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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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AP1000 REACTOR SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

FEBRUARY 7, 2018

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear
 Regulatory Commission, Two White Flint North, Room
 T2B1, 11545 Rockville Pike, at 1:02 p.m., Harold B.
 Ray, Chairman, presiding.

COMMITTEE MEMBERS:

- HAROLD B. RAY, Chairman
- RONALD G. BALLINGER, Member
- DENNIS BLEY, Member
- CHARLES H. BROWN, JR., Member

1 MICHAEL CORRADINI, Member

2 VESNA B. DIMITRIJEVIC, Member

3 WALTER L. KIRCHNER, Member

4 JOSE A. MARCH-LEUBA, Member

5 DANA A. POWERS, Member

6 JOY L. REMPE, Member

7 PETER C. RICCARDELLA, Member

8 GORDON R. SKILLMAN, Member

9 JOHN W. STETKAR, Member

10 MATTHEW W. SUNSERI, Member

11

12 ACRS CONSULTANT:

13 UPENDRA ROHATGI

14

15 DESIGNATED FEDERAL OFFICIAL:

16 WEIDONG WANG

17

18 ALSO PRESENT:

19 CLINT ASHLEY, NRO

20 JAMES BRADLEY CHAMBERLAIN, Southern Nuclear*

21 JASON EISENHAUER, Westinghouse*

22 DONALD HABIB, NRO

23 JESSE KLINGENSMITH, Westinghouse*

24 YUEN-LI LI, NRO

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1 KEVIN MCNAMEE, Westinghouse
2 GREG MAKAR, NRO
3 ANDREW PFISTER, Westinghouse
4 SHAYAN SINHA, Westinghouse
5 COREY THOMAS, Southern Nuclear
6 BOYCE TRAVIS, NRO
7 ANDREA D. VEIL, Executive Director, ACRS
8 KAI ZHANG, Westinghouse*

9

10 *Present via telephone

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P R O C E E D I N G S

1:02 p.m.

MEMBER RAY: Well, now that we've got essentially everyone here, we'll please call the meeting to order.

This is a meeting of the AP1000 Reactor Subcommittee, a Standing Subcommittee of the Advisory Committee and Reactor Safeguards.

I'm Harold Ray, Chairman of the Subcommittee.

ACRS members in attendance are Ron Ballinger, Matt Sunseri, Dick Skillman, Dana Powers will join us shortly as will Mike Corradini, Dennis Bley, John Stetkar, Jose March-Leuba, Walt Kirchner, Charlie Brown, Joy Rempe and Vesna Dimitrijevic. And, thank you, Pete Riccardella.

He wasn't there when I wrote my list down and so I missed him.

Thank you.

Also, ACRS Consultant, Upendra Rohatgi is present and will assist the Subcommittee in this review.

Weidong Wang is the Designated Federal Official for the meeting.

In this meeting, the Subcommittee will

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1 review a Westinghouse Topical Report, WCAP 17938-P
2 Revision 2 entitled AP1000 In-Containment Cables and
3 Non-Metallic Insulation Debris Integrated Assessment
4 and the associated staff Safety Evaluation Report.

5 The WCAP proposed changes to Tier 2
6 provisions of the existing AP1000 DCD. These
7 provisions are critical to ensuring that the natural
8 circulation function of the passive design is not
9 compromised by debris which might result from a pipe
10 break or from chemical effects following flooding.

11 These are GSI 191 considerations as
12 uniquely applied to natural circulation, differential
13 pressures in the AP1000.

14 The existing DCD requires that zero debris
15 result from a pipe break or flooding. And, this was
16 to be achieved by use of insulation and chilling
17 materials and by location or protection of electrical
18 cable so that debris would not result from pipe rupture
19 or flooding.

20 Further development of the design has made
21 it necessary to use alternate materials for which
22 suitable equivalency, those words in quotes, must be
23 demonstrated and to establish more specific
24 requirements for the electrical cable.

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1 The standard of zero debris remains a
2 requirement -- remains the requirement, therefore, our
3 review is to establish whether the alternate materials
4 and requirements addressed by the WCAP that we are
5 reviewing maintain that -- comply with that
6 requirement.

7 We will hear presentations from the NRC
8 staff and the representatives from the design
9 certification holder.

10 We have received no written comments or
11 requests for time to make oral statements for members
12 of the public regarding today's meeting.

13 Part of the presentations I expect after
14 our break will be closed in order to discuss information
15 that is proprietary to Westinghouse and its contractors
16 pursuant to 5 U.S. Code 552(b)(c)(4).

17 Attendance at these portions of the meeting
18 that deal with such information will be limited to the
19 NRC staff and its consultants, Westinghouse and those
20 individuals and organizations who have entered into
21 appropriate confidentiality agreement with them.

22 Consequently, we will need to confirm at
23 that time that we have only eligible observers and
24 participants in the room for the closed portion.

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1 The Subcommittee will gather information,
2 analyze relevant issues and facts and formulate
3 proposed positions and actions as appropriate, and this
4 is important, for deliberation by the Full Committee.

5 The rules for participation in today's
6 meeting have been announced and are part of the Notice
7 of this meeting published previously in the Federal
8 Register.

9 A transcript is being kept and will be made
10 available as stated in the Federal Register Notice.

11 Therefore, we request that participants
12 in this meeting use the microphones located throughout
13 the room when addressing the Subcommittee.

14 The participants should first identify
15 themselves and speak with sufficient clarity and volume
16 so that they may be readily heard.

17 We'll now proceed with the meeting, but
18 first, let me turn to Don and ask if he has any opening
19 remarks.

20 MR. HABIB: Thank you very much and I
21 appreciate this opportunity to make the presentations
22 and we don't have any other remarks at this time.

23 MEMBER RAY: That's fine.

24 Then, I'll turn it over to which ever of

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1 the gentlemen here will take charge for Westinghouse
2 and please you to proceed.

3 MR. SINHA: Good afternoon.

4 My name is Shayan Sinha, I will be
5 presenting the public slide material for Westinghouse.

6 We also wanted to thank you for the
7 opportunity, we are grateful to be able to discuss this
8 topical report with the ACRS.

9 I'd like to begin by talking about a little
10 bit of background of the GSI 191 related design basis,
11 specifically, how they apply to AP1000.

12 So, the resolution of GSI 191 requires
13 nuclear plants to place limits on potential sources
14 of debris inside containment. This is to ensure that
15 you don't have potential -- some blockage following
16 a loss of coolant accident where there's a pipe break
17 inside containment.

18 The AP1000 actually significantly reduces
19 and eliminates many of the debris sources that are found
20 in typical Generation II plants. And, by incorporating
21 a lot of these lessons learned into the design prior
22 to construction and operation.

23 The maximum allowable fibrous debris
24 inside containment for AP1000 is 6.6 pounds. And, this

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1 is all attributable to latent debris. So, in other
2 words, the expectation is that following a loss of
3 cooling accident, there would be no debris generated
4 as a result of that -- fibrous debris generated as a
5 result of that LOCA.

6 There's metal reflective insulation used
7 within the AP1000 extensively including only insulation
8 for the reactor vessel itself.

9 The DCD provides requirements of what must
10 be demonstrated if and AP1000 decides to use a type
11 of insulation other than metallic reflective
12 insulation, or MRI. And, these requirements include
13 that we need to demonstrate that the insulation is a
14 suitable equivalent to MRI for the purposes of GSI 191.

15 And, in order to qualify as a suitable
16 equivalent, testing must be performed to show that
17 debris is not generated or transported.

18 And, finally, there's a requirement in the
19 DCD that states that the suitable equivalent testing
20 must be approved by the NRC.

21 So, the purpose of this topical report,
22 WCAP 17938, is to gain approval for three items.

23 The first item is to establish a zone of
24 influence applicable to AP1000 in-containment cables

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1 that demonstrates that the cabling will not generate
2 debris following a LOCA.

3 The second is to gain approval for that
4 the non-metallic insulation used in the AP1000 reactor
5 vessel insulation system is a suitable equivalent to
6 MRI for the purposes of GSI 191.

7 And then, the third item is to gain approval
8 for the AP1000 to utilize the approved methodology for
9 defining debris generation break size from NEI Guidance
10 Document 04-07.

11 So, this methodology is generically
12 approved, is part of the safety evaluation for NEI 04-07
13 by the NRC. However, what we're trying to do in this
14 topical report is gain approval to use this methodology
15 for AP1000.

16 And, as I'll demonstrate in the -- I'll
17 discuss in the next few slides, testing analysis has
18 been completed that shows that the cabling and the NMI
19 does not generate debris following a LOCA.

20 So, there was two factors that led to the
21 creation of this topical report, WCAP 17938. The first
22 factor is that the AP1000 -- there was an issue
23 identified that the AP1000 cabling contained fibers
24 and other materials that were not originally considered

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1 as a debris source when -- as part of the AP1000 GSI
2 1919 related evaluations.

3 So, as this issue was resolved, corrective
4 actions were taken and these corrective actions
5 included developing a testing program to establish a
6 zone of influence for the containment cabling.

7 And, the second factor is that the
8 non-metallic insulation is required for certain
9 subcomponents of the reactor vessel insulation system
10 because some of these subcomponents performed functions
11 other than insulation such as shielding or in vessel
12 retention.

13 So, if you take a look at this diagram here
14 to the right, the CA31 module shown at the top of the
15 reactor vessel performs a shielding function. It is
16 needed to prevent radiation streaming upward into
17 containment.

18 And then, the lower neutron shield which
19 is more on the bottom half of the reactor vessel shown
20 here forms a shielding function that provides shielding
21 for the lower reactor cavity.

22 Then, finally, the water inlet doors at
23 the very bottom of the vessel support this in vessel
24 retention support for certain beyond design basis

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1 events.

2 MEMBER REMPE: So, when I was reviewing
3 the information for this meeting, I kept thinking to
4 myself, jeepers, shouldn't Westinghouse have known that
5 the cabling -- I mean, this isn't your first PWR, right,
6 that would exist and these materials might exist and
7 that you might need this material?

8 And, why, you know, right now, the way you
9 presented it, it was like, well, okay, we figured you
10 might have to do some qualification for NMI.

11 But, I just was surprised. I mean, did
12 this all come as a surprise to you all and you didn't
13 think about it during design certification?

14 MR. PFISTER: So, I'll take the question
15 on cabling first because they're separate.

16 Traditionally, cabling isn't considered
17 a source of debris for GSI 191. As we try to do, we
18 look into what the industry has done. That's not a
19 source that's generally being considered as a debris
20 generation source.

21 Or, if it is, it's just rolled into the
22 other margin for operating plants.

23 And, the insulation design within cabling
24 is going to be vendor specific.

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1 And so, as we went through the process of,
2 you know, defining the specification for cabling,
3 working with vendors and procuring cabling, you know,
4 we became aware that there is fibrous materials as
5 insulation within some cables, not all cables. But,
6 that is a material that cable vendors use.

7 So, within the design certification,
8 there's some generic language that says, you know,
9 insulation or other materials won't become debris.

10 And, because we work through NEI guidance
11 where we have established ZOIs, whether it was through
12 an NEI program or a PWR OG program or something specific
13 for AP1000, there had never been an established ZOI
14 for cabling.

15 So, we identified, this is a gap and said,
16 not necessarily that it is a debris source, but it
17 certainly could be one. So, we had to take the
18 necessary steps to say, where must it be located
19 relative to high energy lines in order to preclude it
20 from being a debris source?

21 So, that's where this came from.

22 MEMBER RAY: Where -- you said -- well,
23 we are going to have some specific questions about the
24 testing of cabling and so on. Is that best addressed

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1 in the proprietary portion of the discussion?

2 MR. PFISTER: Yes.

3 MEMBER RAY: Okay, go ahead, Walt.

4 MEMBER KIRCHNER: This might be
5 proprietary, too, so I can hold it. I was just curious
6 what the shielding material is that --

7 MR. PFISTER: So, we use two different
8 shielding materials. So, I'll speak generically about
9 them.

10 MEMBER KIRCHNER: Okay, or you can just
11 wait until later and we can --

12 MR. PFISTER: Yes, and then I can answer
13 it generically now and then --

14 MEMBER KIRCHNER: And, not to force you
15 all the way back to slide two or one, how do you know
16 you have 6.6 pounds of latent material? And, how do
17 you measure that and what's the -- is there a tech spec
18 that governs operation as a result of that?

19 MR. PFISTER: So, as to the shielding
20 question first and --

21 MEMBER KIRCHNER: There's some precision
22 there --

23 MR. PFISTER: -- the 6.6 --

24 MEMBER KIRCHNER: -- that's often hard to

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1 measure in light weight --

2 MR. PFISTER: Yes.

3 MEMBER KIRCHNER: -- material.

4 MR. PFISTER: So, the shielding material,
5 so within the lower neutron shield, we use a boron
6 silicone material. And, to note, that all the
7 shielding is non-safety related shielding. So, this
8 is shielding that we only credit during normal
9 operations and shutdown, not shielding that we credit
10 for accidents.

11 And, within CA31, which is shield --
12 essentially shield blocks that will go into more detail
13 --

14 MEMBER RAY: Let interrupt you for just
15 a second.

16 You were asking about the 6.6, weren't you?

17 (OFF MICROPHONE COMMENTS)

18 MR. PFISTER: He asked -- so, I was
19 answering the question about shielding then I was going
20 to answer --

21 MEMBER RAY: Okay.

22 MR. PFISTER: -- the 6.6.

23 MEMBER RAY: I missed the --

24 MR PFISTER: And, within the CA31 which

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1 are 60 individual blocks inherently designed within
2 the refueling cavity floor, we use boron carbide for
3 shielding there.

4 So, relative to your second question, how
5 do we demonstrate 6.6 pounds? And so, ultimately,
6 that's something that must be demonstrated prior to
7 fuel load and prior to each refueling.

8 It's done in almost the exact same way you
9 would do it for an operating PWR is that, as part of
10 your containment cleanliness program, you have to
11 quantify and demonstrate containment cleanliness. You
12 typically do that, they almost call it a white glove
13 test where you go around and you test certain areas.

14 And then, you know, the -- I think the
15 industry standard is, of the debris that you quantify
16 for all of containment, the assumption is 15 percent
17 of that debris is fibrous.

18 And so, when they do their containment
19 cleanliness and they go in, you know, to their pre-fuel
20 load inspections, you know, as part of their containment
21 cleanliness program, that would define how you measure
22 the total amount of debris.

23 And then, industry standard is 15 percent
24 of that is assumed to be fibrous.

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1 MEMBER KIRCHNER: What struck me was that
2 the 6.6 is a fairly precise number.

3 MR. PFISTER: Yes. And so, the 6.6 was
4 established during design certification as part of the
5 fuel assembly and sump testing. And so, that's
6 essentially the limit we were able to push our fuel
7 assembly testing to.

8 You know, with the combination of latent
9 debris and chemical debris to show we didn't get
10 unacceptable DP across the fuel.

11 MEMBER KIRCHNER: No, I knew the basis for
12 the amount, but I was curious about how you measure
13 it to that precision.

14 MEMBER RICCARDELLA: Are your limits
15 smaller than a conventional PWR because of the passive
16 nature of the system?

17 MR. PFISTER: Essentially, the answer is
18 yes. So, you'll see a range of limits within PWRs.
19 You'll see what they consider high fiber plants where
20 the limits are much, much higher.

21 And, you'll see low fiber plants. You
22 know, we're probably the lowest of the low fiber plants.

23 But, a lot of that's driven by acceptable
24 DP we can withstand due to the passive recirculation.

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1 MEMBER RICCARDELLA: Okay, thank you.

2 MR. SINHA: Okay, so, on slide six, this
3 just summarizes the results that came from our program
4 to evaluate the non-metallic insulation and the
5 in-containment cables.

6 So, firstly, the first bullet talks about
7 the zone of influence of four diameters. There are
8 four times the debris generation break size was
9 established for in-containment cables. And, this was
10 done through an extensive large-scale jet impingement
11 testing program which was conducted at a facility that
12 had been previously used by the pressurized water
13 reactor zoners group for other operating plant
14 evaluations related to GSI 191.

15 And so, this cable as the OI, was able to
16 be incorporated into the design requirements and then
17 the location of the cables and the cable trays, we
18 consider them as, you know, as the locations were
19 developed for the plant.

20 The WCAP also invokes the alternative
21 evaluation methodology from NEI 04-07 for determining
22 the limiting RCS break size, you know, in our debris
23 generation evaluations.

24 And so, this was done through a structural

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1 evaluation that reviewed whether the hot leg or cold
2 legs would fully separate following a loss of coolant
3 accident.

4 And then, this is compared against the NEI
5 04-07 criteria and shown to be acceptable for AP1000.

6 And then, finally, jet impingement and
7 submergence testing program was performed for the
8 non-metallic insulation. And, the insights from this
9 programs were used to strengthen the design of the
10 elements for the reactor vessel insulation system.

11 So, essentially, this resulted in design
12 changes that used a thicker and more robust
13 encapsulation for the neutron shield blocks.

14 And then, the final slide is the
15 conclusions for the public portion.

16 The jet impingement testing program that
17 was conducted was used to justify a cable ZOI for L/D
18 for the AP1000 in-containment cabling.

19 The cabling was found to contribute no post
20 LOCA debris.

21 The application of the NEI 04-07 ultimate
22 break methodology was acceptable for the AP1000. And
23 then, the encapsulated non-metallic insulation was
24 found to not produce debris when subjected to the jet

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1 impingement from the limiting RCS lines -- line breaks.

2 And then, the cabling and the NMI were
3 evaluated for chemical debris and found that neither
4 types of components would contribute to chemical
5 debris.

6 And, this -- the conclusions related to
7 jet impingement and chemical debris were used to make
8 the conclusion that the non-metallic insulation in the
9 reactor vessel insulation for AP1000 is a suitable
10 equivalent to MRI for the purposes of GSI 191.

11 And then, I just wanted to highlight the
12 overall conclusion that the WCAP justifies that there's
13 no debris -- no new debris generated for AP1000 from
14 the cables and the non-metallic insulation.

15 So, that is all we have for the public
16 portion. We can open it up for questions.

17 MEMBER BROWN: Just a question on the
18 previous slide, two previous slides, six.

19 What the design was changed to use thicker
20 and more robust -- what's meant by more robust? I
21 missed that if you --

22 MR. SINHA: Yes, we're going to detail it
23 more --

24 MEMBER BROWN: You're going to talk about

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1 that -- okay, then, we'll wait.

2 MR. SINHA: So, it's the weld type that
3 we use.

4 MEMBER BROWN: It's the what -- the weld
5 --

6 MR. SINHA: We use a more robust weld type.

7 MEMBER BROWN: -- the welding --

8 MR. PFISTER: The welding techniques that
9 we use.

10 MEMBER BROWN: Okay, all right.

11 MEMBER RAY: Any other questions?

12 MR. ROHATGI: Anyway, are you going to
13 change the weld technique that you'll discuss later
14 on?

15 MR. SINHA: Yes.

16 MR. ROHATGI: Because they're not going
17 to be all the same techniques?

18 MR. SINHA: Correct.

19 MR. ROHATGI: Okay.

20 MR. SINHA: Yes, the different
21 subcomponents have different weld techniques.

22 MEMBER RAY: Okay, we've got the scope of
23 the discussion here clear, I think, and the purpose
24 of it and so on.

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1 Anything else?

2 (NO RESPONSE)

3 MEMBER RAY: If not, we will have an
4 opportunity for public comment following the staff open
5 discussion.

6 MR. SINHA: I apologize, I actually had
7 -- there's one other comment I wanted to make was about
8 the utility -- the licensee, Southern Nuclear wanted
9 to make a comment about the usage of this topical report
10 for Vogtle Units 3 and 4.

11 MEMBER RAY: Okay, that's fine. Please
12 --

13 MR. THOMAS: Yes, this is Corey Thomas from
14 Southern Nuclear, Vogtle 3 and 4 Licensing.

15 First of all, this WCAP is important to
16 us from a construction sequence to allow us to continue
17 with the installation of non-metallic insulation inside
18 containment and installation of the cable inside
19 containment.

20 Thank you.

21 MEMBER RAY: Yes, and because of that, we
22 were all geared up to write your letter this week.
23 But, we understand that we've got a little more time.
24 So, we'll have the Full Committee consider whether

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1 they wish to write a letter on right now forecasted
2 to be the April Full Committee meeting.

3 Okay, again, we're in public session. We
4 will ask for any public comment, but following the staff
5 presentation.

6 So, we'll trade places now and proceed with
7 the staff and then return -- we may get to the closed
8 session before our break if things continue to move
9 this quickly.

10 And, you'll want to remove that card,
11 that's good.

12 Okay, Don, could you launch the ship,
13 please?

14 MR. HABIB: Thank you and good afternoon.

15 The staff's here to make our presentation -- public
16 presentation for the AP1000 In-Containment Cables
17 Non-metallic Insulation Debris Integrated Assessment
18 and the draft Safety Evaluation that it prepared.

19 So, these are our speakers and they'll
20 introduce themselves.

21 I'm going to turn it over to Clint Ashley
22 who's the first presenter.

23 MEMBER RAY: Before you do, let me say,
24 on the agenda I was given, maybe I should direct to

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1 Weidong, shows only Westinghouse speaking in the closed
2 session. That implies to me that you don't have any
3 closed material to present.

4 MR. HABIB: That's correct. But we do --

5 MEMBER RAY: But, we may have questions
6 for you that need to be discussed in closed session.

7 So, I just want to make that clear to everyone that
8 staff will remain with us for purposes of questions
9 that involve proprietary material and that could be
10 relevant to the discussion we're about to have.

11 So, anyway, for all intents and purposes
12 you'll be with us also in the closed session.

13 Go ahead.

14 MR. ASHLEY: So, good afternoon.

15 My name is Clint Ashley. I'm a Technical
16 Reviewer in the Office of New Reactors.

17 And, we'd all like to thank you for the
18 opportunity to present our draft Safety Evaluation on
19 this particular topical report.

20 And, we do look forward to addressing any
21 of your questions. And, as you mentioned, I think these
22 slides are non-proprietary. But, we recognize that
23 some of the discussions may go into proprietary
24 information and we'll hold those over until the closed

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1 session.

2 So, going back one slide, we're just going
3 to cover a few topics here initially and I'll discuss
4 the introduction and overview and then we'll roll right
5 into the staff's approach and our findings.

6 The next slide shows the presenters here,
7 members of the technical team as well as the project
8 manager. We also worked closely with NRR Technical
9 Reviewer, Steve Smith, as part of this process. So,
10 I wanted to make sure I acknowledged their involvement
11 in this review.

12 So, the next several slides really just
13 try to explain at a base level what a topical report
14 is for those that may not be familiar with them, what
15 guidance the staff used during the review.

16 And, you've already heard Shayan this
17 morning what this topical report is all about. So,
18 I'll probably be able to breeze through some of those
19 background slides.

20 The -- a topical report is a standalone
21 document containing technical information about a
22 nuclear power plant safety topic and provides the
23 technical basis for a licensing action.

24 And, typically, the objective is to add

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1 value by improving the efficiency of other licensing
2 processes. For example, the process for reviewing
3 license amendment requests or we call them LARs.

4 They improve the efficiency of the
5 licensing process by allowing the staff to review
6 proposed methodologies, designs or other safety related
7 subjects on a generic basis so that they may be
8 implemented by reference by multiple licensees once
9 approved by the NRC staff.

10 And, in this particular topical report,
11 Westinghouse updates the AP1000 plant safety analysis
12 related to generic safety issue 191 which is concerned
13 with the assessment of debris on pressurized water
14 reactor sump performance.

15 The WCAP seeks review for three items and
16 we'll talk about these in the next few slides.

17 The main guidance for evaluating this
18 topical report is the Nuclear Energy Institute, NEI
19 document 04-07. And, that was published in 2004 time
20 frame, if I'm not mistaken.

21 The NEI 04-07 submission as approved in
22 accordance with the staff's Safety Evaluation provides
23 an acceptable overall guidance methodology for the
24 plant specific evaluation sump performance.

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1 And, that staff safety evaluation was also
2 completed in 2004 time frame.

3 One thing the NEI 04-07 document mentions
4 is that it didn't really have enough information to
5 conclude anything about chemical effects other than
6 more study was needed.

7 So, the industry put together another
8 topical report, 16530, that the staff approved. And,
9 I believe that approval was completed in maybe the 2008
10 time frame.

11 So, as Westinghouse already communicated
12 earlier, the AP1000 safety evaluation really is based
13 on a zero loss of coolant accident generated fibrous
14 debris source term.

15 So, no LOCA generated fibrous debris,
16 they've gotten rid of all that fibrous insulation that
17 a lot of operating plants are plagued with.

18 And, the way they achieve this is through
19 the use of metal reflective insulation. This is on
20 main coolant piping, steam generators, all those large
21 main coolant system components.

22 The DCD also does allow or permit a suitable
23 equivalent insulation. And, as part of this WCAP,
24 Westinghouse recognizes that there's going to be at

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1 least three locations for suitable equivalent
2 insulation to replace metal reflective insulation.

3 And, the last bullet on this slide, the
4 DCD does specify that NRC approval is required to use
5 a suitable equivalent insulation.

6 Westinghouse already communicated this
7 information. It's about electrical cabling. And, it
8 was -- I would view it as more of a discovery item as
9 Andy Pfister had communicated. So, I don't think
10 there's any need to brief anymore on this slide.

11 Next?

12 So, in light of the AP1000 design basis
13 in which the AP1000 design does not generate fibrous
14 debris during a LOCA, and that coupled with a detailed
15 design reviews which took place on cabling and
16 non-metallic insulation.

17 The WCAP seeks approval for the following
18 three items.

19 And, the first one is zone of influence
20 for electrical cabling.

21 The second is use of non-metallic
22 insulation as a suitable equivalent to metal reflective
23 insulation.

24 And, the last one is use of the NEI 04-07

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1 alternate evaluation methodology for assessment of
2 debris generation.

3 And, the next slide talks about what it
4 means to be a suitable equivalent insulation from a
5 debris generation perspective.

6 Testing must be performed that subjects
7 the insulation to conditions that bound the AP1000 plant
8 conditions.

9 Testing demonstrates that debris would not
10 be generated to include chemical debris.

11 And, this must be approved by the NRC.

12 That's all called out in the DCD.

13 And so, the three requests for NRC approval
14 are detailed in the subsequent slides.

15 And, at this point, I'll turn it over to
16 Boyce Travis who's going to talk through the items one
17 and two.

18 MEMBER RAY: Boyce, before you begin, let
19 me just say that these points that were just covered
20 about in quite detail in the DCD were in anticipation
21 that we would be here having this discussion at the
22 time.

23 That sort of detail isn't spelled out
24 later, but it was just in unresolved matters as to

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1 whether MRI would be totally satisfactory throughout
2 the design. So, there was a provision made for suitable
3 equivalent. Here we are.

4 Go ahead.

5 MR. TRAVIS: As Clint mentioned, my name's
6 Boyce Travis. I'm a Technical Reviewer in the
7 Containment Branch at NRO. I'll be discussing the
8 first two requests in the WCAP.

9 So, item one of the WCAP requests approval
10 for a ZOI for electrical cabling and containment. In
11 order to determine the acceptability of this, staff's
12 goal was to ensure that the tested cables represented
13 a bounding set for all the AP1000 cables and to ensure
14 the test conditions for the facility bound the target
15 conditions expected in the AP1000 plant.

16 In order to make this determination, staff
17 observed the cable jet impingement testing facility.

18 We assessed the applicability of the test facility
19 to produce the conditions representative of the AP1000
20 plant.

21 And, in doing so, we reviewed both the test
22 material -- physical test materials and the prepared
23 test reports for the facility. And, as part of our
24 review, we issued RAIs.

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1 And some additional detail on how we came
2 to our finding is on the following slide.

3 So, as part of the review, staff looked
4 at observations from previous NRC visits to the test
5 facility.

6 In about six, seven years ago, the Office
7 of Research visited the facility which was, at the time,
8 being contracted by the PWR Owners' Group. At that
9 time, the test facility was instrumented to determine
10 whether it was capable of producing jet conditions that
11 would be representative of the large PWR.

12 At the time, the group from research found
13 that they thought it would be able to do so. And, this
14 topical report leverages some of that instrumented
15 testing in its evaluation of the test facility that
16 they used for both the cabling and the NMI.

17 So, as part of the review and the topical
18 report, the test conditions that were generated by the
19 facility for this testing were compared to the facility
20 conditions from the previous testing to verify both
21 repeatability and the expected target conditions were
22 at jet impingement pressures expected for a PWR, in
23 this specific case, the AP1000.

24 MEMBER RAY: Yes, I think we have some

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1 questions perhaps on this point. Our consultant will
2 discuss them.

3 I don't think they will go into proprietary
4 material. They have to do with process.

5 MR. TRAVIS: Okay.

6 MEMBER RAY: And, your oversight of how
7 you're auditing of it.

8 But, if they do, then, of course, we'll
9 stop and resume after we go into -- but we should discuss
10 in the open session as much as we can that's not
11 proprietary.

12 So, go ahead.

13 MR. ROHATGI: Yes, looking at this, when
14 you did the cable testing and you're saying the
15 conditions will bound the LOCA conditions in AP1000?

16 MR. TRAVIS: That's correct.

17 MR. ROHATGI: But, that didn't come out
18 very clearly because, I don't want to go in detail of
19 the size of the jet and all, but --

20 MEMBER RAY: Try and use the other
21 microphone also. There's two microphones not being
22 used there.

23 MR. ROHATGI: Okay, so, what I wanted to
24 know is that how do you decide that this test facility

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1 bounds the condition expected in the containment?

2 MR. TRAVIS: Sure.

3 So, I'll try to do this at a high level
4 and that's all I can do in the open session.

5 But, with respect to the pressure produced
6 by the -- so, the previous testing performed at the
7 facility was well instrumented. And so, for an
8 expected conditions in the -- for expected test
9 reservoir conditions, we have an expected pressure
10 profile that's going to be generated by the jet.

11 At all conditions -- I'll say this, based
12 on the locations that the cables were placed during
13 testing and the distance the cables were from the jet
14 -- from the facility exit nozzle, the instrumented
15 conditions led staff to believe that for those -- for
16 the -- specifically with regard to the cables, once
17 we get into talking about the blocks, it becomes a little
18 more nebulous.

19 But, specifically with regard to the
20 cables, the pressure the cables experienced from the
21 jet is -- would be equal to a greater than that they
22 would see in the AP1000 based on the instrumented test
23 facility and the reservoir conditions of the test
24 facility as was reviewed by the staff.

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1 MR. ROHATGI: So, the jet has a velocity,
2 I don't know, stop me if I go in anything -- so the
3 jet which is running impinged has a velocity profile
4 and the center of the jet will have the largest static
5 pressure?

6 MR. TRAVIS: That's correct.

7 MR. ROHATGI: I mean static pressure may
8 be uniform. So, the question, so, when you impinge
9 on this cable, have you moved around the jet to see
10 each of the cables is subjected to largest static
11 pressure or it was just one short?

12 And, because the damage was -- seems to
13 be random from some cable on the left were damaged or
14 sometimes on the right, but how do they connect to the
15 center of the jet?

16 MR. TRAVIS: So, I think we're going to
17 be getting in to proprietary discussion very quickly
18 there.

19 MR. ROHATGI: Yes, I'll wait, I'll wait.

20 MR. TRAVIS: So, if we could hold that to
21 where I can fully answer the question?

22 MR. ROHATGI: That's fine, thank you.
23 Okay, thank you.

24 MR. TRAVIS: Okay, so, I guess I'll go back

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1 and try and continue -- pick up where we left off.

2 So, as I was saying, as part of the review,
3 staff determined that the facility produced conditions
4 that would bound the expected conditions at a distance,
5 a scaled distance from the jet as would be experienced
6 in the AP1000.

7 And so, as part of testing, the applicant
8 performed tests at different scale, length over
9 diameter ratios and determined a ZOI for what -- when
10 damage would occur, when the onset of damage would occur
11 and when no damage would occur due to cables.

12 And then, did repeated tests to determine
13 -- to make sure that those conditions were represented
14 or that those test conditions could be repeated.

15 And so, that was, at one point, the
16 applicant conservatively made their request that their
17 acceptable ZOI would be that which showed no debris
18 generation.

19 The primary concern is quantifying a ZOI
20 for the cables based on experimental observation and
21 debris generation. And so, by choosing a ZOI that
22 showed no damage to the cables, the staff felt that
23 was a conservative choice in making what would be an
24 acceptable ZOI for cable damage.

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1 I'll note that the applicant tested both
2 aged and unaged cables to serve as a representative
3 bounding set. And, those cables were aged both
4 thermally and radiation -- they were fresh and unaged
5 cables -- fresh and unaged cables tested both from a
6 thermal perspective and a radiation perspective.

7 We can move on to the next slide.

8 MEMBER RAY: Could you repeat that for the
9 record just to make sure it's --

10 MR. TRAVIS: Sure.

11 MEMBER RAY: -- clear. It was a little
12 --

13 MR. TRAVIS: So, the --

14 MEMBER RAY: -- trailing off at the end
15 there.

16 MR. TRAVIS: Yes.

17 There were aged and unaged cables tested.
18 Aging consisted of both of thermal and radiation aging.

19 MEMBER POWERS: The thermal aging and the
20 radiation aging were done together or separate?

21 MR. TRAVIS: That I would to -- I believe
22 separately, but I would have to go back and check that
23 to be sure.

24 MEMBER POWERS: Well, NRC funded Roger

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1 Cliff to look at in-containment cable degradation
2 during service life. And, what he observed was that
3 cable damage due to radiation and thermal conditions
4 were synergistic. So, why would you do the aging
5 separately if there's synergism between thermal and
6 radiation damage?

7 I mean, this is research funded by the NRC,
8 it's publically available.

9 MR. TRAVIS: So, I think that's a fair
10 question. As I said, I'd have to go back and look at
11 when the aging was performed.

12 I will say that, yes, because at the test
13 facility and saw the cables. They were tested and I
14 have verified the aging reports that do exist.

15 But, if we can hold my full answer to closed
16 session, I'll go back and -- I have the topical report
17 right there, and go back and look and make sure that
18 I have a complete answer for you --

19 MEMBER POWERS: I'm very patient.

20 MR. TRAVIS: -- in a few minutes.

21 MEMBER POWERS: -- I'm not going anywhere
22 until Saturday.

23 MR. TRAVIS: Understood.

24 And so, back to the slides.

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1 With regards to the cabling, the staff
2 found that the topical report provided an acceptable
3 technical basis for determining no debris will be
4 generated by the cables at or beyond the proposed ZOI.

5 The testing generated -- the testing as
6 part of the WCAP demonstrated no debris generation would
7 occur outside that ZOI. And, therefore, the staff
8 determined that that ZOI was acceptable.

9 As part of this finding, the staff imposed
10 the limitation and condition as part of the WCAP stating
11 that performance of cables within the ZOI, if any are
12 present, is outside the scope of the WCAP and any cabling
13 that was located within the ZOI would have to be assessed
14 by an applicant or a licensee referencing the AP1000
15 and the WCAP to determine that it was acceptably
16 protected.

17 MEMBER REMPE: I have a question. In the
18 report that Westinghouse submitted, they concluded that
19 chemical testing was not needed. Submergence testing
20 was not needed. And, they cited several reasons.

21 And, in the first reason they said was
22 because of a letter that ACRS wrote. And, you guys
23 actually mentioned that, too. But, nobody said, in
24 your letter, at least your draft, you didn't mention

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1 that that didn't seem like a very good reference to
2 support that ACRS dismissed it.

3 And, I was a little offended that they would
4 even try and use that. Because I read what was in that
5 ACRS letter, it sure didn't support that you didn't
6 need that.

7 And, you're shaking your head yes, that
8 was a bad thing to do and I would have made the applicant
9 prove that sentence.

10 MR. TRAVIS: For that discussion on
11 chemical effects, you're correct.

12 MEMBER REMPE: Okay.

13 MR. MAKAR: What we did -- what we added
14 to that was the -- or in addition to that letter, there
15 were a phenomena identification and ranking table.
16 And then, a subsequent analysis which wasn't mentioned
17 in their topical report that addressed organic
18 materials from a variety of standpoints.

19 And so, they -- the reason that cable
20 materials haven't been included in our standard
21 chemical effects evaluations is because, as aa debris
22 material in and of themselves is they have fallen into
23 the category of uncertainty if you apply the accepted
24 methodology that's based on a lot of conservative

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1 assumptions.

2 And, there are things that we don't know
3 about like cables and other materials whether they would
4 form a chemical precipitant or not.

5 Organic materials, including cables, have
6 been looked at in different ways. Now, from a chemical
7 resistance standpoint, they -- some of these materials
8 are chosen, for example, in the chemical process
9 industry because they have such good resistance to
10 chemicals and elevated temperatures at -- over a variety
11 of chemical conditions.

12 It could change with aging some, but
13 they're often a material choice for aggressive chemical
14 conditions.

15 What they are always -- the way they're
16 always included is from the acidification acids they
17 can generate under a radiation field in the post LOCA
18 environment.

19 And, that acid is then included in the
20 calculations that determine how much pH buffer one needs
21 in the containment.

22 From -- then there are other possible
23 contributors from the organics like agglomeration of
24 things that are in the water and whether that helps

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1 you or hurts you from a debris generation and transport
2 standpoint.

3 And, also complexation. So, if these
4 materials from the -- if the organic materials can bind
5 with metallic ions or other things in the water, they
6 can increase the solubility which could mean less
7 precipitant.

8 So, we've looked at organic materials from
9 a variety of ways and I don't think that, you know,
10 the references we made didn't go into all that detail.

11 MEMBER REMPE: Yes. Well, again, I mean
12 there were several things they cited. It was just one
13 of them didn't seem to jive and I was surprised that
14 that wasn't disputed in your draft SE.

15 MEMBER RAY: Okay, I just -- before we go
16 off of this slide, because later on, my guess is as
17 someone was just mentioning, we're going to get into
18 things where we may forget the last point.

19 I just wanted to reiterate it, performance
20 of cables within the zone of influence, if any, is
21 outside the scope of the WCAP.

22 We're not trying to decide how much damage
23 --

24 MR. TRAVIS: That's exactly right.

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1 MEMBER RAY: -- would result to cables
2 inside the zone of influence.

3 MR. TRAVIS: That's exactly right.

4 The staff's finding is based on at 4-D there
5 will be no damage to the cables.

6 MEMBER RAY: Yes.

7 MR. TRAVIS: Inside that 4-D, the WCAP
8 makes no finding.

9 MEMBER RAY: This is a -- the safety
10 evaluation is very thorough, very detailed, talks about
11 a lot of things which, based on rules like this, really
12 aren't relevant because they're talking about things
13 that, at the end of the day, are outside the scope of
14 what we're doing.

15 MR. TRAVIS: I'll just make a note real
16 quick that I think NEI 04-07, technically, you could
17 define the onset of incipient damage as your acceptable
18 ZOI. That's why I said the applicant chose to
19 conservatively define 4-D --

20 MEMBER RAY: Four instead of three.

21 MR. TRAVIS: -- or whatever.

22 MEMBER RAY: Yes.

23 MR. TRAVIS: I won't get into the numbers
24 in the open session.

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1 But, yes. And so, that's why we were very
2 prescriptive in this determination.

3 MEMBER RAY: Yes.

4 MEMBER SKILLMAN: Can I ask this, please?

5 The gentleman from Vogtle announced that
6 this is an important action that we're undertaking here.

7 With regard to that last bullet, are we
8 in a zone of urgency where there are cabling activities
9 going on at Vogtle that hinge on the last bullet?

10 MR. TRAVIS: I definitely don't have the
11 expertise to answer that. Don, this project --

12 MEMBER SKILLMAN: That might be an
13 inappropriate question. But, what I'm wondering is
14 if there is a practical issue that is before us that
15 we don't fully recognize?

16 MEMBER RAY: Well --

17 MR. TRAVIS: Yes, we're going to --

18 MEMBER RAY: I don't --

19 MR. TRAVIS: We don't have anything on
20 that.

21 MEMBER RAY: I don't believe there is.

22 MEMBER SKILLMAN: I think the answer is
23 no, but that I've just seen some --

24 MEMBER RAY: Let's just assume for now the

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1 answer's no. As I said, we were expecting to need to
2 get our part of this done this month, now is such that
3 we don't have to do it that quickly. That doesn't
4 answer your question, but proceed.

5 MR. TRAVIS: Okay.

6 So, on the next slide, I'll start talking
7 about WCAP item two which requests approval for the
8 use of the non-metallic insulation as a suitable
9 equivalent to the metal reflective insulation.

10 This approval is a -- would be at limited
11 locations and would be bounded by testing and analysis
12 as requested in the topical report.

13 I'll also, at a high level, note that the
14 approval of the blocks differs significantly from the
15 cables in that a single set of jet impingement testing
16 is not enough to qualify the blocks.

17 The blocks themselves require both testing
18 and analysis -- different types of testing and analysis
19 to all form of coherent justification for why they act
20 as a suitable equivalent.

21 And so, as part of the staff's review for
22 the non-metallic insulation blocks, we have served both
23 jet impingement and submergence testing, evaluated
24 thermal expansion testing performed by the applicant,

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1 assessed the applicability of all the test facilities
2 at the affirmation test facilities.

3 Again, reviewed test materials and test
4 reports and issued a number of RAIs related to the
5 non-metallic insulation.

6 In further detail on this next slide, for
7 the qualifying the neutron shield blocks with regards
8 to jet impingement testing, they were tested to qualify
9 the ability -- their ability to withstand jet forces
10 under a variety of ZOIs and block configurations
11 including those both that they expected to be present
12 in the plant and perhaps were more conservative in those
13 expected in the plant.

14 This testing was then supported by a
15 discussion of confined jet behavior as based on their
16 location of the neutron shield blocks, it was not
17 obvious that a free jet was the appropriate model.

18 And so, the confined space of the reactor
19 cavity could have presented a compounding factor for
20 the jet pressure.

21 And so, to qualify that confined space,
22 the WCAP embarked on a literature review which the staff
23 reviewed for applicability.

24 And, ultimately the staff's finding for

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1 jet impingement on the NMI was based on a combination
2 of the presented testing and the literature review for
3 confined space which allowed the staff to verify that
4 the predicted NMI jet impingement pressure would be
5 bounded by the test facility at the requested ZOI.

6 Ultimately, staff feels that the test
7 demonstrated the request nature of the blocks and showed
8 that in the actual plant, no debris would be generated
9 due to a jet at the ZOI expected.

10 On the next slide, the qualifying NMI also
11 required evaluation of chemical effects as the neutron
12 -- some of the neutron shield blocks are below the
13 containment flood up levels.

14 So, there's both a debris generation and
15 a submergence piece to this.

16 Submergence testing measured releases for
17 different levels of NMI encapsulation. Staff used the
18 testing as a means to evaluate that design's ability
19 to prevent chemical effects.

20 And, ultimately, the testing that the
21 applicant performed demonstrated and showed that a
22 complete encapsulation of the block was necessary to
23 prevent the release of any elements that could generate
24 chemical effects and that additional chemical effects

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1 resulting from materials inside the non-metallic
2 insulation would be predicated on what the amount
3 submerged aluminum was present in containment.

4 And so, that led us on the next slide --
5 so the staff's finding is that the topical report
6 provides an acceptable technical basis for determining
7 that no debris will be generated by the blocks.

8 And, as there was no debris generated, the
9 blocks themselves functioned as a suitable equivalent
10 to MRI.

11 But, as part of this, staff imposed a pair
12 of limitations and conditions on this subset of the
13 WCAP.

14 The evaluation -- the staff's evaluation
15 of the NMI is limited to debris generation only, not
16 of their functions provided by the blocks such as the
17 neutron shielding. That ability would be assessed by
18 the supPLICANT on -- in the appropriate change process.

19 And, the staff also imposed a limit on the
20 amount of aluminum in containment based on the blocks
21 as the presence of additional aluminum combined with
22 the submergence effects from the blocks.

23 Basically, the applicant performed their
24 demonstration on the amount expected in the AP1000,

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1 further aluminum could influence the chemical effects
2 generated from the submerged NMI.

3 And, for a discussion of the third request
4 in the WCAP, I'm going to toss it back to Clint.

5 MR. ASHLEY: Next slide, please?

6 So, this third item, the -- and it's the
7 final WCAP item, request approval to use the NEI 04-07
8 alternate evaluation methodology.

9 And this methodology is approved in the
10 Safety Evaluation associated with NEI 04-07 which was
11 done back in 2004 time frame.

12 But, the AP1000 plant design didn't
13 specifically invoke this section of the NEI 04-07
14 document. So, they wanted to be up front in this
15 topical report and show that they wanted to apply this
16 particular section of the 04-07.

17 So, the NEI 04-07 alternate methodology
18 in part assumes a double-ended guillotine break of the
19 postulated pipe breaks in the reactor coolant system
20 main coolant piping.

21 Unless that piping is physically limited.

22 And, it could be limited in a number of ways, piping
23 restraints, supports, other structural members of
24 piping stiffness that could be demonstrated by

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1 analysis.

2 So, if you have this main coolant pipe that
3 is physically limited, the advantages that you can
4 assess a smaller break size for debris generation
5 purposes.

6 Next slide?

7 So, as far as the staff review approach
8 is concerned, we looked at the topical reports
9 implementation of the approved methodology.

10 We did focus our review on reactor coolant
11 system main piping breaks that are physically limited.

12 We audited calculations and reports used
13 to determine that limited separation for those
14 postulated breaks.

15 And, we also reviewed the WCAP's
16 methodology for determining essentially a result in
17 break diameter for limited separation breaks and the
18 associated zone of influence.

19 Next slide?

20 So, our finding, the applicant's approach
21 to determine limited separation breaks, equivalent
22 break diameter and zone of influence was reasonable
23 based on the information reviewed as part of the audit
24 and the information contained in the WCAP.

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1 The WCAP does implement the alternate
2 evaluation methodology consistent with prior staff
3 approval. And, based on those two items, the WCAP's
4 use of NEI 04-07 alternate methodology was acceptable.

5 We did note that, because NEI 04-07
6 methodology, this alternate methodology, permits use
7 of operator actions or credit for non-safety systems,
8 that we wanted to avoid any confusion because the WCAP
9 excludes use of operator actions or used of credit for
10 non-safety systems as part of mitigation.

11 And so, we threw in this limitation and
12 condition just to make sure that was clear.

13 Next slide?

14 So, in summary the staff reviewed the three
15 items that were presented in the WCAP for review and
16 approval and they are summarized on this slide.

17 And, the draft Safety Evaluation, the staff
18 finds the approach described in the WCAP acceptable
19 and the staff approves the request subject to
20 limitations and conditions.

21 That concludes the staff presentation for
22 the public portion.

23 MEMBER RAY: Dana, this discussion here
24 today is only about what is the scope of the WCAP, not

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1 broader issues. But, it does conclude -- reach a
2 conclusion about limitation on aluminum.

3 In the past, you suggested, I think, that
4 zinc is an equivalent to aluminum in some cases and
5 that it might be used in primer coating and so on.

6 MEMBER POWERS: It is used in the primer
7 coating. It is the primer for the epoxy and it is the
8 only coating on the upper part of the containment
9 building.

10 They don't -- they need the conductivity
11 through the containment shield, so they only use a
12 primer coating above a certain level. I can never
13 remember what that level is, but up in the higher dome
14 that's all there is.

15 It is -- I would not characterize it really
16 as equivalent to aluminum. It does form precipitates
17 in the water. They don't tend to be nearly as
18 flocculent and obnoxious as aluminum oxide
19 precipitates.

20 But, they do and so, but are they one to
21 one, I don't know. But, they are a consideration.

22 But, I believe those are taken into account
23 in the existing limitations in the -- for the GDC 191,
24 aren't they? I mean the --

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1 MEMBER RAY: GSI.

2 MEMBER POWERS: GSI, I'm sorry.

3 MR. MAKAR: As a result of the methodology
4 that AP1000 uses for chemical effects analysis, it was
5 not required to evaluate zinc precipitants.

6 The staff hasn't really determined that
7 there are zinc precipitants that occur in the post LOCA
8 environment.

9 MEMBER POWERS: Well, if the staff hasn't,
10 then they're alone in the world because everybody knows
11 you get zinc precipitates in these things.

12 MR. MAKAR: Well, sorry, they were
13 observed not as in as many tests and the conditions
14 under which they occurred at weren't as you think.

15 MEMBER POWERS: Well --

16 MR. MAKAR: And, there were -- the quantity
17 wasn't as much. And so --

18 MEMBER POWERS: My thinking is that what
19 they really did was they took enough bromide in their
20 test solutions to bound not only the aluminum but
21 everything else that they can think of. Because
22 there's a lot of stuff.

23 MR. MAKAR: Say that again, please?

24 MEMBER POWERS: They --

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1 MR. MAKAR: Enough --

2 MEMBER POWERS: In the WCAP where they
3 propose how to drove to resolve the generic safety
4 issue, they formulate a representative solution and
5 they put a lot of simulant materials in there.

6 One of the things they put in is bromide,
7 the other one I think silicon carbide for hard
8 particulates. But, it's not that they have any silicon
9 carbide in the plant, but they wanted to simulate a
10 hard particulate and fiber and a lot of things.

11 And, I think they took enough to simulate
12 what they thought was the amount of zinc that they would
13 get from, you know, blow downs and things like that.

14 MR. MAKAR: In some of the testing, the
15 zinc -- the precipitate was adherent also to the zinc
16 coupons rather than in the water.

17 And, that the --

18 MEMBER POWERS: That's the motion of time.

19 MR. MAKAR: And, again, the methodology
20 is based on if you take this conservative approach with
21 regard to aluminum and the other things that we were
22 -- that the industry was able to identify in the water,
23 the staff felt that that's conservative enough to
24 account for uncertainty about some other elements where

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1 it wasn't clear what the precipitant was and what the
2 effect was on head loss.

3 MEMBER POWERS: Yes, there's --

4 MR. MAKAR: So, I think we -- there's --
5 zinc is -- it would be on the table if someone used
6 a different approach to chemical effects rather than
7 the standard methodology is one way of saying.

8 MEMBER POWERS: Yes, I would -- zinc
9 wouldn't be the first thing I would think of for chemical
10 effects because I don't believe they use triphosphate
11 in this system, do they?

12 MR. MAKAR: In this case, yes.

13 MEMBER POWERS: They do use it?

14 MR. MAKAR: Yes.

15 MEMBER POWERS: Oh God. That's really
16 bad.

17 MEMBER RAY: Well, I raise it here only
18 because, like I say, I don't want to increase the scope
19 of what we're trying to address here now because it's
20 important that we get closure on it ultimately.

21 But, because aluminum had been set up as
22 a consequence of what we're doing here, I felt I needed
23 to ask the question.

24 I don't think from what I've understood

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1 of your dialogue here that we've answered the question
2 as to whether zinc is problematic, have we?

3 MEMBER POWERS: I think you try to bound
4 it with the amount of aluminum in there and it's not
5 going to be worse than aluminum.

6 At least my experience with zinc
7 precipitates is that they're pretty easy to handle.
8 Aluminum precipitates will -- are obnoxious in the
9 extreme.

10 So, if you put a lot of aluminum in, you're
11 okay. That would be my view on the thing.

12 MEMBER RAY: Well, I just want to give you
13 an opportunity to pursue it.

14 MEMBER POWERS: Yes, the -- but the --

15 MEMBER RAY: But, not --

16 MEMBER POWERS: -- issue of aluminum is
17 predominant in my mind as it -- aluminum, as they pointed
18 out, depends on how much you have submerged because
19 the submerged aluminum will corrode and you'll get more,
20 a lot more.

21 MEMBER RAY: Okay, well, I won't raise it
22 again then if you're satisfied.

23 MR. MAKAR: If I can just mention that also
24 with the AP1000, the strainer testing, and there was

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1 bare strainers so that additional chemical effects
2 beyond what's considered in the design basis wouldn't
3 have had an effect. And, I think some of the fuel
4 assembly testing used higher levels than the design
5 basis and, the evaluation on the fuel.

6 So, it was conservative in a number of ways.

7 So, I think additional -- focusing on this conservative
8 methodology and staying within that design basis, staff
9 feels adequate to still to address those -- that kind
10 of uncertainty.

11 MEMBER RAY: Okay, questions?

12 MR. ROHATGI: Yes, just quickly, just a
13 clarification. The NMI has no aluminum, it's all
14 steel.

15 MR. MAKAR: There's no chemical effects
16 from the metal reflective insulation.

17 MR. ROHATGI: So, the aluminum thing is
18 not coming from NMI?

19 MR. MAKAR: That's correct.

20 MEMBER RAY: That's right.

21 MR. ROHATGI: Okay.

22 MEMBER RAY: Other questions?

23 (NO RESPONSE)

24 MEMBER RAY: Okay, it's five minutes after

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1 2:00. So, we're going to make a transition here in
2 a moment into the closed session because I think it's
3 a little early, just an hour into this, to take a break.

4 And, we'll decide, depending on how the
5 closed session goes, whether we'll then take a break
6 during it or perhaps wrap up before need to.

7 So, if we can -- Westinghouse will Be the
8 first up in the closed session.

9 If Westinghouse can come up and, as they're
10 doing so, we'll invite any members here in the audience
11 of the public who will not be remaining with us if there
12 are any comments?

13 (NO RESPONSE)

14 MEMBER RAY: Seeing none, we will ask that
15 the phone line be opened so that we can make a similar
16 question to them.

17 Weidong, is it open and on?

18 MR. WANG: It is open.

19 MEMBER RAY: All right.

20 MR. WANG: All of -- yes, the line is open.

21 MEMBER RAY: Is there anyone on the phone
22 line who would like to make a comment on the discussion
23 that we've had here now?

24 (NO RESPONSE)

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1 MEMBER RAY: Hearing none, we will close
2 the phone line and ask that staff and Westinghouse
3 ensure we have only the allowed participants.

4 Weidong, would you ensure the phone line
5 is closed, please?

6 And, with that, we will declare that we
7 are in closed session and ask Westinghouse to resume.

8 (Whereupon, the above-entitled matter went
9 into closed session at 2:07 p.m.)

10

11

12

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WCAP 17938 Revision 2, ACRS Subcommittee – Public Meeting

February 7, 2018

Andrew Pfister

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:

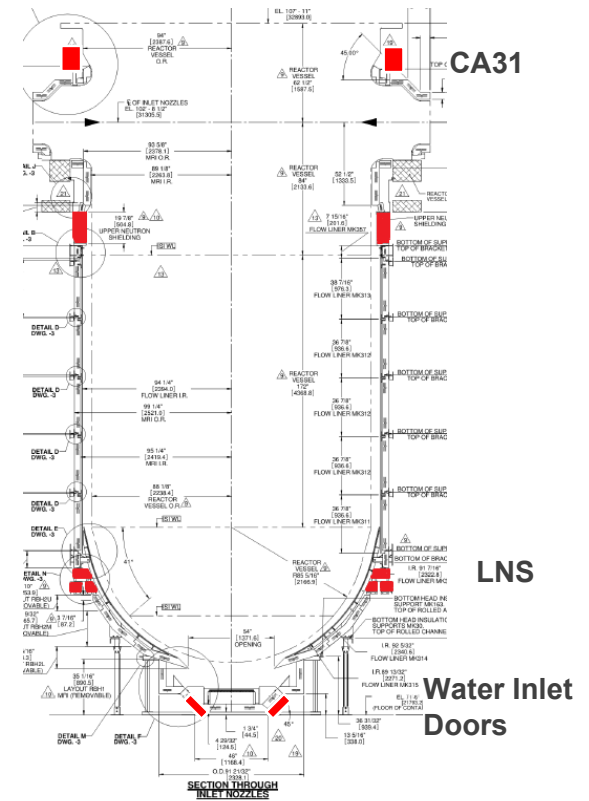
1. Establish a ZOI applicable to all **AP1000** plant in-containment cabling to demonstrate cabling will not generate LOCA debris
2. Gain approval that the non-metallic insulation (NMI) utilized in the reactor vessel insulation systems (RVIS) is a suitable equivalent to MRI for the purpose of GSI 191 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 zone of influence (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

- Jet impingement testing supports a Cable ZOI of 4 L/D for **AP1000** in-containment cabling
- 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 purpose of GSI 191

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



Presentation to the ACRS Subcommittee

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

February 2018

Presentation Topics

- Introduction
- Overview
- Review Approach
- Finding
- 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

- 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”

Overview (cont'd)

- The AP1000 plant safety evaluation decision addressing GSI-191 is based on zero loss-of-coolant accident (LOCA) generated fibrous debris.
 - ♦ Achieved in part through the use of metal reflective insulation (MRI) or a suitable equivalent insulation.
 - ♦ As part of detailed design, the AP1000 plant uses a suitable equivalent insulation in three locations around the reactor vessel.
 - ♦ Use of a suitable equivalent insulation requires NRC review per the AP1000 DCD.

Overview (cont'd)

- The AP1000 plant design also includes electrical cabling that may be directly impinged upon by a loss-of-coolant accident jet.
 - ♦ AP1000 electrical cables may contain fibrous material that was not considered in the original GSI-191 debris source evaluation.
 - ♦ As a corrective action, Westinghouse conducted testing to define a zone of influence for cables.

Overview (cont'd)

- 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)

- To qualify as a suitable equivalent insulation, the AP1000 DCD states in part that:
 - ♦ Testing must be performed that subjects the insulation to conditions that bound the AP1000 plant conditions.
 - ♦ Testing demonstrates that debris would not be generated, to include chemical debris.
 - ♦ Testing and/or analysis must be approved by the NRC.
- The three WCAP requests for NRC approval, are detailed on the following slides.

WCAP Item 1

- Requests approval for a ZOI for electrical cabling in containment.
- Staff review approach
 - ◆ Observed cable jet impingement testing
 - ◆ Assessed the applicability of the test facility
 - ◆ Reviewed test materials
 - ◆ Audited test reports
 - ◆ Issued requests for additional information

WCAP Item 1

- Staff review approach (cont'd)
 - ◆ Staff reviewed observations from previous NRC visits to the test facility, and examined the facility conditions produced during instrumented tests
 - ◆ These conditions were compared to facility conditions for current testing to verify repeatability
 - ◆ Staff determined the facility produced conditions that would bound as-built facility conditions
 - ◆ Applicant determined a ZOI for onset of damage, then conservatively requested an acceptable ZOI tested just beyond that showing no debris generation

WCAP Item 1

- Staff Finding
 - ◆ The topical report provides an acceptable technical basis for determining that no debris will be generated by cables located at or beyond the proposed ZOI.
 - ◆ Because the WCAP demonstrated no debris generation outside the ZOI, the proposed ZOI for electrical cabling is acceptable.
- Limitations and Conditions
 - ◆ Performance of cables within the ZOI (if any) is outside the scope of the WCAP.

WCAP Item 2

- Requests approval for the use of NMI as a suitable equivalent insulation to MRI.
- Staff review approach
 - ◆ Observed jet impingement and submergence testing
 - ◆ Evaluated thermal expansion testing
 - ◆ Assessed the applicability of test facilities
 - ◆ Reviewed test materials
 - ◆ Audited test reports
 - ◆ Issued requests for additional information

WCAP Item 2

- Staff review approach (cont'd)
 - ◆ Neutron shield blocks tested to qualify the blocks ability to withstand jet forces under variety of ZOIs/block configurations.
 - ◆ This testing was supported by a discussion of confined jet behavior, as reactor vessel cavity could be considered a confined space.
 - ◆ WCAP used a literature review, which staff reviewed for applicability.
 - ◆ Ultimately, combination of testing and literature review allowed for verification that the predicted NMI jet impingement pressure would be bounded by the test facility jet at the requested ZOI.

WCAP Item 2

- Staff review approach (cont'd)
 - ◆ Qualifying NMI as suitable equivalent also required evaluation of chemical effects.
 - ◆ Submergence testing measured releases for different levels of NMI encapsulation.
 - ◆ Staff used the testing as a means to evaluate the design's ability to prevent chemical effects.
 - ◆ Submergence tests showed complete encapsulation is necessary to prevent the release of elements that could generate chemical effects, and that additional chemical effects were predicated on amount of submerged aluminum.

WCAP Item 2

- Staff Finding
 - ◆ The topical report provides an acceptable technical basis for determining that no debris will be generated by the blocks.
 - ◆ Because there is no debris generation, use of NMI as a suitable equivalent insulation to MRI is acceptable.
- Limitations and Conditions
 - ◆ Evaluation limited to debris generation
 - ◆ Limit placed on the amount of aluminum in containment

WCAP Item 3

- Requests approval to use the NEI 04-07 alternate evaluation methodology.
 - ♦ NEI 04-07 alternate evaluation methodology in part assumes a double-ended guillotine break of postulated pipe breaks in reactor coolant system (RCS) main loop piping unless physically limited by piping restraints, supports, other structural members or piping stiffness as may be demonstrated by analysis.
 - ♦ If physically limited, then a smaller pipe break size may be used to assess debris generation.

WCAP Item 3

- Staff review approach
 - ◆ Evaluated the topical reports implementation of the approved methodology.
 - ◆ Focused review on RCS main loop piping breaks that are physically limited.
 - ◆ Audited reports used to determine the limited separation of the postulated breaks.
 - ◆ Reviewed the WCAP's methodology for determining the equivalent break diameter for limited separation breaks and the zone of influence (ZOI).

WCAP Item 3

- Staff Finding
 - ◆ The applicant approach to determine limited separation breaks, equivalent break diameter and ZOI is reasonable based on information reviewed in the audit and contained in the WCAP.
 - ◆ The WCAP implements the alternate evaluation methodology consistent with prior staff approval.
 - ◆ Based on the above, the WCAP's use of the NEI 04-07 alternate methodology is acceptable.
- Limitation and Condition
 - ◆ Excludes use of nonsafety systems and operators.

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.

BACKUP SLIDES

WCAP-16530 Methodology For Chemical Effects

- Calculates the amount of chemical precipitate calculated based on plant-specific materials and pH buffer
 - ◆ Input the material quantities (e.g., aluminum surface area, fiberglass mass)
 - ◆ Input the pH buffer chemical
 - ◆ Input realistic pH and temperature profiles
 - ◆ Conservative corrosion/release rates applied

WCAP-16530 Methodology For Chemical Effects

- ◆ Released elements assumed to precipitate as certain chemical compounds
 - AlOOH , $\text{NaAlSi}_3\text{O}_8$, $\text{Ca}_3(\text{PO}_4)_2$
- ◆ All precipitates present when the LOCA occurs
- ◆ All aluminum forms a precipitate
- ◆ All calcium forms a precipitate if phosphate is present
- ◆ Surrogate chemicals used in strainer and fuel assembly testing have been shown to clog fiber beds
- ◆ Refinements to the base model must be justified