **Combination of Components/Systems and/or Functions**
 - Mere act of combining does not make the screen adverse
 - If it causes an adverse act on the design function, then adverse
 - Reductions in the redundancy, diversity, separation, or independence of a UFSAR design function screen adverse
- **Human Factors Engineering Evaluation**
 - NEI worked closely with NRC human factors personnel on this section
 - Two steps:
 - Identify generic primary tasks involved
 - For all primary tasks, assess if the mod negatively impacts the primary task

NEI 96-07, Appendix D

Evaluation Section

- Guidance in sections 4.3 aligns with main body of NEI 96-07 and there is a caution that Appendix D is intended to supplement guidance in main body of NEI 96-07
- Sections 4.3.1, 4.3.2, 4.3.5, and 4.3.6 (which align with the Criterion in the evaluation paragraph of 10 CFR 50.59) (50.59(c)(2)) discuss the use of the qualitative assessment outcome (sufficiently low or not sufficiently low) to answer the evaluation questions
- Sections 4.3.3 and 4.3.4 state that they provide no new guidance for digital modifications
 - More than a minimal increase in the consequences of an accident
 - More than a minimal increase in the consequences of a malfunction

NEI 96-07, Appendix D

Evaluation Section

- Guidance in section 4.3.6 (Does the Activity Create a Possibility for a Malfunction of an SSC Important to Safety with a Different Result):
 - Discussion on design basis functions
 - Connection between design basis functions and safety analysis result