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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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652nd MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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OPEN SESSION

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THURSDAY

APRIL 5, 2018

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear
Regulatory Commission, Two White Flint North,
Room T2B1, 11545 Rockville Pike, at 1:30 p.m., Michael
Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

MARGARET SZE-TAI Y. CHU, Member

VESNA B. DIMITRIJEVIC, Member

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- WALTER L. KIRCHNER, Member
- JOSE MARCH-LEUBA, Member
- DANA A. POWERS, Member
- HAROLD B. RAY, Member
- JOY L. REMPE, Member
- PETER RICCARDELLA, Member
- JOHN W. STETKAR, Member
- MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

GIRIJA SHUKLA

ALSO PRESENT:

- CLINT ASHLEY, NRO
- AMY CUBBAGE, NRO
- DON HABIB, NRO
- ZACHARY HARPER, Westinghouse
- WILLIAM RECKLEY, NRO
- SHAYAN SINHA, Westinghouse
- BOYCE TRAVIS, NRO

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PAGE

Advanced Reactor Functional Containment

SECY Paper 4

WCAP-17938-P, Revision 2 83

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

(1:30 p.m.)

CHAIRMAN CORRADINI: Okay. Why don't we get started. So our first topic of the afternoon is review of the draft SECY paper on functional containment performance criteria for non-light water reactor designs. And our illustrious speaker is Bill Reckley. Bill? Well, he's all yours. Oh, I'm sorry. Excuse me. I apologize. I first should turn it over to the Chairman of the Subcommittee, Dr. Bley.

MEMBER BLEY: Thank you, Mr. Chairman.

CHAIRMAN CORRADINI: I apologize. I'm sorry.

MEMBER BLEY: Well, that's okay. Well, he'll lead us through this, I apologize. We're going to hear more, and, Bill, I guess you have a part on here where you're going to tell us about any changes that have been submitted since the last time we talked with you. I think almost all the members who were here at the subcommittee are here now.

So we look forward to hearing what you have to say, and okay.

MR. RECKLEY: Thank you. As Dr. Bley mentioned, what the staff will be looking for out of the day is a letter on the SECY. We did provide a

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1 redline strikeout that was --

2 MEMBER POWERS: For the letter?

3 (Laughter.)

4 MEMBER BLEY: No, sir. They didn't give
5 us a draft letter.

6 (Laughter.)

7 MR. RECKLEY: It's funny that you mention
8 that because among the things we have talked about,
9 the staff would offer up to write your letters.

10 (Laughter.)

11 MR. RECKLEY: If you were willing to start
12 with the letter the staff wanted, we would -- we would
13 offer to draft it for you, so --

14 MEMBER POWERS: And why -- and what
15 deterred you on this? Obviously --

16 MR. RECKLEY: No, I'm saying that as a
17 joke.

18 MEMBER POWERS: -- a very perspicacious
19 undertaking.

20 MR. RECKLEY: We did provide a redline
21 strikeout version, but there weren't very many changes
22 to the -- to the draft SECY that we had talked about
23 during the subcommittee meeting.

24 I'll go a little faster today than we did
25 during the subcommittee, so some of this I'll just

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1 largely skip over. I will -- I will touch on
2 background, and then we'll get into the structure of
3 the paper and a couple of the key topics like the
4 relationship to Reg Guide 1.232 on advanced reactor
5 design criteria.

6 I will mention that was actually issued on
7 Tuesday, so it's finalized and released. It ties in
8 closely with the efforts we currently have underway
9 with the licensing modernization project, and we are
10 on ACRS Subcommittee schedules, at least tentatively,
11 for June and October, and hopefully maybe a full
12 committee meeting in December on the guidance that is
13 being developed there. And, again, I'll touch on the
14 relationship to that.

15 This gets a little complicated because
16 we're trying to develop a licensing framework, if you
17 will, and so we're bringing pieces to you today on --
18 on functional containment performance criteria, but
19 we'll explain how it fits into the longer term effort.
20 But we just thought it was necessary to try to resolve
21 this long-standing issue, so that we could free up, if
22 you -- if you will.

23 As we go through this, the more
24 uncertainty there is in terms of our degrees of
25 freedom to work within, the harder it is or easier it

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1 is to work out a framework. If -- if anyone is going
2 to tell us this is fixed, you cannot -- this is a
3 parameter or this is a regulatory area that's fixed,
4 you can't propose any revisions, then we have to
5 develop the whole framework around that.

6 So as I'll get into later, what we're
7 largely looking to do here is make sure that
8 functional containment is in play, along with
9 everything else associated with advanced reactor
10 designs.

11 MEMBER BLEY: Bill, you set up the
12 question for me there. As I read the second enclosure
13 and look for performance criteria, it seems that what
14 you're really doing is asking the Commission to
15 continue what they told you to do some years ago and
16 develop those criteria. I don't see any real criteria
17 set up already.

18 MR. RECKLEY: There won't. And as I'll
19 talk about -- and even actually on the next bullet, we
20 tried to -- to make a couple changes to the language
21 to emphasize that this paper is laying out a
22 methodology.

23 MEMBER BLEY: Okay.

24 MR. RECKLEY: Doesn't lay out criteria in
25 terms of a leak rate or some other physical parameter.

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1 It lays out a methodology, and so I'll touch on that
2 some more.

3 One of the reasons that we think that's as
4 far as we can go in order to support the developers at
5 this time is on the background slide, the one down in
6 the -- in the corner that was included in the status
7 paper, SECY-18-0011, but it just lays out the number
8 of different technologies and sizes of reactors that
9 are in play.

10 And we're striving to come up with one
11 framework that can address any of these non-light
12 water reactors, ranging from potentially less than a
13 megawatt micro-reactor or mini-reactor, whatever
14 terminology one wants to use, up to more full-scale
15 hundreds of megawatt plants, and ranging in
16 technologies from liquid metal to gas-cooled to molten
17 salt or -- or the fluoride high-temperature reactors.

18 So all of those, we're trying to come up
19 with a methodology or approach that will work for any
20 of those designs, the technology-inclusive approach.
21 So that's the landscape slide that we used in the SECY
22 paper to show all the different designs and sizes and
23 technologies in play.

24 The other thing in terms of background is
25 -- and we have come and talked to the ACRS in the past

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1 about our vision and strategies for addressing non-
2 light water reactors, and our implementation action
3 plans and the various strategies in play, and then,
4 again, I'll mention that all of that is summarized in
5 a relatively recent Commission paper, SECY-18-0011,
6 Advanced Reactor Program Status.

7 So the rest of this presentation will talk
8 about one area, which is an issue that was resolved,
9 was identified in terms of functional containment.
10 And then, as I mentioned, everything in highlight
11 there is in play on this particular issue, the policy
12 issues under strategy 5, and the licensing framework
13 under -- under strategy 3, in our implementation
14 action plans.

15 So just quickly on the format or layout of
16 the paper, the paper is a summary of the two
17 enclosures, and the two enclosures are, one, a
18 background, and then number two, the paper that
19 describes the approach or methodology for any
20 particular non-light water reactor design to define
21 for themselves the performance criteria for a
22 functional containment.

23 So in terms of Enclosure 1, which I'm not
24 going to talk a lot about here because it was -- it
25 just basically provides background, the key documents

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1 are the terminology "functional containment" and issue
2 was brought before the Commission in the -- in the
3 paper SECY-93-092, one of the earlier papers on issues
4 for advanced reactor designs following the development
5 of the advanced reactor policy statement and the
6 receipt of some preliminary designs, such as SAFR and
7 PRISM and the MHTGR in the late '80s and early '90s.

8 That paper basically had the Commission
9 agree that a functional containment was -- could be
10 thought of as in lieu of a pressure-retaining
11 containment like is used for light water reactors.
12 The staff came back to revisit that in SECY-0347. And
13 the Commission said it was a little premature at that
14 time, given the state of the development of the -- of
15 the reactors, to make a final decision, but asked the
16 staff to come back with performance criteria.

17 We come back -- there is about a decade
18 gap. As we go through these periods of interest and
19 waxing and waning of advanced reactor programs, we
20 come back in the -- in the 2000s, under the NGNP, Next
21 Generation Nuclear Plant. And, again, functional
22 containment is one of the key licensing issues for
23 that project.

24 The staff, even at that time, comes and
25 presents to the ACRS and sends a letter to DOE

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1 summarizing where we are. Again, emphasizing, we
2 think, functional containment as a concept is okay,
3 and -- but not fully resolving what the performance
4 criteria would be for -- for the functional
5 containment.

6 We revisit most recently again in Reg
7 Guide 1.232 the advanced reactor design criteria.
8 Again, the staff had several meetings with ACRS on
9 that topic, and we -- and we did issue that on
10 Tuesday.

11 That reg guide reflects within the high
12 temperature reactor -- high temperature gas reactor
13 technology, the MHTGR design criteria, basically the
14 concept of functional containment and the performance
15 criteria that was laid out for NGNP. For the generic
16 or non-technology-specific advanced reactor design
17 criteria, we basically stuck, as you are aware, with
18 the existing general design criteria.

19 But there is terminology within the reg
20 guide that says another technology like molten salts
21 may want to look at the design criteria established
22 either for fast reactors, or in this case the MHTGRs
23 for functional containment concepts. And the reg
24 guide points out that there is a remaining policy
25 issue which this paper is intended to -- to resolve.

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1 But just, again, going kind of through the
2 format of the enclosure, it simply starts out why
3 we're addressing this at this time within the paper.
4 It addresses strategy 3, the regulatory framework for
5 non-light water reactors; and strategy 5, the
6 identification and resolution of technology-inclusive
7 policy issues.

8 I'll just leave it there. I think we
9 talked about that last time. But that's -- what we're
10 trying to do within -- within the framework and within
11 strategies 3 and 5, as well as all of the strategies,
12 to be honest, but we're probably a little further
13 along in strategies 3 and 5 to say how we're trying to
14 develop an integrated approach to support the
15 developers or designers of these non-light water
16 reactors.

17 That community is -- is a very diverse
18 community in terms of it ranges from very established
19 long-standing companies that have designed, built
20 reactors, gone through licensing processes, and so
21 forth.

22 It also includes some much smaller
23 companies trying to take maybe a more entrepreneurial
24 approach to this. They're relatively small. They're
25 trying to fund it through a combination of private

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1 capital and, where possible, maybe some support,
2 technical or financial, from the Department of Energy.

3 But a little different in terms of what
4 they're asking the NRC to do is to interact earlier in
5 the process. So even in the conceptual or preliminary
6 design processes, to interact with the NRC to -- to
7 make sure they're on the right track because the
8 complaint has historically been that regulatory
9 uncertainty is resolved at the eleventh hour, but the
10 financial investment by the eleventh hour has already
11 been substantial.

12 And so the general complaint was to try to
13 reduce the regulatory uncertainty kind of in a line
14 going down as the cost escalated. And so that -- that
15 really did call for us to take this more integrated
16 approach.

17 We tried -- we have tried to represent
18 that using this bowtie diagram where you map out under
19 this approach the threats as identified on the -- on
20 the left, the plant -- and these are just the
21 traditional segregation of events, plant, internal
22 events, external events, and then malicious acts.

23 And any of those can lead to the plant
24 damage state or could potentially lead to a plant
25 damage state where you start to get the migration of

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1 radionuclides or fission products from the core or, in
2 the case of a molten salt, at least out of the
3 configuration they are intended to be in.

4 So in terms of the light water community,
5 this -- this fits very well. The top-level event is
6 core damage, and -- and you have a whole bunch of
7 measures that are taken to prevent it, and you have
8 defined severe accident design features, emergency
9 planning, siting restrictions, a number of things on
10 the mitigation or recovery side of the bowtie diagram.
11 So --

12 MEMBER POWERS: You say the concern is
13 core damage.

14 MR. RECKLEY: The methodology allows you
15 to define whatever top-level event you really want to
16 concern yourself with. I would say traditionally in
17 light water reactors we have defined the top-level
18 event in most of the things we do as significant core
19 damage -- core melt.

20 MEMBER POWERS: I mean, it seems to me
21 that that's -- that's the faux pas in looking at these
22 unusual reactors. It seems to me that you really end
23 up having to say it's radionuclide releases, and then
24 you come to a debate, is it radionuclide releases from
25 boundary 1 or boundary 2 or outside the exclusion

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1 area? That's where the debate is.

2 For instance, we have molten salt reactors
3 that really don't have a defined core. And you have
4 various overly optimistic individuals in the gas
5 reactor community that says, "Our core doesn't get
6 damaged."

7 I mean, don't you want to just
8 automatically say, "We're going to quit doing this
9 core damage thing" and start saying, "It's
10 radionuclide release," and we will debate which
11 boundary we -- we draw the line at, because I don't
12 know what it -- you know, I don't know where it is,
13 but, I mean, I -- I would think that that's -- that's
14 almost required in this context.

15 MR. RECKLEY: And you can do it. And I'll
16 be honest, the first time I -- the first time I drew
17 the bowtie my top-level event was radiological release
18 as opposed to core damage or some rough equivalent,
19 which I came up with the language of unplanned
20 migration of fission products because, again, that's
21 not core damage or core melt per se. It's just a loss
22 of control of the radioactive material within its
23 normal state or configuration.

24 The reason I ultimately changed it was to
25 better -- actually to better align it with traditional

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1 approaches and, for example, the IAEA five levels. If
2 you say radiological release, you're almost by -- your
3 top-level event is already at level 4 or 5.

4 And traditionally in the IAEA language,
5 mitigation is the things you take like a core spreader
6 or a core catcher or other severe accident design
7 feature is usually a mitigation measure on the right-
8 hand side of this diagram, on the mitigation side.

9 So I was trying to align it. You could
10 draw it exactly as you're describing it. I mean, the
11 methodology lets you define whatever top-level event.
12 I was trying to align it with more in line with the
13 light water reactor and IAEA standard five levels in
14 which you would have more than just emergency planning
15 as a mitigation measure.

16 You would have -- are you going to do
17 something other than emergency planning, like a severe
18 accident design feature on the light water reactor
19 side.

20 MEMBER MARCH-LEUBA: Focusing on what
21 we're doing today, which is reviewing the functional
22 containment --

23 MR. RECKLEY: Right.

24 MEMBER MARCH-LEUBA: -- the function of
25 the containment is to prevent radioactive release even

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1 in the core.

2 MR. RECKLEY: Right.

3 MEMBER MARCH-LEUBA: So if you remove that
4 function, then you don't need a containment. So if
5 you are willing to limit yourself to I will never melt
6 the core --

7 MR. RECKLEY: And one of the reasons I
8 actually kind of -- I like the bowtie diagram is, if
9 you look, it considers not only the damage state but
10 the extent of the hazard.

11 So when you get, for example, to a very
12 small reactor or potentially as a fuel form where a
13 loss of the normal safety functions, like cooling,
14 does not lead to radioactive materials going airborne
15 or in some other releasable form, then your top-level
16 event really doesn't have much consequence, and you
17 wouldn't need all of the mitigation measures on the
18 other side.

19 I compare it to if you have, either
20 because of its size or a technology, that a power-
21 producing device that were treated as the reactor, is
22 as safe as a radiography machine in terms of it's a
23 threat. I mean, there's radioactive material there.
24 It's not as if you can ignore it, but it doesn't
25 require things to keep it safe, other than shielding.

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1 If you had a reactor that was as safe as
2 that, then you wouldn't need all of those things.
3 You'd need shielding, but you wouldn't need all of
4 these emergency functions.

5 And this -- this -- I don't want to
6 overstate the usefulness of the representation, but it
7 lets you take into account the hazard in terms of the
8 source term, the amount of radioactive material you
9 are dealing with.

10 But, again, to Dr. Powers' point, it's --
11 this is a way to draw it. I wouldn't say it's the
12 only way to draw it, but it does -- it does let you
13 define those actions or barriers or controls, whatever
14 structures, systems, and components that you're
15 putting into the design to keep the radioactive
16 material in place, and those things that you might add
17 if you lose control of it, assuming that the loss of
18 control puts it in a form that might be releasable.
19 So --

20 MEMBER MARCH-LEUBA: This is a little bit
21 of semantics. Whether you call the containment a blue
22 prevention, it prevents the radionuclides from
23 leaving, or you call it a mitigation after it melts
24 the core is the same thing.

25 MR. RECKLEY: I don't disagree with you.

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1 It just -- it's an accounting measure. It doesn't
2 result in any difference in terms of --

3 MEMBER MARCH-LEUBA: And also there will
4 --

5 MR. RECKLEY: So, but what it allow us to
6 do, going back to the integrated activities, is what
7 we were trying to make sure -- and this is more
8 applicable perhaps to some of the early developers or
9 less experienced developers, to make sure they were
10 thinking about the total -- the total picture.

11 That two -- and this is the way light
12 water has actually evolved, and that was because we
13 were learning and imposing additional restrictions as
14 we went along. But to make sure we incorporate all of
15 those lessons learned, all of those activities into
16 the initial design.

17 And one example is if I'm -- an easy
18 example on the structural side is if I'm going to have
19 a wall that is providing my wind protection, tornado
20 or hurricane protection, I don't want to go way into
21 the design and then decide later on now I'm going to
22 do my aircraft impact assessment and find out the wall
23 is not thick enough.

24 I want to take an integrated look at my
25 design as I'm going through the process and say, "What

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1 am I going to credit for external events? What am I
2 going to credit for security? What am I going to
3 credit for aircraft impact?" And come up with the
4 best design. And from a designer standpoint, the more
5 you can take credit for the same thing for multiple --
6 for multiple external hazards or internal events, the
7 better in terms of the simplicity of the design.

8 So that's just laying out the backdrop.
9 And then, on the consequence side, also look at it for
10 all the regulatory decisions that we need to make, not
11 only health effects but also the societal and
12 environmental decisions that we need to -- to make
13 during the review.

14 So I mentioned how this plays into the
15 ARDC. You just had a recent meeting on this, but this
16 -- this slide defines for design criteria 16 for the
17 modular high-temperature gas reactor, MHTGR, and you
18 can see that the term "functional containment" is
19 included and defined, and the definition is there.

20 It can be a barrier or set of barriers
21 taken together that limitly effect -- or effectively
22 limit the physical release of radionuclides for all of
23 the event categories. And we're going to get to that
24 in the next slide or two.

25 MEMBER MARCH-LEUBA: I don't have any

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1 problem with your definition of functional containment
2 or the use of a functional containment. As long as it
3 functions and it retains radioactivity, it's a good --
4 it's a good containment.

5 But, however, I have a problem with the
6 previous paragraph. In the write-up, you say that to
7 accommodate defense-in-depth will require multiple
8 barriers. I would have liked to say that there are
9 multiple independent barriers, be specific about it,
10 because if the failure of barrier 1 automatically
11 fails barrier 2, you will have multiple barriers.

12 MR. RECKLEY: Right.

13 MEMBER MARCH-LEUBA: So we need to be more
14 specific in saying that when we -- when we say
15 multiple barriers, we mean multiple independent
16 barriers.

17 MR. RECKLEY: Okay.

18 MEMBER MARCH-LEUBA: Definitely I would
19 like to call them diverse also, but I won't push it
20 that hard.

21 MEMBER POWERS: I'll echo here, and say it
22 should be multiple independent barriers of increasing
23 conservatism.

24 MEMBER MARCH-LEUBA: That's the way it
25 used to be. It doesn't need to be that. I mean, you

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1 have a very good one at the beginning. I don't see
2 the increasing concern about this and being a
3 requirement. Multiple independent, I think it is.

4 MEMBER BLEY: Independent under what
5 condition?

6 MEMBER MARCH-LEUBA: That's the --

7 MEMBER BLEY: See, we thought we had
8 independent barriers, and then we had PWR-1 and we
9 found out the same thing that broke the core broke the
10 containment.

11 MEMBER MARCH-LEUBA: Yeah.

12 MEMBER BLEY: And we said, "Gee, they're
13 not so independent." And any set of barriers will be
14 not independent under some external insult if it's big
15 enough. So, you know, we dream of independence, but
16 we don't get it ever.

17 MEMBER MARCH-LEUBA: Yeah. But we should
18 at least try.

19 MEMBER BLEY: We can try, but when we say
20 it must be independent, it never is.

21 MEMBER MARCH-LEUBA: You put a call
22 related to it.

23 MEMBER STETKAR: No. Because when you say
24 "independent," they are truly independent. That's the
25 problem -- that's the dichotomy that you run into,

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1 that you will find people who say unless there is
2 precisely a zero percent joint probability of their
3 failure, they are not independent.

4 MEMBER MARCH-LEUBA: So because they have
5 10 to the minus 6 probability --

6 MEMBER BLEY: No.

7 MEMBER MARCH-LEUBA: -- they won't be
8 independent, we give up?

9 MEMBER BLEY: No. But --

10 MEMBER STETKAR: You characterize it --

11 MEMBER BLEY: -- you get yourself in a box
12 when you say they must be independent and you can't do
13 it. So as independent as possible, independent
14 under --

15 MEMBER STETKAR: Not linked functionally.
16 Something like that, such that a single --

17 MEMBER BLEY: And that's really where I
18 think --

19 MEMBER STETKAR: -- failure of a single
20 function --

21 MEMBER BLEY: -- Jose, you were coming
22 from, is that they are -- they are not linked
23 internally such that one automatically fails the
24 other. And that's okay. I mean, that's something we
25 want.

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1 MEMBER MARCH-LEUBA: I have serious --

2 MEMBER BLEY: That we can do.

3 MEMBER MARCH-LEUBA: I have serious
4 problems in that I -- let's pick up in one of these
5 sites. With two of the barriers -- two of the other
6 barriers are within a millimeter of each other and
7 enclosed by a burnable material?

8 MEMBER BLEY: Then an earthquake will
9 break them when they bang together.

10 MEMBER MARCH-LEUBA: Yeah. You're never
11 going to be perfect, but removing the -- at least the
12 goal, making them as independent as possible --

13 MEMBER BLEY: We've heard from some of us
14 and from other people, once we define something, then
15 we think we have to meet the definition, absolutely.
16 And that gets us into --

17 MEMBER MARCH-LEUBA: Let's define --

18 MEMBER BLEY: -- silliness, a word I heard
19 earlier today.

20 MEMBER MARCH-LEUBA: Let's define it
21 properly. But giving up the goal of independence
22 because you cannot achieve it perfectly is not --

23 MEMBER BLEY: Would be silly.

24 MEMBER MARCH-LEUBA: That would -- well,
25 that's what we're doing. We're being silly.

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1 MEMBER BLEY: No, I don't think so.

2 MEMBER MARCH-LEUBA: With those
3 independent --

4 MR. RECKLEY: Okay. We did add -- and
5 we'll get -- we'll get to it later and we'll see -- we
6 tried to add something. We'll see if it's -- it's
7 enough to scratch your itch.

8 The other thing I'll mention is that we
9 will revisit this in the June and October meetings, as
10 we talk about the overall framework and the
11 incorporation of defense-in-depth as a specific
12 activity or process within that framework in order to
13 do not only the containment design but all of the
14 safety functions really that are -- that are
15 associated with -- associated with reactors.

16 And so I'm not trying to punt all
17 together, but the concept of defense-in-depth and
18 independence, and so forth, we can come back in a more
19 general sense under the framework discussions that
20 we'll -- that we'll have. So --

21 MEMBER KIRCHNER: Bill, before you go
22 on --

23 MR. RECKLEY: Yeah. I'm not --

24 MEMBER KIRCHNER: -- of the three choices
25 you could have made, I know that implied behind the

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1 functional containment is the HTGR design and the
2 unique design aspects and challenges they have for
3 certain events, design basis events and postulated
4 accidents.

5 And blowdown gives them a particular
6 challenge. It's really an economic challenge. It
7 would be very expensive to build a building that could
8 be essentially leak-tight against a blowdown of a
9 high-pressure helium system of that size. But I
10 wanted to go back to -- so you're going forward with
11 the HTGR advanced reactor design criterion as the
12 basis for functional containment.

13 But as we went through previously, and
14 Dana mentioned early on, it -- it does imply, because
15 you change an important word from the more generic
16 advanced reactor design criteria, and that is you go
17 from uncontrolled release, essentially a leak-tight
18 barrier against uncontrolled release, to one that
19 provides a controlled release, and that begs the
20 question of -- I know you said you're not going to
21 have the metric in this paper. That I guess would
22 come later, but it -- it really refers you back to 10
23 CFR 50.34 for offsite dose consequence limits.

24 So that -- that would come in conjunction
25 with your definition down the road when you --

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1 MR. RECKLEY: Yeah. It actually got --
2 well, let's go to the next slide. The approach will
3 be to have event categories. And so for most of the
4 time, if you -- if you're going to be talking about
5 ultimately the blow of containment to limit the public
6 dose, the performance criteria is going to be for
7 design basis accidents or design basis events in that
8 middle category of frequency -- it's going to be the
9 50.34 limit.

10 MEMBER KIRCHNER: Limit.

11 MR. RECKLEY: As you get lower in
12 frequency into the beyond design basis event, it ends
13 up being the safety goals that -- that establish the
14 performance criteria.

15 The other line on this slide that becomes
16 important is the EPA, Environmental Protection Agency,
17 Protective Action Guidelines dose guidance levels at
18 one rem. And you will hear in the future about a
19 general goal which has existed all along for
20 Generation IV reactors to not rely on offsite
21 emergency planning as much.

22 And so most -- I'll get in trouble. Some
23 designs, many designs, are establishing as a goal that
24 they won't exceed the protective action guidelines
25 beyond the fence, 400 meters, 800 meters, such that

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1 the offsite emergency planning provisions of alert
2 notification, drills, evacuations, all of those things
3 can be relaxed.

4 So to the degree that a design strives to
5 reduce the offsite emergency planning, the performance
6 criteria could be much lower than the 50.35 number.
7 But assuming that they keep the existing requirements
8 in terms of offsite emergency planning, it would be
9 the 50.34 number or the safety goal if it's dealing
10 with sequences much lower in -- in frequency.

11 So, but the introduction of this frequency
12 consequence target figure within the paper is in large
13 part just to describe the general framework. And this
14 is -- this is not really new, and it's -- it's not
15 dramatically different than light water reactors, if
16 you look at some of the later ANS standards that adopt
17 event conditions or event categories based on
18 frequencies.

19 Most of the light waters were -- were
20 actually licensed before that version of the ANS
21 standard. But it's not -- it's not a new -- not a new
22 concept, and so basically -- and the categories will
23 found familiar, anticipated operational occurrences,
24 design basis events are the middle category, and then
25 beyond design basis events.

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1 MEMBER BROWN: Before you go -- go back to
2 the other one again. I guess I'm still struggling --
3 and this follows from the previous meeting that we
4 had. I'm echoing Walt a little bit, and we've gone
5 from some specificity in terms of when we did the
6 advanced reactor design stuff to meet the 10 CFR
7 whatever it is, 50.34. But yet this goes to the point
8 that we're going to control it to ensure conditions
9 important.

10 But there is no -- there is no illusion or
11 no alluding to some type of criteria, not even a more
12 generic criteria such as onsite/offsite exposures as
13 defined by the Commission, or something that's not
14 referring to a rule, but what isn't currently in place
15 is acceptable.

16 This makes it sound like that plant to
17 plant to plant we can have a vastly different set of
18 exposure, either onsite/offsite exposure criteria,
19 than what -- than you would -- than I would envision.
20 It seems to me you can't have inconsistent
21 requirements or different requirements from plants --
22 from the standpoint of onsite and offsite dose
23 consequences to the public.

24 MR. RECKLEY: And I -- again, outside of
25 the introduction of the potential to set up emergency

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1 planning as another threshold, in order to reduce
2 offsite emergency planning you've got to lower the
3 radiological releases. Outside of that being
4 introduced, the criteria are basically the same as
5 light water reactors, which is 10 CFR 50.34, the 25
6 rem for the worst two hours, the 25 rem for --

7 MEMBER KIRCHNER: Population zone for the
8 entire event.

9 MR. RECKLEY: Right. So those two are
10 also in play here. You can back up and say basically
11 the analysis that was done for the existing fleet, in
12 terms of the leak rates and performance of the
13 containments, are basically the same. They were set
14 up, and the calculations showed that they remain below
15 those regulatory thresholds or guidelines.

16 Then, as severe accidents or beyond design
17 basis events were introduced increasingly into the
18 light water reactor licensing arena, the safety goals
19 ended up being used indirectly as acceptance criteria
20 because that's what we use as the backfit threshold.

21 And so requirements were put in place when
22 an action was needed -- and simplifying a little bit.
23 But since we use the safety goals as the threshold for
24 the backfit determinations, it became a kind of de
25 facto acceptance criteria for the light water fleet.

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1 So I don't -- it's a little different in
2 the way that you will address the releases will vary
3 a lot by technologies because what they're going to
4 rely on as the functional containment will look
5 different. But in terms of ultimately the acceptance
6 criteria, it will be basically the same, which is that
7 25 rem number, for design basis accidents and the
8 safety goal for very infrequent accidents.

9 MEMBER MARCH-LEUBA: The other problem I
10 have with that approach -- and let me just put it on
11 the record -- is that you will judge the acceptance
12 criteria for a set of events that you define. And
13 what we have found in severe accidents in the past is
14 there was an event that we didn't consider.

15 And, therefore, the releases that you are
16 going to calculate are -- by the way you calculated,
17 a lower bound, non-conservative bound of what the
18 release frequency is going to be, because you forgot
19 some events. And that's where defense-in-depth comes
20 along.

21 You put another barrier in there just in
22 case you didn't consider everything. And if you do a
23 probabilistic analysis of everything you have, and you
24 are right at the limit, you will say it's okay. I
25 will say it's not, because you didn't catch every

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1 possibility.

2 MR. RECKLEY: Right. I -- again, I think
3 when we come back and talk to you about the defense-
4 in-depth approach in the summer, I hope you'll see
5 that -- that it's not as simple as what you just laid
6 out. And this is not the case, but if there were no
7 uncertainties, you could do what you were saying. You
8 could do that PRA, and you could say, "We know how
9 things behave, and, therefore, we'll -- we'll
10 establish things right to the -- to the acceptance
11 criteria."

12 The methodologies that we'll be presenting
13 to you in the summer recognize that that's not the
14 case, and there are a lot of uncertainties and you
15 have to take actions to -- to address those.

16 MEMBER MARCH-LEUBA: I'm eager to see --
17 I'm eager to see those. Can you move to the next
18 slide?

19 MR. RECKLEY: Uh-huh.

20 MEMBER MARCH-LEUBA: Okay. If -- I know
21 that we haven't defined this, but if we define the
22 blue line as our acceptance criteria, right now we
23 have the DOE and all the other reactors that have been
24 built for the last years, which are fantastic, super
25 safe, and incredible because the requirements from DOE

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1 were it has to be critical, so you can produce power,
2 and it has to be safe.

3 So they are orders of magnitude to the
4 left of that line. I mean, you cannot even -- But
5 the moment you put venture capital to design a real
6 reactor to be licensed, then the requirement change.
7 It has to be critical, so we can produce power, and it
8 has to be cheap. Safety doesn't count anymore because
9 safety is sustained below the blue line.

10 And I guarantee you when those reactors
11 designed by venture capitalists come, they will be
12 right at the limit. So by defining criteria, they are
13 going to get right there. And we are kind of in our
14 mind thinking about the DOE reactors, which are not
15 the ones that are going to come for licensing.

16 MR. RECKLEY: What we've seen --

17 MS. CUBBAGE: The dots will also have
18 uncertainty bands. This is Amy Cubbage from NRC
19 staff.

20 MEMBER REMPE: In fact, if I look at the
21 Y-axis, it has mean frequency. It doesn't have point
22 estimates. That implies you need to consider
23 uncertainties, right?

24 MR. RECKLEY: Well, if the --

25 MEMBER BLEY: Excuse. Amy, when you chime

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1 in, we need your name on the record.

2 MS. CUBBAGE: I did.

3 MEMBER BLEY: Oh, did you? I missed it.

4 Thank you.

5 MS. CUBBAGE: I did it fast.

6 MR. RECKLEY: The figures that we've seen
7 for the analysis that has been done would tend to show
8 that the doses tend to be very -- the consequences are
9 on the -- to the far left, close to the axis, and you
10 don't get that effect.

11 I understand what you're saying, and I
12 can't dispute it. I would simply say that, from the
13 regulatory perspective, the closer you get to the line
14 the more attention you get, the more safety systems
15 you're likely to have to add, and so there -- it's not
16 quite as simple as design to the line, because the
17 closer you are to the line the more expensive your
18 machine is going to be for that purpose.

19 Now, I understand what you're saying.
20 There's a tradeoff there, and that's really up to --
21 that's up to the designer to really say what kind of
22 strategy they -- they want to take, and there's always
23 tradeoffs in the design process.

24 MEMBER MARCH-LEUBA: My concern is on the
25 record.

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1 MEMBER BLEY: No, no.

2 MEMBER MARCH-LEUBA: And the moment you
3 draw the line.

4 MEMBER BLEY: I've got to throw one on the
5 record, too, because the claim that DOE reactors sit
6 way down here is -- is -- when we -- if it's my
7 reactor, I know it's way down low until I analyze it.
8 There have been a few DOE reactors that have been
9 analyzed impartially, and I suggest you are overly
10 optimistic.

11 MEMBER REMPE: And, in fact, some of them
12 don't operate at their full rate of power because of
13 that concern.

14 MEMBER BLEY: Yes, indeed. Or they don't
15 operate at all anymore.

16 MEMBER MARCH-LEUBA: I didn't want to
17 criticize the existing reactors. I'm thinking about
18 the future.

19 MEMBER BLEY: I know, but it's the context
20 there. It's overstated.

21 MR. RECKLEY: And you -- one can argue you
22 had this -- the same thing with the operating fleet.
23 And that is, as PRAs were introduced, and maybe not
24 only PRAs but other analytical improvements were made,
25 they were taken advantage of, right? You had power

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1 uprates, you had other -- you had other things to try
2 to take advantage of that -- of that identified
3 margin.

4 So I understand what you're saying. It's
5 not something I can really answer, other than it's up
6 to the designer.

7 CHAIRMAN CORRADINI: But I guess I want to
8 get to this, because you -- this is somewhere where
9 you had a -- you had a redline addition. I thought
10 you were going to mention something in the text. This
11 is the closest thing to a concept of how you would
12 establish this from a process standpoint.

13 But as I remember from the subcommittee
14 meeting, you were hesitant to say this is what you
15 want the Commission to consider. But this is getting
16 perilously close to a process.

17 MR. RECKLEY: No. I --

18 MEMBER BLEY: I want to chime in on that
19 one, too. It is, and it's similar to ones that were
20 used in a number of previous applications, not exactly
21 the same.

22 But the one thing I'll point out, and
23 we'll follow this later because I don't think it
24 applies right now, I mean, this is a concept, when you
25 actually try to apply it to a real reactor, you have

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1 to start thinking about how you do that without -- you
2 know, analysts can drop things smaller and smaller,
3 and you can get every scenario down low.

4 And what they had to do on 1860 when they
5 looked at an existing light water reactor was figure
6 out a way to group these, and they did it by looking
7 at systems and not looking at little contributors but
8 aggregating them at the systemic level, so that you
9 compare one plant with another. And in a sensible
10 way, you could apply such criteria, if this would
11 become a criteria.

12 CHAIRMAN CORRADINI: And I don't want to
13 get to your end, but I'm still trying to -- the way I
14 at least interpret the -- the policy paper is that --
15 don't go back a slide, but if I were to look at the
16 slide before, all containments essentially are
17 functional containments. Current containments are
18 functional containments because there is a defined
19 tech spec leak rate, which means it's a controlled
20 release of radiation. It is not a zero release.

21 MR. RECKLEY: Right.

22 CHAIRMAN CORRADINI: That's point one.
23 Point two is that what I think you're asking is just
24 permission to proceed, and we're not sure what you're
25 going to proceed with because we still don't have the

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1 concept you're going to proceed with, but we have a
2 sense of how you might attack it.

3 MR. RECKLEY: Right. That's generally
4 true. On this particular figure, I would say we're
5 making the Commission aware that we're going to more
6 officially formally adopt this kind of approach. What
7 the foot -- what the footnote on the slide and the
8 text in the SECY is saying is we're going to use this
9 approach, this methodology, or we're proposing to.

10 What we're not ready to ask the Commission
11 to weigh in on is where the lines are. Ten to the
12 minus four, okay, that -- that's a line on that graph.
13 It may stay there over the summer as we work with
14 licensing modernization on the -- on this next
15 approach. Maybe it changes. I'm not predicting. It
16 has been -- since NGNP and a lot of other projects,
17 these lines have been fairly steady and unchanging.
18 But we weren't being asked yet at that time to
19 officially endorse them in regulatory guidance.

20 The document we'll be preparing over the
21 summer will include a graph like this that we will
22 endorse or propose to endorse in regulatory guidance,
23 and we just wanted the summer to work out whether we
24 want to tweak any of these lines. So that's -- that's
25 the disclaimer we were putting into the paper.

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1 The concept we're ready for. The
2 specifics give us to the next reg guide, which we plan
3 to develop over the summer.

4 MEMBER BLEY: When you get to that reg
5 guide, I'd recommend you look back at 1860's
6 application.

7 MR. RECKLEY: Yes.

8 MEMBER BLEY: Because how in this reg
9 guide you tell people to use this is not transparent
10 without a fair amount of work.

11 CHAIRMAN CORRADINI: And that was the time
12 where there was debate amongst the committee that
13 caused it to kind of stop in the midst of preparation.
14 I mean, because I -- I seem to remember, as we went
15 back to 1860, the question was really, what are the --
16 as you said, where do you draw the lines? What's the
17 access supposed to be? How do you bundle these so you
18 don't, by fractionation, make them look --

19 MEMBER BLEY: What I can say is, at some
20 point -- because I was involved in that process. At
21 some point in that, it looked like there was going to
22 be a volunteer of a new design to actually apply --
23 try to apply those approaches and that disappeared.
24 And then there was the suggestion, why don't you apply
25 it to an existing LWR, and in fact, yeah, that

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1 probably took another six months or longer before that
2 got worked in.

3 MS. CUBBAGE: So this is Amy Cabbage
4 again. Just to refresh that we're coming in June to
5 the subcommittee for the preview of these topics, and
6 so we'll be able to get into a lot more specifics of
7 where the staff is headed on that, and then again in
8 October the subcommittee, and then December full
9 committee on that other draft reg guide.

10 MEMBER BLEY: So June is the
11 modernization?

12 MS. CUBBAGE: That's what we're talking
13 about.

14 MEMBER BLEY: And that's where you're
15 talking about. These will all start coming together
16 there.

17 MS. CUBBAGE: Absolutely.

18 MR. RECKLEY: The other note is, again,
19 this isn't the first proposal to use this, hopefully.
20 In that that's the reason for the subcommittee visits,
21 we have -- we have addressed some of those concerns or
22 the -- the industry has in their guidance that we hope
23 to endorse.

24 But our message in the previous white
25 papers is, you know, stop calling it a limit line, for

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1 example. It's not an acceptable line. It's a
2 judgment call, and what we're planning to use it for,
3 the further away you are, the more comfortable we are.
4 Not if you're on one side you're okay and if you're on
5 the other side you're not.

6 In terms of other measures -- and then
7 I'll move on -- it's not just this line. You do have
8 to consider aggregating all of the events, so that you
9 don't end up doing some maneuvers to say I don't have
10 any event that's -- that's over -- that's of concern.

11 You also look at aggregate measures to say
12 that all of the -- all of the events put together, but
13 that's a preview, a trailer for the -- for the June
14 meeting that -- that we'll be in for.

15 MEMBER KIRCHNER: For the record, too,
16 10 CFR 50.34 makes it clear that it's not that point.
17 That's an --

18 MR. RECKLEY: It's not a point.

19 MEMBER KIRCHNER: It's not a point. That
20 the expectation is below.

21 MR. RECKLEY: Yes.

22 MEMBER KIRCHNER: And I think the
23 Commission's prior statements on advanced reactor
24 expectations would drive you in the same --

25 MR. RECKLEY: Push it even further away.

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1 MEMBER KIRCHNER: Yes.

2 MR. RECKLEY: Right.

3 MEMBER DIMITRIJEVIC: Well, this is what
4 I was going to suggest. It would be very interesting
5 because I have a tough time imagining where the
6 current light water reactor -- because I'm not sure of
7 the meaning of some of those regions.

8 So it looked to me the current light water
9 reactor would be farther on the left based on this
10 curve, and we want to design for better performance
11 than that. So it would be interesting actually to
12 look where the current light water reactor fit on this
13 curve. You know, why I have a problem, because
14 anticipated operational occurrence are initiating
15 events, not sequences.

16 So I am not sure, does this mean every
17 sequence would start to an anticipated initiating
18 event or what does it mean in the -- in the PRA world
19 of the life of the reactor? So for me it will be
20 interesting to see how these compare -- how this
21 current fleet fits on this curve.

22 MS. CUBBAGE: So one way -- this is Amy
23 Cubbage again. One way I -- just thinking about it as
24 you were talking -- good points is that, yes, the
25 current LWR, we would expect all to be inside of those

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1 lines because those are bounded in regulatory
2 requirements like 50.34.

3 However, they may need a lot more safety
4 systems and components to get there, whereas these new
5 plants may have more inherent safety characteristics,
6 passive, et cetera, such that in a more simpler way
7 they can achieve the safety. I mean, that's just one
8 way to think about it.

9 MEMBER DIMITRIJEVIC: Well, but in the
10 end, we still talk about frequency. So it doesn't
11 matter how did you get there, but --

12 MS. CUBBAGE: Oh, yeah. That -- yeah, I
13 wasn't speaking to that part of it, but --

14 MEMBER DIMITRIJEVIC: Yeah.

15 MS. CUBBAGE: And, you know, just to get
16 -- drill down a little on the advanced reactor policy
17 statement, there is not an explicit expectation that
18 they be quote/unquote "safer," but they are supposed
19 to use simplified inherent passive means to achieve
20 safety with less reliance on power, operator actions,
21 et cetera, et cetera.

22 So the Commission policy really has the
23 expectation of a different way of achieving safety.

24 MEMBER BLEY: Amy, I think when you made
25 your statement about existing reactors you meant the

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1 design basis events for existing reactors.

2 MS. CUBBAGE: Yes. Yes.

3 MEMBER BLEY: Not all possible events
4 beyond the design basis.

5 MS. CUBBAGE: That's a good point. Yes,
6 I was focusing more on --

7 MEMBER BLEY: Which would be looked at on
8 here, by the way.

9 MS. CUBBAGE: Yes. I was focusing more so
10 on the -- the AOO DBA portion, that we would expect
11 them to be below the line. You're right.

12 MR. RECKLEY: And this -- this approach is
13 -- again, the light water approach evolved. And so
14 one difference here is that there will be a much more
15 structured look at those beyond design basis events,
16 those events of lower frequency, than may have been
17 done for the light water, not -- not in terms of the
18 PRAs. The PRAs have probably caught up to look at
19 those events. But in terms of the regulatory
20 treatment of them, this is being built into this
21 approach.

22 CHAIRMAN CORRADINI: So let me ask a --
23 maybe -- I know we asked you this question at the
24 subcommittee, but maybe -- I guess I want to ask it
25 again because I don't remember the answer, to be quite

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1 honest. All of these are design basis events which
2 essentially would be looking at some sort of
3 calculational approaches to what the mean is, what's
4 the uncertainty in both directions.

5 But then if I go to Chapter 15, I have a
6 set of required assumptions that make me bias --
7 forget about the Y-axis, makes me bias the X-axis in
8 a -- in a direction. So is that still part of the
9 anticipation is they will have to be --

10 MR. RECKLEY: Yeah.

11 CHAIRMAN CORRADINI: Okay.

12 MR. RECKLEY: Really, just --

13 CHAIRMAN CORRADINI: So I have -- so if I
14 might say, you don't have to go back to the cartoon,
15 but as you pepper this with what you have as a bundle
16 of potential events, you would bias them towards the
17 line based on the DBA assumptions.

18 MEMBER REMPE: Well, I thought maybe in
19 our subcommittee meeting, but somewhere I've seen that
20 it wouldn't quite be the same. One might say I'll
21 only rely on safety-related equipment, structures, and
22 components, instead of -- and call those to be design
23 basis events. It's not the traditional way of doing
24 things is what I thought I heard.

25 MR. RECKLEY: Well, the summary of this

1 curve, if you just put it in the bullets, is the
2 events are looked at from a probabilistic standpoint,
3 a PRA standpoint, and broken down by frequency into
4 anticipated operational occurrences, design basis
5 events, and beyond design basis events based on the
6 event frequencies.

7 MEMBER DIMITRIJEVIC: Well, okay. This is
8 what is very important for me. It is based on event
9 sequence frequencies, not on event -- not on
10 initiating event frequency.

11 MR. RECKLEY: Under this proposal, yes.

12 MEMBER DIMITRIJEVIC: Yes. So that's
13 completely different because there is million event
14 sequences that start with a different initiator.

15 MR. RECKLEY: Yes.

16 MEMBER DIMITRIJEVIC: Right.

17 MR. RECKLEY: Right.

18 MEMBER DIMITRIJEVIC: So, for example,
19 when we talk about design -- beyond design basis
20 events, let's say tsunami of 14 feet, that would not
21 only influence so much my release and steam generator
22 tube rupture, which is design basis event. So this is
23 what I just want to say. This is very difficult to
24 say what we are taking about, because from the PRA
25 point of view we have like, for example, large release

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1 frequency, which all the initiating events contribute,
2 but which ones contribute the most we don't know.

3 It doesn't have to be beyond design basis
4 event. Not beyond -- it's not necessarily beyond
5 design basis events which contribute most to large
6 releases. And this is which we are talking about here
7 is releases.

8 MR. RECKLEY: If the -- if the events
9 result in releases, you -- yeah, they -- they --

10 MEMBER DIMITRIJEVIC: See, for example,
11 the loss of offsite power, which is like, you know,
12 one of the high frequency events often leads to the
13 largest releases. So how -- so what we are talking,
14 where does that fit on this curve? I mean, you know,
15 or that's what I am asking. I mean --

16 MR. RECKLEY: Well, the --

17 MEMBER BLEY: Can I help you out, Bill?

18 MR. RECKLEY: Please.

19 MEMBER BLEY: And especially with respect
20 to what Joy said earlier, if you look back at the MHGT
21 -- MHGTR application and the way they approached it,
22 if you look at 1860 and what they did, and if you look
23 at the white papers and what they were proposing, all
24 of those looked at whole PRA sequences, plotted those,
25 and then looked at ways to aggregate them to make sure

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1 you were looking at the same thing. And that was the
2 aggregations that dealt with these things.

3 But they all came up with this concept,
4 and Dana argued against it at the subcommittee
5 meeting, by the way. We ought to have something
6 analogous to the current design basis accident, so
7 you'll take those out of that PRA set, and for that
8 small set, which sit over by the axis because they
9 have no releases or no big releases, you'll apply the
10 old rules of Chapter 15 to them and that adds a
11 conservatism.

12 Dana was saying, well, why in the world
13 should we do that? Should we still be going back to
14 that? And that's something I think we'll talk about
15 this summer.

16 MR. RECKLEY: Right.

17 MEMBER BLEY: That's a kind of definition.
18 But that's where the thing you talked about was those
19 they called licensing basis events, and they treated
20 them the way we treat design basis accidents now and
21 added a lot of conservatism into them and designed the
22 systems so that they could still meet those kind of
23 conservative criteria.

24 MEMBER REMPE: But, again, we can't apply
25 all of the Chapter 15 things to a non-LWR. So, in

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1 some cases, perhaps the gas reactor --

2 MEMBER BLEY: The Chapter 15 kinds of
3 assumptions.

4 MEMBER REMPE: Yeah, kinds. But I thought
5 that they were trying -- some of the designers are
6 trying to push back and say, okay, let's just say
7 we're going to rely on safety-related equipment that's
8 cost -- safety grade, and that's it, and that's where
9 I thought they --

10 MR. RECKLEY: And that's the last bullet.
11 So -- so the first sweep will be just looking at
12 events and analyzing them kind of in normal PRA, what
13 equipment do I have, how is it going to work, what
14 equipment fails, that might put me on a different
15 sequence, but you just do all of those assessments,
16 and that's the first -- the anticipated operational
17 occurrences, design basis events, beyond design basis
18 events.

19 And the reason for largely coming up with
20 those designations is the acceptance criteria could be
21 different for those. For anticipated operational
22 occurrences, there better be no releases basically or
23 very small releases, and you shouldn't be failing even
24 your first fission product barrier, right? I mean,
25 that's the same concept as now. Anticipated

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1 operational occurrences should -- should be benign.

2 Then you get into design basis events less
3 frequent. Well, they are less frequent. You can have
4 -- in theory, rely on different systems, go a little
5 further in your defense-in-depth, you are now relying
6 on a backup system perhaps, and your offsite dose
7 could be a little higher.

8 And then if you get into the very
9 infrequent, again, you're starting to pick up doses
10 that could be more significant, but you're comparing
11 them to the -- to the safety goal as your -- as your
12 criteria.

13 Now, all of that is done, and then in
14 addition to that assessment you do another set of
15 events that you're picking out of that design basis
16 event category. So you're not going way down into the
17 -- into the very improbable events, but you're picking
18 out of the design basis event category the events and
19 saying, "For those I am going to now analyze them in
20 a more traditional Chapter 15 sense."

21 And I'm only going to rely on design -- on
22 safety-related equipment. The assumptions might be a
23 little more conservative in terms of your initial
24 conditions, and the computer codes that you're using
25 might be more in line with Chapter 15. So you'd pick

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1 up all of that Chapter 15 conservatism.

2 And you're doing that for a number of
3 reasons. Those are a little easier and more clear-cut
4 historically to define engineering safety margins
5 because you're now calculating temperatures,
6 pressures, things you can compare, the ASME code
7 requirements.

8 And that's also traditionally where you
9 get your technical specifications from, so you can
10 maintain that kind of historical connection between
11 Chapter 15 and where you're getting other regulatory
12 controls on your safety-related equipment.

13 So this really was kind of a compromise,
14 bringing a large part of the regulatory structure for
15 light waters or existing plants into this, trying to
16 improve it, trying to make it more structured, more
17 organized, but also keeping some continuity in terms
18 of things like Chapter 15, technical specifications,
19 and safety classification.

20 MEMBER BLEY: I just wanted to interrupt
21 with two things. One is we're down to our last 55
22 minutes.

23 MR. RECKLEY: Right.

24 MEMBER BLEY: And we have more things to
25 talk about on functional containment.

1 MR. RECKLEY: Right.

2 MEMBER BLEY: This I think is stuff we're
3 going to address in the summer more. But if somebody
4 wants to pursue it a little bit, I think we're okay.
5 But we don't want to run out of time for the new
6 things here.

7 MEMBER DIMITRIJEVIC: But this is in that
8 paper.

9 MEMBER RICCARDELLA: I have a question.
10 I'm just trying to understand that chart. Could you
11 go back to the chart? So if I evaluated an existing
12 operating light water reactor, and wanted to plot it
13 up here, would I get a whole bunch of points for each
14 event?

15 Or would I get a line that's the -- that,
16 you know, presumably all the points, all the
17 individual points for each event sequence would be
18 below that line. But do I have to do some summing to
19 get a line -- a bounding line for all of the events of
20 that frequency and make sure that the -- I mean, that
21 last one --

22 MR. RECKLEY: That's a valid point.

23 MEMBER RICCARDELLA: Is it a cumulative
24 plot or a distributed plot?

25 MR. RECKLEY: It's a bunch of points.

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1 MEMBER RICCARDELLA: Huh?

2 MR. RECKLEY: A bunch of points for events
3 -- typically not individual because you're grouping
4 them, but -- but families or small groups of sequences
5 that are very similar.

6 MEMBER RICCARDELLA: But if I had a whole
7 bunch of points that all had a frequency of 10 to the
8 minus third, and if I had a thousand of them, then
9 I've got a -- then I've got a much higher frequency,
10 right?

11 MEMBER STETKAR: That's what Dennis was
12 talking about earlier. This notion -- until we have
13 the opportunity to see what they work through sometime
14 in the summer about what is an event sequence, we
15 don't -- it's difficult to implement this process
16 because an event --

17 MEMBER BLEY: Two things --

18 MEMBER STETKAR: -- some people will say
19 an event sequence is a cut set, and billions and
20 billions and billions of cut sets are billions and
21 billions and billions of sequences, and you run into
22 your problem.

23 MEMBER BLEY: Go back.

24 MEMBER STETKAR: Other people will say
25 it's a path through a stylized event tree, but people

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1 draw event trees differently. So that's not a
2 sequence either. So until the staff and the industry
3 have some coherent understanding of what you mean by
4 a sequence, you can't answer your question about --

5 MEMBER BLEY: But to help a little bit,
6 two things. If you looked at the design basis events
7 for current light water reactors, they are all
8 clustered along the Y-axis. They're all there. They
9 aren't anywhere else. They're at different
10 frequencies, but they're over there at almost no
11 release. And if you want to see one way you could go
12 --

13 MEMBER DIMITRIJEVIC: Wait, wait, wait,
14 wait, wait.

15 MEMBER BLEY: If you want to see one way
16 you could go at this, I'd recommend you look at
17 Appendix E in 1860, NUREG-1860. And there are a
18 couple of other sources to look at, but that's the
19 easiest one to find. I'm sorry, Vesna.

20 MEMBER DIMITRIJEVIC: Okay. Because it's
21 still important for me to understand what you just
22 said, because design basis events with vessel failure,
23 mitigating system --

24 MEMBER BLEY: No longer design basis
25 event.

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1 MEMBER DIMITRIJEVIC: Oh, what do you mean
2 it's no longer --

3 MEMBER BLEY: I mean the things that are
4 analyzed in Chapter 15.

5 MEMBER DIMITRIJEVIC: Okay. Then there is
6 no single event, other than maybe vessel failure,
7 which will actually result in releases.

8 MEMBER BLEY: Which is not analyzed in
9 Chapter 15. That is definitely not a design basis
10 event.

11 MEMBER DIMITRIJEVIC: Okay. So any
12 additional failure makes an event?

13 MEMBER BLEY: Not a design basis event.

14 MEMBER DIMITRIJEVIC: Here, how it's
15 interpreted, right?

16 MEMBER BLEY: Yeah. All of the -- all of
17 the sequences in the PRA have to go here somehow, but
18 you have to decide how you -- how you ought to arrange
19 them to look at them here. But the design basis --

20 MEMBER DIMITRIJEVIC: All right. Well,
21 that's completely strange for me. I mean --

22 MR. RECKLEY: But it's -- this is a little
23 different than the -- than the light water approach
24 because in light water -- in light water or existing
25 -- this was all done after the fact. So this is --

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1 this is trying to bring this concept into the
2 regulatory framework and a little more organized.

3 So it will be -- it will be a little
4 different. And, again, I -- in the summer we'll --
5 we're making notes that this will be an area that we
6 have to explain a little better. And it was an issue
7 when we were doing NGNP reviews, this -- this --
8 what's a family, what's a sequence. It was the same
9 discussions.

10 MEMBER BLEY: I can give you three
11 references that I mentioned, the old gas reactor
12 submittal, the 1860, and the white papers. We wrote
13 letters on those three or four years ago, yeah. So we
14 have all of that we can look at.

15 MR. RECKLEY: So getting beyond the -- the
16 events, the paper --

17 MEMBER DIMITRIJEVIC: Wait. Because I
18 just thought about, if this isn't called event
19 sequence, so then what is event sequence, for example,
20 for unprecedented operational occurrence? What's --
21 or what is event sequence for, let's say, loss of
22 offsite power? Because that is --

23 MEMBER BLEY: There are lots of them. You
24 know that --

25 MEMBER DIMITRIJEVIC: Hmm?

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1 MEMBER BLEY: There are lots of them.
2 They all start with a loss of offsite power.

3 MEMBER DIMITRIJEVIC: Yes. But then you
4 say if it's only additional -- if there is any
5 additional failure, it is not anymore, that design
6 basis event.

7 MR. RECKLEY: That would all depend on the
8 plant and the -- and the reliability or whatever you
9 have in place to -- to respond to it. So --

10 MEMBER DIMITRIJEVIC: But we just
11 discussed the case, if I have event sequence, we have
12 additional failure, loss of offsite power. These are
13 failures to start for whatever, failure of recovery,
14 blah, blah, blah, blah. That's not any more the
15 event, design basis event. That's what that has just
16 told me.

17 MEMBER BLEY: You've read Chapter 15. A
18 large LOCA is analyzed as a large LOCA with -- in most
19 reactors one loop not working, and one other active
20 failure.

21 MEMBER DIMITRIJEVIC: So that's event
22 sequence they are talking here about.

23 MEMBER BLEY: No.

24 MEMBER DIMITRIJEVIC: It's not the PRA
25 sequence.

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1 MEMBER BLEY: That is -- so that's makes
2 a bunch -- a whole bunch of things I don't think I can
3 answer at one time.

4 MR. RECKLEY: I think some of the --

5 MS. CUBBAGE: What I was going to say is
6 this will be based on the PRA sequences, not a
7 stylized deterministic approach to all of the
8 different Chapter 15 things.

9 MEMBER BLEY: Selection of the events,
10 yeah.

11 MS. CUBBAGE: Right.

12 MEMBER BLEY: It was --

13 MS. CUBBAGE: It was just certain events
14 that were selected to be representative for the large
15 light --

16 MEMBER BLEY: "Selected" is the right
17 word. They were picked with some rationality.

18 MR. RECKLEY: We'll provide what Dennis
19 was mentioning. We'll provide that background
20 information, the 1860 and some of the NGNP papers that
21 -- that describe how -- how this works a little
22 better.

23 And, again, we'll be back in the summer,
24 first -- first meeting in mid-June.

25 The other important item, or another

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1 important item within the paper that we talk about
2 because we have to mention it is -- is mechanistic
3 source term, because obviously the purpose of the
4 functional containment is to retain the radionuclides
5 within the plant.

6 And the importance then of understanding
7 the behavior of the reactor systems, the transport of
8 the radionuclides for various events, is key, and
9 that's -- there has been previous white papers talking
10 about mechanistic source term.

11 This figure also, though, I like this
12 figure that -- that originated in the NGNP papers and
13 then goes forward is some of the topics we have been
14 talking about, we're laying out the highest level
15 regulatory kind of framework here. This -- this
16 figure starts to show some of not only the high-level
17 regulatory questions, but the technical work that has
18 to get done. And we often get questions of how you
19 can set out a regulatory approach before you've done
20 some of the technical work.

21 And, you know, we'll be the first to admit
22 that's a challenge. We're trying to lay out
23 performance-based approaches such that we'll
24 acknowledge all of these things need to be done, and
25 in many cases they're only beginning for some designs

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1 and technologies. But they will need to be -- to be
2 done ultimately.

3 But, again, what we're being asked is
4 before there is a -- before there is a large
5 expenditure of money on something like fuel
6 qualification, to understand how fuel qualification
7 fits into the whole plant design. And we'll talk a
8 little later about I think it's obvious how those kind
9 of things go together.

10 How much do I have to prove the fuel is
11 going to retain the material, can be in a design
12 aspect a function of what am I going to require in
13 terms of additional barriers. And so, but what's key
14 to this figure is even when we lay this out in a high-
15 level regulatory context, we're -- you know, the
16 designers work -- this is just freeing them up to know
17 what they need to do, but they still will need to do
18 fuel qualification work.

19 Dana had brought up last time the
20 analytical codes and the validation work. That -- you
21 know, we're assuming -- we don't talk about it very
22 much in this paper. It's inherent in this, and if we
23 need to clarify -- we tried, but we can just make it
24 clear all of this work has to be done.

25 We're just laying out a framework, and all

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1 of the underlying technical work and understanding of
2 the designs still needs to be -- to be done. We're
3 just -- you know, we're -- when this paper goes up, it
4 will be still the beginning process. This doesn't
5 really enable anybody to just quickly move through.

6 It only enables them to know what they
7 have to do in terms of all of this work, in terms of
8 developing the equipment, the qualification of the
9 materials, the qualification of the fuel, the
10 qualification of the computer codes, and all of that.
11 So --

12 MEMBER KIRCHNER: Bill, I would just throw
13 out a caution that both the NGNP work and the -- their
14 approach to functional containment was predicated on
15 having robust solid fuel, not circulating fuel. I
16 just --

17 MR. RECKLEY: And we're -- we're in the --

18 MEMBER KIRCHNER: So just --

19 MR. RECKLEY: No, no. And we're now in
20 the midst of -- if you're alluding to molten salts,
21 we're -- we're just in the process now of starting to
22 say what does fuel qualification mean for a fuel
23 that's -- that's going around the reactor coolant
24 system. So we --

25 CHAIRMAN CORRADINI: You don't corrode the

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1 first barrier.

2 MR. RECKLEY: And that's -- that's a
3 proposal. I mean, that's a first step. So -- so we
4 had -- we had the event categories.

5 And, again, the structure that is being
6 proposed in the paper, the reason we spent so much
7 time on event categories is because it really does
8 explain how we are proposing -- the methodology that
9 is being proposed for defining performance criteria,
10 because you have, just like you have now, different
11 performance criteria for -- or acceptance criteria.
12 Maybe I'll change the language. You have different
13 acceptance criteria for each event category, and you
14 have that now largely with the operating fleet. That
15 will continue.

16 In general, the more you go down in terms
17 of lower and lower frequencies, the more the -- the
18 higher the acceptance criteria is in terms of
19 allowable consequences, if you will.

20 MEMBER DIMITRIJEVIC: Well, what type of
21 acceptance criteria?

22 MR. RECKLEY: And we'll go in the next
23 slide --

24 MEMBER DIMITRIJEVIC: No, no, no.
25 Currently, you compare it to current. So what type of

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1 acceptance criteria you are saying goes down with it?

2 MR. RECKLEY: Well, if you start with
3 anticipated operational occurrences, in light water or
4 current reactors, those are basically required to show
5 that you don't fail the cladding on the fuel. Then,
6 by the time you get to large break LOCAs, you are
7 using the 2200. And this is in the Chapter 15 space.
8 In --

9 MEMBER DIMITRIJEVIC: In the PRA space.

10 MR. RECKLEY: In the PRA space -- I'm not
11 a PRA person, but in general you're going to aggregate
12 those and compare them to the safety goals.

13 MEMBER DIMITRIJEVIC: Yes. But that's
14 completely independent of this, and it doesn't change
15 once you --

16 MR. RECKLEY: And that is one of the --
17 that -- to some degree it's one of the differences
18 that will exist, in that large light water reactors --
19 man, I wish Marty or somebody was here to be my call
20 a friend, but he has left. And I'm going to go beyond
21 my station here.

22 But, and maybe I'll look at the PRA people
23 here, but anticipated operational occurrences aren't
24 going to get much attention in a light water reactor
25 PRA, because you're ending it very early, saying I

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1 don't get core melt, I don't get core damage.

2 And so those event sequences are going to
3 end relatively -- I mean, they're not addressed very
4 much. In this sequence -- in this proposal --

5 MEMBER BLEY: They're in there, but
6 they're not tracked.

7 MR. RECKLEY: Yeah, okay.

8 MEMBER DIMITRIJEVIC: Wait a second. Do
9 you consider transient anticipated occurrence, plant
10 transient? Yeah. I mean, therefore, we have to be
11 mostly protected for --

12 MEMBER BLEY: There's a group of
13 transients that are called anticipated events, but
14 there are also some transients that are in the PRA
15 that go well beyond those.

16 MEMBER DIMITRIJEVIC: Okay. Well, that's
17 -- I just want to say that PRA has nothing to do, and
18 actually you need to protect more against more likely
19 events to, you know, prevent them to resulting --

20 MR. RECKLEY: And that's what this would
21 show is that your first line of defense is going to
22 work most often --

23 MEMBER BLEY: I've got to interrupt.

24 MR. RECKLEY: Yeah.

25 MEMBER BLEY: We're running out of time.

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1 MR. RECKLEY: Yeah.

2 MEMBER BLEY: And we've been on this topic
3 longer than we have time for.

4 MR. RECKLEY: Okay.

5 MEMBER BLEY: You've got to get us to
6 anything that has changed.

7 MR. RECKLEY: Okay. So to go to the -- to
8 the meat of the paper, then, that the proposed
9 methodology is to take the acceptance criteria for
10 each event category -- for example, the fuel design
11 limits or the frequency consequence targets, which are
12 different for each event category, and you see in the
13 terms of the functional containment, which is those
14 things that you're putting in place to retain
15 radionuclides, what structures, systems, and
16 components am I relying on to meet the acceptance
17 criteria for that event category.

18 And so, for example, under normal
19 operations, I'm operating under Part 20 as my
20 acceptance criteria. Well, what, under normal
21 operation, am I relying on to keep me under Part 20?
22 And anticipated operational occurrences assume I set
23 my acceptance criteria to be some fuel design limit
24 like the specified acceptable radiological release,
25 the SARRDL, or -- or on the molten salts maybe it's

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1 the integrity of the first barrier. Then that becomes
2 my acceptance criteria for the event category. What
3 am I relying on in order to retain those
4 radionuclides?

5 And so that -- that just becomes the
6 methodology for defining what is the requirements for
7 functional containment. You aggregate, then, all the
8 structures and systems and components that I'm relying
9 on for all of the event categories, and then that
10 becomes my performance criteria for the functional
11 containment.

12 There is a separate discussion in the
13 paper on physical enclosures or physical buildings,
14 only because the history of this topic has always --
15 as soon as you say containment, what comes into
16 people's minds is the structure. And so there's
17 always -- often been discussions of what is the -- the
18 purpose or the role of the physical enclosure, so we
19 included a discussion within the paper.

20 Certainly, if there is a -- if there is a
21 role for the building or the enclosure in retaining
22 radionuclides for any event category, now that
23 building is part of my functional containment. In
24 some cases, it might be part of my functional
25 containment for maybe only the last category.

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1 So using that as an example, if I'm only
2 using my reactor building as a last line of defense
3 against a beyond design basis event, it's still now
4 part of my functional containment. But how I define
5 what the regulatory requirements are will be
6 reflective of what are regulatory requirements for
7 equipment serving beyond design basis events.

8 So it could end up being a reactor
9 building that's non-safety-related, but credited
10 within my mechanistic source term in a best estimate
11 approach to how that building would help me retain the
12 radionuclides. Whereas, I could also be crediting a
13 reactor building or enclosure for my design basis
14 accidents in order to retain the fission products, in
15 which case now that enclosure will be a safety-related
16 structure under the existing arrangement.

17 So it's just a way to organize and
18 determine what is serving the role of retaining the
19 radionuclides and then setting the regulatory
20 requirements in line with which event category it's
21 being credited for.

22 That's not dramatically different than how
23 stuff is done for light water reactors where you just
24 -- you aggregate, you go into a design basis document
25 for some component and they have basically done this

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1 same thing to say, okay, is it serving any safety-
2 related function? And then it's on the -- you know,
3 it's on the cue list. If it's -- if it's not, it
4 still may have requirements to meet some regulation or
5 it may have a reliability goal within the PRA or the
6 maintenance program.

7 So it's not dramatically different. We're
8 just trying to be a little more structured and
9 organized. Then, the other thing that is called out
10 in the paper, again, just because it's so common, if
11 you go into discussions of the physical enclosure --

12 MEMBER REMPE: Bill, before you leave that
13 slide, when I looked back about our meeting last time,
14 the only thing I didn't you that I wanted to was I
15 looked at the June 2003 paper and how the
16 Commissioners had not approved the recommendations
17 related to the confinement building.

18 They cited you needed to have performance
19 requirements and you should work with industry, and
20 some things that they wanted to get back from you
21 before they ever considered it. Do you have any feel
22 about whether you think you've got enough now that
23 they can make a decision? Because, frankly, I think
24 their not making a decision has hindered progress in
25 this area. And what do you think?

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1 MR. RECKLEY: Well, what we're going to --
2 what we're going to say in the paper, and then there's
3 a Commission meeting coming up, and we'll tell them
4 this paper is coming, but in general the message that
5 we're getting is there are too many questions about
6 what is fixed and what's in play, what can a designer
7 have under their control, and -- and that is the
8 purpose of the paper.

9 So, yeah, I won't say that -- yeah. But
10 a decision is needed now, so that we can incorporate
11 functional containments into the next set of papers to
12 say what the overall framework is going to be.

13 So, yeah, we're going to say a decision is
14 needed as soon as the -- obviously, we don't dictate,
15 but --

16 MEMBER REMPE: And you hope that you've
17 got this --

18 MR. RECKLEY: We hope.

19 MEMBER REMPE: -- industry interactions
20 indicate you probably -- they think you have enough
21 stuff in there for them to --

22 MR. RECKLEY: Right. I mean, this -- this
23 reflects -- and, really, it has been fairly continuous
24 fits and starts. I shouldn't say continuous. It is
25 over a long period of time with fits and starts, but

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1 this same basic approach is -- is not -- it's from the
2 '80s all the way up to now. Even the paper in '93
3 said this approach would be built around event
4 categories. This is -- again, it's not -- this whole
5 -- this whole approach.

6 And then the most interaction lately that
7 we would rely on in terms of this notion of the deal
8 with stakeholders was NGNP, and then the follow-up
9 more recently with this licensing modernization
10 project. So, yes, we think we've done it.

11 MEMBER REMPE: We've matched the rear --
12 it's different commissioners, but you know --

13 MR. RECKLEY: Yes. We think -- we think
14 we have, and we think -- and the underlying message is
15 we need a decision on this in order to -- to move
16 forward.

17 I already really talked about this in the
18 previous, but -- but it just reinforces, for example,
19 that there are related topics, and some of this will
20 have to get worked out in an integrated fashion
21 because you have all of these parts. And as soon as
22 you try to answer one part in isolation, then it just
23 cascades back.

24 And so one that was brought out in Reg
25 Guide 1.232 was the use of specified acceptable

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1 radionuclide release design limits, or SARRDLs, and
2 the role that -- the relationship between a SARRDL and
3 the functional containment.

4 And so the -- you know, the designers are
5 looking at an approach where they could set very
6 restrictive SARRDLs, meaning there wouldn't be very
7 many radionuclides in the inventory to be released,
8 and then you can have a functional containment that
9 works a certain way.

10 If you're going to -- if you're going to
11 say all plants need to have basically the equivalent
12 of a -- of a current pressure-retaining containment,
13 it raises other issues, but it also would say, if I
14 have another barrier, maybe my SARRDLs can be higher.

15 And so those tradeoffs are what the
16 designers are looking for, and we're just -- we're
17 just trying to basically, again, say as long as the
18 integrated plant design considers all of these things
19 and models them through, they have the flexibility to
20 pick where they want to put the emphasis, provided the
21 net result, which is public health and safety, is --
22 is provided or protected.

23 MEMBER KIRCHNER: Just Bill, one more
24 cautionary note. On certain design concepts where you
25 do have liquid fuel, you, in the traditional sense,

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1 have already eliminated one of the barriers. And I
2 would suggest, I think your paper, although I didn't
3 see it in the viewgraphs, talks about undue reliance
4 on any one barrier.

5 MR. RECKLEY: That was --

6 MEMBER KIRCHNER: Because now the burden
7 of proof, I would presume, would be much higher on how
8 essentially leak-tight that barrier is for that kind
9 of concept.

10 MR. RECKLEY: Right. And, again, you have
11 to evaluate the fuel form, and assume it -- assuming
12 it reaches your first barrier, what happens to the
13 fuel? And, therefore, then what kind of barrier do I
14 need given that it reached the first, right?

15 So, again, all of the molten salt
16 discussions are preliminary. But there is -- there is
17 some discussion about the ability of the salt, once it
18 reaches the first barrier, to actually retain the
19 fission products and, therefore, the role of the
20 second barrier might not be as great as it sounds on
21 first blush. Not that you don't need a second
22 barrier, but what -- what it has to address in terms
23 of the potential to retain nuclides --

24 MEMBER KIRCHNER: It's not just fission
25 products. You have the actinides in circulation.

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1 MR. RECKLEY: Oh, yeah, yeah. Okay.

2 So -- so, again, this is just summarizing
3 basically the proposed approach, and I've gone through
4 it before. The physical structures, the paper lays
5 out some other possible uses, the protection against
6 external events, weather, aircraft impact, potential
7 delay in security scenarios, and so forth.

8 So in addition to whatever role it has in
9 retaining radionuclides, the physical enclosure might
10 be subject to any number of other regulatory
11 requirements or asset protection requirements that the
12 designer is -- is establishing.

13 And so to get to Dr. Bley's suggestion, we
14 do want to point out what we changed in the -- in the
15 paper, and it's not a lot, but -- but we did try to
16 address some of the things that we heard. One is in
17 a few places -- and I don't want to overstate, but in
18 a few places we -- we made sure that it was
19 characterized as a methodology.

20 These are not performance criteria if
21 you're looking for physical parameters. This is a
22 methodology by which a designer can determine those
23 physical parameters based on all the discussion we
24 just had about what are they relying on for functional
25 containment. So --

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1 MEMBER BLEY: By the way, you've still got
2 approach in some places in the paper.

3 MR. RECKLEY: Yes.

4 MEMBER BLEY: The same thing that you used
5 methodology for.

6 MR. RECKLEY: Yeah. I'll be honest, this
7 didn't go through the technical editor, so I -- I was
8 putting -- I put it in a few places.

9 MEMBER BLEY: I just wanted to let you
10 know.

11 MR. RECKLEY: Okay. We added a sentence
12 on validation of computer codes. As I talked about,
13 you know, in this slide, there is -- we're laying out
14 a framework.

15 The assumption, inherent assumption, is
16 that all of this traditional work, like fuel
17 qualification, validation of computer models, really
18 everything you need to understand about the behavior
19 of the plant and the behavior of how radionuclides go
20 from one barrier to another or get stopped by a
21 barrier, all that work, scientific work, has to be
22 done to support the safety case.

23 We're just laying out kind of the
24 regulatory structure. All the technical work still
25 needs to get done to support the safety case argument.

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1 We did add one sentence. We had -- we had
2 alluded to we made it a little more clear that there
3 will be future papers coming out of the licensing
4 modernization project activities. Again, where --
5 where we're coming back to the ACRS in the summer to
6 talk about the general framework and some of the
7 things in more detail, our thinking is things like the
8 frequency consequence target figure, once we make a
9 move to say we're going to endorse it in a regulatory
10 guide, we want to at least make the Commission aware
11 of that.

12 It may be -- we haven't decided yet, but
13 it may be that we have to ask the Commission to weigh
14 in on that, so that we get something firm to move
15 forward on. So there's an understanding that this
16 will be the first paper and there will be a number of
17 -- at least one -- in all honesty, there will be any
18 number of papers that come out of this effort to go to
19 the Commission to weigh in on specific aspects of the
20 framework.

21 In a few places, we tried to change the
22 wording just a little bit to tweak it, in that there
23 were places we said the building -- should the
24 building have this function. And it's likely the
25 building is going to have some function in retaining

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1 radionuclides.

2 Once I build it, why would I not take
3 advantage of it in the analysis. And so -- so we
4 changed -- just tweaked the words to make it a little
5 more clear that it's likely that the enclosure would
6 serve -- would serve some purpose in at least some of
7 the event categories.

8 MEMBER KIRCHNER: I would recommend that
9 you add shielding. I think it's there, but now that
10 I look at it again, I don't see it.

11 MR. RECKLEY: Okay.

12 MEMBER KIRCHNER: At least it -- I don't
13 see it in the bowties list.

14 MR. RECKLEY: Okay. And then in terms of
15 the defense-in-depth discussion, we had a couple of
16 sentences. But the meat of it is here on the slide,
17 that the performance criteria are met without
18 exclusive reliance on a single element of a design or
19 a program. I don't know if that goes as far as -- as
20 you would propose. Probably not, but it --

21 MEMBER MARCH-LEUBA: No. I wanted
22 diversity independence.

23 MR. RECKLEY: Okay.

24 MEMBER MARCH-LEUBA: If you put two pieces
25 of paper, you have two but they are still the same

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1 thing. But it's a good try. It's a good try.

2 MR. RECKLEY: Part of the -- part of the
3 problem -- I'll be honest, part of the problem is when
4 you look at the spectrum of possible things we're
5 trying to address here, it makes it even difficult for
6 me to say straightforward anything that looks close to
7 -- to what full size the existing plant looks like, I
8 think no one would really argue the point, because as
9 you get smaller and smaller, I don't know that you
10 reach -- or some of these technologies, and we're
11 trying to make sure that we don't unnecessarily start
12 putting up restraints that may not be needed for some
13 designs. But that -- this will be a discussion that
14 we continue.

15 And then, so those are really kind of a
16 summary. Again, we didn't change very much from the
17 subcommittee.

18 And then, lastly, the recommendation stays
19 basically the same, that we're asking the Commission
20 to go ahead and approve the use of this kind of a
21 methodology to define the performance criteria for a
22 functional containment, and then we summarize that
23 approach or methodology in terms of the event
24 categories, and aggregating all of the credit that is
25 taken for any particular SSC. And then that becomes

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1 the performance criteria for the functional
2 containment for that design.

3 So that really is the end of the --

4 MEMBER MARCH-LEUBA: Can I make a
5 philosophical comment? You started this presentation
6 saying that one of the driving forces here was to
7 reduce the regulatory uncertainty, which is a very
8 good goal. I am worried that what we are adding here
9 is a lot of regulatory burden, because if you follow
10 this approach to the letter, you are going to have to
11 require a perfect PRA with extreme detail, full of
12 analysis, whereas the directors are expecting to write
13 a single piece of paper saying, "We don't melt the
14 core. We don't need nothing."

15 MR. RECKLEY: And we're having that
16 discussion. What -- if we can -- if we can lay out
17 that this -- that this general approach would work for
18 the whole set, if any particular developer can say,
19 for example, I don't want to do analysis of all of
20 this stuff, I want to, for example, go back to a
21 concept of maximum hypothetical accident and simply
22 say -- well, it's used -- the reason it comes up is
23 some of these reactors are getting in size comparable
24 to research reactors, and research reactors still use
25 a concept of maximum hypothetical accident that just

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1 says you take my inventory and treat it even non-
2 realistically.

3 And I still don't get -- I still -- if any
4 developer wants to make a similar argument, my point
5 is they can make the argument and they can say, "Using
6 that most conservative maximum hypothetical accident,
7 I'm near zero, and that thing is way down there at 10
8 to the minus 7 or 8," and that's an argument that I
9 don't need to do much other assessments.

10 What we're -- what we're trying to weave
11 in is whether that's a different approach or it's a --
12 it's a different path within this same approach. And
13 we're still working with the industry to say how they
14 want to characterize that. Personally, I think --

15 MEMBER MARCH-LEUBA: Just make sure --
16 just make sure you don't preclude that simple
17 approach.

18 MR. RECKLEY: No, no. And as Amy
19 mentioned in the -- in the severe -- in the advanced
20 reactor policy statement, it's a goal that when you do
21 stuff simpler, the analysis and other aspects of the
22 licensing is also made simpler. You don't want to
23 have a simple design and then us not recognize it as
24 also supporting a simpler approach in terms of the
25 analysis and the licensing.

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1 So, yeah, we're -- we're cognizant.

2 MEMBER BLEY: Okay. Anything from the
3 members?

4 MEMBER RAY: Well, since I think we've got
5 a minute here, we can't start --

6 MEMBER BLEY: Well, there is something
7 else we can do.

8 MEMBER RAY: I see. All right.

9 MEMBER BLEY: But if you want to make a
10 speech, that's fine.

11 MEMBER RAY: I don't plan that. I just
12 want to take advantage of the time if we had it, but
13 if you've got something else to do, I want to just say
14 to Bill that there was a couple of times he made
15 comments that I wondered about, but I didn't want to
16 interrupt. And you talked about Chapter 15 items or
17 Chapter 15 analyses, things that we rely on being on
18 a cue list. A couple of times you mentioned tech
19 specs.

20 If somebody has operated plant -- I'm not
21 the only one here who has -- I just would like to be
22 sure that the import of having some things -- the
23 availability of something covered in tech specs is
24 understood, and there isn't just this continuum of,
25 oh, well, we'll set reliability goals and we have the

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1 maintenance rule and stuff like that, because it's a
2 world of difference between having something available
3 in accordance with the tech spec and having to have it
4 available on any other basis you want to think about.

5 MR. RECKLEY: Yes. The -- yes, there will
6 be those. The reason I hesitate or stammer here a
7 little bit is because -- because you know what's going
8 on in tech specs for operating reactors is -- as
9 things like completion times and other things are less
10 prescribed than they used to be.

11 And I don't want to say that approach
12 won't be taken here, but I will -- I will say there
13 will be limiting conditions for operations, and -- and
14 requirements in terms of availability in the tech
15 specs, maybe not as prescribed as they were originally
16 in light water reactors, this is way beyond the
17 discussions we're having yet with the community.

18 But the importance of that I share with
19 you is that I look at that as another defense-in-depth
20 kind of approach in that you're analyzing them
21 different, you're treating them somewhat different.
22 You know, one is over here in a reliability assurance
23 program; one is over here in tech specs, and you get
24 that kind of --

25 MEMBER RAY: Yeah. I mean, so often

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1 people think of things that are on a cue list as just
2 gold-plated. It's not necessary; it's a bunch of
3 crap. But when you're running a plant around the
4 clock, if it's a requirement -- and I'm not saying the
5 requirements should be as they were in the past -- but
6 if it's a requirement and you're going to get cited if
7 you fail to meet that requirement, it's a big
8 difference between that and what you assume about what
9 we now call Chapter 19, beyond design basis, FLEX
10 stuff, and all that. It's just a world of difference.

11 MR. RECKLEY: Right. All of the
12 discussions to date, that is maintained.

13 MEMBER BLEY: Thank you. Anything else?
14 Is there any -- yes, ma'am.

15 MEMBER DIMITRIJEVIC: I know you're not
16 going to be happy to see me talking about this, and
17 especially, you know, I can see history of the curve,
18 but looking -- and I saw it before. And to me, it
19 looks like, you know, this story about naked king and
20 nobody wants to say the king is naked. But actually
21 it's naked.

22 MEMBER BLEY: The Emperor's New Clothes.

23 MEMBER DIMITRIJEVIC: Well, the thing is,
24 this is not the PRA curve. If it's a PRA-related
25 curve, it should be really clear what event sequences

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1 we are talking about. Is that, you know, large
2 releases, the Level 3, Level 2, and they are not
3 really directly related to initiating events.

4 So if this is deterministic approach,
5 that's fine, and I am getting all related things. If
6 this is deterministic structure, that's a
7 deterministic structure. But then let's don't discuss
8 the PRA approach, and that's my point.

9 MEMBER BLEY: Is there anybody in the room
10 who would like to make a comment? Is the phone line
11 open? Ron, is there anybody on the phone line who
12 would like to make a comment? Please identify
13 yourself and do so.

14 Hearing no comments, I'm going to turn it
15 back to you -- no, I'm not. I'm going to -- I'd like
16 to go through my bullet points after we end this piece
17 of the session.

18 At this point, we're going to go off the
19 record and thank the staff for a great discussion.

20 (Whereupon, the above-entitled matter went
21 off the record at 3:18 p.m. and resumed at 3:49 p.m.)

22 CHAIR CORRADINI: Okay. We'll come back
23 into session. We'll take up our second topic of the
24 day, which is the WCAP 17938.

25 And Harold, do you want to lead us through

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1 this, please?

2 MEMBER RAY: Yes. Thank you, Mr.
3 Chairman. On February 7 the AP1000 subcommittee met
4 on this topic, WCAP 17938, Revision 2.

5 And we will now be presenting it here to
6 the full committee. The document is almost entirely
7 proprietary, as is the staff safety evaluation.

8 And therefore, we will conduct an open
9 meeting, which is what we're in now. We will take
10 following the Westinghouse and staff presentations, we
11 will take any public comments.

12 Then we will close the line. And the
13 remainder of the meeting will be closed to include
14 just those who are qualified to participate in the
15 discussion of the proprietary material.

16 I think that's the -- all I need to say by
17 way of introduction. Don, is there anything you
18 wanted to say before Westinghouse begins?

19 MR. HABIB: No. We're ready on the staff
20 side.

21 MEMBER RAY: Okay. Then in the interest
22 of time, I'll turn it over to Westinghouse. And
23 please proceed.

24 MR. SINHA: Okay. Good afternoon. My
25 name is Shayan Sinha. I work in the AP1000 licensing

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1 group.

2 And here with me is Zach Harper. He's a
3 manager of the AP1000 licensing group. And we're
4 representing Westinghouse and will be -- we're very
5 grateful also to be able to present this topic, WCAP
6 17938 to the ACRS full committee.

7 So, I just wanted to start by discussing
8 a little bit about the background of GSI 191. And
9 specifically the GSI 191 related design basis.

10 So as part of GSI 191 plans that are
11 required to place limits on debris inside containment.
12 And the purpose of these limits is to ensure that
13 following a LOCA that the debris doesn't result in
14 some clogage.

15 It's part of the recirculation and long-
16 term debris cooling. Long-term core cooling. So the
17 AP1000 actually significantly reduces many of the
18 limits compared to a lot of the generation two plants.

19 Essentially, this is because some of the
20 GSI 191 related learnings can be incorporated into the
21 design. And put into practice before construction and
22 operation.

23 One of the limits that is considerably
24 lower is the fibrous debris limit inside containment,
25 which is 6.6 pounds per the AP1000 DCD. All this

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1 fibrous debris is attributable to latent debris.

2 So in other words, following the LOCA, the
3 expectation is that no debris will be generated
4 because of the LOCA.

5 MEMBER RAY: Well, and let me just quibble
6 a little. I guess I would say it's a requirement, at
7 least as far as we're concerned in this proceeding.

8 MR. SINHA: Correct. And that's how we're
9 treating it again, in our evaluation of this topic.

10 MEMBER RAY: Yeah. That's right.

11 MR. SINHA: The metallic reflective
12 insulation is used extensively inside containment
13 including on the reactor vessel itself. And the DCD
14 and the Vogtle FSAR provide requirements that must be
15 demonstrated if you want to use an alternative fibrous
16 debris rather as opposed to MRI.

17 And these requirements include that we
18 need to demonstrate that this alternative insulation
19 is a suitable equivalent for the purposes of GSI 191.

20 There needs to be testing that will
21 demonstrate that this alternative insulation is a
22 suitable equivalent to metallic reflective insulation.
23 And will not generate debris or transport debris. And
24 also that the testing must be approved by the NRC.

25 So the purpose of WCAP 17938 is three

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1 items. The first item is we wanted to establish a
2 zone of influence applicable to all AP1000 in
3 containment cabling that would demonstrate that it
4 would not produce debris following a LOCA.

5 We wanted to gain approval that
6 nonmetallic insulation used in the reactor insulation
7 system for AP1000 is a suitable equivalent to MRI for
8 the purposes of GSI 191. And we also wanted to gain
9 approval to utilize NEI 04-07 alternate methodology
10 for defining debris generation break sizes.

11 Which is a methodology that is approved
12 generically in the NEI 04-07 safety evaluation.
13 However, it was not previously applied to AP1000
14 specifically.

15 And essentially the testing analysis that
16 I'm going to describe is -- helps us demonstrate that
17 neither in the cabling nor the nonmetallic insulation
18 would contribute to post-LOCA debris.

19 MEMBER MARCH-LEUBA: Shayan, can you
20 shortly for the record, tell us whether these are
21 post-core cables? So if a cable has to penetrate the
22 zone of influence, what happens?

23 MR. SINHA: So the -- essentially we would
24 have to protect it. We'd have to incorporate a
25 protection scheme that we think would prevent it from

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1 producing debris.

2 So yeah, I think that's something that's
3 noted in the topical report that it's not specifically
4 approved in the topical report. But essentially
5 that's a criteria for cable that would go unprotected,
6 is the 4D ZOI.

7 However, if it's inside the 4D ZOI, then
8 we would have to come up with a different protection
9 scheme.

10 CHAIR CORRADINI: So, can you slow down
11 and say that again?

12 MR. SINHA: Sure.

13 CHAIR CORRADINI: So that if it's inside
14 the zone of influence, it has to be protected?

15 MR. SINHA: Yes. That's correct.

16 CHAIR CORRADINI: Okay. Fine. And if
17 it's outside, based on some methodology, it remains
18 however it's normally -- the cable is normally
19 supported in and installed?

20 MR. SINHA: Yes.

21 CHAIR CORRADINI: Okay. Great. Thank
22 you.

23 MEMBER RAY: Let me just add one little
24 thing here too actually in the staff safety
25 evaluation. It's the responsibility of the licensee

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1 to, and they use the term various methods for
2 providing protection, to demonstrate the adequacy of
3 the protection provided within the zone of influence.

4 So, it's agreed outside the scope of what
5 we're dealing with here.

6 MR. SINHA: Slide please. So a little bit
7 of background of how this topical report came about.
8 There were two items that essentially led to the
9 creation of WCAP 17938.

10 The first item was that an issue was
11 uncovered that the cabling inside the AP1000
12 containment may contain fibers and other materials --
13 fibrous materials and other materials that could
14 potentially be debris. But it was not -- were not
15 sufficiently evaluated previously as debris sources.

16 So, as part of the resolutions issue,
17 corrective actions were taken. And they included the
18 development of a test program to establish a zone of
19 influence for in containment cabling.

20 The second item is that nonmetallic
21 insulation is required in the reactor vessel
22 insulation, because they are components that perform
23 functions beyond the insulation function.

24 So for example, the three subcomponents
25 are locations that are in the scope of this topical

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1 are shown in that figure to the right. And the CA 31
2 module, neutron shielding blocks are there for neutron
3 shielding function.

4 They prevent neutron streaming upwards in
5 the containment. The lower neutron shield is there to
6 prevent neutron streaming into the reactor cavity to
7 reduce some of the dose in the reactor cavity in the
8 lower portions of containment.

9 And then the water inlet doors support the
10 in-vessel retention function for the -- for the beyond
11 basis accident scenarios.

12 CHAIR CORRADINI: Can you point to those
13 again? I'm sorry.

14 MR. SINHA: The water inlet --

15 CHAIR CORRADINI: Well, you have the
16 mouse. And you can do the mouse.

17 MR. SINHA: Right. So the water inlet
18 doors are here.

19 CHAIR CORRADINI: Oh, okay. Thank you.

20 MR. SINHA: Yeah, so those are there to,
21 you know, they need to allow water in like following
22 a severe basis accident and when we are demonstrating
23 the in-vessel retention capabilities.

24 So, some of the summaries of the results
25 of our program that we -- that evaluated these

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1 nonmetallic insulation cables. So there was extensive
2 large-scaled jet impingement testing that was
3 performed to establish the zone of influence for in
4 containment cables of 4 L/D.

5 This testing was performed at a laboratory
6 that was used previously for a Pressurized Water
7 Reactor Owners Group in their establishing of the zone
8 of influence for other operating plants.

9 And essentially this 4 L/D ZOI was
10 incorporated in as a design requirement, as a design
11 criteria, as we evaluated the routing cables inside
12 containment in advance of actually installing any
13 cable or cable tray.

14 The WCAP invokes the alternate evaluation
15 methodology from NEI 04-07 to determine the minimum
16 break size when considering debris generation break in
17 AP1000 components. And then the insights from the
18 nonmetallic insulation, jet impingement, and
19 submergence testing programs resulted in design
20 changes that strengthen elements of the second points
21 of the reactor vessel insulation.

22 So essentially the design was changed to
23 use thicker and more robust encapsulation methods. So
24 essentially, as part of these programs, we were -- the
25 WCAP justified that no new debris was generated from

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1 the AP1000 cabling for nonmetallic insulation.

2 And then finally, so our conclusions. So
3 a zone of influence of 4 ID is applicable to the
4 AP1000 in containment cabling founded by testing
5 analysis.

6 The application of the NEI 04-07 alternate
7 break methodology was acceptable for use in AP1000.
8 And the cabling does not contribute to AP1000 post-
9 LOCA debris limits.

10 With regards to the nonmetallic
11 insulation, the encapsulated nonmetallic insulation
12 used in the AP1000 reactor vessel insulation, would
13 not produce debris when subjected to jet impingement
14 from limiting line breaks.

15 And then neither the cabling nor the NMI
16 was found to contribute to the chemical debris when
17 it's imposed by GSI 191.

18 And then finally, based on the
19 consideration of the submergence testing and the jet
20 impingement testing and analysis, the conclusion was
21 that the nonmetallic insulation used in the reactor
22 vessel insulation is suitable equivalent to MRI for
23 the purposes of GSI 191.

24 And just to kind of reiterate the overall
25 conclusion that the WCAP justifies that there's no new

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1 debris generation for AP1000 cabling for nonmetallic
2 insulation.

3 MEMBER RAY: Questions? On this segment.
4 Okay.

5 MEMBER SUNSERI: I had one. Just one
6 question.

7 MEMBER RAY: Yeah. Sure, go ahead.

8 MEMBER SUNSERI: So I don't -- I remember
9 we had the discussion. But I don't remember the
10 outcome during the subcommittee meeting.

11 But, -- so the cables that were tested, I
12 mean different manufacturers will have different
13 insulation systems, different filament material, et
14 cetera.

15 So, is this evaluation for that specific
16 manufacturer for zone of influence of 4? Or is it a
17 generic cable?

18 MR. SINHA: So, the -- essentially the --
19 well, we -- yeah, this cabling that we used from this
20 vendor is a benchmark of sorts.

21 And we've added wording into the DCD
22 markup that says that it's a 4D of ZOI is applicable
23 -- it's essentially that the bullet that's there that
24 says it's applicable to AP1000 containment cables
25 founded by testing and analysis.

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1 And I think -- I believe the staff has
2 added some wording to the safety -- to the revised
3 safety evaluation saying that really if, you know, it
4 would need, the cable would need to be reassessed if
5 there's a change in vendor.

6 So, I think the staff could expand on that
7 more when they have their discussion. But, as an
8 outcome of that comment from the last two meetings,
9 those two changes were considered and made and we're
10 moving forward with the topical.

11 MEMBER RAY: We'll follow up on that a
12 little bit in the impression part of the meeting.
13 Anything else?

14 (No response)

15 MEMBER RAY: Okay. Thank you very much.
16 We will now ask the staff to come and give their
17 corresponding presentation.

18 And then as I said at the beginning, we'll
19 seek any comments that members of the public may have.
20 Please proceed when you're ready.

21 MR. HABIB: Good afternoon. My name is
22 Don Habib. I've been serving --

23 MEMBER RAY: Don, I question if you have
24 your microphone on. Or if it's close enough to you.
25 There you go.

1 MR. HABIB: Now we're good. Better.
2 Thank you.

3 Good afternoon. My name is Don Habib.
4 I've been serving as the project manager for the staff
5 review of this technical report.

6 And I'm joined by Clint Ashley and Boyce
7 Travis, who are members of the technical review team.
8 And we'd like to thank you for the opportunity to
9 present the draft safety evaluation topical report.

10 And look forward to answering your
11 questions either in this public session or in a closed
12 session for any proprietary matters.

13 Since the subcommittee meeting on February
14 7, the staff had made changes to the draft safety
15 evaluation. And we've provided that revised draft to
16 the subcommittee.

17 The staff inserted additional information
18 partly in consideration of remarks from the
19 subcommittee meeting. And we also revised it to
20 address the change to the topical report submitted by
21 Westinghouse.

22 And so in the next few minutes I'll
23 provide an overview of the staff's review. And after
24 that, Clint will talk about those key changes that we
25 made.

1 The technical review team includes Clint
2 Ashley, Boyce Travis, as well as Renee Li, Greg Makar,
3 and Malcolm Patterson. They're all from the Office of
4 New Reactors.

5 We also worked with our counterparts in
6 the Office of Nuclear Reactor Regulation. So they
7 also participated in the review.

8 As background, this topical report is a
9 document that addresses a technical topic related to
10 power plant safety. And these topical reports, they
11 address generic issues.

12 They can affect multiple plants. And are
13 intended to help make the licensing change process
14 more efficient for those plants.

15 For example, when multiple plants will be
16 addressing the same licensing issue. In this case the
17 topic relates to GSI 191 and examines the assessment
18 of debris and PWR sump performance.

19 And this topical report is specific too
20 just the AP1000 design. So approval of -- a staff
21 approval of this report would allow AP1000 licensees
22 to use this in support of future licensing changes.

23 The AP1000 design as it's currently
24 certified states that a loss of coolant accident, or
25 LOCA, in the AP1000 does not generate fibrous debris

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1 due to damage to insulation or other materials in the
2 AP1000 design.

3 Instead of using fibrous insulation around
4 pipes and components, the AP1000 design uses metal
5 reflective insulation. Which does not generate debris
6 during the LOCA.

7 The AP1000 again, the design allows for
8 substituting other materials that are considered
9 suitable equivalents to metal reflective insulation.
10 If the testing shows that they do not generate or
11 transport debris, and if that testing is approved by
12 the staff.

13 This topical report seeks NRC approval for
14 three items related to the potential generation of
15 debris. First it requests that a zone of influence be
16 established for electrical cabling and containment.

17 The AP1000 as it's currently certified
18 does not explicitly address cabling and cable
19 insulation. Or the generation of debris from cable.

20 And so this topical report, under this
21 certain cables could be used in containment if they
22 are located outside the defined zone of influence.

23 Second, the report requests NRC approval
24 for the use of nonmetallic insulation as a suitable
25 equivalent to metal reflective insulation at certain

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1 locations within containment.

2 And as previously mentioned, the use of
3 metal reflective insulation is a key design feature of
4 the AP1000 design that supports a generation of zero
5 debris in containment.

6 Finally, the report requests NRC approval
7 of the use of NEI 04-07 PWR sump performance
8 evaluation methodology. Which requests -- which
9 provides an alternative methodology for plant specific
10 evaluation of sump performance.

11 And that's already been approved by the
12 NRC. And this would allow it to be applied
13 specifically for the AP1000 design.

14 The main guidance that staff used in
15 support of the evaluation included the NEI 04-07, as
16 well a -- the staff safety evaluation that's written
17 in approval of the NEI 04-07.

18 In addition, it included WCAP 16530,
19 evaluation of post-accident chemical effects in
20 containment sump fluids to support the PSI 191. And
21 that takes the evaluation a further step, looking at
22 chemical affects in addition to debris.

23 MR. ASHLEY: Hi. I'm Clint Ashley. These
24 are just some of the updates that we made to the WCAP
25 and the associated safety evaluation.

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1 So when the subcommittee meeting was held
2 on February 7, 2018, there was some discussion amongst
3 the members about the potential for replacement cables
4 to have a different construction and possibly
5 performance when it came to zone of influence.

6 So in response to that, the applicant did
7 strengthen the WCAP. And in particular that language
8 that's incorporated in -- that will be incorporated by
9 a licensee who adopts this WCAP.

10 In their updated final safety analysis
11 report will clarify that that ZOI radius applicable to
12 AP1000 in containment cables is bounded by the testing
13 and analysis that's presented in the WCAP.

14 So that was one area that the applicant
15 strengthened their WCAP. And in response to that same
16 overall comment, the staff added a limitation.

17 And we recognize that there could be new
18 or evolving cable designs that may have different
19 cable construction. And these cables may exhibit a
20 different zone of influences.

21 So the licensee or an applicant would need
22 to evaluate those cable design changes to ensure that
23 those new designs don't impact adequate and long term
24 core cooling.

25 We also clarified a comment that Dr. Rempe

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1 had made, on the WCAP used the reference towards an
2 ACRS letter when it talked about chemical affects and
3 cables. So we clarified some of the language in the
4 SE that talked about how the staff actually used that
5 WCAP reference. Next slide.

6 In summary the staff reviewed the three
7 items presented in the WCAP, and summarized on this
8 slide. In the draft safety evaluation, the staff
9 finds the approach described in the WCAP acceptable.

10 And approves and requests subject to
11 limitations and conditions. I just sited a new
12 limitation and condition that we added on the previous
13 slide.

14 Just for rec -- to recall, we also talked
15 about a limitation and condition about performance of
16 cables within the zone of influence was outside the
17 scope of the WCAP.

18 We also have a limitation on the quantity
19 of aluminum in containment. We also have a
20 limitation. It talks about the evaluation of the
21 neutron shield block.

22 We didn't evaluate it for its neutron
23 performance or shielding performance. It was merely
24 an evaluation to look at it from a GSI 191
25 perspective, a debris generation perspective.

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1 And I think that covers most of the
2 limitations. That concludes the staff's presentation.

3 MEMBER RAY: Thank you Clint. Okay.
4 Questions on this phase of the staff's presentation
5 before we move onto the closed session?

6 (No response)

7 MEMBER RAY: Okay. And now then I will
8 have to pause for a bit and ask for the comments that
9 members of the public may have who are either here in
10 the room. Are there any in the room who wish to make
11 a comment?

12 (No response)

13 MEMBER RAY: If not, then I'll make a
14 similar request to anyone on the telephone line. I'm
15 assured that it's open. And if --

16 MR. BROWN: The line is open.

17 MEMBER RAY: Thank you Theron. If there
18 is anyone who would like to make a comment, please
19 merely identify yourself and make your comment.

20 (No response)

21 MEMBER RAY: Nothing then. In that regard
22 we'll close the line and enter the proprietary section
23 of the meeting today.

24 And in this case I'll ask that
25 Westinghouse and staff verify that the room is

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1 occupied only by those who are authorized to
2 participate or observe the proprietary discussion.

3 (Whereupon, the above-entitled matter went
4 off the record at 4:12 p.m.)

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Presentation to the ACRS Full Committee

**Draft Safety Evaluation
AP1000 In-Containment Cables and Non-Metallic Insulation
Debris Integrated Assessment
WCAP-17938-P, Revision 2**

April 2018

Presentation Topics



- Introduction
- Overview
- Updates
- Summary

Introduction



- NRC Technical Reviewers

- ♦ Clint Ashley Containment and Ventilation Branch
- ♦ Boyce Travis Containment and Ventilation Branch
- ♦ Renee Li Mechanical Engineering Branch
- ♦ Greg Makar Materials & Chemical Engr. Branch
- ♦ Malcolm Patterson PRA and Severe Accidents Branch

- NRC Project Manager

- ♦ Don Habib Licensing Branch 4

Introduction (cont'd)

- A topical report is a document that addresses a technical topic related to nuclear power plant safety.
- In topical report WCAP-17938, Westinghouse updates the AP1000 plant safety analysis related to Generic Safety Issue 191 (GSI-191).
- Westinghouse seeks review and approval of WCAP-17938 by the U.S. Nuclear Regulatory Commission (NRC) for use in the licensing process by AP1000 licensees.

Overview

- The AP1000 design basis in part states that “a LOCA in the AP1000 does not generate fibrous debris due to damage to insulation or other materials included in the AP1000 design,…”
- As such, the WCAP seeks NRC approval for three items:
 1. A zone of influence (ZOI) for electrical cabling in containment.
 2. Use of non-metallic insulation (NMI) as a suitable equivalent to metal reflective insulation (MRI).
 3. Use of NEI 04-07 alternate evaluation methodology to assess debris generation.

Overview (cont'd)

- Main guidance for evaluating WCAP-17938:
 - ♦ Nuclear Energy Institute (NEI) 04-07, “PWR Sump Performance Evaluation Methodology”
 - ♦ Safety Evaluation for NEI 04-07, “PWR Sump Performance Evaluation Methodology”
 - ♦ WCAP-16530-NP-A, “Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191”

Updates (WCAP and SE)

- ACRS Subcommittee meeting held on February 7th 2018.
 - ♦ Identified the potential for replacement cables to have a different construction and performance (i.e., ZOI).
- In response, the applicant strengthened the WCAP:
 - ♦ ZOI radius is applicable to the AP1000 in-containment cables “...bounded by testing and analysis...”
- In response, the staff added a limitation:
 - ♦ “Because new or evolving cable designs may have a different cable construction that could exhibit a different ZOI, licensees or applicants must evaluate cable design changes to ensure that new designs do not impact adequate long term cooling.”
- Staff also clarified the SE discussion (Section 3.2) on references used for assessing chemical effects due to cables.

Summary

- The WCAP requests staff review and approval for three items:
 - ♦ the application of the proposed ZOI for cables
 - ♦ the determination that NMI located in the reactor vessel cavity is a suitable equivalent insulation
 - ♦ the application of the alternate evaluation for debris assessment
- The staff finds the approach described in the WCAP acceptable and approves the requests, subject to limitations and conditions.

WCAP 17938 Revision 2, ACRS Full Committee Meeting

April 5, 2018

Zachary Harper

Shayan Sinha



Background

AP1000 GSI 191 Design Bases

- **AP1000** design significantly reduces / eliminates debris sources that are typically found in Generation II plants
- Maximum allowable fibrous debris inside containment is 6.6 lbs
 - All fibrous debris is attributable to latent debris
 - There is no fibrous debris generated during a LOCA
- Metal reflective insulation (MRI) is extensively used in containment
- DCD/FSAR provides requirements that must be demonstrated if an alternative (fibrous) insulation to MRI is utilized
 - Insulation must be demonstrated to be a suitable equivalent insulation to MRI for the purposes of GSI 191
 - To qualify a suitable equivalent testing must be performed to demonstrate that debris will not be generated or transported
 - Suitable equivalent testing must be approved by the NRC



Background

WCAP 17938 Purpose

Purpose of WCAP 17938 is to obtain approval of the following:

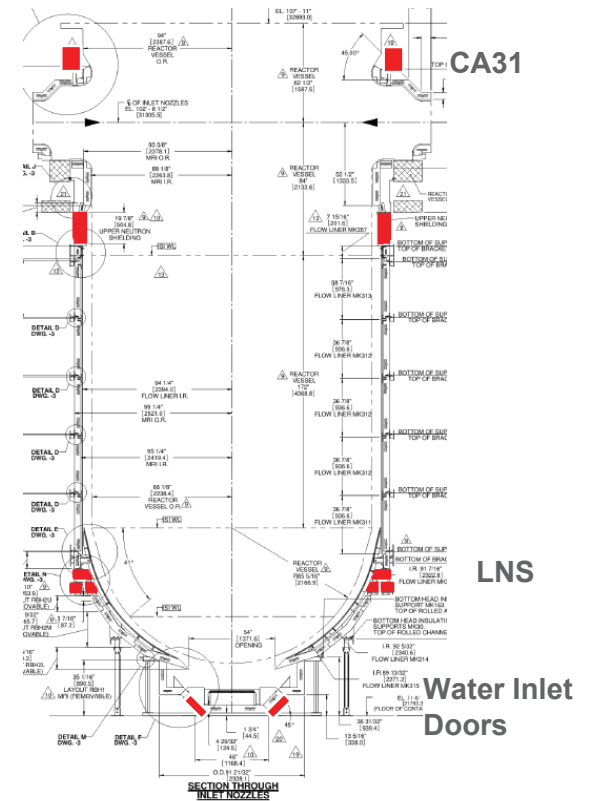
1. Establish a zone of influence (ZOI) applicable to all **AP1000** plant in-containment cabling to demonstrate cabling will not generate LOCA debris
2. Gain approval that the non-metallic insulation (NMI) utilized in the reactor vessel insulation systems (RVIS) is a suitable equivalent to MRI for the purpose of GSI 191 as applied in **AP1000**
3. Gain approval to utilize the approved NEI 04-07 alternative methodology for defining debris generation break sizes for **AP1000**

Testing and analysis is complete to demonstrate that neither cabling nor NMI will contribute to post LOCA debris



Background WCAP 17938

- **AP1000** cabling may contain fibrous and other materials that were not considered in initial GSI 191 debris source term evaluations
 - Corrective actions included development of a test program to establish a ZOI for in-containment cabling
- NMI is required in RVIS because subcomponents of the RVIS perform functions in addition to insulation (such as shielding and in-vessel retention support)



Summary of Results

- Extensive large scale jet impingement testing established a ZOI for in-containment cables of 4 L/D
 - Cabling ZOI design requirements were incorporated into the detailed design in advance of any cable or tray installation
- WCAP invokes the alternate evaluation methodology provided in NEI 04-07 to determine a limiting RCS break size in debris generation evaluation for certain **AP1000** components
- Insights from NMI jet impingement and submergence testing resulted in strengthening design for elements of the RVIS
 - Design was changed to use thicker and more robust encapsulation

WCAP justifies no new debris generation for AP1000 from cabling or NMI



Conclusions



Conclusions

- A ZOI radius of 4 IDs is applicable to the AP1000 in-containment cables bounded by testing and analysis
- Application of NEI 04-07 alternative break methodology is acceptable for **AP1000**
- Cabling does not contribute to **AP1000** post LOCA debris limits
- Encapsulated NMI applications utilized within the AP1000 RVIS will not produce debris when subjected to jet impingement from limiting line breaks
- Neither cabling nor NMI within the RVIS contribute to GSI 191 chemical debris limits
- NMI utilized as part of the RVIS is a suitable equivalent to MRI for the locations bounded by testing and analysis (for the purpose of GSI 191)

WCAP justifies no new debris generation for AP1000 from cabling or NMI

