



**UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001**

April 11, 2016

MEMORANDUM TO: ACRS Members

FROM: Maitri Banerjee, Senior Staff Engineer **/RA/**
 Technical Support Branch
 Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS FUTURE
 PLANT DESIGNS SUBCOMMITTEE MEETING MARCH 1, 2016,
 IN ROCKVILLE, MARYLAND

The minutes for the subject meeting were certified on April 8, 2016. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc with Attachments: A. Valentin
 M. Banks



**UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001**

MEMORANDUM TO: Maitri Banerjee, Senior Staff Engineer
Technical Support Branch
Advisory Committee on Reactor Safeguards

FROM: Michael Corradini, Chairman
Future Plant Designs Subcommittee
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS FUTURE PLANT
DESIGNS SUBCOMMITTEE MEETING MARCH 1, 2016, IN
ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on March 1, 2016, are an accurate record of the proceedings for that meeting.

/RA/

April 8, 2016

Michael Corradini, Chairman
Future Plant Designs
Subcommittee

Dated

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE FUTURE PLANT DESIGNS SUBCOMMITTEE
MEETING ON MARCH 1, 2016

The ACRS Future Plant Designs Subcommittee held a meeting on March 1, 2016 in T2B1, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 8:30 a.m. and adjourned at 4:27 p.m.

The meeting was open to the public.

No written comments or requests for time to make oral statements were received from members of the public related to this meeting. Member Rempe had a conflict of interest and did not attend the meeting.

ATTENDEES

ACRS Members/Staff

M. Corradini, Chairman
D. Bley, Member
D. Skillman, Member
D. Powers, Member
R. Ballinger, Member
C. Brown, Member
J. Stetkar, Member
Q. Nguyen, ACRS Staff (DFO)

NRC Staff and Consultants

Lynn Mrowca, NRO *	Omid Tabatabai, NRO
Mark Caruso, NRO	Mark Tonacci, NRO
Rick Jerve, NMSS	Greg Cranston, NRO
Prosanta Chowdhary, NRO	Tony Nakanishi, NRO
Anne-Marie Grady, NRO	John Monninger, NRO

Other Attendees

T. Bergman, NuScale	S. Mirsky, NuScale
Bill Galyean, NuScale	K. Welter, NuScale
Mark Peres, NuScale	Cindy Williams, NuScale
Steven Pope, NuScale	Walt Kirchner, Public

*Connected via telephone

SUMMARY

The purpose of the meeting was to review the NuScale-submitted topical report on risk determination methodology (NuScale Licensing Topical Report TR-0515-13952-NP, Rev. 0, "Risk Significance Determination," July 2015 (ML15211A470)), the NRC staff's review of it, and NuScale's plan to use this methodology in their design certification application for their design of the small modular reactor that uses integrated pressurized water reactor (iPWR) technology. The meeting transcripts are attached and contain a description of each matter discussed during the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

The following list describes significant issues discussed during the meeting with the corresponding pages in the transcript referenced.

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Steven Mirsky, NuScale introduced his team, and Bill Galyean, NuScale provided an overview of the subject topical report. He noted the objective of this topical report was to outline an approach for identifying the input from the PRA, which would be one of the inputs, for the determination of risk significant structures, systems and components (SSCs) in the NuScale design to be candidates for the NuScale Design Reliability Assurance Program (DRAP).	7-10
Upon member Skillman's question, Mr. Galyean discussed the process the DRAP panel uses to make a determination on risk significance of SSCs.	11-13
Mr. Galyean noted the current industry/NRC criteria for determining risk-significance are RAW (risk achievement worth) of two and a Fussell-Vesely (FV) of 0.5 percent that are consistent with the ASME/ANS PRA standard. With NuScale internal events core damage frequency (CDF) at power being 1×10^{-7} (two orders of magnitude less than operating reactors),	14-26

NuScale felt the need for different criteria for determining risk significance. The existing criteria were determined to be too low that would dilute the focus of resources on a range of SSCs which were not necessarily risk significant. Also the levels of uncertainty at that low CDF would be high. Upon members' question a discussion of relative vs. absolute risk significance measures and threshold values took place.	
Mr. Galyean noted their methodology was consistent with the guidance in RG 1.174 and conforms to the NRC safety goals for new reactors. A discussion evolved regarding NuScale's use of component level basic events in determining risk significance and how failure modes were considered. Use of system level basis event, and consideration of common-cause failures were explored. Members asked if earthquakes and inter-system common-cause failures were considered. Existence of multiple modules in a common pool was cited as an example. Mr. Galyean noted that following the current requirement the PRA addressed one reactor, and not multiple modules.	26-40
Mr. Galyean discussed how NuScale criteria for conditional core damage frequency (CCDF) at component (3×10^{-6}) and system level (10^{-5}) meet the NRC safety goal and RG 1.174. Discussion took place on how uncertainties in the PRA models (i.e., modeling uncertainties) were considered. Members questioned how a potential increase of the CDF from the current value after consideration of events beyond internal events at full power (i.e., fires, internal floods, seismic events, high winds, and low-power/shutdown) would be handled given the current approach of using an absolute threshold for risk significance.	41-52
Discussion took place on applying an absolute threshold value for large release frequency (LRF), and how that value was selected. The difference between LRF and LERF (large early release frequency) was discussed.	53-57
Mr. Galyean discussed their basis for selecting a threshold value for risk-significance in FV, and how it was to be applied. A discussion broke out on application of this method to two scenarios and two components with respective FV and relative risk significance numbers as examples. Mr. Galyean explained that inconsistent levels of conservatism and inconsistent boundary conditions resulted in NuScale's hazard-by-hazard consideration for FV results. Member Stetkar noted a two-tiered backstop approach used in some applications.	58-65
Mr. Galyean summarized their risk significance criteria, and NuScale response to NRC staff RAIs. Member Bley asked if NuScale needed to truncate their PRA models before finding a RAW value. His concern was that high order cut sets may have been truncated. Mr. Galyean noted that NuScale used 10^{-15} for truncation, otherwise computer time was too long, but they had not done any sensitivity study yet, i.e., to determine if the	65-70

value of RAW would change with truncation levels. Mr. Galyean stated they would look into it.	
Member Bley noted that treatment of possible coupling of “module-to-module” under a seismic condition using the policy for ground based reactors might not be the right answer. He noted also that the range of CDF values over which the proposed method would be used by NuScale was not defined.	70-71
Mr. Tabatabai, NRO, provided a short introduction on NRC staff review of the NuScale proposed method. He noted that the staff left themselves a path to revise their safety evaluation after the ACRS meeting, if needed.	72
Mr. Caruso, NRO, provided the staff presentation. He noted there was no guidance available to the staff on how to do the review. Hence they reviewed the concept and the application of the concept and the acceptability of the approach. He noted the use of RG 1.174 method. But the staff did not espouse a relationship in choosing the threshold values with the base core damage frequency. A long discussion took place regarding the approach of choosing an absolute value for RAW as threshold when the CDF value may go higher given future changes in the base PRA. The staff seemed to have accepted the premise that at some point NuScale would automatically default to the RG 1.174 method.	73-83
To expand upon the above concept further, member Stetkar noted that keeping a CCDF at 3×10^{-6} when the base CDF goes up to the same value would put all components at the plant in the DRAP. Both the NRC staff and NuScale stated, in that case, the current industry/NRC criteria for RAW and FV would apply. The members pressed upon the staff for a more unified approach that could be applied irrespective of the CDF/LRF values. The staff hinted that future/ongoing review of issues like, what else can effect risk, multi-module or seismic considerations, etc., may modify the method and hence DRAP. The staff also pointed out that they were approving a methodology, not particular numbers for RAW and FV.	83-94
Discussion on the 4 th condition in staff’s safety evaluation: Members noted the intent/meaning of the condition was not clear. Discussion on scalability of the two risk significance measures regarding the risk values (CDF/LRF) took place. Staff noted their approval of NuScale method relied on NuScale’s method meeting RG 1.174, but agreed to revise their safety evaluation for more clarification.	95-100
Member Skillman asked how risk would be assessed for a full-built, 12-module NuScale plant given module interactions. Mr. Caruso described an NRC working group’s effort on the subject of multi-module risk that resulted in a qualitative guidance to iPWRs. The NRC staff had revised SRP 19.0 to add guidance that noted the need for a systematic assessment of design	103-110

to identify those events that could evolve potential core damage accidents on multiple modules simultaneously, and identify design features included to make the risk of such an accident insignificant. The NRC staff is also working on how to deal with design basis accidents that involve multiple modules. Mr. Tonacci, NRO, noted the extent of that review to be quite involved and described it briefly. Staff also noted that a SECY paper (SECY 16-0012) on mechanistic source term had a very brief discussion on multi-module events.	
Chairman Corradini asked the public telephone line be opened for comments from the attending public, either on the phone line or physically at the meeting. No comments were offered.	110-111
Chairman Corradini asked for comments from members. The issue of risk from multi-module operation was noted for further consideration. The need for an universal approach on how to determine risk significance in the context of quantitative risk information across the range of possible designs, CDF values, single or multiple modules/units on a single site was noted also. The members thanked NuScale for bringing the subject up for review in advance of their design certification application. The need for revising the staff safety evaluation with additional clarifications resulting from discussions (noted above) was mentioned.	111-116
Chairman Corradini asked if an ACRS letter and hence a Full Committee presentation were needed. The NRO staff did not ask for a letter, and members discussed instances when ACRS did or did not write a letter on their review of topical reports submitted with design certifications. Further discussion on this subject was left for the upcoming ACRS planning meeting/session.	116-119
Chairman Corradini adjourned the meeting at 4:27 p.m.	119

Following action items resulted from issues discussed above:

ACTION ITEMS	
Action Item	Reference Pages in Transcript
NRO staff to provide revised safety evaluation to ACRS.	115

Documents provided to the Subcommittee

1. NuScale Licensing Topical Report TR-0515-13952-NP, Rev. 0, "Risk Significance Determination," July 2015, ML15211A470
2. NuScale RAI Response dated December 11, 2015, ML15348A369
3. NRC Staff Safety Evaluation Report, "NuScale Power, LLC Licensing Topical Report: TR-0515-13952-NP, Revision 0, "Risk-Significance Determination," February 10, 2016, ML16019A399
4. Stetkar, John W., Chairman, Advisory Committee on Reactor Safeguards letter to Mr. Mark A Satorious, Executive Director for Operations, USNRC, "Standard Review Plan Chapter 19 and Section 17.4," July 16, 2014, ML14196A119

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
 Future Plant Designs Subcommittee

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, March 1, 2016

Work Order No.: NRC-2224

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UNITED STATES OF AMERICA
 NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

FUTURE PLANT DESIGNS SUBCOMMITTEE

+ + + + +

TUESDAY

MARCH 1, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear
 Regulatory Commission, Two White Flint North, Room
 T2B1, 11545 Rockville Pike, at 2:00 p.m., Michael
 Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL CORRADINI, Chairman

DENNIS C. BLEY, Member

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR. Member

DANA A. POWERS, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

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 WASHINGTON, D.C. 20005-3701

DESIGNATED FEDERAL OFFICIAL:

QUYNH NGUYEN

ALSO PRESENT:

THOMAS BERGMAN, NuScale

MARK CARUSO, NRC NRO

BILL GALYEAN, NuScale

STEVE MIRSKY, NuScale

LYNN MROWCA, NRC NRO *

OMID TABATABAI, NRC NRO

MARK TONACCI, NRC NRO

KENT WELTER, NuScale

*Present via telephone

T-A-B-L-E O-F C-O-N-T-E-N-T-S

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

2:04 p.m.

CHAIR CORRADINI: Okay. Any more button pushing to happen? All right. Why don't we get started. The meeting will come to order. This is a meeting of the Future Plant Designs Subcommittee of the ACRS.

I am Mike Corradini, acting chairman of the Future Plant Designs Subcommittee. ACRS members in attendance are Dennis Bley, Ron Ballinger, John Stetkar, Dick Skillman, Charlie Brown soon to be, and Dana Power soon to be. Mr. Quynh Nguyen is the designated federal official for this meeting.

Today we have members of NuScale Power, LLC, otherwise known as NuScale, and the NRO staff, to brief the subcommittee on the NuScale-submitted topical report on risk determination methodology and the NRC staff's review of it and NuScale's plan to use this methodology in their design certification application for their design of the small modular reactor that uses integrated pressurized water reactor technology.

The rules for participation in today's meeting were announced in the Federal Register on

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1 February 19th, 2016. The meeting was announced as
2 an open-to-public meeting. No requests for making
3 a statement to the subcommittee has been received
4 from the public.

5 We have one bridge line established
6 with multiple invitees. I'll ask that the folks on
7 the line go into mute so that we can minimize a
8 bunch of background noise. The bridge number and
9 the password were published in the agenda posted on
10 the NRC website.

11 To minimize disturbances -- I've
12 already said all that. Please, everybody in the
13 room, try to turn off your audible parts of your
14 appliances such as iPhones, Google phones and
15 whatever.

16 The public will have the opportunity to
17 make a statement or provide comments at the
18 designated times towards the end of the meeting.
19 So, I'm going to invite Mark Tonacci to kick us
20 off.

21 Mark.

22 MR. TONACCI: Thank you, Dr. Corradini
23 and members of the ACRS staff. I appreciate the
24 opportunity to present the staff's findings on the
25 NuScale Risk Significant Topical Report. I believe

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1 this is our first opportunity with ACRS to truly
2 dig into the technical areas of the NuScale design
3 and we look forward to your comments and your
4 feedback.

5 I believe we start with the NuScale
6 presentation on the topical report itself. So,
7 I'll turn it over, if it's okay with you, Dr.
8 Corradini, to NuScale.

9 CHAIR CORRADINI: Sounds good. Steve,
10 are you going to lead us?

11 MR. MIRSKY: Yes.

12 CHAIR CORRADINI: Okay.

13 MR. MIRSKY: Good afternoon. My name
14 is Steven Mirsky. I'm the NuScale regulatory
15 affairs manager located here in Rockville, Maryland
16 where we operate a suite of offices approximately
17 two blocks from here.

18 Seated next to me over to my right are
19 Dr. Kent Welter and Mr. Bill Galyean. Kent is the
20 nuclear safety engineering manager at NuScale
21 Power. In this capacity he manages a team of about
22 70 engineers responsible for safety analysis, PRA,
23 radiological engineering and nuclear methods.

24 Kent has 14 years of experience,
25 including working at the NRC in the area of new and

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1 advanced reactors.

2 Bill Galyean seated right next to me
3 here, is the NuScale Power PRA supervisor. He
4 leads a group of 20 staff members. He has 39 years
5 of experience, including five years at NuScale, 24
6 years at the Idaho National Laboratory working on
7 PRA projects for a number of federal agencies, and
8 ten years working for three different PRA
9 consulting companies.

10 NuScale appreciates the opportunity to
11 present a summary of our Risk Significance
12 Determination Topical Report to the ACRS Future
13 Plant Designs Subcommittee.

14 This topical report was developed to
15 reflect the significantly improved safety and
16 reduced risk inherent in the NuScale SMR design.

17 The theme of enhanced safety associated
18 with fewer systems, fewer structures, fewer
19 components coupled with passive design features
20 associated with normal, abnormal and accident
21 conditions will be repeated in many future topical
22 reports that will be presented to the ACRS.

23 The presentation in our Risk
24 Significance Determination Topical Report will be
25 made by Mr. Galyean.

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1 Bill.

2 MR. GALYEAN: Thank you. So, this is
3 the presentation on the NuScale Risk Significance
4 Determination Topical Report. Here is the
5 acknowledgment and disclaimer of the support of the
6 U.S. Department of Energy.

7 And the agenda, the purpose of this
8 presentation is to provide an overview of the
9 licensing topical report that NuScale provided to
10 the NRC staff.

11 The objective of this topical report is
12 to outline an approach for identifying the input
13 from the PRA on -- for the determination of what is
14 risk significant in the NuScale design.

15 The PRA, of course, is just one input
16 considered in the final determination of what is
17 risk significant. The final determination being
18 made at least in the NuScale case, is by what we
19 call our DRAP Panel, which stands for Design
20 Reliability Assurance Program, which is a multi-
21 disciplinary panel of knowledgeable subject matter
22 experts who make the final determination of what is
23 risk significant.

24 The purpose of the licensing topical
25 report is to outline the method of generating the

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1 PRA information that goes into that process.

2 The topical report, we talk a little
3 bit about the determination -- or the definition of
4 what is significant. We cover why we need a new
5 criteria for determining the risk significance of
6 SSCs.

7 And in this presentation, I will talk
8 about the determination of risk significance, but I
9 hope everybody keeps in mind that this is just in
10 the context of providing the PRA information to the
11 DRAP Panel. Okay. Just keep in mind that the
12 final determination is being made by the DRAP
13 Panel.

14 CHAIR CORRADINI: I don't -- since I'm
15 -- although I'm, in theory, in charge of this, I'm
16 not very much of a PRA aficionado. So, can you
17 kind of say that again so that I understand the
18 nuance you make there?

19 MR. GALYEAN: The determination of risk
20 significance is risk-informed, it's not risk-based,
21 okay. The PRA information is one input to the
22 overall or final determination of what is judged as
23 risk significant in the NuScale design.

24 The final determination will be made by
25 a panel of subject matter experts that will review

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1 the PRA information, as well as any available
2 deterministic information, operating experience,
3 insights and whatever.

4 CHAIR CORRADINI: Okay.

5 MR. GALYEAN: And they will be the
6 final judge on what is risk significant.

7 CHAIR CORRADINI: So, to say it a
8 little bit differently, this, what we're looking at
9 today, is the criteria that they will use in their
10 deliberations as one of their inputs.

11 MR. GALYEAN: This is the criteria that
12 will be used to identify the candidate risk
13 significant SSCs.

14 CHAIR CORRADINI: Okay.

15 MEMBER SKILLMAN: Bill, if you would,
16 explain to us what constraints are on your DRAP
17 panel?

18 MR. GALYEAN: I'm not sure what you
19 mean by "constraints." The DRAP panel is not --

20 MEMBER SKILLMAN: Let me explain. So,
21 you get inputs from the PRA and they are
22 considerations. You get some deterministic inputs,
23 too.

24 Then you have some people who sit
25 around the table and say, I don't believe any of

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1 that. I think you could have an earthquake, you
2 could have a failure of the containment, you could
3 failure of the outer vessel and now you have a --
4 you have a high rate of strain, potential fracture
5 in the reactor vessel and I've just spilled all of
6 the radiological contents.

7 But if that doesn't come up on your
8 chart, if the DRAP panel is not thinking outside
9 that box, then they have some constraints on them.

10 What confines the DRAP panel to ensure
11 or to preclude they're failing to see perhaps
12 failure modes that they otherwise wouldn't see?

13 MR. GALYEAN: Well, the process
14 generally goes every system in the plant is
15 reviewed in the NuScale -- in the process, okay.
16 Every single system from potable water, to control
17 room ventilation, to the emergency core cooling
18 system, okay. Now, there -- and a presentation is
19 made or information is provided by the system
20 engineer for that system.

21 The DRAP panel consists of subject
22 matter experts from a variety of disciplines, PRA,
23 safety analysis, operations, design, licensing,
24 okay. So, it really is an interdisciplinary panel.

25 The process is geared to cover any and

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1 all aspects of, you know, what could go into
2 judging what is risk significant or not.

3 Is there a potential that something
4 could be missed? Sure. There's always that
5 potential, but I think the process that is in place
6 is very comprehensive.

7 MEMBER SKILLMAN: Perhaps we'll hear
8 more about this as you proceed, but I'll be -- I'd
9 be happy to hear you say more about this further on
10 --

11 MR. GALYEAN: Well, now this
12 presentation and the licensing topical report is
13 aimed at characterizing the PRA input to that
14 process. It's not aimed at describing the function
15 of the DRAP panel or the overall or the final risk
16 significance determination.

17 MEMBER SKILLMAN: I understand.

18 MR. GALYEAN: Okay.

19 MEMBER SKILLMAN: Thank you.

20 MR. GALYEAN: So, we go through the
21 need for NuScale criteria. We talk about the
22 proposed criteria and thresholds and finally
23 implementation, and then the request for additional
24 information that we receive from the NRC.

25 So, the current definition of risk

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1 significance or, again, what is judged as -- what
2 is used to identify the candidate risk significant
3 SSCs, comes from the standard review plan, Chapter
4 19, Reg Guide 1.200 and also the NEI-00-04 on --
5 that addresses guidance for the 10 CFR 50.69
6 process.

7 Generally the criteria consists of a
8 risk achievement worth of -- or RAW of two, and a
9 Fussell-Vesely of 0.5 percent. I'll talk more
10 about these in just a minute.

11 Typically these criteria are judged or
12 measured against the core damage frequency and the
13 large early release frequency for operating plants.
14 Or in this case since we're in the design
15 certification phase of the development, for the
16 large release frequency.

17 They are consistent with the ASME/ANS
18 PRA standard and have been used in the industry for
19 quite a few years.

20 So, the risk achievement worth, or RAW,
21 just briefly it's a measure of the increase in core
22 damage frequency when the SSC of interest is set to
23 failing a hundred percent of the time.

24 So, you assume it fails a hundred
25 percent of the time. Then you measure what -- or

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1 you calculate what the resulting core damage
2 frequency would be. You take the ratio of the new
3 core damage frequency over the baseline core damage
4 frequency, and that gives you your RAW.

5 Fussell-Vesely is, in a sense, what we
6 in the PRA community call a risk reduction type of
7 importance measure.

8 It basically identifies the percentage
9 of the core damage frequency in which that
10 particular SSC contributes, okay.

11 Now, it's not, you know, that
12 particular SSC by itself. It's just that that
13 particular SSC appears in the cut sets that
14 collectively contribute, in this case, 0.5 percent
15 of the overall core damage frequency.

16 CHAIR CORRADINI: A little education
17 for me. So, if you -- if the Fussell-Vesely
18 becomes -- so, can you kind of just walk through
19 the thinking?

20 So, I assume a failure and I see the
21 effect of the failure relative to the change in the
22 overall contribution to risk? Am I understanding -
23 -

24 MR. GALYEAN: Well, think of it this
25 way: Remember in each cut set, each cut set every

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1 failure has to occur to achieve, in this case, core
2 damage, right?

3 So, if we're saying that a particular
4 component, for example, has a Fussell-Vesely of 0.5
5 percent, okay, and, again, so that particular
6 component appears in the cut sets that collectively
7 contribute 0.5 percent of the core damage
8 frequency.

9 So, if you were to make that particular
10 component perfectly reliable such that it never
11 fails, okay, you would be reducing the total core
12 damage frequency by 0.5 percent.

13 Because if you say that particular
14 component never fails, you're saying that -- the
15 cut sets in which that component appears --

16 CHAIR CORRADINI: Have now become --

17 MR. GALYEAN: -- cannot occur.

18 CHAIR CORRADINI: Okay.

19 MR. GALYEAN: Okay. So, the current
20 criteria are based on relative significance, the
21 RAW of two and the -- and, again, Fussell-Vesely at
22 0.5 percent.

23 You're talking about you have a base
24 case. And then if that component fails in the case
25 of the RAW, how much increase do you see in the

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1 core damage frequency?

2 So, the existing nuclear power plant
3 fleet, we can say approximately their core damage
4 frequencies in general are about one times 10 to
5 the minus five per year.

6 If you say a RAW of two then, then that
7 implies that your acceptable change in core damage
8 frequency is on the order of one times -- of two
9 times 10 to the minus five, right.

10 So, that would be the new conditional
11 core damage frequency and -- I'm sorry, the
12 acceptable change in core damage frequency would be
13 one times 10 to the minus five.

14 And so, it would be -- a component
15 would be risk significant if when you fail it a
16 hundred percent of the time, okay, the core damage
17 frequency increases by one times 10 to the minus
18 five.

19 Now, in a case of NuScale, which has a
20 much reduced core damage frequency and probably for
21 all the advance designs as well, but here we're
22 just talking about NuScale --

23 MEMBER STETKAR: Bill.

24 MR. GALYEAN: Yes.

25 MEMBER STETKAR: Let me since you

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1 brought this up, before you go on to your
2 justification, you assert that NuScale has a core
3 damage frequency of 10 to the minus seven.

4 It's my understanding that that is an
5 estimate that's a snapshot of the internal event at
6 our core damage frequency; is that correct?

7 MR. GALYEAN: That's -- well, the
8 actual snapshot is lower than that, okay. Of --
9 for internal events --

10 MEMBER STETKAR: At power.

11 MR. GALYEAN: -- at power --

12 MEMBER STETKAR: Okay.

13 MR. GALYEAN: -- that's right.

14 MEMBER STETKAR: That is not an
15 absolute estimate of the total core damage
16 frequency.

17 MR. GALYEAN: That is correct.

18 MEMBER STETKAR: Okay. Thank you.
19 That's good enough. I just wanted to get that on
20 the record. I'll use that later.

21 MR. GALYEAN: Okay. So, in the case of
22 if you've got a total core damage frequency on the
23 order of 10 to the minus seven, now you're saying
24 an allowable increase in core damage frequency is
25 only one times 10 to the minus seven, okay.

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1 So, on one hand if you've got a plant
2 with a higher core damage frequency, the allowable
3 increase, if you will, for achieving risk
4 significance is quite a bit higher than if you've
5 got a safer plant. So, this inconsistency is what
6 we are trying to mitigate.

7 The traditional relative criteria do
8 not allow for these global improvements in safety.
9 Basically in this context, there is no advantage to
10 having a safer plant. And, in fact, there's --

11 MEMBER STETKAR: Let me also just
12 interrupt you here because of where the emphasis
13 is. "Limitations in emphasized relative importance
14 measures." Don't you mean the limitations in a
15 risk achievement worth of 2.000 and a Fussell-
16 Vesely importance of 0.005?

17 MR. GALYEAN: That's correct.

18 MEMBER STETKAR: Okay. So, that's not
19 relative. It's those particular numerical values.
20 Is that your concern, or is it the use of relative
21 measures?

22 MR. GALYEAN: The --

23 MEMBER STETKAR: In an abstract sense.

24 MR. GALYEAN: In the abstract sense
25 it's the traditional use of the existing values.

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1 Okay. I mean, if --

2 MEMBER STETKAR: That's -- but what I'm
3 trying to differentiate here is because you've
4 emphasized the term "relative" and "absolute." You
5 want to use an absolute measure.

6 MR. GALYEAN: Right.

7 MEMBER STETKAR: But are you concerned
8 with the concept of using relative measures, or are
9 you only concerned with the particular numerical
10 values of the measures that have been used to date?

11 MR. GALYEAN: Well, frankly, both.

12 MEMBER STETKAR: Okay. I'm interested
13 in understanding why the concept of relative
14 measures, and you may get to that, is of concern.

15 I understand the concept of the
16 absolute numerical values of those measures that
17 are currently applied.

18 MR. GALYEAN: The difficulty --

19 MEMBER BLEY: Kind of following that
20 up, I heard that you would -- you have a problem
21 with a relative measure even if you have a sliding
22 scale for that relative measure based on the base
23 core damage frequency.

24 MR. GALYEAN: That's --

25 MEMBER BLEY: Is that what I heard?

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1 MR. GALYEAN: In a sense, that's
2 correct. I don't know how you -- if you start
3 adjusting the relative measure according to the
4 base core damage frequency, haven't you then just
5 turned that into an absolute measure, an absolute
6 threshold?

7 So, I guess I don't -- yeah, I mean,
8 you can have a flexible relative measure, but it --
9 again, if you're adjusting it based on your base
10 core damage frequency all the time, that's --
11 there's no difference between that and absolute
12 threshold.

13 MEMBER STETKAR: Well, wouldn't -- I'm
14 going to be quiet and let you -- other than
15 specifics -- no, other than specifics and ask you a
16 fundamental question when you get to the end --

17 MR. GALYEAN: Okay.

18 MEMBER STETKAR: -- that's going to
19 address what both Dennis and I have been talking
20 about.

21 CHAIR CORRADINI: But since they know
22 this better than I what -- just to repeat what you
23 said to us, which is if you start thinking about
24 the RAW of two and the FV, I'm not going to try to
25 pronounce that damn thing, the FV of 0.005, that's

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1 good at high CDFs, but may not be appropriate at
2 low ones.

3 If you start developing a sliding
4 scale, you've essentially admitted to the fact that
5 I've got to adjust it based on the absolute
6 estimate.

7 MR. GALYEAN: That's correct.

8 CHAIR CORRADINI: Okay.

9 MR. GALYEAN: So, the other aspect of
10 having criteria that is too low for risk
11 significance is that you're basically diluting the
12 focus of your resources on a broader range of SSCs
13 which are not necessarily risk significant, okay.

14 So, the -- additionally in the context
15 of very low core damage frequencies, we find our
16 experience has been that it becomes very
17 challenging to -- very challenging on the state of
18 the art of PRA for identifying these very low
19 likelihood hazards and how you would assure
20 completeness in identifying the hazards.

21 The bottom line is that it's very easy
22 to see drastic changes in the risk profile based on
23 assumptions or conservatisms in your PRA when
24 you're dealing with such low risk numbers.

25 You can add things, you can make

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1 conservative assumptions, you can look at very low
2 likelihood events. One I like to use is meteor
3 strikes, right.

4 There comes a time when if you make
5 your plant safe enough that getting hit by a meteor
6 then becomes your highest risk contributor. And
7 so, you can add -- you can look at things like that
8 and the state of the art isn't really geared toward
9 capturing a complete risk picture when you're
10 dealing with such low risk numbers.

11 MEMBER SKILLMAN: May I ask you to back
12 up a slide, please?

13 CHAIR CORRADINI: Turn your mic on.

14 MEMBER SKILLMAN: Thank you. Bill,
15 maybe this is a case where no good deed goes
16 unpunished. Perhaps that's what we're really into
17 here, but let me give you an example.

18 You said, hey, look, existing plants at
19 one times 10 to the minus five, industry's kind of
20 comfortable with that. If you have a RAW of two,
21 it goes up to two times 10 the minus five. We say,
22 okay, we can live with that.

23 Now, you say, but guess what, we've got
24 one that's really beginning at two times 10 to the
25 minus seven. And so a meteor strike or something

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1 that's very, very, very improbable all of a sudden
2 becomes real important, because our initial CDF is
3 so low.

4 I understand that argument, but the
5 flip side of the argument is with your plant with
6 its CDF of two times 10 to the minus seven, you can
7 have a RAW of 200 and be up to one times 10 to the
8 minus five. And you can probably say, why isn't
9 that okay, because that's kind of where industry
10 is. So, it seems like this argument can backfire.

11 MR. GALYEAN: Well, we don't ignore the
12 Fussell-Vesely, okay. But -- and we are trying to
13 -- we do identify criteria that we believe are
14 consistent with the current practice, okay.

15 So, I guess I'm not really sure where
16 you're going with your question.

17 MEMBER SKILLMAN: Well, I guess I'm
18 kind of on the verge of asserting if we buy the
19 argument that, gee whiz, we start at two times 10
20 to the minus seven, this is a very, very, very low
21 CDF plant, but we've got lots of margin to what is
22 the industry-accepted standard. So, in some cases
23 we could take a pretty good hit and, guess what,
24 there's no harm, no foul.

25 And I guess I would say, boy, I'd like

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1 to talk to your design and review panel and see
2 what they think about that. That's why I asked the
3 question about where are the constraints on your
4 DRAP.

5 That sounds to me like a design review
6 panel that is taking at least as partial input your
7 PRA results, plus some smorgasbord of deterministic
8 events in order to make an informed decision.

9 But it just seems to me that this can
10 be gained to where one could say, oh, the CDF is so
11 low to begin with we can have something really
12 terrible happen and it's of no consequence. And
13 that sounds, to me, like an argument we probably do
14 not want to support.

15 CHAIR CORRADINI: I think they might
16 say not no consequence, Dick. I think they might
17 say low risk.

18 MR. GALYEAN: That's right.

19 CHAIR CORRADINI: I think that's what I
20 --

21 MR. GALYEAN: That's right. We're
22 talking probabilistic context here. I mean, the
23 deterministic aspects are already being considered
24 and this is just the probabilistic part or the risk
25 part which includes both likelihood and

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1 consequences.

2 MEMBER SKILLMAN: I'm just reminded of
3 the architect of the Titanic. She can't sink.
4 Well, she was made of iron and she did sink.

5 At some point, the argument that the
6 probability is so low and hence we can take a
7 pretty good hit in probabilistic space, needs to be
8 challenged to the point that we're comfortable
9 where you haven't created a logic that has given us
10 false confidence.

11 MR. GALYEAN: Well, I would just argue
12 that this is not the only input to the panel,
13 right. We do have input from safety analysis. We
14 do have all of the deterministic and the
15 expectation from the NRC rules and regulations and
16 guidance.

17 We do have folks with operating plant
18 experience and of course the designers. And so
19 this piece, the risk-related piece is just one part
20 of the puzzle. Again, the process is risk-
21 informed, it's not risk-based.

22 MEMBER SKILLMAN: Thank you.

23 MR. GALYEAN: So, the criteria that we
24 have for -- we've developed for NuScale, we
25 developed them to be consistent with Reg Guide

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1 1.174. Which for those of us in the PRA community
2 understand that that's, in essence, the underlying
3 foundation for just about all risk-informed
4 processes that occur in the United States in the
5 regulatory environment.

6 We're consistent with the guidance in
7 1.174. We want to conform with the NRC safety
8 goals for new reactors, including CDF and LRF and
9 the conditional containment failure probability.

10 The CDF criteria from Reg Guide 1.174
11 identifies three regions that are -- will be
12 considered for acceptability in -- when making
13 permanent changes to a plant's licensing basis.

14 Reg Guide 1.174, of course, is the
15 guidance the NRC has provided for when a plant
16 wants to make a change to the licensing basis.
17 Obviously it is limited to plants that already have
18 a license and are operating and wish to make
19 changes.

20 Then the -- this is the chart or the
21 figure that shows the core damage frequency
22 thresholds which depending on the base case core
23 damage frequency, there are different levels of --
24 I won't call them acceptability, but different
25 levels at which the -- they will be considered as

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1 acceptable by the NRC.

2 So, in this case, I want to point out
3 that if a plant has a core damage frequency of on
4 the order of 10^{-5} , then anything
5 less than a delta CDF of 10^{-5} would
6 be considered as acceptable or -- yeah, that's
7 right, considered.

8 In this case, NuScale has come up with
9 a component level risk significant criteria of
10 three times 10^{-6} , right. And this
11 of course is basically the midpoint for the Region
12 II area shown on the Reg Guide 1.174.

13 MEMBER STETKAR: Bill, this is perhaps
14 a minor point, but if I were going to be applying
15 the guidance and actually turning a crank, it might
16 affect me.

17 In the report on this slide, it uses
18 the term a component risk-significant if the
19 conditional core damage frequency is greater than
20 or equal to three times 10^{-6} per
21 year.

22 In the report, you seem to use the
23 concept of component basic event, basic event and
24 component interchangeably.

25 And in particular whenever I looked at

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1 the tables in the report, they always carefully say
2 "component level basic event."

3 What does that mean? Because a basic -
4 - if I have a valve, for example, it can fail to
5 open, it can fail to close, it can spuriously open,
6 it can spuriously close and that component failure
7 mode may contribute to different event scenarios in
8 my PRA depending on the development of the event
9 scenario.

10 The component is still the valve. It's
11 not those four distinct, basic events. So, how is
12 this supposed to be applied in practice? At the
13 basic event level --

14 MR. GALYEAN: Correct.

15 MEMBER STETKAR: -- or the component?

16 MR. GALYEAN: Yeah, I --

17 MEMBER STETKAR: Why the basic event
18 level then? If I can subdivide my component into
19 37 basic events, I can always make them small
20 enough.

21 MR. GALYEAN: Oh, I'm sorry. The
22 intent is that it's at the component level.

23 MEMBER STETKAR: Ah, okay. So, why are
24 all of the criteria then specified as basic event
25 criteria --

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1 MR. GALYEAN: Well, in most cases --

2 MEMBER STETKAR: -- in the report?

3 MR. GALYEAN: -- typically when we do
4 evaluations --

5 MEMBER STETKAR: I don't care what when
6 you do. I want to understand the philosophy here.
7 So, why are they specified at the basic event
8 level?

9 MR. GALYEAN: The philosophy is aimed
10 at being at the component level and the system
11 level.

12 MEMBER STETKAR: Okay.

13 MR. GALYEAN: The terminology is simply
14 an artifact of the way we at NuScale execute this
15 process.

16 MEMBER STETKAR: Well, that's why I
17 introduced it why if I were going to be doing this,
18 it would affect how I would -- how I would do this.
19 Because if I were told to develop a conditional
20 core damage frequency on a basic event level, I
21 would fail basic events one by one.

22 If I were to do it on a component
23 level, I would fail all of the basic events
24 associated with that component. It's a different
25 process.

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1 MR. GALYEAN: Agreed.

2 MEMBER STETKAR: And I'm going to ask
3 the staff since they have completely endorsed this
4 process, how they're interpreting it, because they
5 haven't said anything about whether it's basic
6 events or components.

7 MR. GALYEAN: The intent is that it's -
8 - is that it's at the component level and --

9 MEMBER STETKAR: I was just curious
10 because the term "component" is used mostly --

11 MR. GALYEAN: Right.

12 MEMBER STETKAR: -- until I get to the
13 tables where it's carefully said that these are
14 basic events.

15 MR. GALYEAN: Well, that's intended to
16 apply to things when we get to it, and particularly
17 Fussell-Vesely criteria.

18 MEMBER STETKAR: Well, but why Fussell-
19 Vesely if a -- if I can divide a component into 37
20 basic events, I can always make its Fussell-Vesely
21 importance low enough.

22 MR. GALYEAN: What I meant, to
23 continue, I mean, the intent is like initiating
24 events and human actions would be basic events.

25 In those cases, the -- it's not --

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1 those are not components, right, but you still want
2 to do importance measures on initiating events and
3 human actions, okay. So, the intent is that the
4 basic event captures that aspect of it.

5 As I mentioned, it -- part of this is
6 an artifact --

7 MEMBER STETKAR: That's presuming that
8 you have a particular model format for your
9 particular PRA where you have initiating events
10 modeled as basic events.

11 MR. GALYEAN: Right.

12 MEMBER STETKAR: Other people don't.

13 MR. GALYEAN: I understand.

14 MEMBER STETKAR: Okay. That's why I'm
15 trying to get to the concept.

16 MR. GALYEAN: Again, this is for
17 NuScale, okay. What we're talking about here is
18 for NuScale.

19 CHAIR CORRADINI: But I'm a bit lost.
20 These guys aren't, but I am. So, again, just to
21 reiterate it a different way, so the use of the
22 term "basic event" is not -- how you use it and how
23 John is using it is identical, or different?
24 That's where I am confused.

25 MR. GALYEAN: The intent is that at the

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1 component level, all the basic events associated
2 with that component would be rolled up and
3 evaluated as a group.

4 CHAIR CORRADINI: Okay.

5 MR. GALYEAN: Okay. That's the intent.
6 Now, there are some events in the PRA which are not
7 associated with a component. And in those cases,
8 all you have is a basic event.

9 And so, the intent is to capture all of
10 these and in some cases it would be a collection of
11 basic events, and in other cases it would be a
12 single basic event.

13 CHAIR CORRADINI: Can you give me an
14 example of what you mean by that? I'm not --

15 MR. GALYEAN: Well, like an operator
16 action.

17 CHAIR CORRADINI: Okay.

18 MR. GALYEAN: Okay. You know, there's
19 only one basic event that represents that operator
20 action. Initiating events, there's only one basic
21 event that represents that initiating event.

22 CHAIR CORRADINI: Okay.

23 MR. GALYEAN: And so here as this slide
24 illustrates, the intent is at the component level
25 that if the component risk-significance if it

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1 generates a conditional core damage frequency
2 greater than or equal to three times 10 to the
3 minus six.

4 We also do system-level risk
5 significance. And here we're proposing one times
6 10 to the minus five is the threshold for
7 determining a risk-significant system.

8 CHAIR CORRADINI: So, can I -- I'm
9 sorry. You're still educating me here. So, let me
10 -- so, I understand the concept that if something
11 is of less probability to get an event such as the
12 CDF, there's the chance that I'm going to allow a
13 greater swing on any sort of event -- or what used
14 to be a RAW or a delta CDF, right? You're allowing
15 a larger delta CDF.

16 So, looking at the --

17 MR. GALYEAN: Not a larger delta --
18 well, larger delta CDF. Yeah, that's correct.

19 CHAIR CORRADINI: Yeah. I mean, so the
20 -- so, I was waiting for the curve because I
21 thought, okay, we're on the way left-hand side
22 here.

23 So, if I have something that's a CDF of
24 10 to the minus six or 10 to the minus seven going
25 to the left, I'm allowing instead of something

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1 changing with the factor of two, I'm allowing
2 something to change with the factor of 30.

3 So, my question is, how did you get 30?

4 MR. GALYEAN: Well, we'll get to that.

5 CHAIR CORRADINI: Okay.

6 MR. GALYEAN: Okay.

7 CHAIR CORRADINI: And then -- that's
8 fine.

9 MR. GALYEAN: Okay.

10 CHAIR CORRADINI: And then -- because I
11 read your document and I struggle. The second part
12 of this is why does the system allow for three
13 times larger delta than the component?

14 Is it because it's a collection of
15 components? I don't --

16 MR. GALYEAN: Exactly.

17 CHAIR CORRADINI: Okay.

18 MR. GALYEAN: That's exactly it. I
19 mean, a system would have multiple components
20 associated with it and we are failing them all
21 collectively, okay.

22 CHAIR CORRADINI: So, what is the
23 definition of a system in NuScale's vernacular?
24 What's a component, what's a system, and how do I
25 know what's what?

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1 MR. GALYEAN: Well, I guess --

2 CHAIR CORRADINI: Do you know what I'm
3 asking? If it's a pump, I'm clear it's a
4 component, I think.

5 MR. GALYEAN: Right. Right.

6 CHAIR CORRADINI: But is it the CVCS
7 system --

8 MR. GALYEAN: Exactly.

9 CHAIR CORRADINI: -- a system?

10 MR. GALYEAN: That's right. It's the
11 NuScale -- the way NuScale happens to define
12 "systems," that's what we're using for determining
13 the risk significance of a system.

14 CHAIR CORRADINI: Okay.

15 MR. GALYEAN: It's just based on where
16 in the design, where we draw the boundaries in our
17 design.

18 CHAIR CORRADINI: Okay.

19 MEMBER BLEY: And when you talk --
20 well, two things. One is the two things these guys
21 have been talking about seem to me like they should
22 be defined in the document.

23 And it seems to me as if the staff
24 should have that if they didn't find it defined
25 there, should have defined it so anybody reviewing

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1 later knows that when you say a basic event on the
2 RAW side, you mean component level.

3 MR. GALYEAN: Right.

4 MEMBER BLEY: It's not transparent to
5 me. You said something about common cause for risk
6 achievement. And that's where risk achievement
7 gets pretty useful.

8 If an earthquake can take out all of
9 the same kind of components at similar locations,
10 somewhere one ought to be thinking if I have that
11 earthquake and I lose all of those, when I lose
12 that as a group, what happens to my core damage
13 frequency?

14 Are you covering that side of risk
15 achievement?

16 MR. GALYEAN: We believe it's being
17 covered by the system level metrics, okay, that --

18 MEMBER BLEY: It's not at all clear to
19 me that's true and do you have a basis for that?

20 MR. GALYEAN: There's -- I agree in
21 theory there's a potential of inter-system common-
22 cause failures, okay. But in our particular case,
23 we don't have any inter-system common-cause
24 failures. That any common-cause failures are
25 restricted to within a single system and thereby --

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1 MEMBER BLEY: That's why I brought up
2 an earthquake.

3 MR. GALYEAN: -- we believe that the
4 system risk-significant criteria cover or encompass
5 the common-cause failure aspect.

6 MEMBER BLEY: You don't use identical
7 components across any systems that are essentially
8 at the same elevations then?

9 MR. GALYEAN: Identical, no. At least
10 not to my knowledge. I don't know that we have --
11 I'm trying to think. It has not come up in any of
12 our modeling.

13 MEMBER BLEY: I'm curious as to how it
14 would have come up unless somebody from the other
15 end and saying, where could we get coupling here?

16 MR. GALYEAN: We've been looking at
17 this -- I've been looking at this for five years
18 now and watched the design develop.

19 So, I don't -- I feel comfortable in
20 saying that inter-system common-cause failures, I
21 cannot think of any.

22 MEMBER SKILLMAN: Bill, I think we
23 covered at least this topic, in part, like six
24 months ago, a year ago, two years ago. And what I
25 remember is the conversation around the common pool

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1 on a full build, you've got 12 of these machines,
2 correct?

3 MR. GALYEAN: Yes.

4 MEMBER SKILLMAN: And they're all
5 shielded by a common pool of water one way or the
6 other. And to Dr. Bley's question, aren't there
7 virtually identical components feeding if you're a
8 full build, all 12 machines operating at power,
9 virtually identical components feeding and taking
10 energy from those 12 devices?

11 MR. GALYEAN: Consistent with the
12 current industry practice, the core damage
13 frequency results that we're talking about are for
14 a single reactor.

15 So, risk significance is judged based
16 on the PRA for a single reactor. And the results -
17 -

18 MEMBER BLEY: But you're building a
19 modular machine here with a bunch of them all
20 hooked together. I mean, leaning back on saying I
21 got a unit here and a unit here on the same site,
22 I'm thinking of those separately, which this
23 committee hasn't always agreed is the right thing
24 to do, it seems a big leap to go to build a machine
25 with nine pots in it, 12 pots in it and saying, I

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1 don't have to think about things that will couple
2 these.

3 MR. GALYEAN: Well, that's --

4 MR. BERGMAN: Hi. Tom Bergman of VP
5 Reg Affairs. We raised this issue with the NRC in
6 a letter dated July 22nd of 2015.

7 We do -- any time we share systems, we
8 do treat the shared systems per GDC-5 in
9 particular, but our position which the NRC is
10 discussing with us with respect to, in particular,
11 large external events that the difference in
12 spacing between modules was not material given the
13 geographic scale of those events to multi-unit.
14 And thus, we should treat those types of events as
15 the same as for a multi-unit. In other words, we
16 were a multi-unit site as well as a multi-module
17 site. When you get to very
18 localized external events like say an aircraft
19 impact or a tornado, then you would have to look at
20 multi-module effects. But for the types for a very
21 large earthquake where you might have to look at
22 the fragility of all the containment isolation
23 valves across, that the agency's position should be
24 the same as for any other multi-unit site, but we
25 don't have a final agency position on that.

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1 MEMBER BLEY: Okay. Thanks, Tom.

2 MR. GALYEAN: The basis for the
3 thresholds that we've developed for core damage
4 frequency, the component level, again, component
5 level conditional core damage frequency of greater
6 than three times 10 to the minus six, the intent is
7 to be under the NRC safety goal of 10 to the minus
8 four by an order magnitude and then have an extra
9 half order of magnitude margin for uncertainty.

10 The system-level core damage frequency
11 of 10 to the minus five is intended to be an order
12 of magnitude below the NRC safety goal, the 10 to
13 the minus four.

14 The criteria that we've come up with
15 are consistent with Reg Guide 1.174 criteria for
16 Region II making permanent changes to a licensing
17 basis. And also the component level versus the
18 system level adjustment is in line with the NEI
19 guidance for a 50.69 process. Although, we use a
20 half order of magnitude instead of a full order
21 magnitude, basically, in going from the single
22 component to a system.

23 And we use the system, as I mentioned
24 before, analogous to what other folks would use as
25 common-cause failure criteria.

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1 MEMBER STETKAR: Bill, so I want to
2 make sure, because this is a concept that I want to
3 understand. Tell me if I've got it.

4 You took the 10 to the minus four core
5 damage frequency and you said, well, we'll drop
6 that an order of magnitude to 10 to the minus five.
7 And then we'll take another half order of magnitude
8 on a logarithmic basis.

9 MR. GALYEAN: Right.

10 MEMBER STETKAR: So, that gives me the
11 factor of three.

12 MR. GALYEAN: Right.

13 MEMBER STETKAR: And set that as our
14 target.

15 MR. GALYEAN: That --

16 MEMBER STETKAR: Because -- and that
17 half order of magnitude, if you will, on a
18 logarithmic scale is supposed to account for
19 uncertainties in the PRA models; is that right?

20 MR. GALYEAN: Basically. Basically.
21 That and we also want it to be consistent with the
22 Reg Guide 1.174 guidance which we looked at this
23 and saw 10 to the minus five criteria.

24 So, we wanted to be under the 10 to the
25 minus five threshold from 1.174 and again give us

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1 another half order of magnitude for the uncertainty
2 aspect.

3 So, together Reg Guide 1.174 in
4 combination with the safety goal seemed to lead us
5 to this three times 10 to the minus six criteria.

6 MEMBER STETKAR: Now, you say that
7 extra half order of magnitude is intended to
8 account for uncertainties in the PRA models. Right
9 now you have only internal events at full power
10 operation.

11 How does that particular scope of your
12 PRA account for model uncertainties? In other
13 words, you've said, well, we have a core damage
14 frequency of some value. I see 10 to the minus
15 seven. You say it's less than 10 to the minus
16 seven.

17 Does that estimate account for modeling
18 uncertainties?

19 MR. GALYEAN: No.

20 MEMBER STETKAR: It does not.

21 MR. GALYEAN: And that's simply
22 consistent with the, you know, kind of practice in
23 the industry in general. All we have to work with
24 is basically the uncertainty that comes out of the
25 uncertainty analysis in the PRA where you've got a

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1 core damage frequency represented by a probably
2 dense -- or a probability.

3 MEMBER STETKAR: But you're confident
4 that if you're actually -- if it were actually
5 possible to quantify that model uncertainty, it
6 would be less than a factor of three.

7 MR. GALYEAN: I don't know that I'm
8 confident about that. I mean, again, we do have
9 the full order of magnitude from the base safety
10 goal.

11 When the PRA state of the art is --
12 gets advanced enough to be able to quantify model
13 uncertainty, perhaps it will be time to revisit
14 this, but right now all we have to work with is the
15 current state of the art.

16 MEMBER STETKAR: Okay.

17 CHAIR CORRADINI: So, let me ask the
18 question a bit differently. So, if you did what
19 you call a complete estimate of the CDF with all
20 the various modes and you got 10 to the minus six,
21 would you still want to keep three 10 to the minus
22 six as the change point?

23 MR. GALYEAN: That is -- that's
24 something that, frankly, we have not thought about.
25 Certainly there are constraints that if you buy

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1 into this process that there are certain
2 expectations on what your base core damage
3 frequency is.

4 We've gone into this process with the
5 assumption that our base core damage frequency is
6 going to be on the order of 10 to the minus seven.

7 MEMBER STETKAR: Okay. I was going to
8 wait until the end, but I -- since the good Dr.
9 Corradini brought it up, I'll go in with the
10 assumption it's going to be three times to the
11 minus six considering all fires, internal floods,
12 seismic events, high winds, low-power/shutdown,
13 everything, okay.

14 Now, how does three times 10 to the
15 minus six fit? And if it doesn't, I don't buy your
16 argument at all.

17 MR. GALYEAN: I'm not sure -- I don't
18 follow --

19 MEMBER STETKAR: If it doesn't fit, if
20 your core damage frequency is three times 10 to the
21 minus six, then it doesn't fit at one times 10 to
22 the minus seven, because conceptually it makes no
23 sense. It makes no sense.

24 MR. GALYEAN: I disagree.

25 MEMBER STETKAR: Okay. I want to

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1 understand why. So, let's take the position where
2 your core damage frequency from everything is three
3 time 10 to the minus six per year.

4 What would you use as now an absolute
5 measure of risk-significance? What? You've
6 studied it for how many years?

7 MR. GALYEAN: I wouldn't use this
8 process. I would simply use the existing process
9 of --

10 MEMBER STETKAR: Oh.

11 MR. GALYEAN: -- relative --

12 MEMBER STETKAR: Well, where do we make
13 the change now in terms of the spectrum of 10 to
14 the minus four down to 10 to the minus 80th?

15 Where do we make that step change that
16 we use your three times 10 to the minus six, and me
17 if I have a core damage frequency of three times 10
18 to the minus six, I'm saddled with RAW of two?

19 MR. GALYEAN: So, why is the process
20 that has been used for all these years, for all the
21 existing plants and all the PRAs suddenly becomes
22 invalid for NuScale? Why do you say that?

23 MEMBER STETKAR: I'm not saying that
24 the process becomes invalid. I'm saying that a
25 particular numerical threshold that is somehow

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1 derived from a particular guess of a particular
2 core damage frequency is flawed, because that
3 starts to cherry-pick, well, my plant -- I'll come
4 in with plant Gobbledygook next year, and I guess
5 that my core damage frequency is three times 10 to
6 the minus eighth.

7 Should I use three times 10 to the
8 minus six? Should I use one times 10 to the minus
9 six? What should I use?

10 MR. GALYEAN: Well, everyone is free to
11 come in with their own application to the NRC and -
12 -

13 MEMBER STETKAR: So, we're going to
14 negotiate what's important to risk on a case-by-
15 case basis.

16 MR. GALYEAN: All we can do is provide
17 the NuScale position on this particular topic.

18 MEMBER BLEY: Bill.

19 MR. GALYEAN: We are not representing
20 the industry or anything like that.

21 MEMBER STETKAR: Okay.

22 MEMBER BLEY: I'm a little confused at
23 this point, because I thought the whole argument
24 for the NuScale position for NuScale was that --
25 and it seemed a general argument that instead of

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1 using the specific thresholds for RAW and Fussell-
2 Vesely importance that has been used with existing
3 reactors, it really makes more sense to have a
4 fixed value that's not relative and you've anchored
5 those to the relative values for plants with an
6 assumed 10 to the minus fifth per year. So, all of
7 a sudden it sounds like you're changing direction.

8 You don't know what your total core
9 damage frequency is going to be when you finish
10 looking at all these external events. It could
11 turn out the way John suggested.

12 MR. GALYEAN: It could. It could.

13 MEMBER BLEY: And the two things I'm
14 confused about is; one, I thought your arguments
15 you intended to be able to stand up no matter what,
16 and --

17 MR. GALYEAN: Well --

18 MEMBER BLEY: -- two, that if you get a
19 higher core damage frequency, you'll abandon this
20 and go to everybody else's --

21 MEMBER STETKAR: Well, but the problem
22 is this is a topical report that the NRC will have
23 accepted already.

24 It doesn't say that if your core damage
25 frequency changes in the future, we're going to

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1 look at it. The NRC's safety evaluation says, we
2 accept --

3 MEMBER BLEY: And I haven't asked them
4 yet, but among their conditions they didn't have
5 one that said the core damage frequency is 10 to
6 the minus seven.

7 MR. GALYEAN: Didn't see it.

8 MEMBER STETKAR: We'll ask them. I was
9 going to ask them the same question later.

10 CHAIR CORRADINI: We should let him
11 continue.

12 MR. GALYEAN: So, the whole point of
13 this is that when you have a base case core damage
14 frequency that is so much lower than existing or
15 traditional core damage frequencies, there is an
16 option to do a more rational approach for
17 determining risk-significance. That's the --
18 that's the premise here.

19 If the premise is not satisfied,
20 there's no reason to go with this approach.

21 MEMBER STETKAR: Bill, I personally --
22 I agree fully with the premise. I agree fully with
23 the premise. This is subcommittee meeting. This
24 is my personal opinion.

25 I agree fully with the premise that as

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1 the absolute level of risk for a particular plant
2 becomes smaller, that the available margin in terms
3 of regulatory attention and everything else to
4 particular items in that plant ought to be relaxed.
5 That's a premise.

6 How that premise is represented for the
7 full spectrum of plant designs and quantified risk
8 metrics with core damage frequency or large release
9 frequency is what we're talking about here.

10 Because if you start to do this on a
11 case-by-case basis with particular numerical
12 values, NuScale gets a three times 10 to the minus
13 six if, and only if, their core damage frequency is
14 one times 10 to the minus seven.

15 Applicant Y gets 1.2 times 10 to the
16 minus six if and if -- only if their core damage
17 frequency is three times 10 to the minus eighth and
18 so forth. I'm not sure what we're doing here. So,
19 that's -- I'm not arguing with the premise. I'm
20 arguing with how it's applied.

21 And whether or not the approach being
22 proposed now by NuScale is robust enough such that
23 if your core damage frequency finally were to be
24 something on the order of three times 10 to the
25 minus six, the approach consistently accounts for

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1 that, or if it turns out to be, you know, one times
2 10 to the minus eighth.

3 MR. GALYEAN: Okay.

4 MEMBER STETKAR: Okay.

5 MR. GALYEAN: Yeah, I would
6 characterize the premise slightly differently that
7 it's not so much relaxing the regulatory oversight.
8 It's more of focusing on those issues that are
9 truly risk-significant, okay.

10 The differentiation here is that when
11 we talk about risk that is so low that to me the
12 overriding question is a completeness one and how
13 do you -- how do you spend resources, how do you
14 justify spending resources on issues that are
15 basically in the noise risk-wise when they could be
16 changed or subject, or so unstable as to be subject
17 to various assumptions and boundary conditions and,
18 you know, hazards that you've identified or not
19 identified that can drastically change the risk
20 profile.

21 And to use the existing criteria on
22 such low risk numbers is basically a foolish way to
23 spend money, in my opinion.

24 MEMBER STETKAR: I agree completely
25 with the last part of that statement if what you

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1 mean is a risk achievement worth of 2.0 and a
2 Fussell-Vesely importance of 0.005.

3 When I said "regulatory oversight," I
4 said that intentionally because what you're doing
5 here is you're trying to develop thresholds for
6 which equipment populate either your RTNSS category
7 or your design reliability assurance program, which
8 has subsequent regulatory oversight both in terms
9 of maintenance rule and, by implication, the
10 reactor oversight process in terms of significance
11 determination. So, I said "regulatory oversight"
12 intentionally despite how you want to characterize
13 it.

14 I do agree with you completely that
15 applying a risk achievement worth of two and a
16 Fussell-Vesely importance of 0.005 to your design
17 doesn't make any sense.

18 MR. GALYEAN: Okay. And -- thank you.
19 The other aspect that I want to emphasize is that
20 the discussion here is for NuScale. It's for a
21 NuScale design and the approach being presented is
22 for our design certification and future
23 applications for NuScale designs.

24 It's not being represented as an
25 industry-wide initiative or anything like that. It

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1 is strictly for a NuScale design.

2 If there are other stakeholders at
3 which to propose this on an industry-wide basis,
4 they're certainly free to do so. This will be
5 public information.

6 CHAIR CORRADINI: Keep on going.

7 MR. GALYEAN: Okay. So, we still have
8 the large release frequency thresholds which mirror
9 those for the core damage frequency. Again, we're
10 using absolute RAW and component levels and system
11 levels consistent with the Reg Guide 1.174
12 criteria.

13 The basis for the large release
14 frequency thresholds again mirror those for the
15 core damage frequency thresholds where we've got
16 component level conditional large release frequency
17 at three times 10 to the minus seven, system level
18 one times 10 to the minus six.

19 They meet the NRC commission safety
20 goal for large release and we're also below the L-
21 E-R-F guideline for -- again, below the LERF safety
22 goal.

23 MEMBER STETKAR: Bill, this one I
24 actually got lost in this line of thought, because
25 I thought that -- I thought that I understood the

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1 basic rationale for how you got to three times 10
2 to the minus six. That you took 10 to the minus
3 four, dropped an order of magnitude, and then
4 dropped it a factor of three for model uncertainty.

5 On your Slide Number 8 and in the
6 report, you note that for new reactors the large
7 release frequency goal is 10 to the minus six per
8 year.

9 So, if I apply the same rationale, I
10 drop that by a factor of 10. I drop it by another
11 factor of three to account for model uncertainty.
12 I get three times 10 to the minus eight per year,
13 not three times 10 to the minus seven per year.
14 So, I'm not -- why a different philosophy on large
15 release frequency?

16 MR. GALYEAN: Well, for one thing --

17 MEMBER STETKAR: Especially considering
18 from my experience that the uncertainties in the
19 Level 2 PRA models are even larger than the
20 uncertainties in a Level 1 PRA model. So, I could
21 argue about that half order of magnitude for
22 uncertainty.

23 MR. GALYEAN: Well, in our particular
24 case again for the NuScale position, we take, I'll
25 say, a more aggressive approach to large release

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1 frequency.

2 Remember, the size of our core is only
3 five percent the size of a large light-water
4 reactor. Okay. So, you've basically got a 1/20th
5 reduction in potential consequences, okay.

6 So, we're not being -- I hope, you
7 know, I think -- I think we're being consistent
8 with the philosophy here in that we're looking at
9 large release frequency both for the NRC safety
10 goal and for the large release expectations.

11 I believe that we have reason to, don't
12 want to say be more aggressive, but be less
13 conservative in the case of large release
14 frequency.

15 And also, remember, this is being
16 driven by the conditional containment failure
17 probability expectation of 10 percent based on, you
18 know.

19 CHAIR CORRADINI: So, I'm going to let
20 John understand that answer. I want to go back to
21 in the figure you have, you talk about LERF, but
22 we're talking LRF. So, they're not one in the
23 same.

24 MR. GALYEAN: Right.

25 CHAIR CORRADINI: Remind me -- I think

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1 I know what LRF is. I think that's the probability
2 to get to a prompt -- to an early fatality.

3 MR. GALYEAN: Well, that's what L-E-R-F
4 is intended to be.

5 CHAIR CORRADINI: Oh.

6 MR. GALYEAN: Okay.

7 CHAIR CORRADINI: So, what is L-R-F
8 then?

9 MR. GALYEAN: Well, LRF was developed,
10 and probably the staff can be more definitive about
11 the description, but my understanding is that LRF
12 was aimed at design certifications and where you do
13 not have a site. And, hence, you do not have
14 surrounding population demographics, you don't have
15 any evacuation plans in place.

16 So, there can't be any consideration of
17 evacuation. So, all releases are basically being
18 judged in absence of evacuation, which would be, in
19 theory, considered an LERF analysis, okay.

20 So, the distinction between LERF and
21 LRF is typically or in practice one between -- in
22 one case you've got a specific site, and in the
23 other case you don't have a specific site. And
24 really that's the practical difference.

25 CHAIR CORRADINI: Okay.

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1 MR. GALYEAN: Okay. The intent, I
2 believe, is identical. They're intended to be
3 surrogates for the early fatality quantitative
4 health objective.

5 CHAIR CORRADINI: Okay.

6 MR. GALYEAN: So, we talked about
7 uncertainty margins based on the component
8 thresholds and 10 to the minus five core damage
9 frequency from Reg Guide 1.174 plus a half order of
10 magnitude margin.

11 The comparisons for measuring against
12 the thresholds will be mean values or the intent is
13 that they are mean values.

14 Our expectation is that the NuScale PRA
15 will be state of the art and that the as-built and
16 as-operated PRA, the uncertainties will be
17 consistent with what we have currently.

18 MEMBER STETKAR: You mean if they're
19 log-normal distributions -- I don't know if they're
20 log-normal distributions, but it gets better if
21 they're not.

22 If you have an order of magnitude
23 between the fifth and the 95th, then mean value is
24 about 1.6 times the median, not about three.

25 MR. GALYEAN: Yeah, that's correct.

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1 MEMBER STETKAR: So, that's doesn't
2 justify your three.

3 MR. GALYEAN: You're right. I was
4 thinking 2.66.

5 MEMBER STETKAR: It's 1.6 something or
6 other.

7 MR. GALYEAN: Right.

8 MEMBER STETKAR: Three, four, five, I
9 think.

10 MR. GALYEAN: So, the Fussell-Vesely,
11 we've got the risk-significant -- judging risk-
12 significance at the Fussell-Vesely is greater than
13 20 percent using this for both CDF and LRF aimed at
14 initiating events, human actions and individual
15 components.

16 We came up with this 20 percent by
17 looking at what you would get from a typical
18 operating reactor with a core damage frequency of
19 10 to the minus five. And a 0.5 percent criteria
20 you would get a core damage frequency of five times
21 to the minus eight. Using a 20 percent and a CDF -
22 - a base CDF of 10 to the minus seven, you would
23 get two times 10 to the minus eight.

24 So, the intent is that the Fussell-
25 Vesely will be assessed, you know, on a --

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1 individually for the different aspects or different
2 pieces of the PRA that is the full-power internal
3 events would be evaluated for Fussell-Vesely, the
4 low-power/shutdown would be evaluated for Fussell-
5 Vesely, seismic PRA would be evaluated and the
6 assessments would be done individually.

7 MEMBER STETKAR: And that if a
8 particular component was judged to be significant
9 for any one of those, it would therefore be
10 significant?

11 MR. GALYEAN: That's correct.

12 MEMBER STETKAR: And it would not be
13 significant if it was not for any of them.

14 MR. GALYEAN: Correct.

15 MEMBER STETKAR: Okay. So, I tried to
16 understand how this would be done in practice. So,
17 I came up with a little example. And you have to
18 trust me that this is the first example that I came
19 up with. I didn't try to cook the books.

20 If I had an internal events core damage
21 frequency of -- don't try to do this in real-time,
22 it will be on the record. Internal events account
23 for 15 percent of the total core damage frequency.
24 Seismic events account for 85. I just used two,
25 because it's easier to just think about two.

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1 Fussell-Vesely of Component X for
2 internal events is 0.25. It's 0.1 for seismic
3 events. Component Y has a Fussell-Vesely of 0.15
4 for internal events and 0.15 for seismic events.

5 So, Component X is important to risk
6 because it satisfies greater than 0.20 for internal
7 events. I said it was 0.25. You said any one of
8 the things makes it okay.

9 Component Y is not important to risk,
10 because it's only 0.15 for internal events and 0.15
11 for seismic.

12 But if I combine now seismic and
13 internal events, Component Y has a 15 percent
14 Fussell-Vesely and Component X only has 0.122. In
15 other words, Component Y is more important to risk
16 than Component X. And yet, for some reason I track
17 Component X because it satisfied my threshold for
18 internal events. I don't track Component Y.

19 I didn't -- I spent five minutes doing
20 this. I didn't spend an hour trying to come up
21 with a pathological case, but I did select
22 something that may be more relevant to NuScale
23 where your risk from external events and the
24 relative importance for that is more important than
25 internal events.

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1 And the relative importance of
2 different components changes as a function of the
3 particular hazard.

4 MR. GALYEAN: The issue that we were
5 most concerned about is, and it's outlined on the
6 slide, inconsistent levels of conservatism and
7 uncertainty among different analyses in the PRA.

8 As you know, seismic analyses generally
9 have wider uncertainties and also the hazard that
10 is considered will sometimes be inconsistent in
11 that you might choose to go lower on an earthquake
12 hazard compared to what you can reasonably account
13 for in other PRA aspects.

14 For example --

15 MEMBER STETKAR: Okay.

16 MR. GALYEAN: -- maybe in your seismic
17 hazard curve you go down to 10 to the minus seven
18 or 10 to the minus eight on your hazard frequency.
19 You're not typically going to do that for internal
20 events. You're not typically going to do that for
21 other aspects of your PRA, go down that low.

22 Again, you get into this completeness
23 issue and how do you rationally justify or assert
24 that you -- it's even possible to identify all the
25 hazards with a frequency on the order of once in a

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1 hundred million years, you know.

2 The state of the art does not support
3 that kind of detail. And so, we were concerned
4 about consolidating the results and having
5 conservatisms and modeling assumptions dominate the
6 results.

7 MEMBER STETKAR: I guess we'll have to
8 read the transcript, because I quite honestly
9 didn't follow any of that line of reasoning at all.

10 MR. GALYEAN: Okay. The line of
11 reasoning is that you do the seismic PRA, you do a
12 low-power/shutdown PRA, you have full-power
13 internal events PRA. The assumptions and boundary
14 conditions in those different analyses will not
15 always be consistent.

16 MEMBER STETKAR: Right.

17 MR. GALYEAN: Okay. And the example I
18 gave was in a seismic PRA you might choose to go
19 down to lower hazard-like frequencies compared to
20 what you do for a low-power/shutdown PRA or an
21 internal events PRA or other external events simply
22 because the state of the art isn't developed
23 sufficiently to be able to predict events with such
24 a low likelihood.

25 MEMBER STETKAR: For internal events?

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1 MR. GALYEAN: For anything. How do you
2 predict all of the potential human errors of
3 commission, for example, for internal events,
4 right?

5 They're going to be very unlikely, but
6 how do you assure completeness when I'm trying to
7 predict human errors of commission that have a
8 likelihood of once in a hundred million years or a
9 hundred million opportunities? It's just not
10 possible.

11 And so, the concern was that these
12 inconsistent levels of conservatism, these
13 inconsistent boundary conditions, if you will,
14 would then be driving your Fussell-Vesely results
15 and we did not want to go there.

16 MEMBER STETKAR: So, that's why you
17 proposed applying it on a hazard-by-hazard basis.

18 MR. GALYEAN: That's correct.

19 MEMBER STETKAR: Okay. I get that. I
20 understand that. My example says that if I do
21 that, and I recognize benefits of doing that, I may
22 be saying that Component X in my example because it
23 is significant for internal events, is now in my
24 DRAP box. So, it's got additional attention
25 applied to it because it's important to risk.

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1 But Component Y, which is more
2 important to overall plant risk, is not in my DRAP
3 box and --

4 MR. GALYEAN: Well, I'm not convinced
5 that your conclusion is valid, that Component Y is
6 more important to risk.

7 MEMBER STETKAR: It is --

8 MR. GALYEAN: And that's where I
9 disagree.

10 MEMBER STETKAR: Okay. I don't know
11 how else I quantified it, but where I was leading
12 is that if to alleviate some part of this concern
13 people have often proposed a two-tier type of
14 importance measure that you look at importance on a
15 hazard-by-hazard basis to account for the types of
16 issues that you've raised in terms of different
17 assumptions, different levels of completeness and
18 things like that. And you have another value that
19 you look at in terms of overall as a backstop.

20 So, for example, I don't want to -- I
21 don't want to propose numbers here because they
22 tend to take on a life of their own, but you could
23 have a particular Fussell-Vesely threshold for
24 hazard-by-hazard basis that is N, and a different
25 Fussell-Vesely threshold for overall that is

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1 different from N and perhaps lower. Try to capture
2 these two types of issues that I've raised here.

3 And, in fact, I've seen people propose
4 that type of kind of two-tiered backstop approach.

5 MR. GALYEAN: Okay.

6 CHAIR CORRADINI: I think we need to
7 move on.

8 MEMBER STETKAR: Yeah.

9 MR. GALYEAN: So, the NuScale criteria,
10 we have a component level, conditional core damage
11 frequency of three times 10 to the minus six.
12 System level, conditional core damage frequency of
13 one times 10 to the minus five.

14 The basis, we wanted to be below the
15 NRC safety goal. We wanted to be consistent with
16 Reg Guide 1.174. And we understand that there's
17 some adjustment when you go from a component level
18 to a system level.

19 Similarly for the large release
20 frequency criteria, we have the component level at
21 three times 10 to the minus seven, which primarily
22 reflects this desire to be consistent with the 0.1
23 for conditional containment failure probability.

24 Then the system level conditional large
25 release frequency. And then finally basic events

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1 and contributors for Fussell-Vesely of 0.2.

2 For implementation, we're planning on
3 using our full scope PRA, including internal events
4 and external hazards, all operating modes assessed
5 collectively for risk achievement and individually
6 for Fussell-Vesely.

7 Following Reg Guide 1.200 for the
8 approach for determining technical adequacy,
9 obviously we want to have a technically adequate
10 PRA.

11 The objective is to identify candidate
12 risk significant SSCs with the idea it will be used
13 for a risk-informed process, application in
14 particular, for the Design Reliability Assurance
15 Program.

16 We had three RAIs from the NRC staff.
17 One was they wanted us to confirm that the proposed
18 threshold provided reasonable results. As a result
19 of the RAI, we went back and did a collective
20 evaluation where we evaluated our PRA using only
21 safety-related and risk-significant SSCs.

22 The PRA as it stands now, we are still
23 below the Region III thresholds from Reg Guide
24 1.174 when we do that sensitivity study.

25 There was a question about whether we

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1 did sensitivity studies in -- coming up with the
2 risk criteria, the importance criteria.

3 It was not our intent to tailor the
4 criteria to the results we were getting. We wanted
5 to develop criteria that were, in effect, based on
6 first principles. In particular, Reg Guide 1.174.
7 And then lastly the question about the uncertainty
8 margin which we've already talked about. And that
9 concludes my presentation.

10 CHAIR CORRADINI: Any questions by the
11 committee?

12 MEMBER BLEY: One question, and then
13 I'll -- well, maybe a couple questions. I haven't
14 seen your PRA model.

15 MR. GALYEAN: Right.

16 MEMBER BLEY: I'm guessing you've got
17 fewer components than the regular models have. Are
18 there sufficiently small number of basic events
19 such that you do not have to truncate your models
20 before you find a RAW?

21 MR. GALYEAN: We do.

22 MEMBER BLEY: You do truncate?

23 MR. GALYEAN: Yes.

24 MEMBER BLEY: How do you know you've
25 gotten a decent RAW?

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1 MR. GALYEAN: Well, you know, we used
2 10 to the minus 15 for our truncation. You know,
3 we've tried to quantify it at higher or lower or
4 without truncation.

5 MEMBER BLEY: Do you have to truncate
6 it?

7 MR. GALYEAN: What's that?

8 MEMBER BLEY: It won't run if you don't
9 truncate it?

10 MR. GALYEAN: It will. It just takes a
11 long time.

12 MEMBER BLEY: Hm. Even with these
13 computers, okay. I've seen, you know, various
14 studies by PBU. I don't know if you have high
15 order cut sets that are being truncated. And
16 that's the thing you worry about with --

17 MR. GALYEAN: And of course in the --
18 it becomes somewhat impractical because when you
19 start dealing with such small numbers, right, 10 to
20 the minus 15, you then start to --

21 MEMBER BLEY: Yeah, but that's made up
22 of a bunch of bigger numbers multiplied together.
23 So --

24 MR. GALYEAN: Well, that's correct.

25 MEMBER BLEY: And those bigger numbers

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1 represent components. And those components if you
2 got a whole bunch of them and the whole bunch fail,
3 that silly low number suddenly becomes important
4 because it's not low anymore.

5 So, you're truncating on frequency, on
6 probability, I guess. And so --

7 MR. GALYEAN: That's right.

8 MEMBER BLEY: Do you do any -- have you
9 done any checking? Are there some really high
10 order cut sets for which this might be a problem?
11 Do you have any way to know? Do you save all that
12 stuff somewhere? Have you ever run just to get a
13 tabulation of what's in these cut sets?

14 MR. GALYEAN: Now, again, we haven't --
15 as I mentioned, we haven't really gone through and
16 done detailed sensitivity studies on the results.
17 We routinely generate updated risk importance
18 results or -- yeah, importance measure results
19 whenever we update the PRA. I mean, we do update
20 the PRA quite frequently.

21 MEMBER BLEY: Well, let me ask it a
22 different way. You said you run some sensitivity.
23 So, if you ran -- you're going to 10 to the minus
24 15, which I don't know how many components that
25 involves, but if you ran it at 10 to the minus 15,

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1 10 to the minus 13, 10 to the minus 11, 10 to the
2 minus nine, does your RAW change as you look
3 through those different truncation levels?

4 MR. GALYEAN: Frankly, we have not done
5 that exercise.

6 MEMBER BLEY: If it doesn't, you know,
7 I'd be pretty comfortable. If it changes a fair
8 amount, I'd be a lot less comfortable and you don't
9 know -- I've seen some studies by the Scandinavians
10 who have played with that and they had some
11 surprises.

12 MR. GALYEAN: We'll look into that.

13 MEMBER BLEY: I already said there
14 might be good reasons based on physics for cutting
15 out the coupling of seismic module-to-module, that
16 sort of thing. Basing it on policy for ground-
17 based reactors doesn't seem like the right answer
18 to me.

19 I guess those are the big ones I wanted
20 to mention. And that's -- and that affects --
21 could affect the RAW level. It could affect --
22 there could be things hiding there that could be
23 important. Okay. Enough said -- well, you said
24 early on if you used the sliding scale, it would be
25 the same. Well, it would be the same if your core

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1 damage frequency was 10 to the minus seven.

2 In a discussion you said, well, gee, if
3 the core damage frequency turns out to be three
4 times 10 to the minus six, I wouldn't use this
5 approach. So, over what range of core damage
6 frequencies would you use this approach?

7 And you didn't say that in the document
8 anywhere or anything like that, that I recall
9 seeing. You said these absolute ones are the right
10 things to do.

11 MR. GALYEAN: For low core damage
12 frequency plants and PRAs, yes. I don't --

13 MEMBER BLEY: Which isn't quite defined
14 --

15 MR. GALYEAN: That's right.

16 MEMBER BLEY: -- except -- well, around
17 10 to the minus seven, which is from which -- for
18 which you've defined these absolutes.

19 MR. GALYEAN: That's correct. That's
20 correct.

21 MEMBER BLEY: You would have given
22 yourself more flexibility for the future if you had
23 done the other -- okay. That's all, Mr. Chairman.

24 CHAIR CORRADINI: Okay. Other
25 questions?

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1 (No response.)

2 CHAIR CORRADINI: All right. The staff
3 is up next. Thank you, guys, but don't go far.

4 (Pause.)

5 CHAIR CORRADINI: Okay. Go ahead. I
6 think you need to make the green light go on.

7 MR. TABATABAI: Good afternoon. My
8 name is Omid Tabatabai. I'm a senior project
9 manager in the Office of New Reactors. I work on
10 the NuScale project.

11 I just wanted to thank the committee
12 for this opportunity and Mark Caruso will start the
13 presentation. Mark doesn't need any introduction.
14 He's our senior PRA expert.

15 (Pause.)

16 MR. TABATABAI: Okay. Just a little
17 bit of background. We received this topical report
18 from NuScale in July of 2015. We sent an
19 acceptance letter in September and we have written
20 the draft SER.

21 So, pursuant to this meeting if there
22 is any reason for us to go back and update our SER
23 for any reason, it has not been finalized. I just
24 want to make sure that the committee knows this.

25 With that introduction, I will turn the

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1 presentation to Mark.

2 MR. CARUSO: I don't have that many
3 slides. So, I thought I would just move through
4 them quickly and I think there is some -- a number
5 of topics that I heard you say you wanted to talk
6 to -- you wanted to ask me about, too. So, I think
7 it's probably more of what your questions are.

8 I think presumably you read the SER.
9 So, I think, you know, we don't need to spend a lot
10 of time walking through it.

11 So, I'm really -- whatever you want is
12 fine with me on this. If you want to just go
13 through particular topics, or you want to just --

14 CHAIR CORRADINI: I think you want to
15 go through your presentation --

16 MR. CARUSO: Okay.

17 CHAIR CORRADINI: -- but we do have
18 questions.

19 MR. CARUSO: Okay. So, basically the
20 agenda for my presentation is to talk about, you
21 know, what areas did we look at, what did we look
22 at, what did we find and a discussion of we have a
23 section in there where we've put some conditions
24 and limitations on the use of the topical report in
25 terms of application and some other areas. And so,

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1 we'll go -- I thought we would go over that.

2 So, the next slide is -- so, first off
3 I would say, you know, there's no SRP for reviewing
4 this topical report. There's no staff guidance
5 that you can pull out that says, you know, here's
6 the acceptance criteria you should use to judge a
7 topical report like this.

8 So, to me it was what are the key
9 issues here that are being raised in this topical
10 report? And I saw them as, you know, the concept
11 of basing your assessment in the -- with the PRA of
12 significance, you know, doing your risk ranking and
13 sensitivity study, if you will, using an absolute
14 risk measure as the basis for it as opposed to just
15 simply, you know, picking the old numbers, factors
16 of two and 0.005 or whatever they are.

17 So, we looked into that -- to that
18 concept and the application of that concept and the
19 acceptability of that approach.

20 Then we basically looked at, you know,
21 what were the threshold values they picked. What
22 was the basis they used? How reasonable are they?
23 What -- do we have some means of, you know, some
24 criteria that we can compare them against or
25 something we can use as a benchmark or basis to

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1 say, you know, we're okay with them.

2 And then the last thing was, how are
3 they going to apply this methodology? What are
4 they going to use it for? How are they going to
5 use it? That sort of thing.

6 So, in the findings that we -- in
7 looking at the use of the absolute change or the --
8 an absolute metric -- basis of an absolute metric
9 versus the relative approach of using the existing
10 RAWs and Fussell-Veselys as a measure of, well, if
11 I increase it by this factor, then that must mean
12 it's significant.

13 We, you know, we looked in Reg Guide
14 1.174. They brought it up and there's a long
15 discussion in there about the appropriateness of
16 doing this.

17 I think, you know, when you think about
18 it, it makes perfect sense. What you're saying is
19 when I -- and when I do these kinds of sensitivity
20 studies, what I care about is when I make change to
21 a base PRA, when I fail some component or some
22 system, you know, how much does risk go up and what
23 risk level do I get to?

24 And if you have a, you know, a
25 benchmark for feeling that you've reached a point

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1 where there's a general consensus that it's
2 significant, that that's a better approach to use.

3 And that for all the reasons that
4 NuScale said when you start to look at base core
5 damage frequencies and applying -- just applying
6 the old numbers, you know, you start to find that
7 the amount of risk increase that's associated with
8 that can be very, very small or could be
9 potentially very, very small.

10 So, I guess basically the way I saw
11 this, and I have a feeling I saw it differently
12 than you do, is that this concept is not -- I don't
13 see a relationship in choosing the thresholds with
14 the base core damage frequency.

15 To me, it's about using the base core
16 damage frequency that you have. And I don't claim
17 to know what NuScale has either. They haven't told
18 us. We don't know.

19 And this absolute metric, that putting
20 those two together is the appropriate way to look
21 at risk significance from the sensitivity studies.

22 And that I believe you'll find that,
23 you know, in the limit that you go to operating
24 plants and their, you know, base core damage
25 frequencies, you'll find that that approach lines

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1 you up with the same importance value. The same
2 values.

3 CHAIR CORRADINI: So, Mark, though, can
4 I ask the question -- John and Dennis know this in
5 much more detail. But just from a common sense
6 standpoint if I understand this correctly, if I
7 were to apply an absolute, whatever that means, and
8 so that if I am sitting at -- if I -- so, let me do
9 it in a relative basis just so that in my mind at
10 least I've got it.

11 So, if I have an estimated CDF of 10 to
12 the minus fifth, then for this RAW score if I get
13 two, then as long as I stay below two, I'm all
14 right. That component, that SSC is not in the
15 pool. If I get above it, it falls into the pool.

16 Now, if the CDF estimated is 10 to the
17 minus seven, the proposal is the RAW is 30,
18 essentially.

19 MR. CARUSO: Yeah, you would derive
20 that.

21 CHAIR CORRADINI: Yeah.

22 MR. CARUSO: Right.

23 CHAIR CORRADINI: That's the only math
24 I can do.

25 MR. CARUSO: Right.

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1 CHAIR CORRADINI: The RAW is 30. So,
2 now -- so, I've got this point and I've got this
3 point. Now, that's an estimate on the below CDF.

4 So, my question to the staff is, is
5 your approval of this contingent up on that
6 absolute number of the estimated CDF, or --

7 MR. CARUSO: No.

8 CHAIR CORRADINI: Then what was in the
9 back of your mind to say it's good to go if it
10 happens to start creeping back up to 10 to the
11 minus four -- or 10 to the minus fifth?

12 MR. CARUSO: Because --

13 CHAIR CORRADINI: I'm trying to
14 understand the logic of how I interpolate between
15 those two values.

16 MR. CARUSO: Because what you care
17 about is where you end up, not where you start.
18 So, if you're going to start closer, there's
19 probably a lot more components that are going to
20 get you, you know, get you in the bin.

21 It's about where you go to. It's not
22 from where you start.

23 CHAIR CORRADINI: Right, but --

24 MR. CARUSO: If you start with an
25 operating reactor and you go up about two, you're

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1 going to end up going up to about the same point
2 you would for NuScale.

3 CHAIR CORRADINI: But, I mean, so I'm
4 going to ask it another way and then let you try --

5 MR. CARUSO: Yeah, sure.

6 CHAIR CORRADINI: -- and then I'll
7 stop.

8 MR. CARUSO: The other --

9 CHAIR CORRADINI: It seems to me that
10 you have these two values that you're -- and
11 NuScale said it and I kind of agree with them that
12 it's absolutely relative. In some sense the very
13 fact that I'm moving based on CDF, I essentially
14 have some sort of sliding scale.

15 But between those two, there's either a
16 threshold or there's a sliding scale and I'm trying
17 to understand what the staff is thinking of if when
18 do you come in with the final numbers for the PRA
19 that is used as part of the criteria to decide the
20 DRAP -- the input of DRAP for their candidates, is
21 it a sliding scale, or is there a threshold?

22 And if there's a threshold, what is it?
23 Because that seems to be missing in the logic of
24 the --

25 MR. CARUSO: Well, the threshold is the

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1 three times 10 to the minus six.

2 CHAIR CORRADINI: So, I can use that
3 even I get a CDF of --

4 MR. CARUSO: Yes.

5 CHAIR CORRADINI: -- three times 10 to
6 the minus six?

7 MR. CARUSO: That's the whole point of
8 using it. That's the absolute. And the reason we
9 call it an absolute -- there are no absolutes,
10 right?

11 CHAIR CORRADINI: Yeah.

12 MR. CARUSO: But that three times 10 to
13 the minus sixth, the absolute nature of that is
14 because it's kind of linked through the consensus
15 of the NRC and the Commission and it's kind of
16 linked to the safety goals.

17 CHAIR CORRADINI: Okay, but ---

18 MR. CARUSO: To the -- to certain
19 safety goals.

20 CHAIR CORRADINI: Okay, but let me push
21 my point. So, let me just make sure I understand
22 your point.

23 Your point is that it stays three point
24 whatever the number is, three to the minus sixth.
25 And now if my CDF estimate after they do all their

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1 work is three times 10 to the minus six, it pops up
2 to one times 10 to the minus fifth?

3 In other words, there's a -- in my
4 mind, there's got to be a continuum here. And as I
5 do my estimate as I get a larger and larger
6 estimate for the CDF, do I automatically default to
7 the already 1.174 values?

8 MR. CARUSO: I believe you will.
9 Because if you go back and derive importance
10 measures, RAWs and Fussell-Veselys, go back and
11 look at the definitions of them in terms of base
12 CDF and increases and that sort of thing, and take
13 -- and use the absolute and look at driving what
14 would come out of that for the actual values,
15 you'll, you know, they will change as the base core
16 damage frequency changes.

17 So, in a sense of the thing that's
18 being held constant between the old reactors and
19 the new reactors, is the fact that once you get up
20 close to three times 10 to the minus six or one
21 times 10 to the minus five, that's going to trigger
22 you.

23 So, it's -- there's such a, you know,
24 the other way you can look at it is I -- if what I
25 start is way down here, then I should have bigger

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1 factors to go up to, but it's all about where you
2 get to. And both -- all the plants are bound by
3 getting too close to 10 to the minus five.

4 CHAIR CORRADINI: As a delta.

5 MR. CARUSO: No, as the end point.

6 CHAIR CORRADINI: Oh, as the end point.

7 MR. CARUSO: I start here, I go here.
8 They're not providing a threshold, a delta
9 threshold. In fact, I made that point in the SER
10 that Reg Guide 1.174, they're deltas.

11 They're not talking about a delta.
12 They're talking about the end put. They're talking
13 about I started here, I failed the component, which
14 to me means it doesn't work, it doesn't do -- in
15 every single cut set, it doesn't do what it's
16 supposed to do. However it got there, it got
17 there.

18 And whatever I have to do in the PRA to
19 make that happen, that's what they do. I don't
20 know how they do it either. But when we talk about
21 component failure, the component -- that's what
22 they're trying to look at.

23 What happens if I don't have this
24 component that it can't do what it's supposed to
25 do? What does that do in the PRA?

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1 And to me, you know, it's an
2 engineering sensitivity study, but the point is, is
3 that you put that in and then you calculate the new
4 CDF. And if it goes over three times 10 to the
5 minus six --

6 MEMBER STETKAR: Okay.

7 MR. CARUSO: -- boom, you're in the
8 risk significant bin.

9 MEMBER STETKAR: Let me try this:
10 Suppose their core damage -- their base core damage
11 frequency is three times 10 to the minus six.
12 Every single component in that plant will then be
13 in their DRAP program, because the conditional core
14 damage frequency by definition if I fail any
15 component, will be greater than three times 10 to
16 the minus six.

17 If the core damage -- baseline core
18 damage frequency with failure rates that are all
19 less than 1.0, is three times 10 to the minus six
20 no matter what component I fail, the conditional
21 core damage frequency will be greater than three
22 times 10 to the minus six.

23 Hence, every single component in that
24 plant, maybe even stuff they haven't modeled, will
25 be in their DRAP. Because by definition, their

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1 conditional core damage frequency for each
2 component will be greater than three times 10 to
3 the minus six. So, that's what we want to do --
4 well, I wouldn't want to do that if I was NuScale,
5 but --

6 MR. CARUSO: Well, I'm not sure what
7 you're cranking over there, but I looked at in
8 terms of --

9 MEMBER STETKAR: No, no, no, this is a
10 real example, Mark.

11 MR. CARUSO: -- how you derive --

12 MEMBER STETKAR: This is not --

13 MR. CARUSO: Well, I went through my
14 own real example and I was convinced that the way
15 they're doing it, that it doesn't --

16 MEMBER STETKAR: The way they're doing
17 it is conditional --

18 MR. CARUSO: It's the fundamental way
19 to do it and it's exactly the way the operating
20 reactors are doing it, because they essentially
21 base those importance measures on that amount of
22 risk going up, not going above that. And I think
23 you can just plug in their numbers and crank up the
24 values.

25 MEMBER STETKAR: What they're proposing

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1 is a little different, though, because they're
2 saying anything that -- if I fail it, anything that
3 causes the conditional core damage frequency, now,
4 in an absolute sense to be greater than three times
5 10 to the minus six, is in my bucket. It's in --
6 it's important. It's important enough that it's in
7 the DRAP program and it's important.

8 MR. CARUSO: Okay.

9 MEMBER STETKAR: That might give me an
10 appropriately-sized bucket if my core damage
11 frequency baseline is 10 to the minus seven.

12 I will tell you that if my core damage
13 frequency baseline is three times 10 to the minus
14 six, my bucket is full of every single piece of
15 equipment in the plant, by definition.

16 MR. CARUSO: How it should be.

17 MEMBER STETKAR: By definition. And it
18 should be -- well, it should be, but I'm not sure
19 what that means in terms of --

20 MR. CARUSO: 1.174 would say, you know,
21 if you start from there and you go way up to there,
22 you know, I don't like that at all.

23 MEMBER STETKAR: 1.174 says I should
24 have a different threshold on margin at one times
25 10 to the minus four versus one times 10 to the

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1 minus five --

2 MR. CARUSO: They're all in the --

3 MEMBER STETKAR; -- versus one times 10
4 to the minus six.

5 MR. CARUSO: They're all in the range
6 10 to the minus five, three times 10 to the minus
7 six. So, it's -- yeah, they have -- sure, they
8 have the two regions, but --

9 CHAIR CORRADINI: But I think, Mark,
10 what's -- I don't -- what's troubling me is that
11 there's a -- I'm not sure I want to ask the NuScale
12 folks again, because I thought I asked the question
13 of them and they would have said that if I start
14 approaching this estimate of the CDF being of the
15 order of their -- of their criteria, they would
16 essentially jump back to the current plant
17 criteria.

18 They have a plant that's of a certain
19 technology that, therefore, I would look for a
20 threshold of one times 10 to the minus fifth, not
21 three times 10 to the minus sixth. That was my
22 interpretation of their -- of the -- so, there is a
23 threshold. I'm just trying to understand --

24 MR. CARUSO: They didn't say that --

25 CHAIR CORRADINI: -- how the staff is

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1 understanding --

2 MR. CARUSO: -- in the topical report.

3 CHAIR CORRADINI: -- the threshold.

4 MR. CARUSO: They didn't say that in
5 the topical report.

6 CHAIR CORRADINI: So, can I get a
7 clarification from NuScale? Because I asked the
8 same question about if the --

9 MR. CARUSO: Well, they proposed a
10 methodology.

11 CHAIR CORRADINI: You have to get to
12 the mic and identify yourself.

13 MR. GALYEAN: Well, I think -- is this
14 on?

15 CHAIR CORRADINI: Yes.

16 MR. GALYEAN: The point is that we
17 certainly -- oh, this is Bill Galyean, NuScale
18 Power. The point being there would certainly not
19 be any incentive to employ this new approach if you
20 were in that range of base core damage frequency.

21 And since the staff has already
22 accepted the traditional approach, then why not
23 just use the traditional approach?

24 I don't --

25 CHAIR CORRADINI: Okay. So, don't go

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1 anywhere. So, for both of you the question would
2 be, how close do you have to be to three times 10
3 to the minus six before you would abandon the
4 suggested approach and move to the old approach?

5 MR. GALYEAN: Well, so far that
6 situation has not arisen. So, we haven't really
7 crossed that bridge. I haven't really given that
8 much thought.

9 CHAIR CORRADINI: Okay. And so now, to
10 the staff. So, if they come back to you with an
11 estimate of two times 10 to the minus six, are you
12 going to force them to hold to three times 10 to
13 the minus six to give their candidate DRAPs, or are
14 you going to let them default to the current
15 approach?

16 MR. CARUSO: Well --

17 CHAIR CORRADINI: I'm just trying to --
18 I'm just trying to understand.

19 MR. CARUSO: We approve this method.

20 CHAIR CORRADINI: If we -- if we --

21 MR. CARUSO: Come in with the DC
22 application and say, you know what? We were way
23 off and now we want to propose a new method. So,
24 we'd say, okay, we'll look at that. And we'll say,
25 well, it's just like the one you approved for

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1 everybody else. And you'll say, well, you can
2 probably use that.

3 MEMBER STETKAR: Mark.

4 MR. CARUSO: And so what, I mean --

5 MEMBER STETKAR: Mark, and then larger
6 staff, why do we need to have this discussion time
7 and time again for every new applicant when we're
8 talking about specific numbers?

9 Why can't the staff develop some
10 approach to determine what is important to safety
11 quantitatively and apply that uniformly that it's -
12 - and I don't care what the numbers are. I really
13 don't care what the numbers are.

14 I just don't want to sit in these
15 stupid meetings for 25 -- it's a stupid meeting for
16 25 different -- 25 different applicants that come
17 in with different -- slightly different
18 philosophies or that say, well, you did it for
19 NuScale, so you should do it for me even though my
20 core damage frequency is a little different.

21 MR. CARUSO: I understand. I
22 understand completely. We -- the method I think
23 that you would -- the staff has, you know, wrapped
24 itself around is the approach DRAP.

25 We have guidance on doing DRAP. DRAP

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1 is risk-informed. We see, you know, the PRA input
2 as one input. It's you got this PRA, you try and
3 do a sensitivity study with these risk-ranking
4 things to get some ideas of what's important.

5 And by the way, you know, to me, you
6 know, risk-ranking and all that sort of stuff made
7 a lot of sense when you had these very, very
8 complex older plants with five million systems and
9 lots of dependencies and lots and lots of non-
10 safety systems that could be risk-significant.

11 You get to NuScale now and they're so
12 simple, you know. I'm not sure, you know, what all
13 the big benefit is to this right here, but that's
14 just a personal thing.

15 But, anyway, so we're counting on --
16 what I'm counting on and what we're counting on is
17 we want to see all the rest of the picture of
18 determining risk significance.

19 And that includes -- that includes, you
20 know, if I have something that's going to affect
21 multi modules, how do you factor that in your DRAP
22 program, you know?

23 We haven't seen that yet. They haven't
24 given it to us. We don't know what they're going
25 to show us, you know.

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1 Remember, most DCs don't even do a
2 seismic PRA. They use insights from the seismic
3 margins analysis to make judgments about what
4 should go in there.

5 So, when you ask the staff, what is the
6 staff going to do, I mean, I think, you know,
7 there, you know, there's a very interesting paper
8 that Gareth Parry, Mike Cheok and Rich Cherry wrote
9 about different approaches to using risk importance
10 measures and that sort of thing and I think that's
11 good stuff.

12 I don't think that the staff has in
13 their mind, I mean, I think there are these issues
14 of scaling and I think it makes sense that, you
15 know, you shouldn't be tied to those numbers that
16 were developed numerically based on the profiles of
17 operating reactors.

18 So, I think that's okay, that makes
19 sense and if they want to come in and propose it,
20 you know, we don't say go away, you know, we don't
21 want to do that. We don't have a basis for
22 rejecting, you know, a topical report on that
23 basis. We look at it and we make a -- we make a,
24 you know, an assessment of it.

25 CHAIR CORRADINI: But if I might just

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1 repeat it back to you, so what I'm hearing from the
2 staff is your anticipation is even though we don't
3 know what their final results are from their PRA
4 analyses, the expectation is it will be less than
5 three times 10 to the minus six.

6 So, the approach of using that as an
7 absolute measure of what the equivalent or in
8 substitute for the RAW is reasonable.

9 MR. CARUSO: Yes.

10 CHAIR CORRADINI: So, can I go back to
11 the second measure, which is the FV? I'm not going
12 to try to pronounce it.

13 MR. CARUSO: Yes.

14 CHAIR CORRADINI: So, what is the
15 staff's view on changing it from essentially the
16 0.5 percent to the 20 percent? I think I got that
17 right.

18 MR. CARUSO: Well, you know, they're
19 using it to look for things that are not showing up
20 in the other one. Things that are only causing
21 small rises that don't even get near the threshold,
22 but they're saying there may be stuff in there
23 that's going to show up in a big chunk of cut sets.
24 And I want to know that and understand it.

25 And, you know, they looked at what

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1 would be a big chunk if I used a Fussell-Vesely at
2 0.005? For them if you have a very low core damage
3 frequency, you're not going to get a big chunk.

4 So, when you use theirs, that number
5 goes up to --- I think for them it was like it goes
6 up to -- if you scale it up, goes up to 50 percent.
7 And they said, well, I'll probably put stuff in
8 that shouldn't be. So, we used 20. We don't have
9 any, I mean --

10 CHAIR CORRADINI: I understand.

11 MR. CARUSO: Yeah.

12 CHAIR CORRADINI: But their calculation
13 and their viewgraph kind of goes with the words in
14 your SE where you said a threshold of 50 percent
15 for NuScale would identify contributors that
16 represent the same level of absolute risk as the
17 operating plant.

18 So, again, that calculation is assuming
19 a CDF and kind of backing into it. So, I'm trying
20 to understand another way of justifying the 20
21 percent versus the five percent, because in some
22 sense the way I understood their presentation and
23 the way I understand the staff's SE, if it's 0.5
24 percent and it's a hundred times less of a CDF,
25 then I can move everything by two orders of

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1 magnitude and on essentially the same point, but
2 I'm not exactly sure. So, I'm not going to use 50,
3 I'm going to use 20 percent.

4 That's how I read the words in the SE.
5 Am I misunderstanding?

6 MR. CARUSO: Well, I think we try to
7 make a point at the end there. We're not approving
8 any, you know, we're approving the approach of
9 driving that value using base core damage frequency
10 and we're not approving any specific values, any
11 RAWs, any Fussell-Veselys.

12 So, you know, that number makes sense,
13 you know, if it's very, very low.

14 CHAIR CORRADINI: So, the approach
15 makes sense, but the actual number is --

16 MR. CARUSO: Right.

17 CHAIR CORRADINI: Okay. All right.
18 All right. Thank you.

19 MEMBER STETKAR: Now --

20 MR. CARUSO: If you feel that I've said
21 in there --

22 MEMBER STETKAR: -- is that -- let me
23 see if I can understand that --

24 MR. CARUSO: In fact, I think we have a
25 --

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1 MEMBER STETKAR: -- that fourth
2 condition. It says, specific values for importance
3 measures such as risk achievement worth or risk
4 reduction worth derived from the criteria listed in
5 Section 4, must reflect base core damage frequency
6 and will be reviewed case-by-case by the NRC.

7 But that still doesn't change your
8 acceptance of their three times 10 to the minus six
9 or Fussell-Vesely of 0.2.

10 MR. CARUSO: No, I don't think --

11 MEMBER STETKAR: Does it?

12 MR. CARUSO: The 0.2 is a scale value.

13 MEMBER STETKAR: But not --

14 MR. CARUSO: We've said in there we
15 don't know -- we don't know what the core damage
16 frequency is going to be.

17 And so, if they came in and said, yeah,
18 it's really three times 10 to the minus six or one
19 times 10 to the minus five, but we're still going
20 to use 0.2, no.

21 And if I haven't made that clear, then
22 I'd like to know that and --

23 MEMBER STETKAR: That -- boy, I'll tell
24 you I didn't get that from the last --

25 MEMBER BLEY: Yeah, neither did I.

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1 MEMBER STETKAR: -- that last --

2 MEMBER BLEY: Neither did I. That was
3 one of the big things I had circled on that.

4 MR. CARUSO: Did you think we were
5 approving the 0.2 no matter what their core damage
6 frequency was?

7 MEMBER BLEY: Yeah. Well, you had one
8 condition that hinted at it, but it only hinted.

9 MEMBER STETKAR: It's that fourth
10 condition.

11 MEMBER BLEY: Yes, the fourth
12 condition.

13 MEMBER STETKAR: My note next to that
14 is, what does this mean? Because I --

15 MEMBER BLEY: Mine said, there's
16 nothing here tying it to CDF unless four does, but
17 I can't see exactly how.

18 MR. CARUSO: Okay. That helps.

19 MEMBER BLEY: So, it's that condition
20 that didn't ring clear.

21 MEMBER STETKAR: But by importance
22 measures, you specifically call out risk
23 achievement worth or risk reduction worth. They're
24 very careful -- they don't use either of those
25 terms. You did.

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1 They use terms like an absolute
2 conditional core damage frequency and a Fussell-
3 Vesely importance applied per hazard.

4 MR. CARUSO: Yes.

5 MEMBER STETKAR: You use these --
6 these, risk achievement worth and risk reduction
7 worth, are defined -- I can look up definitions,
8 and there are numerical definitions.

9 MR. CARUSO: Yeah.

10 MEMBER STETKAR: Nowhere in the topical
11 report do they propose to use those for anything at
12 all.

13 MR. CARUSO: On the other hand, the
14 whole concept they proposed in the topical report
15 is the idea that I'm scaling these things according
16 to base whatever. So, but I agree, you know. We
17 need to make it crystal-clear.

18 MEMBER STETKAR: If you --

19 MR. CARUSO: One of the things that's
20 crystal-clear to me is that we are approving the
21 approach and method of applying the absolutes with
22 the core -- with whatever core damage frequency you
23 have.

24 And it's not -- it's not -- we're not
25 approving stuff that assumes you have 10 to the

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1 minus seven, but which means that 0.2 would be
2 good.

3 MEMBER STETKAR: Mark, let me --
4 because I really want to understand this because I
5 think you need to reword that last condition and
6 limitation.

7 MR. CARUSO: Okay.

8 MEMBER STETKAR: Is it the intent of
9 that last condition that you don't accept three
10 times 10 to the minus six as an absolute value?

11 MR. CARUSO: That's part of what we're
12 accepting.

13 MEMBER STETKAR: Okay. Is it the
14 intent of the last item that you do not accept
15 Fussell-Vesely importance of 0.2?

16 MR. CARUSO: Yes, because that's a
17 relative, right?

18 CHAIR CORRADINI: But, Mark, then the
19 logic, I mean, I think I get it now. I didn't get
20 it by reading the SE, at least the limitations
21 part. So, I get it.

22 So, the FV factor is scale, but the
23 substitute for the RAW score is not scale because
24 you're going to hold the three times 10 to the
25 minus six and see that from your perspective that's

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1 an acceptable value.

2 MR. CARUSO: Right. It's not a -- it's
3 not a RAW. It's not a relative --

4 CHAIR CORRADINI: I understand it
5 isn't. I understand it isn't. It's an absolute,
6 but I --

7 MEMBER BLEY: It's an absolute, but
8 they generate it through scaling.

9 MR. CARUSO: No, they didn't. They
10 chose it as --

11 MEMBER BLEY: He read a different
12 report than I did, that's all.

13 MR. CARUSO: Well, I don't think so.
14 And I don't think -- I think ours is very clear
15 that what we said was we're approving that number
16 because given Reg Guide 1.174 in terms of what's
17 significant and what's not, given our regulatory
18 analysis guidelines that looks at when should I
19 make a decision to do something in terms of -- that
20 that number is consistent with that, that's sort
21 of, you know, into what we would consider a line of
22 significance.

23 And that's the basis for it, not that
24 it was -- not that it was scaled to make sure that
25 they got some answer, no.

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1 CHAIR CORRADINI: Okay. All right.
2 That at least helps me, because I missed that. So,
3 thank you.

4 I'm sorry, Dennis. Did you want to ask
5 --

6 MEMBER BLEY: No.

7 CHAIR CORRADINI: John.

8 MR. CARUSO: I mean, the one thing we
9 did put constraint on was in the PRA you do use is
10 the one they committed to using in all modes,
11 hazards, shutdown, yada-yada-yada, technically
12 adequate, but not any particular numbers because we
13 don't know what they are yet. We haven't seen
14 their application.

15 CHAIR CORRADINI: Okay. Other
16 questions by the committee?

17 Charlie.

18 MEMBER BROWN: I'm just trying to get a
19 -- I'm not a PR -- as you are well aware, I have
20 little, if any, knowledge on PRAs and risk and I
21 did enjoy reading this topical report dwelling in
22 my ignorance.

23 And I'm just trying to boil it down a
24 little bit to the fact that you all at least said
25 they have to address other modules in their

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1 analyses somewhere along the line in terms of their
2 effect on their PRA. That's in your Item 4, I
3 think, or Item 3.

4 And your last statement, which you talk
5 about the specific values or stuff they may use,
6 you've -- the message you're giving to me is that
7 you all evaluate this and you may not necessarily
8 agree with them on the application of their method
9 in some circumstances if you think it is not
10 applied -- or doesn't give a result you think is
11 consistent with satisfying safety criteria that you
12 think are relevant.

13 MR. CARUSO: Yeah, we haven't approved
14 its application, you know, in any --

15 MEMBER BROWN: I mean, this is a big,
16 fuzzy logic topical report to me.

17 MR. CARUSO: Yeah.

18 MEMBER BROWN: I mean --

19 MR. CARUSO: I agree.

20 MEMBER BROWN: -- there is a lot of
21 ifs, ands and buts and it's also based on them
22 having an actual PRA that demonstrates the low --

23 MR. CARUSO: Yes.

24 MEMBER BROWN: -- 10 to the minus
25 seventh or lower, I guess --

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1 MR. CARUSO: Yes.

2 MEMBER BROWN: -- CDFs and --

3 MR. CARUSO: Yes.

4 MEMBER BROWN: -- that they're
5 advertising. Once it goes above that, this gets a
6 little bit mushier in terms of how close you get to
7 the existing operating fleet so that -- so, this
8 seems to me to be kind of a piece of Jell-O that
9 you're sticking your hands in and you're going to
10 have to evaluate case-by-case.

11 And I kind of thought of it the way you
12 framed it, and so I'll --

13 MR. CARUSO: Yeah, I --

14 MEMBER BROWN: That's my opinion.

15 MR. CARUSO: No, I --

16 MEMBER BROWN: I'm not speaking for
17 anybody else if they understand what I'm saying,
18 because it was kind of interesting to read the
19 thing since I -- I learned a little bit from doing
20 this. So, I appreciate the clarifications.

21 MR. CARUSO: It's a very, very narrow
22 request and I think it was important to get the
23 staff's up or down on one particular concept and
24 issue and move forward.

25 And so, we had to be very specific

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1 about what we were saying we were accepting, not
2 accepting and I guess we weren't quite careful
3 enough.

4 MEMBER BROWN: All right. Well, thank
5 you.

6 MEMBER SKILLMAN: Mark, I'd like to ask
7 this question, please.

8 MR. CARUSO: Sure.

9 MEMBER SKILLMAN: The gentleman from
10 NuScale was very clear that this past summer they
11 received a letter from the NRC communicating that
12 there is an understanding that if there are two
13 NuScale plants perhaps at a site, that they are
14 treated independently from each other.

15 I can understand that. Let's say it's
16 a 1500-acre site and there are two 12-module
17 NuScale plants 500 yards apart. That would be very
18 much like any of the big twin Ps or Bs that we have
19 in the country today.

20 What's not clear in my mind is how a
21 full-build, 12-module NuScale plant risk is
22 assessed module to module to module to module to
23 module, and I'm struggling with that.

24 MR. CARUSO: I can understand. I'm
25 glad you asked that question, because this is a

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1 topic that we need to talk to you about and we'll
2 start it off today.

3 We had thought about multi-module,
4 multi-module risk issues a couple years ago. And
5 in 2011 we formed a small working group of risk
6 people and other people to think about it, because
7 we had put in our draft SRP 19-0, we put a
8 statement in there that said if you have -- for
9 IPWRs if you have a facility that includes multiple
10 modules, you need to address the risks of potential
11 multi-module instance. And that's all we said.

12 And so, we thought about that and we
13 said, what does that mean? Can we be a little bit
14 more, you know, don't we need to be a little bit
15 more specific about that, you know? How are they
16 going to do it? Are we giving enough guidance to
17 industry?

18 So, we put together this group and we
19 thought -- put a lot of ideas on the table, multi-
20 module PRAs, new risk metrics, frequency
21 consequence stuff, a number of things.

22 I think we came up with three options.
23 We brought it to our management and --

24 CHAIR CORRADINI: This is recently?

25 MR. CARUSO: This was probably two

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1 years ago.

2 CHAIR CORRADINI: Oh.

3 MR. CARUSO: I'm going to get --

4 CHAIR CORRADINI: You're on your way
5 somewhere.

6 MR. CARUSO: I'm on my way somewhere,
7 yes. I'm on my way to a couple different places.
8 Anyway, so their guidance at the time was that new
9 risk metrics was probably not a road we wanted to
10 go down at this time, because -- and new
11 approaches, because the Commission already had in
12 front of them a couple of proposals about new risk-
13 informed approaches, and they had the Apostolakis
14 thing in front of them and that there was a
15 tendency to feel they did not want to get out in
16 front of the Commission or anything by proposing
17 that we develop multi-module metrics or multi-
18 module safety goals or whatever.

19 So, the working group went back and to
20 -- with the guidance to try and find something a
21 little bit more qualitative.

22 So, what we came up with is some
23 qualitative guidance to IPWRs that says we need to
24 do two things.

25 First, you need to identify -- you need

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1 to do a systematic assessment of your design and
2 identify, you know, those events that could evolve,
3 you know, potential core damage accidents on
4 multiple modules simultaneously and identify what
5 they are. And identify those design features
6 you've included to make the risk of such an
7 accident acceptably insignificant or I forget what
8 the word is.

9 The message being we want to see -- we
10 want to see your qualitative story of how your
11 design, you know, how your design will be robust
12 enough at such incidents that the risks associated
13 with such incidents are beyond the safety goals,
14 are clearly very, very small. It's not
15 quantitative.

16 So, that's what we have in SRP 19-0 and
17 unfortunately you never saw it. And we saw it
18 because it was put in at the, you know, after we
19 had met with you. It was kind of like ships
20 passing in the night. And so, we want to have a
21 discussion with you about that, those criteria.

22 In addition to that, the question of
23 how do you deal with design basis accidents that
24 then involve multi-modules? It's something that
25 we're working on right now in a similar way. What

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1 criteria, you know?

2 If I have a steam line break on Module
3 A, you know, and the steam line breaks and it's
4 blowing steam through the building and I'm in
5 Module B, what does that mean?

6 If I have some accident that puts
7 radioactivity in the pool that triggers some water
8 on the other modules and trips them, what does that
9 mean? If I fail the only one offsite powerline and
10 my island mode doesn't work and I have 12 reactor
11 trips, is that an AOO, is that an accident?

12 So, we are working on that right now
13 and we feel that we should come to you to discuss
14 both of those issues.

15 Is that -- Mark.

16 MR. TONACCI: You were okay until the
17 last sentence.

18 CHAIR CORRADINI: I was okay until that
19 last sentence.

20 MR. TONACCI: So, we are working, as
21 Tom mentioned a minute ago -- and, by the way, I'm
22 Mark Tonacci.

23 As Tom mentioned a minute ago, NuScale
24 has asked us a similar question. We are responding
25 to them in a letter, but this particular area was

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1 thornier than we could deal with immediately.

2 And as we're getting into this, we're
3 finding it's not such an easy question. Does GDC-5
4 say that you're not allowed to have multi-module
5 events, or that they just can't perpetuate from one
6 module to the next, or does it mean you can have
7 multi-modules as long as you keep the dose criteria
8 within what a DBA is.

9 We're working our way through this. We
10 haven't -- and we're at the working level. We have
11 not fully engaged our management, although they are
12 aware of it and they are giving us periodic
13 guidance, but this is an active area that we need
14 to come to grips with promptly so that we can work
15 our way through the design certification when it
16 comes in and all the other ramifications that go
17 with that.

18 CHAIR CORRADINI: Thank you.

19 MEMBER SKILLMAN: Thank you.

20 CHAIR CORRADINI: I'm not sure what to
21 make of it, but you clearly are worried about it
22 and thinking about it.

23 MR. CARUSO: Yeah. Yeah, and I think
24 originally, you know, we were right at the point
25 where we were going to issue 19-0 and we've been

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1 through -- we met with you and I think at one point
2 we felt, well, we just need to put it -- we'll put
3 it in interim guidance and that way we'll come
4 back. And then there was the thought, we may as
5 well get it in there now, it's going up.

6 And so, it did go up for public
7 comment, but it was after we met with you.

8 CHAIR CORRADINI: Okay. All right.
9 Other questions?

10 MR. CARUSO: I just don't want you to
11 feel that we tried to sneak something by.

12 CHAIR CORRADINI: Well, we never feel
13 left out.

14 MR. TONACCI: I think it's also worth
15 mentioning there was a SECY paper that went to the
16 Commission here recently, 16-0012, on -- what was
17 it? It was mechanistic source term. And in the
18 back in the enclosure, there was a discussion very
19 brief on multi-module events.

20 And so, that started -- that didn't
21 start our thinking, but it helped to add some
22 clarity, but it is really not sufficient for what
23 we -- where we need to take this topic.

24 CHAIR CORRADINI: Okay. Can you remind
25 me of the SECY that I don't remember?

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1 MR. TONACCI: It was -- I want to say
2 it was 16-0012. Came out within the last month, I
3 think.

4 CHAIR CORRADINI: Okay. Thank you.

5 MR. TONACCI: There was only -- it's
6 really not the intent of the overall SECY. It's
7 just a paragraph in it.

8 CHAIR CORRADINI: Okay. Other
9 questions by the committee?

10 (No response.)

11 CHAIR CORRADINI: Okay. So, I ask
12 Quynh to go and open the line. Do we have comments
13 from members in attendance here in the general
14 public?

15 MR. NGUYEN: It's open.

16 CHAIR CORRADINI: Can somebody please
17 acknowledge that they're out there on the line? It
18 must be open. It's crackling, but can somebody
19 acknowledge they're out there, please? Anybody?

20 MS. MROWCA: This is Lynn Mrowca. We
21 hear you loud and clear.

22 CHAIR CORRADINI: Thanks, Lynn. Okay.
23 Do I have any comments from the members of the
24 public on the line?

25 (No response.)

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1 CHAIR CORRADINI: Okay. Hearing none,
2 why don't we close the line before we -- okay.
3 Let's go around the table and I want to get
4 people's comments.

5 Ron.

6 (Off microphone comment.)

7 CHAIR CORRADINI: Turn on your green
8 light so we can understand you.

9 MEMBER BALLINGER: I thought I
10 understood this last night. I now realize that I
11 don't. So, now I need to go back and read it
12 again.

13 CHAIR CORRADINI: That's your comment?

14 MEMBER BALLINGER: That's my comment.

15 CHAIR CORRADINI: Okay. Dick.

16 MEMBER BALLINGER: You guys have got me
17 completely confused.

18 MEMBER SKILLMAN: Thank you, Mike. I
19 understand that the goal by NuScale is to present a
20 license application that begins with an extremely
21 low absolute CDF and a very low LRF. I get that.

22 And I understand how they added a
23 decade and a third of a decade for conservatism and
24 for error and oversight or whatever the term is.

25 My greatest concern is the multi-module

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1 issues that the PRA may not presently address. And
2 perhaps it will address it in time, but I have this
3 -- I guess I'm infected by the you-don't-know-what-
4 you-don't-know bug and we're in new territory when
5 we have 12 potentially at-power machines competing
6 for shielding, competing for operator attention.

7 And I'm making a disproportionately
8 harsh point. I know that. All I'm saying is when
9 you get 12 of these things operating all at the
10 same time, there are new risks that are presented
11 that at least in my personal opinion we must be
12 very, very careful to assess. Thank you.

13 CHAIR CORRADINI: Dana.

14 MEMBER POWERS: I'm going to jump.

15 Charlie?

16 MEMBER BROWN: No.

17 CHAIR CORRADINI: Okay. I'll now
18 default to our two PRA local experts.

19 Dennis.

20 MEMBER BLEY: I don't have a lot to add
21 other than what I've already said, except to say
22 I'm glad somebody has brought this issue to the
23 table. It's time.

24 I wish our previous advice to address
25 this kind of once and for all in a rational way

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1 that led to something, but this is a good start.

2 CHAIR CORRADINI: You're talking about
3 the risk, the criteria used to determine risk-
4 significant SSCs.

5 MEMBER BLEY: I am, yes.

6 CHAIR CORRADINI: Okay. Nothing beyond
7 that, I guess is what I'm saying.

8 MEMBER BLEY: Yeah.

9 CHAIR CORRADINI: Okay.
10 John.

11 MEMBER STETKAR: I -- Dennis put it
12 very eloquently and very succinctly. My notes were
13 -- I really sincerely thank NuScale for bringing
14 this issue at -- to the forefront at this stage of
15 their licensing where there's still time to think
16 about it rationally.

17 As I mentioned before and as the ACRS
18 has written, I personally think that it's time for
19 the NRC and the industry to address the issue of
20 how does one determine risk significance in the
21 context of quantitative risk information and do
22 that with thought, do that with thought across the
23 range of possible designs and core damage
24 frequencies and whether it's single units or
25 multiple modules or multiple standalone plants on a

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1 single site, but do it with some thought.

2 Put some thought into it so that we
3 don't have individual design and applicant-
4 negotiated numbers that may not make much sense
5 when you consider them in the context of the whole
6 of multiple applications, you know.

7 Why does a risk achievement worth of a
8 factor of five make sense for ESBWR when an
9 absolute risk -- conditional core damage frequency
10 of three times 10 to the minus six makes sense for
11 NuScale.

12 Are they somehow consistent with one
13 another? Gee, I don't know. Maybe there is some
14 way of consistently putting these things together
15 so that, you know, Applicant X 10 years from now
16 coming in with their own design can look at it and
17 say, at least we know what the ground rules are.
18 We're playing baseball, we're not playing
19 combinations of different games.

20 So, you know, that's my -- thanks to
21 NuScale for bringing it up. I agree with their
22 concept that you have -- ought to have more margin
23 at lower risk, completely. How one defines that is
24 something, I think, that requires a lot more
25 thought.

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1 CHAIR CORRADINI: Okay. So, I wanted
2 to thank NuScale and the staff for this. I'm not
3 well versed in this. So, I read through the
4 NuScale description of this risk criteria or risk-
5 significance criteria, as well as the staff SER.

6 I have to admit I did not catch a lot
7 of the nuances. The last limitation that the staff
8 put on it I missed totally relative to the FV
9 factor. So, I do think at least -- at the very
10 least I do think that perhaps the SE might be
11 tidied up a bit so that we're very clear as to what
12 we really are approving and what we are limiting
13 that has to be looked at once the final estimate of
14 the -- or the final PRA analyses come on.

15 I also think that I'd agree with John
16 and Dennis that I do agree that when something is
17 much less likely, then, therefore, you can allow
18 for a greater flexibility in terms of what you
19 determine as risk significance.

20 I don't completely understand the
21 justification and I'm still stuck on the idea that
22 there's this tiered approach and as we approach the
23 -- what the staff has approved as three times 10 to
24 the minus sixth for the CDF if -- is a trigger that
25 we then would revert back to an older approach or a

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1 current approach.

2 That to me still -- I don't completely
3 understand. Maybe I'm going to have to reread
4 things another time, but I think this is a good
5 starting point for a discussion.

6 I did not tell the subcommittee this,
7 but I -- just so that we're clear, the staff is
8 asking us for a letter on this and we have --
9 that's what I was informed. Is that correct?

10 MR. TONACCI: I didn't think we
11 typically asked for a letter on topical reports.

12 CHAIR CORRADINI: We sometimes give
13 them to you.

14 (Laughter.)

15 CHAIR CORRADINI: But you're not
16 asking.

17 MR. TONACCI: No, we're not asking.

18 CHAIR CORRADINI: Okay.

19 MR. TONACCI: But I think you've given
20 us good feedback here --

21 CHAIR CORRADINI: Okay.

22 MR. TONACCI: -- and that we can take
23 and move forward with.

24 CHAIR CORRADINI: Well, the only reason
25 I bring this up is that at least in the initial

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1 discussions, that was the impression I had is the
2 staff wanted to hear something from us.

3 So, if this is still in the mix if
4 we're going to get a revised SE on this, some
5 rewrites, that would be nice to know because at
6 this point it's scheduled to come to the full
7 committee to discuss with maybe a letter or maybe
8 not in April.

9 MR. TONACCI: Okay.

10 CHAIR CORRADINI: I think I've said all
11 I know enough to say about this subject since this
12 is not my normal area of expertise.

13 Dennis.

14 MEMBER BLEY: If we're not doing a
15 letter and we haven't talked about it to decide --

16 CHAIR CORRADINI: We have not.

17 MEMBER BLEY: If we're not doing a
18 letter, is there any reason to bring it to the full
19 committee? Is this a big enough step?

20 CHAIR CORRADINI: No, there -- at this
21 point if it's still being mulled about particularly
22 with these other issues, I would say no.

23 MEMBER BLEY: Maybe wait, yeah, because
24 the other issues are going to be of great interest.

25 CHAIR CORRADINI: Right. So, I guess I

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1 might when we have our full committee discussion on
2 Friday, we might want to bring this up to the full
3 committee to have some sort of judgement so we give
4 the staff fair warning whether they will or will
5 not --

6 MEMBER BLEY: At P&P.

7 CHAIR CORRADINI: At P&P. That's what
8 I meant to say, in our full committee planning and
9 procedures discussion.

10 MR. TONACCI: That's good. And let me
11 go back and be clear on our side about whether
12 we're asking for a letter or not if we -- I didn't
13 think we typically did, but it's always your
14 prerogative to write the letter and give us
15 feedback as you choose.

16 I didn't think it was typical in
17 topical reports for us to get a letter, but let me
18 confirm that and come back with you offline before
19 Friday.

20 CHAIR CORRADINI: Sure.

21 MEMBER STETKAR: I'll tell you what
22 we've done, I can only speak of US-APWR, we've
23 typically written letters on the topical reports
24 that were submitted as part of that design
25 certification.

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1 I believe that we've written letters on
2 all of them that have come to us, yeah, digital
3 I&C, the accumulator, human -- we will be writing
4 one eventually on the man-machine interface.

5 MEMBER BLEY: In other areas we've done
6 some and not done some.

7 CHAIR CORRADINI: Right. I was going
8 to say for ESBWR we did not write topical -- we did
9 not write letters on the topical report.

10 MEMBER BLEY: There's some thermal
11 hydraulic issues where we --

12 MEMBER STETKAR: No, we don't do it
13 necessarily across the board for every topical
14 report that comes to the NRC staff, but I know at
15 least US-APWR we were doing it.

16 MR. TONACCI: Thank you.

17 CHAIR CORRADINI: Okay. Anything else
18 by the members?

19 (No response.)

20 CHAIR CORRADINI: All right. With
21 that, we'll adjourn. Thank you.

22 (Whereupon, the above-entitled matter
23 went off the record at 4:27 p.m.)
24
25

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ACRS Presentation: NuScale Risk Significance Determination Topical Report



Bill Galyean
NuScale PRA Supervisor

March 1, 2016

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Agenda

- Purpose
 - overview of the NuScale Risk Significance Determination Topical Report (TR-0515-13952)
 - submitted to the NRC on July 30, 2015
- Topical report content
 - current definition of *significant*
 - need for NuScale criteria
 - proposed criteria and thresholds
 - implementation
 - NRC requests for additional information (RAIs)

Current Definition

- SRP Chapter 19.0, Revision 3
 - *significant* in the context of probabilistic risk assessment (PRA); is intended to be consistent with RG 1.200
- RG 1.200, Revision 2
 - significant basic event/contributor (i.e., equipment unavailabilities and human failure events)
 - risk achievement worth (RAW) greater than 2, or
 - Fussell-Vesely (FV) importance greater than 0.005
 - measured against core damage frequency (CDF) and large release frequency (LRF), or large early release frequency (LERF)
 - consistent with ASME/ANS PRA Standard
- NEI 00-04, 10 CFR 50.69 SSC Categorization Guideline
 - added common-cause basic event RAW greater than 20

Importance Measures

- Risk achievement worth (RAW)
 - *relative increase in risk with event always failed*
 - *traditionally significant if risk doubles*
 - $RAW = R1/Rb$
 - $R1$ = increased risk with basic event set to true (1.0, failed)
 - Rb = baseline PRA risk
- Fussell-Vesely (FV)
 - *relative contribution of an event to risk*
 - *traditionally significant if contributes 0.5%*
 - $FV = 1 - R0/Rb$
 - $R0$ = decreased risk with basic event set to false (0.0, perfectly reliable)
 - Rb = baseline PRA risk

Relative Criteria Significance

- Existing nuclear power plants CDF $\sim 1 \times 10^{-5}/\text{yr}$
 - RAW of 2 implies conditional CDF of $\sim 2 \times 10^{-5}/\text{yr}$
 - results in *acceptable* change in CDF $\sim 1 \times 10^{-5}/\text{yr}$
- If CDF $\sim 1 \times 10^{-7}/\text{yr}$, then
 - RAW of 2 implies conditional CDF of $\sim 2 \times 10^{-7}/\text{yr}$
 - results in *acceptable* change in CDF $\sim 1 \times 10^{-7}/\text{yr}$
- Relative criteria results in inconsistent risk-significance values
 - based on risk profiles of operating reactors
 - substantial CDF difference in what is significant ($10^{-5}/\text{yr} \gg 10^{-7}/\text{yr}$)

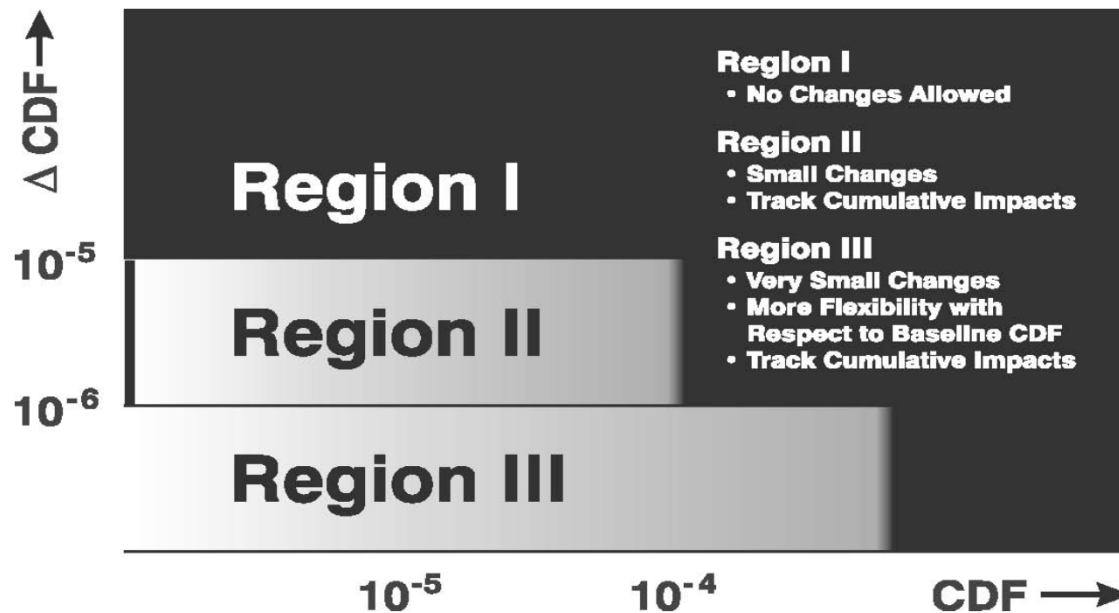
Need for NuScale Criteria

- Limitations in *relative* importance measures
 - traditional relative criteria do not account for global improvements in safety (i.e., no benefit for a safer design)
 - for low risk plants the traditional relative criteria identify as important structures, systems, and components (SSCs) that don't really impact the risk results
 - effectively diluting the focus on the truly risk-significant SSCs
- Low risk estimates
 - challenge resolution capability of PRA technology
 - as risk is reduced, the incompleteness in unaccounted-for hazards becomes greater and uncertainties become larger
 - easy to change risk profile when exercising judgement on very low risk (e.g., including or screening out natural disasters or human errors of commission)

Basis of NuScale Criteria

- Consistent with RG 1.174, which:
 - supports NRC's policy statement on using PRA to improve safety, decision-making, and regulatory efficiency
 - provides risk-informed integrated decision-making framework for changes to a plant's approved licensing basis
 - presents acceptance guidelines for permanent plant changes
- Conforms with NRC safety goals and goals for new reactors
 - $CDF < 10^{-4}/\text{yr}$
 - $LRF < 10^{-6}/\text{yr}$
 - conditional containment failure probability (CCFP) < 0.1

CDF Thresholds



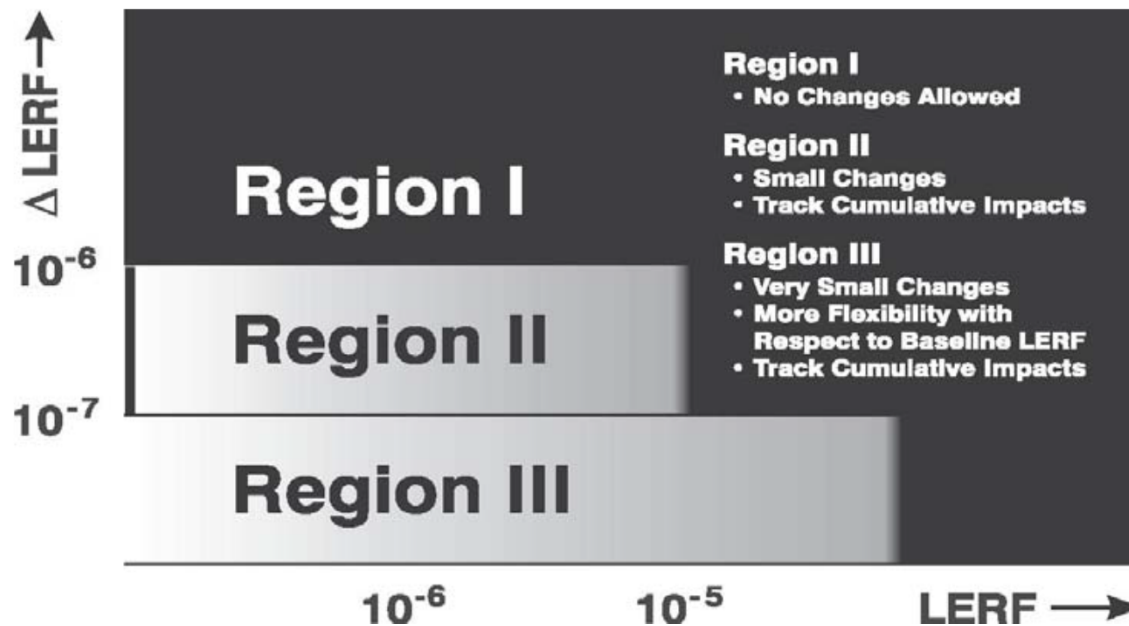
RG 1.174, Figure 4

- NuScale thresholds based on *absolute* RAW
 - component risk-significant if conditional CDF (CCDF) $\geq 3 \times 10^{-6}/\text{yr}$
 - system risk-significant if CCDF $\geq 1 \times 10^{-5}/\text{yr}$

Basis CDF Thresholds

- Component level: $\text{CCDF} > 3 \times 10^{-6}/\text{yr}$
 - component criterion set an order of magnitude below NRC safety goal of $1 \times 10^{-4}/\text{yr}$ for CDF (surrogate for Quantitative Health Objective) with an extra half-order of magnitude margin for uncertainty
- System level: $\text{CCDF} > 1 \times 10^{-5}/\text{yr}$
 - system criterion set an order of magnitude below NRC safety goal of $1 \times 10^{-4}/\text{yr}$ for CDF
- Consistent with RG 1.174 criteria for Region II permanent licensing basis changes: ΔCDF between 10^{-5} and 10^{-6} considered if $\text{CDF} < 1 \times 10^{-4}/\text{yr}$
- Component level versus system level adjustment in-line with NEI 00-04

LRF Thresholds



RG 1.174, Figure 5

- NuScale thresholds based on *absolute* RAW
 - component risk-significant if conditional LRF (CLRF) $\geq 3 \times 10^{-7}/\text{yr}$
 - system risk-significant if CLRF $\geq 1 \times 10^{-6}/\text{yr}$

Basis LRF Thresholds

- Component level: $\text{CLRF} > 3 \times 10^{-7}/\text{yr}$
- System level: $\text{CLRF} > 1 \times 10^{-6}/\text{yr}$
 - meets NRC safety goal of $1 \times 10^{-6}/\text{yr}$ for large release
 - meets Commission-established goal of $< 1 \times 10^{-6}/\text{yr}$ for LRF for new reactor designs
 - consistent with Commission-established goal of 0.1 for CCFP for new reactors
 - below LERF guideline of $10^{-5}/\text{yr}$ used as surrogate for the Quantitative Health Objective
 - consistent with RG 1.174 criteria for Region II permanent licensing basis changes: ΔLERF between 10^{-6} and 10^{-7} considered if $\text{LERF} < 1 \times 10^{-5}/\text{yr}$

Uncertainty Margins

- Based on component thresholds and 10^{-5} CDF value from RG 1.174 Region II (i.e., half-order of magnitude margin)
- Uncertainty between 5th and 95th risk values are typically an order of magnitude
 - uncertainty range consistent with NuScale preliminary results
- Mean risk values used for comparison to risk significance thresholds
 - span between mean risk and 95th risk < half-order of magnitude
 - mean risk is approximately 3 x median
- NuScale PRA is state-of-the-art
 - uncertainty in design certification PRA expected to be consistent with as-built and as-operated NuScale PRA

FV Threshold and Basis

- Risk-significant if total FV ≥ 0.20
 - CDF and LRF
 - aimed at initiating events, human actions, and individual components
- Consistent with criteria for operating plants
 - operating NPP CDF of $\sim 1 \times 10^{-5} / \text{yr} \times 0.005 = 5 \times 10^{-8} / \text{yr}$
 - a CDF of $\sim 1 \times 10^{-7} / \text{yr} \times 0.2 = 2 \times 10^{-8} / \text{yr}$
- Inconsistent levels of conservatism and uncertainty in external events and low-power/shutdown assessments (assessed individually) may bias risk significance
 - minimized by using higher threshold

NuScale Criteria

Risk-Significant Criteria		NRC Goals and Guidelines
Component level	$CCDF \geq 3 \times 10^{-6} / \text{yr}$	<ul style="list-style-type: none"> Below NRC safety goal of $1 \times 10^{-4}/\text{yr}$ for CDF. Below CDF guideline of $10^{-4}/\text{yr}$ used as surrogate for the cancer fatality Quantitative Health Objective. Consistent with RG 1.174 criteria for Region II permanent licensing basis changes: ΔCDF between 10^{-5} and 10^{-6} considered if $CDF < 1 \times 10^{-4}/\text{yr}$. Component level vs. system level in line with NEI 00-04.
System level	$CCDF \geq 1 \times 10^{-5} / \text{yr}$	
Component level	$CLRF \geq 3 \times 10^{-7} / \text{yr}$	<ul style="list-style-type: none"> Meets NRC safety goal of $1 \times 10^{-6}/\text{yr}$ for large release, meets Commission-established goal of $< 1 \times 10^{-6}/\text{yr}$ for LRF for new reactor designs, and consistent with Commission-established goal of 0.1 for CCFP for new reactors. Below LERF guideline of $10^{-5}/\text{yr}$ used as surrogate for the prompt fatality Quantitative Health Objective. Consistent with RG 1.174 criteria for Region II permanent licensing basis changes: $\Delta LERF$ between 10^{-6} and 10^{-7} considered if $LERF < 1 \times 10^{-5}/\text{yr}$. Component level vs. system level in line with NEI 00-04.
System level	$CLRF \geq 1 \times 10^{-6} / \text{yr}$	
Basic events/contributors	$FV \geq 0.20$	<ul style="list-style-type: none"> Threshold in-line with criteria for operating plants: <ul style="list-style-type: none"> Op. NPP CDF of $1 \times 10^{-5}/\text{yr}$ & FV of 0.05 = $5 \times 10^{-8}/\text{yr}$ NuScale CDF of $1 \times 10^{-7}/\text{yr}$ & FV of 0.2 = $2 \times 10^{-8}/\text{yr}$

Implementation

- Full-scope PRA
 - include internal and external hazards and all operating modes
 - assessed collectively for risk achievement and individually for FV
 - follow RG 1.200 approach for determining technical adequacy
 - recognize limitations in PRA and importance measures
- Identify candidate risk significant SSCs
 - used in risk-informed applications
 - considered with other factors in implementing risk-informed decision making
- Design certification
 - design reliability assurance program

NRC RAIs

1. Confirmation that proposed thresholds provide reasonable results
 - risk calculated crediting only safety-related and risk-significant SSCs remain below RG 1.174 Region III thresholds
2. Sensitivity studies to determine the risk categorization results
 - not done as part of development process, risk categorization based on use of risk-acceptance guidelines in RG 1.174
3. Basis of uncertainty margin (component thresholds) and applicability to combined license
 - uncertainty on risk spans an order of magnitude (range from 5th to 95th), and the span from the mean to 95th is less than a half-order of magnitude
 - deemed applicable to design certification and combined license



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NuScale Topical Report: Risk Significance Determination

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PRA and Severe Accident Branch

Office of New Reactors

Presented to ACRS

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Topics for Presentation

- Areas of staff review
- Staff findings
- Staff approval: conditions and limitations

Areas of Review

- Use of “absolute” versus relative risk metrics for assessing importance of systems and components
- Selection of threshold values for risk metrics
- Application of the risk metrics

Staff's Findings

- Using risk metrics based on absolute changes in risk in conjunction with base CDF and base LRF is OK because it's consistent with guidance in RG 1.174
- Threshold of 3×10^{-6} per year is OK because it's consistent with threshold used in RG 1.174 and NRC regulatory analysis guidelines
- Allowance for uncertainty in PRA is reasonable
- Selection of threshold for system level basic events consistent with industry practice accepted by NRC
- Selection of thresholds for LRF an order of magnitude below the thresholds for CDF is consistent with the approach taken in RG 1.174 and NRC's goal for conditional containment failure in advanced reactors (< 0.1)
- Criterion for identifying SSCs that contribute a significant fraction to a hazard is scaled appropriately based on expected base CDF

Conditions and Limitations on Approval

1. Approval is specific to the NuScale design.
2. Applicant or licensee may compare criteria with PRA results to identify candidate risk-significant SSCs; determination of risk-significance for specific applications will consider additional factors and is reviewed independently.
3. Applicant or licensee must use technically adequate PRA for single module that addresses internal hazards and external hazards, and all operating modes, including low-power and shutdown; PRA must account for contribution to single module CDF and LRF from events or conditions in other modules.
4. Approval is for method of deriving values for importance measures, not specific values of importance measures themselves.