



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

July 9, 2015

MEMORANDUM TO: ACRS Members

FROM: Derek A. Widmayer, Senior Staff Scientist /RA/
Technical Support Branch, ACRS

SUBJECT: CERTIFIED MINUTES FOR THE COMBINED ACRS THERMAL-
HYDRAULICS PHENOMENA AND RELIABILITY AND
PROBABILISTIC RISK ASSESSMENT SUBCOMMITTEES
MEETING, MARCH 18, 2015 – ROCKVILLE, MARYLAND

The minutes of the subject meeting have been certified on July 9, 2015, as the official record of the proceedings for that meeting. Copies of the certification letter and minutes are attached.

Attachment: Certified Minutes

cc w/att.: E. Hackett
M. Banks



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

MEMORANDUM TO: Derek A. Widmayer, Senior Staff Scientist
Technical Support Branch, ACRS

FROM: Dr. Sanjoy Banerjee, Chairman
Thermal-Hydraulics Phenomena Subcommittee

SUBJECT: CERTIFIED MINUTES FOR THE COMBINED ACRS THERMAL-
HYDRAULICS PHENOMENA AND RELIABILITY AND
PROBABILISTIC RISK ASSESSMENT SUBCOMMITTEES
MEETING, MARCH 18, 2015 – ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on March 18, 2015, are an accurate record of the proceedings of that meeting.

~ RA~ 7/8/2015
Sanjoy Banerjee, Chairman Date
Thermal-Hydraulics Phenomena Subcommittee

**ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
THERMAL-HYDRAULICS PHENOMENA AND
RELIABILITY AND PROBABILISTIC RISK ASSESSMENT
JOINT SUBCOMMITTEE MEETING MINUTES**

**March 18, 2015
Rockville, MD**

The Advisory Committee on Reactor Safeguards (ACRS) Subcommittees on Thermal-Hydraulics Phenomena and Reliability and Probabilistic Risk Assessment (PRA) met on March 18, 2015, at 11545 Rockville Pike, Rockville, MD, in Room T2-B1. The meeting was convened at 8:30 am and adjourned at 2:48 pm.

The entire meeting was open to the public. Mr. Derek A. Widmayer was the cognizant ACRS staff scientist and the Designated Federal Official for this meeting. No requests for time to make an oral statement and no written comments were received from the public concerning this meeting.

ATTENDEES

ACRS

S. Banerjee, Chairman, Thermal-Hydraulics Subcommittee
J. Stetkar, Chairman, Reliability and PRA Subcommittee
D. Skillman, Member
J. Rempe, Member
M. Corradini, Member
R. Ballinger, Member
D. Bley, Member
S. Schultz, Member
W. Shack, Consultant
D. Widmayer, ACRS Staff

NRC Staff

L. Regner, NRR/DORL	M. Markley, NRR/DORL
B. Singal, NRR/DORL	C. J. Fong, NRR/DRA
J. Stang, NRR/DSS/SSIB	S. Smith, NRR/DSS/SSIB
V. Cusumano, NRR/DSS/SSIB	A. Guzzetta, NRR/DSS/SSIB
P. Klein, NRR/DE	M. Yoder, NRR/DE
M. Diaz Colon, NRR/DE/ESGB	J. Tsao, NRR/DE/EPNB
T. Lupold, NRR/DE/EMCB	

STPNOC

M. Murray	D. Richards	J. Leavitt
R. Enger	W. Schulz	R. Dunn
E. Kee	W. Harrison	D. Rencurrel

Others

R. Holloway, WCNOG
R. Vaghetto, TAMU
J. Hosanbeih, UT-Austin
K. Wallar, Enercon
P. Grissom, SNC
Y. Massan, Texas A&M Univ
B. Letelier, Alion

D. Johnson, ABS Group
Z. Mohaghigh, Univ. of Illinois
A. Glover, Enercon
P. Leonard, Enercon
C. Gears, NextEra/FPL
S. Unikewicz, Alion

SUMMARY

The purpose of this Joint Subcommittee meeting was for South Texas Project (STP) to present a detailed overview of their revised risk-informed approach to resolve GSI-191, the generic safety issue entitled, “*Assessment of Debris Accumulation on PWR Sump Performance*.” The revised approach is a simplification and revision to the approach submitted by STP to the NRC in November 2013. The revised approach had not been submitted to the NRC for docketing at the time of the Joint Subcommittee Meeting, but STP staff presented detailed information on the approach, including details of the testing which will be relied on in the revised approach. STP’s risk-informed approach, as applied to its Units 1 and 2, is intended to be a pilot for other licensees planning to use a risk-informed approach to resolve GSI-191. NRC staff also discussed the schedule regarding STP’s submittal, as well as the schedule for NRC staff review of the submittal.

<i>SIGNIFICANT ISSUES</i>	<i>Reference Transcript Pages</i>
Dr. Banerjee called the meeting to order and provided the opening remarks.	4 – 6
G. Wilson, Deputy Director, NRR/Division of Operating Reactor Licensing (DORL), introduced the meeting, including the background for the topic of the meeting and the speakers from the NRC staff.	6 – 7
L. Regner, Project Manager, NRR/DORL, opened with a summary presentation on the history of the STP’s submittals on resolving GSI-191, the history of ACRS meetings on the subject, public meetings held on the subject, and the outstanding technical issues that remain from the staff review of STP submittals. ACRS Members addressed the following issues during this part of the meeting:	7 – 19 Slides 1 – 6

<p>ACRS Members addressed the following issues during this part of the meeting:</p> <ul style="list-style-type: none"> • If it is possible for STP to meet the 15 grams per fuel assembly limit in the downstream effects analysis with the existence of fiber, and a brief discussion that the PWROG is preparing a submittal to raise the 15 gram limit (Banerjee) 	<p>85 – 88</p>
<p>Ernie Kee, STPNOC, presented a summary of the new risk-informed methodology, called RoverD, (for Risk over Deterministic) which will be submitted by STP in the near future to resolve GSI-191. The new approach uses test results from 2008, rather than newer ones, to address issues with epistemic uncertainties in correlations that were difficult to resolve during staff reviews, and to reduce the complexity of the methodology. The methodology has not been submitted officially on the Docket by STP, so no review of any of the submittal has been conducted by NRC staff.</p> <p>ACRS Members/Consultants addressed the following issues during this part of the meeting:</p> <ul style="list-style-type: none"> • The proper application of data interpolations described in NUREG-1829 and how they were applied and other methods that might have been used (Stetkar) • The amount of debris collected on a strainer module and the amount passing through, how the strainers might behave sequentially, and whether this behavior is treated appropriately in the analysis and is there data to back up the analysis (Banerjee) • Clarifying the information on Slide 53 through Slide 56 concerning the amount of fiber that remains in the core once it gets to the core, and the behavior over time that is being represented by the graphs. Clarifying also what type of break is being represented (Banerjee and Stetkar) • Clarifying the hot leg break case and the calculations used, and whether it characterizes the worst case scenario for the hot leg break (Banerjee) • How the break sizes discussed on Slide 58 are represented in the frequencies shown and whether this is consistent with NUREG-1829 (Shack) 	<p>90 – 200 Slides 51 – 71</p> <p>122 – 125</p> <p>134 – 140</p> <p>149 – 158</p> <p>160 – 168</p> <p>189 – 195</p>

<p>Wayne Harrison, STPNOC, provided a brief presentation on the regulatory implementation of the RoverD methodology results which would still be an exemption to the long-term cooling calculation, and an amendment to the license for a tech spec change. There is still discussion going on with staff on how these regulatory implementation requirements need to be characterized.</p> <p>ACRS Members addressed the following issues during this part of the meeting:</p> <ul style="list-style-type: none"> That the RoverD method would be submitted both as a response to an outstanding RAI and as a complete submittal later on in a new license amendment request (Bley) 	<p>200 – 212 Slides 72 – 75</p> <p>208 – 209</p>
<p>Chairman Banerjee provided an opportunity for comments from the public from the meeting room and the teleconference line. There were no comments provided.</p>	<p>212 – 214</p>
<p>The Subcommittee Members discussed the presentations and provided summary comments on the issues and asked final questions about the matter. There were no significant issues discussed during this portion of the Subcommittee meeting.</p>	<p>214 – 220</p>

<i>ACTION ITEMS</i>	<i>Reference Transcript Pages</i>
<p>Staff will provide the ACRS Joint Subcommittees with the plan and the report for the upcoming audit to be conducted on STP containment during an outage around March 31st.</p>	<p>18</p>

ATTACHMENT

Official Transcript of Proceedings, Joint Meeting of ACRS Thermal-hydraulics Phenomena and Reliability and Probabilistic Risk Assessment Subcommittees, Wednesday, March 18, 2015, Rockville, MD.

Documents Provided to the Subcommittee:

1. Status Report, Advisory Committee on Reactor Safeguard, Thermal-Hydraulic Phenomena Subcommittee and Reliability and PRA Subcommittee Joint Meeting, "South Texas Project, Risk-Informed Approach to Resolve GSI-191: Assessment of Debris Accumulation on PWR Sump Performance," September 3, 2014 (No ML Number)
2. Memorandum, USNRC, "Certification of the Minutes of the ACRS Thermal-Hydraulics Phenomena and Reliability and PRA Joint Subcommittee Meeting - South Texas Project, Risk-Informed Approach to Resolve GSI-191," September 3, 2014 (ML14318A334)
3. Letter, Singal, USNRC to Koehl, STPNOC, "South Texas Project, Units 1 and 2 - Staff Audit Report Related to Request for Exemptions and License Amendment for Use of a Risk-Informed Approach to Resolve the Issue of Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents At Pressurized Water Reactors," January 15, 2015 (ML14321A677)
4. Summary Of August 20, 2014, Public Meeting with STP Nuclear Operating Company to Discuss the License Amendment and Exemption Requests to Use a Risk-Informed Approach to the Resolution of GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance," (ML14269A002)
5. Summary Of November 6, 2014, Public Meeting with STP Nuclear Operating Company to Discuss the License Amendment and Exemption Requests to Use a Risk-Informed Approach to the Resolution of GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance," (ML14323A576)
6. Summary Of December 1, 2, and 3, 2014, Public Meeting with STP Nuclear Operating Company to Discuss the License Amendment and Exemption Requests to Use a Risk-Informed Approach to the Resolution of GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance," (ML15020A106)
7. Slides presented by STPNOC at the February 4, 2015, Public Meeting with NRC Staff, "STP Risk-Informed Approach to GSI-191," (ML15034A114)
8. STPNOC, "South Texas Project, Units 1 and 2, Docket Nos. STN 50-498 and STN 50-499, Supplement 4 to the Response to Generic Letter 2004-02," (ML083520326)
9. Memorandum, USNRC, "Staff Observations of Testing for Generic Safety Issue 191 During a July 29 To July 31, 2008 Trip to The Alden Test Facility for PCI Strainer Tests," (ML083470317)
10. Memorandum, USNRC, "Staff Observations of Testing for Generic Safety Issue 191 During a February 12 and 13, 2008 Trip to The Alden Test Facility for PCI Strainer Tests," (ML080920398)

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
 Thermal Hydraulic Phenomena and Reliability
 and Probabilistic Risk Assessment

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, March 18, 2015

Work Order No.: NRC-1451

Pages 1-222

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UNITED STATES OF AMERICA
 NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
 (ACRS)

+ + + + +

JOINT MEETING OF THE THERMAL HYDRAULIC PHENOMENA AND
 RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

SUBCOMMITTEES

+ + + + +

WEDNESDAY

MARCH 18, 2015

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittees met at the Nuclear
 Regulatory Commission, Two White Flint North, Room
 T2B1, 11545 Rockville Pike, at 8:30 a.m., Sanjoy
 Banerjee and John Stetkar, Chairmen, presiding.

COMMITTEE MEMBERS:

SANJOY BANERJEE, Chairman

JOHN W. STETKAR, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

MICHAEL CORRADINI, Member

JOY REMPE, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

ACRS CONSULTANT:

WILLIAM SHACK

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

ALSO PRESENT:

VIC CUSUMANO, NRC

DAVID JOHNSON, STP

PAUL KLEIN, NRC

BRUCE LETELIER, Alden

MIKE MURRAY, STP

WES SCHULZ, STP

STEPHEN SMITH, NRC

LISA REGNER, NRC

GEORGE WILSON, NRC

*Present via telephone

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

(8:31 a.m.)

CHAIRMAN BANERJEE: Good morning. The meeting will now come to order. This is a Joint Subcommittee meeting of the Advisory Committee on Reactor Safeguards' Subcommittees on Thermal Hydraulic Phenomena and Reliability and PRA. I'm Sanjoy Banerjee, Chairman of the Thermal Hydraulics Phenomena Subcommittee.

ACRS members in attendance are Dr. Schultz, Dr. Bley, Mr. Stetkar and Dr. Ballinger. Our ACRS consultant, former ACRS chairman Dr. Shack is also present. Mike Corradini will be on and off by phone during the morning and the afternoon. He has to actually be at the University of Wisconsin today. Derek Widmayer of the ACRS staff is the designated federal official for this meeting.

The purpose of today's meeting is for the NRC staff and representatives from the South Texas Project Electricity Generating Station to discuss the revised South Texas Project risk-informed approach to resolving Generic Safety Issue 191. Generic Safety Issue 191 is titled, "Assessment of Debris Accumulation on PWR Sump Performance."

The Joint Subcommittee will gather

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1 information, analyze relevant issues and facts and
2 formulate proposed positions and actions as appropriate
3 for consideration for a future Joint Subcommittee
4 meeting, which is currently scheduled for August of this
5 year.

6 The rules for participation in today's
7 meetings were announced as part of the notice of this
8 meeting previously published in the *Federal Register* on
9 August 19, 2014. The meeting will be open to public
10 attendance. We have received no written comments or
11 requests for time to make oral statements.

12 A transcript of today's meeting is being
13 kept and will be made available as stated in the *Federal*
14 *Register* notice, therefore we request that meeting
15 participants use the microphones located throughout the
16 meeting room when addressing the Subcommittee.
17 Participants should first identify themselves and speak
18 with sufficient clarity and volume so they can be
19 readily heard.

20 A telephone bridge line has been
21 established for this meeting. To preclude
22 interruption of this meeting, please mute your
23 individual telephones and lines during presentation and
24 Subcommittee discussion.

25 I ask that you please silence all cell

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1 phones.

2 We will now proceed with the meeting. I
3 call on George Wilson, Deputy Director of NRR's Division
4 of Operating Reactor Licensing to make introductory
5 remarks.

6 MR. WILSON: Good morning. As stated, I'm
7 George Wilson, Deputy Director of Division of Operating
8 Reactor License. I want to thank you for this
9 opportunity and time to brief you on South Texas
10 Project's risk-informed resolution to GSI-191, which is
11 the assessment of debris accumulation in PWR sump
12 performance and associated Generic Letter 2004-02,
13 which began in 2011. STP is the pilot plant for the
14 risk-informed process. This is an extremely complex
15 review involving 13 technical branches and there has
16 been three course corrections over the four-year
17 effort.

18 We last met with the ACRS Subcommittee in
19 October 2014 on this amendment. Since then STP has
20 shifted its approach and proposed a new methodology that
21 blends both risk-informed and deterministic
22 methodology with two public meetings being held to
23 discuss this new methodology.

24 NRC staff has held preliminary discussions
25 on this, but has not yet received this information on

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1 the docket from South Texas Project. Right now the
2 proposed is that we will receive this information in
3 June 2015. And after the staff has a chance to look at
4 that, we'll be able to come back and talk to the ACRS
5 on our viewpoints on that.

6 At this point I would like to turn the
7 meeting over to Lisa Regner, the project manager for
8 South Texas Project, who will provide the path forward
9 moving on with GSI-191 license amendment applications
10 for South Texas Project. Lisa?

11 MS. REGNER: Thanks, George. I am the
12 fairly new project manager for South Texas Project and
13 I may be the primary presenter to you for the staff
14 today, however, this is a team effort, as all NRC
15 projects are, and I do want to recognize that I've been
16 privileged to work with an exceptional group of
17 professionals on the NRC staff. And I want to thank
18 them for their patience with me and their support as we
19 work through this GSI, or Generic Safety Issue 191, the
20 assessment of debris accumulation on pressurized water
21 reactor sump performance.

22 I've had the opportunity to present to you
23 several times in the past, and I do appreciate the
24 opportunity to present again today. This is a bit more
25 unique than in the past, as George alluded to, not just

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1 because this is a first of a kind license application,
2 but also because of these shifts that have taken place,
3 which is completed expected during a pilot project as
4 we're working through this extremely and unique pilot
5 project.

6 Most recently in December the South Texas
7 Project staff proposed to change their methodology in
8 part to support the staff's requests to remove untested
9 correlations, correct errors and to simplify the
10 methodology. STP now proposes to use both
11 deterministic and risk-based methods, as George said,
12 and they've termed that risk over deterministic or
13 RoverD, which they will explain in much more detail for
14 you today. Again, the staff does not have a formal
15 docketed submittal from the licensee, and because of
16 this the staff is somewhat limited in its ability to
17 provide details on this new methodology.

18 With this in mind, I'd like to provide you
19 a very, very efficient look back and look forward on this
20 pilot project and then get out of the way and let STP
21 give you the details, which I'm sure you want. We will
22 be able to give more feedback and answer questions
23 further on this project once we're able to review in more
24 detail, and we'll look forward to the August
25 presentation where we can give you more feedback.

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1 The first part of the presentation is the
2 deterministic. We do have a lot of details. And Mr.
3 Steven Smith, reactor systems engineer in the Safety
4 Issues Resolution Branch, will be providing a detailed
5 look at his observations since he did observe that
6 testing. So in addition to STP's detailed look, the
7 staff will give you details and will be able to answer
8 questions on that aspect.

9 But in terms of the RoverD, the staff does
10 have few details and they're based on one public
11 meeting. But again, I do want to speak for the entire
12 team in saying that we do appreciate the opportunity to
13 be here and we welcome any feedback, insights and
14 perspectives that you're willing to share with us today.

15 So in terms of the background, this is a
16 pilot project. It's a first of a kind. And though this
17 slide does show some of the challenges and course
18 corrections that have taken place over the past four
19 years, as George said, it is unique and complex. I have
20 only been here for about eight weeks, but there are many
21 that have been on this project for four years, and
22 they've been jogging. If you'll indulge in this
23 analogy, they've been climbing a rocky hill, both sides
24 have, but based on what we have seen of RoverD we are
25 hopeful that we're either close to cresting the hill or

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1 we already have. We do see merit in this new
2 methodology and we do look forward to receiving more
3 details, as you do, from STP. I do want to thank both
4 sides for their patience as we work through this pilot
5 program.

6 We did have 18 pre-submittal meetings in
7 2011-2012 in anticipation of the January 2013 pilot
8 submittal. Unfortunately the submittal did not
9 include an amendment, and there were a few other
10 insufficiencies noted by the staff. Therefore, STP
11 revised the submittal again in June 2013 and due to some
12 self-identified issues they then again supplemented in
13 June 2013. We do expect another supplement -- I'm
14 sorry. They supplemented again in November 2013. And
15 then we expect the RoverD submitted in June of 2015.

16 Requests for additional information that
17 have been issued. In April 2014 the staff issued round
18 1, and a couple of those technical issues, which I
19 believe you have discussed previously, were the use of
20 correlations, the treatment of chemical effects on
21 coating, debris generation and transport, the
22 verification of the containment accident sequence,
23 stochastic analysis or CASA Grande. This is actually
24 the probabilistic risk assessment platform that they
25 use for the PRA and the treatment. And it also includes

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1 uncertainties and sensitivities, in-vessel effects and
2 loss of coolant accident size and frequency. And there
3 were several responses that this slide doesn't show.
4 There were three STP responses in the summers of 2014
5 and 2014.

6 We also issued round 2 RAIs which included
7 many of the same issues in March 2015. Those responses
8 are due at the end of this month.

9 Recent public meetings we have had. I do
10 want to say that we've had almost 30 public meetings over
11 this four-year period. The most recent were in
12 December, February and March, which February 4th was the
13 most significant one where we covered the new RoverD
14 project where -- I'm sorry, STP provided us a
15 presentation on the RoverD process. And that was well
16 received by the staff.

17 We've had regulatory audits. We do have
18 several upcoming audits associated with GSI-191. The
19 most recent one is actually tomorrow at Westinghouse.
20 We'll be looking at in-vessel effects during design
21 basis accidents specific to boron precipitation
22 calculations. At the end of this month the staff will
23 be going to STP and actually will enter containment
24 during their outage to look at some of these affected
25 areas, areas affected by GSI-191. And we think that

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1 will provide a good look, a good perspective of a
2 real-life look at what we're all dealing with on paper
3 here at headquarters. We also expect a spring audit
4 associated with the RAI responses, and there are two
5 more possible over the summer following the RoverD
6 submittal.

7 The environmental assessment has been
8 completed. We still have to do an evaluation to see if
9 that will be affected by the change in methodology, but
10 we will issue that in draft for public comment and then
11 issue the final when and if the staff approves the
12 GSI-191 resolution.

13 Upcoming submittals, as I mentioned, are
14 both March, the round 2 RAI response, and June for
15 RoverD.

16 We also have more ACRS meetings coming up.
17 The third Subcommittee this summer and then a full
18 Subcommittee meeting is proposed this fall. So we'll
19 have two more opportunities to provide you with our
20 perspectives.

21 Outstanding technical issues. Many of
22 those I've mentioned before. They are captured in the
23 RAIs that are currently on the docket.

24 Application completeness and consistency,
25 variability of the submittal. We're hoping to get a

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1 fixed and complete submittal for review very soon, and
2 hopefully that will be with the June submittal.

3 Un-analyzed accidents scenarios. That
4 has to do with situations or sequences that weren't
5 modeled by CASA Grande, but that the licensee was not
6 assuming a conservative outcome. And the staff
7 stressed that that would be important for those
8 un-analyzed accident scenarios to go to failure.

9 Use of correlations. That's been
10 discussed quite a bit.

11 Debris generation and transport largely
12 associated with coatings.

13 And again, validation of the model, CASA
14 Grande model. We've had difficulty performing an
15 independent assessment of CASA Grande results that were
16 in the ballpark. We do believe we've worked through
17 most of those issues but still have some work to do
18 there.

19 And I do want to say --

20 MEMBER BLEY: And can you send --

21 MS. REGNER: Sure.

22 MEMBER BLEY: -- in more about that?

23 MS. REGNER: About the validation with
24 models?

25 MEMBER BLEY: Yes, what problems you were

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1 having and are you really close to resolution?

2 MS. REGNER: We're getting close. For a
3 while we were quite a bit off. And in terms of --

4 MEMBER BLEY: That's using their code?

5 MS. REGNER: Correct. Getting the
6 results from their code and using our independent
7 assessment to determine --

8 MEMBER BLEY: Okay.

9 MS. REGNER: -- debris transport. We
10 weren't real close. Okay? Now more recently we've
11 discovered some issues with the use of the most current
12 modeling and the most current input data values.

13 MEMBER BLEY: This is NRC's model?

14 MS. REGNER: Correct.

15 MEMBER BLEY: Okay.

16 MS. REGNER: Correct. The input data for
17 those models. But for example, another issue is this
18 idea of the moving target, the consistency. In our last
19 public meeting on March 11th, when we felt like we were
20 starting to converge and get closer in the ballpark, STP
21 had noted that they had used -- for insulation loading
22 they had used their new CAD model instead of a much more
23 broad -- I want to say there was a larger estimate
24 previously that we had been given, but they had then used
25 a more accurate insulation loading.

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1 MEMBER BLEY: Which isn't what you were
2 using?

3 MS. REGNER: Which isn't what we were
4 using.

5 MEMBER BLEY: Okay.

6 MS. REGNER: And so, and we didn't know
7 about that. So those kinds of issues are what we need
8 to figure out. What are they actually using that we
9 don't know about, those --

10 (Simultaneous speaking)

11 CHAIRMAN BANERJEE: What about the ZOI?
12 Was it 7 or 17? I mean, that's the first order of
13 problem, right?

14 MR. SMITH: This is Steve Smith. The ZOI
15 they're using is 17D for the fibrous insulation,
16 low-density fiberglass.

17 CHAIRMAN BANERJEE: Okay.

18 MS. REGNER: Thanks, Steve.

19 CHAIRMAN BANERJEE: And there's no
20 settling of the fine and fiber, or are they taking
21 account of that?

22 MR. SMITH: They're probably going to get
23 into that later, but the transport evaluation assumes
24 very little holdup of any fine, either particulate or
25 fibrous debris.

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1 CHAIRMAN BANERJEE: Okay. So it's more or
2 less consistent, right? It's just what's within that
3 17?

4 MR. SMITH: Yes.

5 MS. REGNER: Okay. Any other questions?

6 MEMBER SCHULTZ: One, Lisa.

7 MS. REGNER: Yes?

8 MEMBER SCHULTZ: You mentioned the audit
9 that's going to be performed to examine the containment
10 during the outage.

11 MS. REGNER: yes.

12 MEMBER SCHULTZ: It sounds like a very
13 important opportunity to capture whatever might be
14 important to the overall evaluation of not only the
15 analysis, but also the application.

16 MS. REGNER: Absolutely.

17 MEMBER SCHULTZ: Is the audit plan
18 prepared? Have you been --

19 MS. REGNER: It is in draft.

20 MEMBER SCHULTZ: -- working through what
21 you're going to see and what you need to see?

22 MS. REGNER: It is in draft. It was given
23 to the licensee last Friday, yes. I can get you a copy
24 of that, get you the final. It should be finished this
25 week or early next week. But, yes, we do have --

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1 MEMBER SCHULTZ: At the final time I'd like
2 to have an opportunity to see that.

3 MS. REGNER: Absolutely.

4 MEMBER SCHULTZ: Just in making sure
5 that's optimized. I'm presuming licensee is making
6 sure that's --

7 (Simultaneous speaking)

8 MS. REGNER: They invited us.

9 MEMBER SCHULTZ: Of course.

10 MS. REGNER: So we do thank the licensee
11 for that invitation, yes.

12 MEMBER SCHULTZ: Good. Thank you.

13 MR. CUSUMANO: Yes, excuse me. This is
14 Vic Cusumano. The audit plan isn't going to be
15 tremendously detailed. We are intentionally leaving
16 it a little bit open-ended. We want to look at systems
17 and structures and components that they're referencing
18 in their submittal to us and --

19 MEMBER SCHULTZ: I'm probably more
20 interested in the audit report.

21 MR. CUSUMANO: That's kind of what I
22 figured.

23 MEMBER SCHULTZ: But, yes. So some
24 combination thereof would be useful for us.

25 MR. CUSUMANO: More of interest would

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1 probably be the audits that we do later of the actual
2 inputs, to validate the inputs to CASA Grande.

3 MEMBER SCHULTZ: Thank you.

4 MR. WIDMAYER: Lisa, as usual, you can just
5 work through me.

6 MS. REGNER: Will do. Very good.
7 Understand. I will get you audit plan and audit summary
8 for the audit at the end of this month, March 31st.

9 MEMBER SCHULTZ: Thank you.

10 MS. REGNER: We do expect that many if not
11 all of these outstanding technical issues will be
12 resolved or largely resolved if the RoverD methodology
13 is in fact what we think it is.

14 Debris generation and transport, obviously
15 those issues will still need to be worked through.

16 That basically concludes my presentation.

17 MEMBER BLEY: Just two quick questions:
18 When are you expecting their submittal? And given it
19 comes when you expect it, when do you expect to have your
20 review complete?

21 MS. REGNER: When does the staff expect to
22 complete its review?

23 MEMBER BLEY: Yes.

24 MS. REGNER: If all goes well, I would say
25 probably the first calendar quarter of 2016.

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1 MEMBER BLEY: Okay.

2 MS. REGNER: Okay. And that's assuming no
3 RAIs, assuming we get exactly what we need. That's best
4 case scenario.

5 MEMBER BLEY: Fair enough. Okay.

6 MS. REGNER: Any other questions?

7 (No response)

8 MS. REGNER: Okay. With that, I will turn
9 it over to South Texas Project. Thank you so much.

10 CHAIRMAN BANERJEE: So, welcome. Mike,
11 you are going to lead?

12 MR. MURRAY: Yes, I will. Well, let me go
13 ahead and start. Let's do our introductions from those
14 who are here to support South Texas Project, and then
15 we'll get into the slide show.

16 Mike Murray. I'm the reg affairs manager
17 at South Texas Project. And to my left is Wayne
18 Harrison, our licensing representative. Ernie, would
19 you start?

20 MR. KEE: Ernie Kee, South Texas Project.

21 MR. SCHULZ: Wes Schulz of South Texas.

22 MR. HARRISON: I'm Wayne Harrison, South
23 Texas.

24 RICHARDS: Drew Richards, South Texas
25 Project, Licensing.

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1 MR. RENCURREL: David Rencurrel.

2 CHAIRMAN STETKAR: Come up to the
3 microphones.

4 MR. RENCURREL: David Rencurrel. I'm
5 Senior Vice President of Operations, South Texas.

6 MR. ENGEN: Rob Engen, Engineering
7 Projects, South Texas Project.

8 MR. DUNN: Roland Dunn, South Texas
9 Project. I'm Nuclear Fuel and Analysis Manager.

10 MR. JOHNSON: David Johnson, ABS Group
11 supporting South Texas.

12 MR. LETELIER: Bruce Letelier, Alion
13 Science supporting South Texas.

14 MS. LEAVITT: Janet Leavitt, Alion Science
15 supporting South Texas.

16 MR. HASANBEIN: I am John Hasanbein from
17 the University of Texas at Austin supporting South
18 Texas.

19 MS. MOHAGHIGH: I am Zahra Mohaghigh from
20 the University of Illinois supporting South Texas.

21 MR. VAGHETTO: Rodolfo Vaghetto, Texas A&M
22 University supporting STP.

23 MR. MURRAY: So with that, we'll get into
24 our slide show. Again this is Mike Murray from South
25 Texas Project. And I'm going to practice with our

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1 scroll to make sure it works here. Yes, it's working.

2 So what we would like to do today is go
3 through the introduction of the risk over
4 deterministic. And as you can see, -- as in nuclear
5 power, we always have to make an acronym for it. So we
6 call it RoverD. So that's the term you'll often hear
7 as we're going through our presentation.

8 And how we'll go through it is we'll explain
9 -- and in an early slide I'll kind of show a flow diagram.
10 We'll talk more about that slide later in the
11 presentation, so we won't need to spend a lot of time
12 on it. It just gives you a concept of it. We're going
13 to go through and deterministic element of it. And what
14 we'll do is we'll go through test results that are the
15 basis for our deterministic screening process within
16 it. And then we'll get into how that applies and into
17 the risk element. And then Wayne will carry us through
18 the regulatory basis, and then we'll go through
19 conclusions.

20 Now there was one thing that we'll talk
21 about. Steve, when did you want to interject your
22 thoughts, because Lisa indicate you would. So I'd like
23 to work that in.

24 MR. SMITH: Okay. I guess it's on the
25 schedule. But any time after you finish talking about

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1 the testing.

2 MR. MURRAY: Okay. So that will be a good
3 opportunity.

4 MR. SMITH: The 2008 testing.

5 MR. MURRAY: So we'll work through that as
6 we get to that point, and that will probably be around
7 the first break, or maybe right shortly after it there.

8 CHAIRMAN BANERJEE: Well, Steve is
9 currently scheduled to talk after lunch.

10 MR. MURRAY: Okay.

11 CHAIRMAN BANERJEE: So we'll finish the
12 deterministic.

13 MR. MURRAY: Right. We'll see how it
14 works and see where it fits well. And I'll pay
15 attention to that as we go through it.

16 So I am now on slide 3. Some discussion
17 about it is we have revised this methodology. One point
18 I want to make as we've gone through it is that in each
19 opportunity we've had the risk continues to be very low
20 as in the results of every methodology that was
21 approached as we've gone through the phases. The risk
22 of the final still continues to be very low. So I just
23 wanted to make that point going in.

24 And also I wanted to update one thing. So
25 we're currently in a process of requests for additional

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1 information and included in our March will be the RoverD
2 technical information for the staff to look at. So
3 we'll have that in our March submittal of requests for
4 additional information. So that will help the staff in
5 preparation for when we see it in the June, when we bring
6 all of the submittal together.

7 CHAIRMAN STETKAR: So, Mike, what you're
8 saying is as part of -- I looked through the RAIs -- as
9 part of responses to those RAIs you're basically going
10 to append the whole new methodology?

11 MR. MURRAY: We're going to include the new
12 methodology that we'll discuss today in that RAI
13 response so the staff will be able to start their review
14 on it --

15 CHAIRMAN STETKAR: Okay.

16 MR. MURRAY: -- as we're working on
17 bringing up, as Lisa said, in June all the pieces of the
18 submittal and updating it to RAI responses and preparing
19 it for the final reviews.

20 MEMBER SCHULTZ: So you'll have a full
21 integrated package that you'll be presenting in June?

22 MR. MURRAY: That is correct. That is
23 currently our schedule and target.

24 So go ahead, Wayne, did you want to add?

25 MR. HARRISON: No, I was nodding in

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1 agreement.

2 MR. MURRAY: All right. So where we are is
3 we've -- again we're moving into with a deterministic
4 baseline. And then when we screen through that
5 process, you'll see what remains. And we'll apply a
6 probabilistic or risk-informed approach to it. So the
7 RoverD is less complex. Again, that was the purpose of
8 this change was to get some of the complexity out to
9 clarify the path as we go through it. And you'll see
10 that as we go through it. And please ask questions as
11 we go through it. Not so much of me. Lisa will be able
12 to answer questions.

13 CHAIRMAN STETKAR: Mike, be careful with
14 the papers.

15 MR. MURRAY: I understand.

16 CHAIRMAN STETKAR: That microphone is
17 sensitive.

18 MR. MURRAY: Thank you for that reminder.

19 So moving to the next slide. So high level
20 we assume that all breaks that can introduce more fine
21 fibers than what we have in our test will lead to core
22 damage and then we'll apply that into the probabilistic
23 part of the process, the risk-informed portion.

24 We'll screen the spectrum of break
25 scenarios at all weld locations, find a set of the

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1 smallest breaks that introduce the more fine fiber.
2 We'll assume the larger breaks of the same location will
3 exceed the fine-fiber limits. And then we'll add the
4 cumulative frequencies of these events. And we'll get
5 into that this afternoon.

6 So I wanted to first introduce this from a
7 pictorial. So you can follow it as we go through it.
8 This is how the rubber meets the road, if you could
9 imagine, is we look at the deterministic test data. We
10 examine the breaks. We look for the amount of fine
11 debris out of each break and we base --

12 MEMBER SHACK: This afternoon are you
13 going to discuss what fine debris is sufficient to
14 characterize the complexity of the loading?

15 MR. MURRAY: We will make sure we do, yes,
16 sir. I think we do.

17 And then we carry it into a decision tree,
18 and it really comes down to a true faults almost. Is
19 it less than or not? And if it is not less than, then
20 you get into the -- you take the no line and then you
21 apply the risk-informed utilizing the guidance in Reg
22 Guide 1.174. If the amount of fines meets the yes line
23 going through, then you just -- the scenario is
24 deterministically screened.

25 CHAIRMAN BANERJEE: Is this a clean plant

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1 in terms of latent debris?

2 MR. MURRAY: So what's the term? Clean
3 in --

4 (Simultaneous speaking)

5 MR. SCHULZ: We are a high-fiber plant, so
6 our latent debris is a very small contributor to our
7 total fiber fines.

8 CHAIRMAN BANERJEE: I'm just baselining in
9 my head that even plants which are very clean have
10 downstream effects which are in excess of the typical
11 15 grams per channel that you've allowed. So I'm just
12 trying to baseline what the fines are like. Is it 200
13 pounds, the fiber? I mean, in total latent debris?

14 MR. SCHULZ: Latent debris? Yes, 200
15 pound latent debris. That's what we assumed.

16 CHAIRMAN BANERJEE: Is that what --

17 (Simultaneous speaking)

18 MR. SCHULZ: Which 15 percent is fiber.
19 That was our assumption going in, yes. But that amount
20 is small compared to the amount --

21 CHAIRMAN BANERJEE: What you will
22 generate. Yes.

23 MR. SCHULZ: -- that is generated.

24 CHAIRMAN BANERJEE: So it will be
25 interesting to see how you -- and are you trying to

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1 adhere to to this 15 grams per channel downstream, or
2 is there something else?

3 MR. KEE: We do.

4 MR. MURRAY: So with that, I think our next
5 slide -- I'll turn it over to Wes and Wes will take us
6 through the test. Again, this is the test that we're
7 using as our baseline for the window down below that says
8 -- that I'm pointing to which is total fine less than
9 tested. So that's where we're setting up that
10 deterministic gate.

11 MR. SCHULZ: Hi, my name is Wes Schulz.
12 You'll note that there are a couple ways to spell Schulz,
13 but we pronounced it Schultz. That's how we do it.

14 (Laughter)

15 MR. SCHULZ: I'm a mechanical design
16 engineer at South Texas Project. I've been there
17 working on this for a long time.

18 Okay. I'm going to give you a little bit
19 of STP background, just a quick description of our plant
20 and what it's like. I'm going to talk about the role
21 of flume testing, overview of our deterministic
22 analysis that we did in '07 and '08 and then the testing
23 that was done in '08, talk about the test itself and then
24 how we're going to use this test going forward in our
25 RoverD approach.

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1 And, Steve, when I'm done talking, it would
2 probably be good for you to jump in and talk about that,
3 because I'll be talking about the D in the RoverD. And
4 then when I'm done with testing you can jump in.

5 This is a way too busy figure here. This
6 is an elevation view of the various complements, but the
7 take-away here is I want to make the point that we have
8 three independent trains at South Texas. Each train
9 has its own sump, independent sump with strainers.
10 There's a low-head safety injection pump, a high-head
11 safety injection pump and a containment spray pump.
12 During injection phase it takes suction off the
13 refueling water storage tank. And then during the
14 recirc phase it takes suction off the sump.

15 We have separate RHR, residual heat removal
16 pumps, which is a separate system which we're not using
17 in the recirculation mode. So that's the main thing
18 about South Texas. So we have three separate trains
19 each with its own pump. And the pumps are located below
20 the sump level in the bottom of the containment and the
21 pumps are located in another building, the fuel handling
22 building, which is lower than the containment floor
23 elevation there. So that's the take-away from that
24 slide.

25 That's a picture of our old sump strainer.

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1 It's about 4 foot high, 4 foot wide and 10 foot long.
2 It's just a box with quarter-inch perf plate surrounded
3 by grating. It's about 155 square feet.

4 This is picture a taken during an outage,
5 so that's why there's a box of wipes there and some
6 scaffold frame in front. They were working above the
7 sump at that time.

8 We removed this back in '06-'07 and put in
9 our new advanced design sump strainers. And these
10 consist of about 20 modules per sump. And these modules
11 here. And they connect to a collection box, a plenum
12 box here. And underneath that is our sump pit.

13 CHAIRMAN BANERJEE: These are just disc
14 strainers?

15 MR. SCHULZ: They're discs, yes.

16 CHAIRMAN BANERJEE: What are the hole
17 sizes?

18 MR. SCHULZ: Point oh-nine-five inch.

19 CHAIRMAN BANERJEE: Point oh-nine inches?
20 Is that sort of standard?

21 MR. SCHULZ: Those are standard.
22 Florence Contracting, Incorporated made these
23 strainers for us and several other folks in the
24 industry. They're installed in several plants.

25 CHAIRMAN BANERJEE: And the spacing

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1 between them is?

2 MR. SCHULZ: The spacing between discs is
3 about an inch. You can sort of see it there.

4 And here, after the strainers were
5 installed, a couple years later we installed this
6 protective grating around it. That's just to protect
7 them during outages so no one runs into them and to
8 preclude damage to the strainers during a maintenance
9 state.

10 Here's a picture of inside containment. I
11 think that's me. That's my head that. You can tell by
12 my green eyes.

13 (Laughter)

14 MR. SCHULZ: We're called a high fiber
15 plant because we have NUKON insulation inside
16 containment with all the lines. These are NUKON
17 blankets here that has the fiberglass inside. All the
18 lines are insulated inside containment with the NUKON.

19 There's the next slide here. This shows
20 another picture here. More NUKON insulation. That
21 here with a metal jacket on it, that's the reactor
22 coolant line that. Underneath that metal jacket is
23 just a NUKON blanket like we have here. When we do our
24 debris generation, we don't take any credit for that
25 jacket. So it doesn't matter whether it's jacketed or

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1 un-jacketed. It's still just the same assumption
2 there.

3 MEMBER SHACK: Where is your Calsil type
4 insulation used?

5 MR. SCHULZ: Calcium silicate was used
6 inside here on the reactor vessel nozzles. It was
7 there. In 2008 it was there. So during the test we
8 used that in our strainer head loss testing, but
9 subsequently we removed that insulation about two years
10 after that. So we had no Marinite. Marinite's a trade
11 name.

12 MEMBER SHACK: Yes. Right.

13 MR. SCHULZ: It's calcium silicate. We
14 removed that so there's no calcium silicate insulation
15 inside containment now. So our degree of insulation is
16 the fiberglass insulation on the piping and then on the
17 equipment. So the steam generators and the reactor
18 coolant pumps also have this low-density fiberglass
19 insulation.

20 CHAIRMAN BANERJEE: If I remember the
21 original argument where all this started, was that you
22 to remove this and replace the insulation would give a
23 fairly radiation dose to the workers, right? That was
24 that --

25 MR. SCHULZ: That was the rationale for --

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1 CHAIRMAN BANERJEE: -- rationale for going
2 to the Commission and trying to get them to do this,
3 right?

4 MR. SCHULZ: Right. That is correct. I
5 mean, you see here lots of lines all over the place. It
6 would be a big dose impact to do that.

7 CHAIRMAN BANERJEE: I also remember they
8 were deferring estimates or that at that time from
9 different sources.

10 MR. MURRAY: I think it was 50 rem or
11 greater per unit. It was --

12 MR. HARRISON: I was reviewing what we put
13 in our application last night, and we had our estimating
14 people actually look at that and they estimated
15 somewhere between 156 -- realistic estimate they
16 thought was about 156 to 170 rem. That's for both
17 units, so it would be half of that for each unit.

18 CHAIRMAN BANERJEE: Yes, I seem to
19 remember numbers of that order. Okay. Go ahead.

20 MR. SCHULZ: So that was the rationale for
21 going forward with this approach, what we're doing here.

22 So that's the background. STP has three
23 safety trains, a high-fiber plant, insulation fiber
24 from pipe insulation and equipment insulation.

25 CHAIRMAN BANERJEE: Just a question for my

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1 own sort of clarification here. When that estimate was
2 made, that was to remove all the high fiber regions, I
3 mean, all the NUKON, or --

4 MR. SCHULZ: Yes.

5 CHAIRMAN BANERJEE: -- only the ones that
6 were the most impacted by the breaks?

7 MR. SCHULZ: That was for all of the --

8 CHAIRMAN BANERJEE: So it wasn't sort of
9 greater than what was the highest --

10 MR. SCHULZ: Once you started grading it,
11 we concluded it that, oh, there's some more, there's
12 some more, there's some more. So it was all --

13 CHAIRMAN BANERJEE: Are there regions
14 where it can be removed relatively readily and impact
15 things positively in terms of fiber generation without
16 getting a huge dose?

17 MR. SCHULZ: Well, let me show the next
18 slide. Thank you for that segue.

19 (Laughter)

20 MR. SCHULZ: Here is 17D ZOI. Seventeen D
21 means the radius of that zone of influence is 17 times
22 D. In this case it's a 31-inch double-end guillotine
23 break at the steam generator nozzle here. So 31 inches,
24 22 feet times 17 is 34 -- maybe a 40-foot radius sphere.
25 So all that in there would have to be replaced.

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1 CHAIRMAN BANERJEE: But most -- not all,
2 but most of the debris would be generated off the steam
3 generator, right?

4 MR. SCHULZ: There's a lot --

5 CHAIRMAN BANERJEE: A lot of it?

6 MR. SCHULZ: -- of it in the steam
7 generator, yes. And even that, that would be a big dose
8 hit, too.

9 CHAIRMAN BANERJEE: That's the question
10 I'm asking.

11 MR. SCHULZ: Yes.

12 CHAIRMAN BANERJEE: Is that going to be a
13 very big dose?

14 MEMBER SHACK: Supposed you screen with
15 your RoverD so you only removed the insulation that was
16 affected by the things that didn't pass your
17 deterministic screen.

18 MR. MURRAY: This question, I think when we
19 -- and I'm not trying to put that question off, but I
20 think as we go through it you'll start to see what the
21 results would show us and what the results show us of
22 what welds are left over that don't screen out. I think
23 that -- let's revisit that question at the end. I think
24 we'll have a better appreciation for it.

25 CHAIRMAN BANERJEE: Let's note that and

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1 we'll take it up after.

2 MR. MURRAY: Yes, as we work through it I
3 think you'll have a better appreciation for the answer
4 having seen how we get to that answer.

5 MR. SCHULZ: So that gives a perspective of
6 what a 17D ZOI looks like in containment. We have a
7 four-loop plant, so we have four steam generators.

8 So that's a couple -- overview here. The
9 role of flume testing. We wanted to look at our
10 strainer performance. So the test shows that most of
11 our failure concerns are resolved deterministically.
12 In July 2008 we did these tests based on our response.
13 We were responding to the generic letter. The fiber
14 loading was based on two trains in operation. That was
15 our design basis. Two trains operating out of three.
16 So we split the debris among two safety trains going to
17 two different sumps.

18 We used high fiber loading. We used
19 particulate loading. And we used chemical loading,
20 too. We used chemicals that were generated in
21 accordance with the approved WCAP methodology for --

22 MEMBER SHACK: So your particulate loading
23 would be very conservative now because you've gotten rid
24 of the Calsil?

25 MR. SCHULZ: That's part of it, yes. But

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1 we still have other coatings in there, too. We'll see
2 that coming up, too, yes. But the Calsil was in there,
3 yes. But that was -- we'll see --

4 (Simultaneous speaking)

5 MEMBER SHACK: Well, I guess that's
6 chemicals, too, yes.

7 MR. SCHULZ: We had chemicals, too.

8 The test was successful. We met our
9 objectives. The strainer performed adequately. It
10 was acceptable. So the deterministic land, that was a
11 successful test and we -- with that debris loading. And
12 now we're going to use that debris loading as our screen
13 for going forward in the RoverD approach, and which
14 would eliminate the need for a head loss correlation.
15 So we're not using a head loss correlation in our
16 approach anymore.

17 The purpose of the test was to show again
18 we had adequate strainer performance. We used the
19 guidance of the NEI document to go through our
20 methodology. And we'll discuss that in a little bit.
21 Instead of test for success objective, now we look at
22 a spectrum of LOCA events. That's with our RoverD we
23 will look at breaks, different places, different size
24 breaks rather than just one design basis break. And
25 then we'll talk about our July test that we did.

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1 We did calculations to address each element
2 of the content guidance. The analysis was several
3 -- the analysis was done back in the 2007-2008 time
4 frame. We came up with acceptance criteria for the
5 different strainer performance elements and we used a
6 flume test of a full-scale module using representative
7 STP debris. We'll talk about that in a little bit.

8 CHAIRMAN BANERJEE: So these flume tests
9 had enough turbulence that you didn't get settling of
10 fine debris?

11 MR. SCHULZ: We'll talk about that. Yes,
12 we'll show you that, but yes.

13 CHAIRMAN BANERJEE: But yes or no? Did it
14 allow or not?

15 MR. SCHULZ: It was mild, to be
16 representative of our sump conditions. So we took
17 the --

18 CHAIRMAN BANERJEE: What does that mean?

19 MR. SCHULZ: We took -- I'll show you. We
20 did velocity profiles near the sump and we replicated
21 that in our testing to show the velocity --

22 (Simultaneous speaking)

23 CHAIRMAN BANERJEE: But the sumps that
24 you've got, how do you estimate the Reynolds numbers of
25 the flows? It would be very high coming in, right?

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1 That's one of the reasons why it's very difficult to do
2 that, that we've always been skeptical about settling.

3 MR. SCHULZ: Well, we did CFD analysis to
4 figure out what the velocity profile was adjacent to the
5 sump and we -- I'll show that in a minute.

6 CHAIRMAN BANERJEE: Yes, you can show us
7 that.

8 MR. SCHULZ: Yes.

9 CHAIRMAN BANERJEE: We'll see what the
10 basis of settling is.

11 MR. SCHULZ: Yes, we'll talk about that.
12 You've asked that twice already, so I know --

13 (Simultaneous speaking)

14 CHAIRMAN BANERJEE: Is it important?

15 MR. SCHULZ: Settling, we want it to be
16 representative in what we're doing.

17 CHAIRMAN BANERJEE: Okay.

18 CHAIRMAN STETKAR: Wes, could you back
19 -- and I'll have to defer to the good Dr. Banerjee, but
20 the loading in the test that you did in 2008 was based,
21 you said, on the assumption that two trains --

22 MR. SCHULZ: Yes.

23 CHAIRMAN STETKAR: -- of equipment were
24 running, which is your design basis?

25 MR. SCHULZ: Yes.

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1 CHAIRMAN STETKAR: The risk assessment
2 assumes that you can succeed with only one train
3 running.

4 MR. SCHULZ: That is part of our risk
5 assessment. Ernie will speak more to that point. It's
6 just a single train operation.

7 CHAIRMAN STETKAR: My question is if you
8 had only a single train running, how would have that flow
9 distribution affected the fiber loading for that
10 testing? Would you have had more loading on the
11 strainer with only one train running?

12 MR. KEE: We assume that in our analysis.
13 When we assume a single train, we assume that it loads
14 with the same quantity as two trains running. We
15 tested. So that means you can only tolerate half the
16 amount. In truth it would be a lot lower. There would
17 be a lot more settling.

18 CHAIRMAN STETKAR: Okay.

19 MR. KEE: So it's conservative in that
20 regard. And on top of it we come through to
21 recirculation with success, with a single train, but in
22 truth it's a 60/40 split because that single train may
23 be going out of break location. So actually we
24 overestimate the success of that state in our analysis,
25 because we assign all the frequency that we come through

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1 with that configuration to success.

2 CHAIRMAN STETKAR: Yes. Okay. I'll have
3 to think about that. I just want to make sure that
4 -- because we're now relying on those tests a lot. I
5 understand the change in the -- the risk information is
6 also changing in terms of what you're assuming, but I
7 just want to make sure that I understand the direction
8 we're going in.

9 MR. SCHULZ: Ernie, that's part of your
10 presentation later on, right? Okay.

11 MR. KEE: I think you'll find that we've
12 dealt with that, yes.

13 CHAIRMAN STETKAR: I'll wait. Thanks.

14 MR. SCHULZ: So all this work was going on
15 in 2007-2008 and we did our submittal in December of 2008
16 using the content guide from the staff. And these are
17 the sections in that content guide that the industry
18 used. And I'll briefly talk about each of these things.
19 These are all our deterministic analysis that we did in
20 2008. And I'll talk about what we did for that that we
21 --

22 (Simultaneous speaking)

23 CHAIRMAN BANERJEE: So these tests were
24 done where, in New Jersey or Pennsylvania?

25 MR. SCHULZ: In Massachusetts at Alden

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1 Research Lab.

2 CHAIRMAN BANERJEE: Go ahead.

3 MR. SCHULZ: Okay. So I'll talk about
4 each of these in our deterministic approach here that
5 we've done. Break selection is the first one. For
6 2008 analysis we had to pick a break that would generate
7 debris for our test. And so these are the criteria from
8 the NEI guidance as to how you select breaks. And we
9 came up with breaks. And actually we did our test. We
10 used like a couple of different breaks to give us a
11 bounding amount of debris in when we did our test.

12 This is the basis of the test, but going
13 forward we'll use the actual amount. And we'll talk
14 about that again. The actual amount that was used is
15 our yardstick, is our ruler going forward for our
16 screening.

17 And then debris generation. Most of the
18 debris is from low-density fiberglass, which in 2008 we
19 used 7D ZOI, and which resulted in 192 pounds of fine
20 low-density fiberglass fibers. That's our metric.
21 That's our screen. That was what was used in that test
22 in July that had successful strainer performance. And
23 that's the parameter we're going to us going forward in
24 our --

25 (Simultaneous speaking)

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1 CHAIRMAN BANERJEE: Which is the
2 parameter? The 192?

3 MR. SCHULZ: Hundred and ninety-two is our
4 -- that's our bar. So if we're under the bar, we'd call
5 that acceptable. If we're over the bar, then we'd go
6 to the risk-informed approach.

7 CHAIRMAN BANERJEE: Above 192 pounds you
8 found too high a head loss. Is that it?

9 MR. SCHULZ: We didn't test for that.

10 CHAIRMAN STETKAR: They're assuming.

11 CHAIRMAN BANERJEE: Okay.

12 MR. SCHULZ: We assume of -- it's in
13 failure. Ernie will get into that, but, yes, we didn't
14 test to see what the upper bound was. But that was
15 successful strainer performance with that number there,
16 which was --

17 CHAIRMAN BANERJEE: Did you also measure
18 the pass-through the strainers?

19 MR. SCHULZ: Penetration? We did that in
20 an earlier test, too.

21 CHAIRMAN BANERJEE: So you got how much
22 fiber pass-through?

23 MR. SCHULZ: We'll talk about that later
24 on.

25 MR. KEE: We'll show you --

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1 MR. SCHULZ: And there's another aspect of
2 our --

3 MR. KEE: -- the data that we collected for
4 that test.

5 CHAIRMAN BANERJEE: Okay.

6 MR. SCHULZ: Yes, that will be Ernie's
7 presentation.

8 CHAIRMAN STETKAR: Just to keep me
9 oriented -- I try to look forward, and stop me if you're
10 going to -- and I know you will. But you're basically
11 heading in a direction where you're going to try to show
12 that with now a 17D zone of influence, as long as you
13 generate less than 192 pounds, you win, in simple terms.
14 Is that right?

15 MR. MURRAY: That's it.

16 CHAIRMAN STETKAR: Okay.

17 MR. MURRAY: That's that box, that
18 decision box.

19 CHAIRMAN STETKAR: Right.

20 MR. MURRAY: That's the number that's in
21 the decision box.

22 CHAIRMAN STETKAR: Okay. Thanks.

23 MR. SCHULZ: And what I'm going through now
24 is all those winning conditions and show you how we
25 analyze it. And it generally was per the NEI

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1 methodology that this -- per what the staff has
2 accepted. So that's what we're taking credit for here.

3 Debris characteristics. That was in our
4 submittal. We talked about that per the NRC approved
5 guidance.

6 Latent debris. This is what we talked
7 about before. We did walkdowns to determine we had 165
8 pounds. Two hundred pounds we used in our test. When
9 we approach 15 percent, 30 pounds was fiberglass fines,
10 which ended up in our flume for debris loading.

11 Debris transport. Again we used the
12 standard methodologies. We use a transport fraction of
13 95 percent of fines generated, got transported to the
14 sump. And we also used one percent of large and small
15 fiberglass pieces. One percent of that was considered
16 as fines from erosion of those pieces that are in the
17 flow stream. So that was the contribution to the 192
18 pounds we used.

19 Our strainer vendor did head loss and
20 vortexing calcs. We don't have a vortexing issue with
21 the PCI strainers. Air ingestion is our criteria. And
22 void fraction was less than two percent. These are all
23 the standard methodologies that we used for our
24 submittal back then.

25 Net positive suction head. We did

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1 calculations and PCI did calculations. We used max
2 flow rates and standard assumptions to figure out our
3 NPSH available excluding the strainer and debris and
4 NPSH required for our three different pumps to determine
5 clean strainer head loss. Our debris head loss is based
6 on the actual strainer test and we combine those. We
7 come up with an NPSH margin, which is the difference
8 between available and required, and we show that's
9 greater than our total strainer head loss that we got
10 out of our tests. And as an example there, the start
11 of recirculation when we used a temperature of 267
12 degrees, the containment spray pump had the lowest NPSH
13 margin. It was 5.6 feet. And then compared that to
14 other pumps, but that is still greater than our
15 calculated total strainer head loss of 3.8 feet, which
16 is based on our tests. And that's at that particular
17 temperature at the start of recirc.

18 CHAIRMAN BANERJEE: That was with chemical
19 effects?

20 MR. SCHULZ: Yes, this debris head loss
21 here includes the chemicals, yes.

22 CHAIRMAN BANERJEE: This is just the
23 surrogate chemicals that we approved a long time ago?

24 MR. SCHULZ: Yes. Per the WCAP
25 methodology, yes. Yes, that's what we used. But we'll

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1 talk about that later.

2 CHAIRMAN BANERJEE: Okay. Was there
3 chemical effects at -- that's John's question.

4 MR. SCHULZ: Pardon?

5 CHAIRMAN STETKAR: At that high
6 temperature you aren't getting chemical effects, are
7 you? Again, that's a big conservatism in our analysis,
8 because this NPSH assumes all the debris is there when
9 we start the recirc. So we've taken the highest levels.
10 The coatings have all failed. All the things -- the
11 transport is right there at the sump as soon as we start
12 the pump. So that's a conservatism. We're not looking
13 at time history of NPSH here, so --

14 (Simultaneous speaking)

15 CHAIRMAN BANERJEE: You're also doing a
16 viscosity extrapolation, right?

17 MR. SCHULZ: Correct.

18 CHAIRMAN BANERJEE: Yes.

19 MR. SCHULZ: But that is a conservatism
20 here. For the deterministic we take -- break the
21 -- generates this debris and we -- all the other debris
22 loading, it's there. And what -- calculate what our
23 NPSH is. So, that's what --

24 (Simultaneous speaking)

25 CHAIRMAN BANERJEE: But everybody does

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1 that.

2 MR. SCHULZ: Well, some people talk about
3 using time history and other stuff. And we were looking
4 at time history, too, as part of our earlier effort.

5 CHAIRMAN STETKAR: Originally you were.

6 MR. SCHULZ: A more realistic approach
7 though. But that got into correlations and it got gray.
8 So now we're trying to use a standard which shows, okay,
9 yes, we're here. Everything here is okay. Up here
10 we'll treat as risk-informed.

11 CHAIRMAN BANERJEE: No question that this
12 was a conservative approach which other plants have
13 taken as well.

14 MR. SCHULZ: Okay. Another topic from the
15 guidance report was coatings evaluation. This is how
16 we determined the coatings that we used in our July test.
17 We used a ZOI of 5D based on some testing that
18 Westinghouse did for us in some other plants. That was
19 the basis for our coatings. Ended up as particulates
20 and we had some epoxy chips there. We used tin powder
21 for surrogate. We also used acrylic as a powder and
22 chips as our surrogate.

23 CHAIRMAN BANERJEE: Maybe the staff can
24 comment on this; or will I hope, on the use of
25 surrogates. There's been quite bit a discussion on

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1 what might be the appropriate surrogates. And one of
2 our colleagues, Professor Wallis, has been concerned
3 about this. Do the surrogates that were used for the
4 particulates here meet what we've been doing with the
5 other plants as we've been looking at it, or have we used
6 different surrogates --

7 (Simultaneous speaking)

8 MR. SMITH: This is Steve Smith. And I
9 think in this case the surrogates were actually pretty
10 close to -- they actually used acrylic material and they
11 ground that up or made it into chips. A lot of plants
12 had been using silicone carbide or walnut shell flour.
13 This is a more realistic surrogate for what's actually
14 in the plant.

15 CHAIRMAN BANERJEE: Thanks.

16 MEMBER SHACK: Still wouldn't address
17 Professor Wallis' concern about size distribution,
18 but --

19 MR. SMITH: No. Yes, his concern -- and
20 we'll talk to you later at another time about this, but
21 they're doing some testing, some fuel testing that's
22 using varying size distributions and finding some
23 interesting things with that.

24 MEMBER BLEY: They is who?

25 MR. SMITH: The PWR Owners Group.

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1 MEMBER BLEY: Oh, okay.

2 CHAIRMAN BANERJEE: I guess they're going
3 to come in front of us -- when is that, Steve? Is that
4 scheduled for August or October?

5 MR. SMITH: I don't know if it's been
6 finalized. We've been going back and forth with you
7 guys on what a good date would be. I think it's going
8 to be in the fall.

9 MR. SCHULZ: Okay. Another element of our
10 -- in the content guide was talk about debris source
11 term. We talk about containment earlier. We're doing
12 inspections to make sure that we have no loose debris
13 and we do it before we declare the containment ready to
14 go when we -- at -- in the outage and also during at-power
15 work. We verify that there's no loose debris also.
16 That's part of what we do.

17 Design change process looks at any new
18 proposed insulation to make sure it's consistent with
19 what we've done in our analysis of record. We also
20 would look at any new coatings that will be proposed,
21 any additional metal, any additional aluminum that's
22 proposed to be put in containment. We'll look at that.
23 Keep track of that. Look at the impact of what we've
24 done.

25 CHAIRMAN BANERJEE: Are you trying to

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1 minimize aluminum or -- in containment?

2 MR. SCHULZ: We have a lot of aluminum in
3 containment. We store our scaffold racks. And that's
4 a lot of aluminum there. We store them inside
5 containment. So we have our aluminum consortium is
6 high compared to maybe some other plants. That was the
7 basis for our --

8 CHAIRMAN BANERJEE: Your chemical tests?

9 MR. SCHULZ: -- chemical tests. Yes.

10 MR. MURRAY: And we have a program that
11 monitors --

12 (Simultaneous speaking)

13 MR. SCHULZ: Yes. Oh, yes. Oh, yes, we
14 keep track of that. We monitor how much aluminum we
15 have so we know how much is in there. That way we keep
16 track of how many scaffold racks are in there, too.

17 So that's our design change process. So we
18 evaluate any impacts that would come along to see how
19 that affects our -- what went into our deterministic
20 calculations for debris reloading.

21 These are two more elements out of the
22 content guide. This screen modification package. We
23 remove the initial -- that box that was around the
24 -- original box. That was removed and replaced with
25 strainers. You saw the photos there earlier. Each

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1 sump now has two 5-module assemblies, a 4-module
2 assembly and a 6-module assembly. So there's 20
3 modules per sump. And new strainers, they have almost
4 a factor of 12 difference between the square foot
5 between the old design and new design.

6 CHAIRMAN BANERJEE: That's the free area,
7 right? What is the projected area on the sides?

8 MR. SCHULZ: Projected area --

9 CHAIRMAN BANERJEE: So that -- just
10 imagine that you've got a lot of fiber and eventually
11 the area for the discs is not going to be available.

12 MR. SCHULZ: That would be filled up, yes.

13 CHAIRMAN BANERJEE: Yes, it would be
14 filled up. So what is the side area?

15 MR. SCHULZ: I don't know top of my head.
16 We didn't --

17 CHAIRMAN BANERJEE: You don't fill it up
18 because you don't --

19 (Simultaneous speaking)

20 MR. SCHULZ: Yes, we didn't -- that wasn't
21 part of our test. We didn't notice that. We can talk
22 about that when we get the test, too, but we didn't get
23 there. And we didn't get there with our tests, so
24 everything here is okay.

25 CHAIRMAN BANERJEE: But you never jammed

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1 it completely between the discs with fiber?

2 MR. SCHULZ: Correct.

3 CHAIRMAN STETKAR: Wes -- oh, I'm sorry.

4 CHAIRMAN BANERJEE: No, go ahead. Go
5 ahead. No, I just wanted to be clear what the
6 tests --

7 CHAIRMAN STETKAR: Well, just to make
8 sure. Perhaps I missed something. Back on your -- and
9 I'm not going to challenge the application here, but
10 back when you were showing us pictures of the installed
11 strainers you said that you put up a barrier to protect
12 them during outages. Do you remove that barrier?

13 MR. SCHULZ: That's a permanent barrier.

14 CHAIRMAN BANERJEE: That's permanent?

15 MEMBER BLEY: Oh, it's permanent?

16 MR. SCHULZ: Yes.

17 MEMBER BLEY: I misunderstood.

18 MR. SCHULZ: I'm sorry. Yes.

19 CHAIRMAN STETKAR: Thanks.

20 MR. SCHULZ: Yes, so just some grating that
21 we put on --

22 (Simultaneous speaking)

23 CHAIRMAN STETKAR: Yes. No, I --

24 MR. SCHULZ: -- the plenum to protect it.

25 CHAIRMAN STETKAR: And I know it's back

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1 away from -- I don't know what -- the distance it's away
2 from the strainers and --

3 (Simultaneous speaking)

4 MR. SCHULZ: There's like 18 --

5 (Simultaneous speaking)

6 MR. SCHULZ: It varies.

7 CHAIRMAN STETKAR: Okay.

8 MR. SCHULZ: So that's physical protection
9 of the strainers.

10 CHAIRMAN STETKAR: Yes. Okay. Thank
11 you.

12 MR. SCHULZ: Permanent.

13 CHAIRMAN BANERJEE: Permanent.

14 CHAIRMAN BANERJEE: Remind me about the
15 buffer. Which buffer are you using?

16 MR. SCHULZ: Trisodium phosphate we use.
17 Trisodium phosphate.

18 So the only modifications we did to the
19 plant for -- in response to the generic letter were
20 insulation, new strainers and we removed -- and
21 subsequently we removed the Marinite insulation and the
22 calcium silicate insulation on the reactor vessel
23 nozzles. So those were the only physical mods that we
24 did inside containment.

25 Did calculations for the -- show the

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1 structural adequacy of our strainer using -- show it was
2 adequate using the code allowables. So again, there
3 was margin there against the -- using code allowables.

4 Upstream effects. This is all the
5 standard acceptable methods to look at upstream
6 effects. Doing choke points. Look at the flow
7 -- debris generated inside the steam generator
8 compartments. And then we didn't have any choke points
9 there. And flow can get out and also flow, once it gets
10 out, they can around the secondary shield as well to the
11 sumps. There's pathways there for water. That wasn't
12 an issue at STP. And again, that's something we look
13 at. When we have any proposed modifications, we'll
14 look to make sure we don't impact that.

15 Downstream effects. We used the guidance
16 and methodology in the Westinghouse WCAP to look at
17 where -- due to debris and blockage, and we didn't have
18 any issues with blockage or weren't aware again based
19 on the standard methodology.

20 Let's talk about our tests. The test was
21 done in July at Alden Research Lab in Holden,
22 Massachusetts. We used one full-scale module. Took a
23 module from the warehouse and shipped it up to
24 Massachusetts. And that's what we used in the test at
25 maximum flow rate. And again, we scaled this for two

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1 trains out of three for our debris loading. And again,
2 we designed the flume channel to emulate the approach
3 velocity and turbulence. And let me show you some
4 pictures here.

5 Oh, this here's a diagram. You can't read
6 this, but this right here is -- this shows you the flume.
7 It was a narrow flume. And I'll show the photo here.
8 You can see there's a photo with a narrow flume. That's
9 a flume right there with a strainer module in that, but
10 it -- we determined that the width of that flume based
11 on the expected velocity gradients at those points from
12 the strainer based on a CFD analysis that we did.

13 CHAIRMAN BANERJEE: You're going to talk
14 about the CFD analysis?

15 MR. SCHULZ: Not right now, no.

16 CHAIRMAN BANERJEE: But sometime today?

17 MR. SCHULZ: No. No, we're not. Just
18 that that was done. That's all the details I would
19 know. And we did it to come out with this velocity
20 profile. So it would be representative of what's at the
21 sump strainers.

22 MR. MURRAY: I think Bruce can add
23 something.

24 CHAIRMAN BANERJEE: But you ran some
25 computer code to get the velocity --

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1 MR. SCHULZ: Yes.

2 CHAIRMAN BANERJEE: -- fields in the
3 containment?

4 MR. SCHULZ: Yes. Bruce's outfit did
5 the --

6 (Simultaneous speaking)

7 MR. LETELIER: If I could interject?

8 MR. SCHULZ: Yes.

9 MR. LETELIER: This is Bruce Letelier with
10 Alion Science. We ran the flow 3D model of the
11 containment pool velocities. It's very typical to what
12 many of the licensees had done to examine pool transport
13 considerations.

14 And in regard to one of your earlier
15 questions about the Reynolds number on the approach to
16 the strainer, Wes had not yet emphasized the reduction
17 in the approach velocity that was achieved from the
18 larger strainers. A factor of 12 reduces their
19 entrance velocity to 0.009 feet per second. So we're
20 talking about very low velocities at the face of the
21 strainer. And in fact, some of the higher velocities
22 exist at restrictions in the concrete flow paths, if you
23 will, because when three strainers are drawing the
24 combined flow, there's actually some higher velocities
25 on the containment floor than you actually achieve at

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1 the face of the strainer.

2 CHAIRMAN BANERJEE: That's clear, because
3 of course you got a lot of area at the face of the
4 strainer.

5 What are the velocities that are outside
6 the strainers? That's the suspension velocities. Are
7 we talking about high Reynolds numbers around the
8 strainers? And what's the length scale you're using
9 for the Reynolds number?

10 MR. LETELIER: I don't know those
11 velocities off the top of my head, but that information
12 was used to design the cross-section of the flume that
13 you see on the figure.

14 CHAIRMAN BANERJEE: All right. I mean, if
15 you're going to take credit for that, you need to know
16 what that is. Are you taking any credit for settling
17 on this flume?

18 MR. SCHULZ: The test was made to be
19 representative. And let me show you the picture here.
20 This is where a strainer is in one of the flume. And
21 the next one has a --

22 (Simultaneous speaking)

23 CHAIRMAN BANERJEE: The velocity of the
24 face of the strainer is not relevant from a settling
25 point of view approaching the strainer. We need to know

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1 what the velocities were outside and what was the
2 Reynolds number outside.

3 MR. SCHULZ: Okay. I don't have those
4 particular numbers.

5 CHAIRMAN BANERJEE: Yes, and because if
6 you're going to take some credit for settling -- I don't
7 know if you did. I mean, Steve, did these guys take
8 credit for settling of the fines or --

9 MR. SMITH: This is Steve Smith. The test
10 did have settling that occurred. Settling did occur
11 during the test. The velocity in flume was
12 approximately a half a foot per second.

13 CHAIRMAN BANERJEE: Okay. And that's
14 about the velocities that the CFD shows?

15 MR. SMITH: That is above the velocities.
16 The velocities don't tend to be an issue in these type
17 of tests. They had to conservatively model the
18 velocity because there's -- in the plant you don't just
19 have a single channel going to the strainer. You have
20 flow coming from every direction. So it was a very
21 conservative -- the velocity ended up being very
22 conservative because they had to take the highest
23 velocity and model that at each point back from the
24 strainer. The problems come in with being able to get
25 the correct amount of turbulence when you reduce the

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1 scale.

2 CHAIRMAN BANERJEE: Yes.

3 MR. SMITH: This test was a -- believe it
4 or not; it doesn't look like it because it's a very long
5 flume, this test was a relatively wide test. And we
6 didn't have an issue with the turbulence that was
7 generated during the test. Some licensees tried to run
8 a similar test with narrower flumes and lower
9 velocities. And we had a significant issue with them
10 not generating adequate turbulence to be similar to the
11 plant.

12 CHAIRMAN BANERJEE: So even with half a
13 foot per second because of the length scale there you
14 probably got quite high Reynolds numbers?

15 MR. SMITH: Yes.

16 CHAIRMAN BANERJEE: So enough turbulence.
17 Okay. Thanks.

18 MR. SCHULZ: Here's a picture looking the
19 other way. There was about 40 feet between where we
20 introduced the debris to where the sump strainer module
21 was.

22 And here's the folks there at Alden putting
23 debris -- introducing debris in the flume there.

24 And this is what we used for our test based
25 on our 2008 analysis. Fiberglass fines is 192 pounds

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1 from latent mostly from the insulation from the break.
2 And then we had some smalls. Particulate debris, we
3 used Microtherm. That was another insulating material
4 we had. We used Marinite. That's Calsil which has
5 been subsequently removed. We had 180 pounds of that.
6 And that's our latent dust and dirt. These are our
7 chemical precipitates that we used during the test.
8 Very conservatively based on 30 days of containment
9 spray to get -- maximize the amount of precipitates.
10 That's the total amount we used -- aluminum oxide
11 hydroxide and calcium phosphate we used in the test.
12 And that's how much our coatings we used. We used zinc
13 powder and acrylic powder and acrylic chips. Those
14 were our surrogates that we used during the test. So
15 this is the test parameters that we used in July. So
16 we're using this as our metric going forward for fiber
17 fines.

18 Debris prep. Used water jet separation.
19 Particulates. We've got Marinite we used in the test.
20 It's no longer a source of debris in the containment.
21 And we talk about latent debris and use the coating
22 particulates also.

23 CHAIRMAN BANERJEE: The staff is going to
24 comment on these tests, right, when you talk? Okay.

25 MR. SCHULZ: Here is our chemical

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1 products. This column here the left is what we used in
2 the test. In the Westinghouse calculation they did it
3 two ways, for a maximum volume and a minimum volume to
4 come up with how much of the three different chemical
5 precipitates. And our test took the maximum value from
6 this calculation. That's what we used. So we bound
7 either case here. So it was very conservative in that
8 sense. And again, as a conservative we used a 30-day
9 for containment spray going, which is very conservative
10 because now we can turn them off in a very short time
11 after the accident. So we get a lot of chemical
12 precipitates using that assumption.

13 This is our test. We added the particulate
14 and the fiber debris and then we added the chemical
15 debris. This was over the course of three days and
16 again we -- debris head loss during the test. It
17 stabilized around just over nine feet and full flow.
18 And that was a test temperature of 116 degrees. We
19 heated up the water. So we tried to get close to 120
20 degrees. And then it cooled off because as we were
21 adding debris, there was cold water in those buckets you
22 saw the gentlemen using. But that was our test
23 temperature. And we noticed that approximately half of
24 that head loss was due to the chemical precipitates. So
25 half the test is from the fiber and particulates and the

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1 other half is from the chemical precipitates.

2 CHAIRMAN BANERJEE: Did you also see some
3 saturation of the chemical effect after some additions?
4 Did you add all the chemicals together
5 or --

6 MR. SCHULZ: No, they were batches,
7 discrete batches.

8 CHAIRMAN BANERJEE: They were batches?
9 So was there a saturation effect of head loss or --

10 (Simultaneous speaking)

11 MR. SCHULZ: Well, we'd add some debris.
12 Head loss would go up. Then we'd wait. Then it would
13 be stable. Then we'd add another batch.

14 CHAIRMAN BANERJEE: Right. But I'm
15 saying at some point did it make any difference whether
16 you added more chemicals?

17 MR. SCHULZ: Oh, correct. Sometimes we
18 did not get a instant head loss increase.

19 CHAIRMAN BANERJEE: Yes, so all the
20 details are in the report?

21 MR. SCHULZ: Yes. The report, yes. And I
22 think the staff has seen that. I think they asked about
23 that, yes.

24 MR. MURRAY: Steve, did you want to add
25 something to that right now at the same time that --

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1 MR. SMITH: This is Steve Smith. I think
2 you did get it. The initial chemical additions did make
3 the biggest difference. And the aluminum made a bigger
4 difference than the calcium.

5 CHAIRMAN BANERJEE: Okay. Thanks.

6 MR. SCHULZ: So observations from our
7 tests. All the performance goals were met based on
8 -- that we set up. Representative settling allowed
9 fine fiber to arrive at the strainer. So we tried to
10 set up what was prototypical at STP in the flume, so we'd
11 add debris and try to achieve velocity profiles that
12 would be prototypical.

13 We did have a large quantity of particulate
14 in combination with chemical load. When we looked at
15 the test, there was a small amount of fiber and
16 particulate bed underneath the larger layer of chemical
17 debris. And the conclusion was that we -- it was much
18 less than an eighth of an inch, so we did not do a
19 separate thin-bed test, a test for thin bed. So we
20 thought we achieved that in the way we conducted the test
21 using standard procedures that were acceptable to --

22 (Simultaneous speaking)

23 MEMBER BALLINGER: What was the difference
24 between with and without the calcium? Do you know that?
25 Because if you removed the calcium-based insulation,

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1 then that contributed to the head loss in this test.

2 MR. SCHULZ: Right.

3 MEMBER BALLINGER: But what's the
4 difference between 9.1 feet with it and without it?

5 MR. SCHULZ: Oh, that was not tested. We
6 did not test that. We just did the one test -- we did
7 one test with the calcium silicate.

8 MEMBER SHACK: That's a fair amount of it.

9 MR. SCHULZ: Yes, but the aluminum is
10 probably enough to do the --

11 (Simultaneous speaking)

12 CHAIRMAN STETKAR: Because what they said
13 is the aluminum had the biggest numbers.

14 MR. SCHULZ: Yes, it was our -- well,
15 that's our Marinite calcium silicate, 183 pounds. And
16 then we added 2,000 pound of -- 1,900 pound of coatings
17 and that's our --

18 MR. LETELIER: Excuse me, Wes. Could I
19 interject?

20 MR. SCHULZ: Sure, Bruce.

21 MR. LETELIER: This is Bruce Letelier. I
22 don't want there to be any confusion about the addition
23 of calcium phosphate as a chemical product versus the
24 calcium silicate which is the insulation.

25 MR. SCHULZ: Okay. I'm sorry.

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1 MR. LETELIER: All right.

2 MR. SCHULZ: Maybe I was confusing your
3 questions.

4 MEMBER SHACK: No, I understood that.

5 MR. MURRAY: Okay. Thanks, Bruce. So
6 again on the timeline when we did the test there was
7 still Marinite in the plant, correct?

8 MR. SCHULZ: Yes.

9 MR. MURRAY: And then after that we removed
10 that type of insulation from our plant?

11 MR. SCHULZ: Yes. I want to show you some
12 of the conservatisms in the chemical portion. We've
13 done some recent testing as part of this risk-informed
14 approach. It would show no evidence of chemical
15 precipitates based on a CHLE test that we've done. We
16 looked at the quantities of chemical surrogate.
17 They're unlikely to occur at STP.

18 CHAIRMAN BANERJEE: So if you reduce the
19 chemical surrogate in the tests because we added them
20 in batches, we could actually see the effect of reduced
21 chemical surrogates on the results, right?

22 MR. SCHULZ: That's true. I mean, we
23 haven't measured head loss as we -- as we added we knew
24 what the head loss was as we went along, yes.

25 CHAIRMAN BANERJEE: Yes, that would be an

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1 interesting thing to know. At what point there is a
2 significant decrease. I mean, is it just that you can
3 add very small amounts of chemical and get a large head
4 loss and then the subsequent tests are -- you know, the
5 additions don't have that --

6 (Simultaneous speaking)

7 MR. SCHULZ: There is that effect where the
8 initial batch is a big loss. Then subsequent batches
9 are much smaller impacts.

10 CHAIRMAN BANERJEE: So actually it's
11 amount of that initial addition which has the main
12 effect?

13 MR. SCHULZ: I think Steve wants to jump
14 in.

15 MR. SMITH: I was just going to say Paul
16 pointed out you do have a graph in your backup slides
17 of the test that shows when you put the chemicals in.

18 CHAIRMAN BANERJEE: Well, that would be
19 very nice to see, if you have that.

20 MR. SMITH: We didn't bring that? We
21 didn't bring the backups? Okay. I can --

22 CHAIRMAN BANERJEE: It's always
23 dangerous --

24 (Simultaneous speaking)

25 MR. SMITH: I have a copy here that I'll

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1 give you.

2 CHAIRMAN BANERJEE: Okay.

3 MEMBER SHACK: Are they part of the
4 presentation you gave to the staff in February?

5 MR. HARRISON: No.

6 MR. MURRAY: But, Steve, you did say you
7 had a copy?

8 MR. SMITH: Yes.

9 MR. SCHULZ: Yes, that will be -- we will
10 submit that, because that was one of the RAIs. We had
11 RAIs from -- as we made our December 2008 submittal, we
12 had RAIs in that and we discussed some of them with the
13 staff informally, but we never responded on the docket.
14 And then we embarked on this risk-informed approach.

15 CHAIRMAN BANERJEE: Yes, but the only
16 thing --

17 MR. SCHULZ: So we can go back and answer
18 some of those RAIs formally.

19 CHAIRMAN BANERJEE: -- our past experience
20 indicates that a little chemical can do a lot of damage
21 to the head loss.

22 MR. SCHULZ: So we do have that data from
23 our tests.

24 This is something Janet put together here
25 just to show our margin here. The column on the left

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1 is what we tested for total amount of chemicals using
2 the WCAP methodology. For the two different cases, the
3 min and max volumes that's what they calculate and view
4 as a more representative amounts rather -- we used
5 -- based the calcs on more aluminum that we actually had
6 in containments. Some other stuff, too. So actually
7 using representative amounts, it's this much. And then
8 we use -- it goes a risk-informed approached based on
9 our recent testing and we would expect less than this
10 here. So our chemicals that we used in our July 2008
11 tests are very conservative.

12 So this is a segue to Ernie, but we're going
13 to have Steve jump in here I guess into this. But this
14 is how we apply our test results. We assume all breaks
15 that can introduce more fiber fine than we actually had
16 in out tests. We relegate those to a bin, a bucket with
17 -- leads to core damage. So we look at all the different
18 scenarios at all the weld locations to see if the fiber
19 is more or less than this ruler. And then we look at
20 this. We use debris generation. Ernie will talk about
21 this, but this is -- and then we have our limits. And
22 then those that exceed the limit go to core damage.
23 Those scenarios there.

24 MR. MURRAY: Mr. Chairmen, we're at a point
25 where we're planning to transition, so it might be a good

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1 opportunity then to --

2 CHAIRMAN BANERJEE: That's what I was
3 looking at. So the agenda that's in front of us has a
4 discussion of strainer head loss tests through lunch and
5 -- I mean, not speaking during lunch, but until after
6 lunch. And then it ends up with Steve talking from the
7 staff right at the end of all this.

8 Now, where does this RoverD discussion fit
9 into the agenda as -- you've got the agenda in front of
10 you, right? Or no? Yes. Where are we on this agenda,
11 if I'm trying to maintain sort of time control?

12 MR. SCHULZ: I would say we're at a good
13 time for a break. When we come back from break, we can
14 as Steve to do his presentation.

15 CHAIRMAN BANERJEE: Then after we take a
16 break you would have Steve come on after that before you
17 go to Rover? Or do you want to go to Rover and then
18 finish that then?

19 MR. MURRAY: I would believe it would
20 facilitate best for all of us if Steve came on after
21 -- before we went in. Then we could understand the
22 deterministic basis for Rover as we go in and answer
23 those questions about the test data. I think it gets
24 us in a good grounding point to move forward.

25 CHAIRMAN BANERJEE: Perfect. So, Steve,

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1 will you be prepared to talk after the break then?

2 MR. SMITH: I'm prepared.

3 CHAIRMAN BANERJEE: All right. So we're
4 going to take a break then right now at this point. And
5 I think we'll take a break until 10:15, or do --

6 MEMBER SHACK: So generous.

7 CHAIRMAN BANERJEE: -- you want it longer?
8 What?

9 MEMBER SHACK: So generous.

10 CHAIRMAN BANERJEE: All right. So we'll
11 take a break until 10:15.

12 (Whereupon, the above-entitled matter went
13 off the record at 9:57 a.m. and resumed at 10:20 a.m.)

14 CHAIRMAN BANERJEE: All right. So let's
15 hand it over to you, Steve.

16 MR. SMITH: Okay. Thank you.

17 MR. WIDMAYER: Steve, sorry, before you
18 start, I had a request from somebody on the phone that
19 if you could please identify the slide that you're on;
20 And that goes for all the speakers, so they can follow
21 along.

22 MR. SMITH: Okay. We're going to start
23 out on slide 2.

24 MR. WIDMAYER: Thank you.

25 CHAIRMAN BANERJEE: And this is the --

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1 MR. SMITH: Yes, that's the correct one.

2 CHAIRMAN BANERJEE: -- STP deterministic
3 trainer testing.

4 MR. SMITH: And, I'm Steve Smith, and Paul
5 Klein is also up here to help make this presentation and
6 answer any questions you have. A lot of this
7 information was already presented by South Texas, so I'm
8 going to go pretty quickly through it. And you guys
9 just ask questions; I'm sure you will, wherever they
10 come up.

11 So just a little bit of background about STP
12 is they are a high-fiber plant and they don't have very
13 much other insulation material. They have a little bit
14 of micro-coarse insulation in the plant.

15 They went through that they three trains
16 and two trains are required for operability. And they
17 also mention the strainer face velocity, which is about
18 0.009 feet per second, which, as we discussed, that's
19 not the same as the velocity of the water flowing to the
20 strainer.

21 They did make a submittal based on this test
22 in 2008. And I have the ML number there so you can look
23 at it. It has information on the test in there. And
24 one thing I do want to note is that we do have some
25 outstanding RAIs which we quit working on because they

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1 changed the way that they were going to address
2 -- they're going to the new RoverD methodology. But a
3 lot of the RAIs that we originally asked on that may
4 still be applicable now that they're going to use the
5 test.

6 MEMBER BLEY: Do you have to go back
7 through that? I thought I heard them say they were
8 going to respond to those.

9 MR. SMITH: They are going to respond to
10 the ones that are necessary to --

11 MEMBER BLEY: Okay.

12 MR. SMITH: But before we can really make
13 a decision on how we can apply these test results, we
14 need to know the answers to some of these RAIs.

15 MEMBER BLEY: Sure.

16 CHAIRMAN BANERJEE: Just a number
17 -- you've got the strainer face velocity there. What
18 is the average velocity onto the sides of the strainer?
19 Not the face, but --

20 MR. SMITH: I didn't calculate that.

21 CHAIRMAN BANERJEE: Okay. But it would be
22 quite a bit higher, right?

23 MR. SMITH: It would be quite a bit higher,
24 yes.

25 CHAIRMAN BANERJEE: Of the order of half a

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1 foot per second?

2 MR. SMITH: I think --

3 CHAIRMAN BANERJEE: You did that
4 calculation for us --

5 MR. SMITH: I did that calculation for you
6 and told you, and we both forgot the answer.

7 (Laughter)

8 CHAIRMAN BANERJEE: That was for a
9 different project, right?

10 MR. SMITH: Maybe it was for a different
11 -- so it's probably a similar --

12 CHAIRMAN BANERJEE: It wasn't for this.

13 MR. SMITH: For that one I think it was
14 about a 9:1 ratio, so it may be similar --

15 CHAIRMAN BANERJEE: Okay.

16 MR. SMITH: -- for this. So it would be
17 more like 0.1 or a little bit below 0.1.

18 CHAIRMAN BANERJEE: Okay.

19 MR. SMITH: This just lists the things that
20 we look at when we're going through. This is basically
21 -- Wes had his No. 6 of head loss and vortex. And this
22 is the things we look at under No. 6, head loss and
23 vortexing area when we're looking at strainer testing.

24 And this just talks about the test methods
25 that were used. One of the questions that came up was

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1 the question about near field settling, and there was
2 only strainer vendor that was using near field settling
3 in their testing, and that was PCI, the test that was
4 being done up at Alden Labs. And these are the things
5 that we talked about with Alden and PCI when they were
6 doing the test, when they were developing the near field
7 testing procedures.

8 CHAIRMAN BANERJEE: How much of the
9 fibrous material was settling?

10 MR. SMITH: One thing that we negotiated
11 with them when they were doing the test is that they were
12 to put all the fine debris in first. They were to put
13 the debris in more transportable, then less and less and
14 less. So they put in the fine debris and then the small
15 and then the large. Because what we didn't want to have
16 happen was have some non-prototypical hold up of debris
17 on larger pieces.

18 So for the fine debris I think that almost
19 all of it would have transported. And then some of the
20 smalls, a significant amount of the small debris
21 actually settled in the flume, and then the large debris
22 really -- it just didn't transport if any was put in.
23 Some tests it was. I don't remember if they put it in
24 their test or not.

25 CHAIRMAN BANERJEE: As you know, the

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1 concern is mainly with the fiber and the fine
2 particulate debris. And if essentially all of it
3 transports, then -- because I personally didn't have a
4 concern with the larger debris.

5 MR. SMITH: I would say essentially all of
6 the fine debris transported, because at 0.5 feet per
7 second you're going to get it all there. You know, the
8 tumbling velocity for smalls is like 0.12 feet per
9 second.

10 CHAIRMAN BANERJEE: Yes.

11 MR. SMITH: So for fine it's all going to
12 transport. And PCI did some testing in a glass flume
13 that they had, not the plywood flume, the smaller flume,
14 with different degree sizes and showed what was likely
15 to transport and what wasn't. And the fine debris does
16 transport.

17 CHAIRMAN BANERJEE: Did they also measure
18 how much of it passed through on a pass?

19 MR. SMITH: We don't have any results from
20 this particular set of testing that was done up at Alden
21 with PCI, but STP did some additional testing down at
22 Texas A&M and they actually did do sampling. A lot of
23 the Alden tests did do sampling of downstream, but it
24 had particulate and fiber in it. And I'm not sure if
25 they were able to characterize what was fiber, what was

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1 particulate in those tests. And they may have actually
2 done some tests where they only --

3 CHAIRMAN BANERJEE: They just weighed what
4 came through?

5 MR. SMITH: Right. They may have also
6 done some tests where they had fiber only, but I haven't
7 seen any results of those tests.

8 CHAIRMAN BANERJEE: So in looking at
9 downstream effects like from the core, what would the
10 assumption then in terms of pass-through of the fine
11 fibers and things? I mean, if you don't have the
12 measurement, then you fall back on some other data,
13 right?

14 MR. SMITH: The staff's fall-back
15 measurement would be that 45 percent of the fiber would
16 go through. And that's based on a test that barely
17 covered the strainer. And so you weren't getting any
18 filtering. So if you have a large amount of fiber,
19 you're going to have a much lower percentage actually
20 going through. So for plants like South Texas, plants
21 that are high-fiber plants, they could not survive with
22 that assumption. They have to do testing to figure out
23 how much fiber is --

24 CHAIRMAN BANERJEE: Fiber is going
25 through?

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1 MR. SMITH: Right.

2 CHAIRMAN BANERJEE: But a fall-back
3 position for barely covering, I think that's
4 reasonable.

5 MR. SMITH: It was based on some testing
6 that was actually done up at Alden, yes.

7 CHAIRMAN BANERJEE: Yes. Okay.

8 MR. SMITH: The scaling for this was about
9 two-and-a-half percent of two trains. As Wes said,
10 they have 20 modules per train and this was a two train
11 test and it was one module, so that makes sense. One
12 out of 40 is about 22. So I guess my scaling calculation
13 was correct. And 100 percent of the debris predicted
14 to transport to the strainer was included in the test,
15 but as we talked about some of the larger debris did
16 settle. The smalls and the large debris settled, but
17 not much of the fines.

18 CHAIRMAN STETKAR: Steve?

19 MR. SMITH: Yes?

20 CHAIRMAN STETKAR: Just make sure you
21 -- for the folks on the bridge line, we're on slide 5?

22 MR. SMITH: I'm sorry. We're on slide 5.
23 Yes, I forgot.

24 We did observe the test that Wes talked
25 about, which was the July 2008 test. And then there was

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1 a test that was previously done in February. The test
2 that was done in February was based on a 17D zone of
3 influence. So that test resulted in excessive head
4 loss before the chemicals even went in. So there were
5 some other differences in the surrogates they used in
6 the test, but we feel that the majority of the difference
7 was just in the amount of fine fiber that got on the
8 strainer and created a bed that was just -- it was just
9 too much for the strainer to be able to handle, for that
10 size strainer.

11 CHAIRMAN BANERJEE: But we have the
12 results for that, too.

13 MR. SMITH: There's a trip report, which
14 I've listed there on slide five. And I don't think we
15 have any official results from that because the test
16 didn't really do -- it was not good for them. The
17 results were bad enough that they couldn't use them.

18 CHAIRMAN BANERJEE: Everything is
19 valuable to understand.

20 MR. SMITH: Yes. So you can look at that
21 trip report and then if you have questions, I might still
22 remember back that far and be able to answer more
23 questions.

24 MEMBER BLEY: Can you remember anything
25 about what you mean by "bad?" Was it the head loss was

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1 high is all, or was --

2 MR. SMITH: The head loss, yes --

3 MEMBER BLEY: -- there something wrong in
4 the process?

5 MR. SMITH: I remember the head loss got to
6 about 28 feet with just fine fiber being put in and fine
7 particulate. And the pump flow rate had to be reduced
8 significantly in order to be able to continue the test.
9 And then I think it was decided just to stop the test.

10 CHAIRMAN BANERJEE: All right. So the
11 July tests of course are well documented.

12 MR. SMITH: The July test is -- and that's
13 included in that --

14 CHAIRMAN BANERJEE: Yes.

15 MR. SMITH: -- I think it was on slide 2
16 we've listed the ML number for the submittal there.

17 So I'll go to slide 6. This kind of talks
18 about the February test, which we've already talked
19 about. We concluded from that that the amount of fine
20 fibrous debris in conjunction with the particulate
21 debris was just excessive. The strainer just couldn't
22 handle it. So the July 2008 test on slide 7, this lists
23 the differences between the two tests.

24 So the non-zinc coatings were represented
25 by acrylic paint instead of walnut shell flour. Some

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1 of the coatings were added as chips. And Wes had a slide
2 that showed -- I think it was about less than a quarter
3 were added as chips. The biggest difference was the
4 fibrous debris was reduced.

5 Now I don't know the amounts of fibrous
6 debris because I don't know what was put in the test and
7 I don't have it documented. I might have known when I
8 was there. But the difference between the 7D and the
9 17D ZOI, the volume is 14 -- it's 14 times bigger for
10 a 17D ZOI. So there was a significantly larger amount
11 of debris in the test that was run in February. So
12 somewhere between the 7D and 17D ZOI amount of debris
13 is the point where you would actually have a strainer
14 failure. You wouldn't be able to -- the strainer
15 wouldn't be able to handle that amount of debris.

16 So we think it's probably pretty close,
17 Nine point one feet I think is what they came up with.
18 It was about nine feet. We think it's probably pretty
19 close to the 192 pounds that they came up with. It might
20 be a little bit higher than that. It's just without
21 doing a test you can't really tell.

22 CHAIRMAN BANERJEE: So you were showing us
23 the curves with the chemicals. You don't have that
24 slide to show all that you sent --

25 MR. KLEIN: That was actually a back-up

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1 slide that STP had sent us. We don't have an electronic
2 copy. But the performance of the strainer in that test
3 was not atypical to what we've seen with other
4 utilities. And the first batch is that chemical
5 precipitate oftentimes produced the most dramatic
6 increase in head loss. And then there appears to be
7 what you had called a saturation effect where the head
8 loss levels off and maybe even decays over time,
9 subsequent batches.

10 In this case they had run the test overnight
11 and they saw slow decay in the head loss, and then in
12 the morning they saw a jump again with the chemical
13 precipitate addition.

14 CHAIRMAN BANERJEE: So typically you see
15 the peak and then it sort of goes down and can be
16 attributed to many different effects. And then when
17 you add chemicals again, it will go up and it would stop
18 slowing decay, right? But that's the sort of thing that
19 --

20 MR. KLEIN: That's the usual type behavior
21 that we've seen, although there's always exceptions.

22 CHAIRMAN BANERJEE: Yes, there are always
23 exceptions. But also when you add chemicals you sort
24 of -- you reach that peak fairly quickly. And then if
25 you add more chemicals, it almost flattens and it may

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1 even come down a little bit.

2 MR. KLEIN: And that's what their first
3 -- their graph shows that they reached a peak and then
4 when they finished adding the chemicals for the day,
5 they continue to test during the night. There was a
6 decay in head loss overnight until we added more batches
7 in the morning.

8 CHAIRMAN BANERJEE: Okay.

9 MR. KLEIN: But their test was
10 conservative both on the quantity of precipitate that
11 was added clearly, but also the type. In their
12 subsequent testing at University of New Mexico, they did
13 not observe that type of amorphous aluminum hydroxide
14 that they used in the flume tests at Alden Lab.

15 MEMBER SHACK: Well, because they were
16 waiting for it to precipitate out. They weren't doing
17 a Westinghouse-type of test.

18 MR. KLEIN: Yes, it was --

19 MEMBER SHACK: Okay.

20 MR. -- a test much like an ICET-type test
21 where you have a chemical source term and let the
22 environment evolve over time.

23 MR. SMITH: On slide 8 we have the summary.
24 Kind of just compares the two tests. The July 2008 test
25 was similar to the February test with a little bit of

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1 improved methodology and just a reduced ZOI.

2 CHAIRMAN BANERJEE: But effectively that
3 meant less fiber and less --

4 (Simultaneous speaking)

5 MR. SMITH: Yes, less fiber. So the July
6 test, although we accepted the methodology, we wouldn't
7 accept it because it assumed there was a 7D ZOI, which
8 we never -- you know, that was another discussion that
9 we rejected, that 7D ZOI. And we maintain that 17D is
10 the proper ZOI for that.

11 So even though that test can't be used as
12 a justification for overall plant acceptability, the
13 test was -- it was conducted acceptably and we feel that
14 the test can be used to justify a maximum amount of
15 debris that can be used in the RoverD calculation.

16 The thing that we don't really have a full
17 understanding of is how the test is going to be applied
18 and how the plant conditions in the test are going to
19 be balanced against each other to show that -- how do
20 they actually reach this 192 pounds of fine fiber in the
21 plant. That's something that we need to examine and
22 understand.

23 CHAIRMAN BANERJEE: That's a separate
24 issue.

25 MR. SMITH: That's a separate issue. The

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1 testing was good. The testing was conducted under
2 acceptable methodology. It came up with a good head
3 loss. And they have an actual known limit that was put
4 into that test as far as fine fiber, and that's a good
5 limit for us to use to apply to the RoverD methodology.

6 MEMBER BLEY: So even though it's a
7 separate issue --

8 MR. SMITH: Yes.

9 MEMBER BLEY: -- when they use the RoverD,
10 they're going to have to come up with some of these
11 -- work out on these questions to your satisfaction
12 that right now have a great deal of uncertainty. Where
13 I'm kind of hanging up is they've backed away from what
14 they were doing before on the probabilistic approach to
15 some extent, well, to a major extent to some issues of
16 uncertainties and maybe lack of confidence in some of
17 the models. But here we have those same kind of issues
18 applied to exactly how much debris will be generated.
19 And that's going to have to be worked out.

20 MR. SMITH: That's what we have to look at.
21 As long as they use the NEI, the staff-approved NEI
22 guidance for how much debris is generated in transport
23 to the strainer, we're not going to have a big problem
24 with it. And there's other things that have to be
25 looked at like erosion, where debris gets held up, how

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1 much is eroded from various areas, things like that. As
2 long as they follow the NEI guidance, we're not going
3 to have significant issues with what they're doing.

4 So the question comes in between how does
5 the NEI guidance and this test and the RoverD -- how do
6 they all mesh together? And that's what we really need
7 to examine.

8 CHAIRMAN BANERJEE: So I have a slightly
9 different question. Maybe I shouldn't be asking this,
10 but with latent debris of 200 pounds, we know extremely
11 clean plants -- we won't name them here, but we know
12 -- who use the same sort of strainers, right? And they
13 barely make the downstream effects criteria, right?
14 Forget fiber at all. With these strainers they barely
15 make the downstream effect. To add any fiber to it and
16 you assume the same sort of pass-through that we're
17 talking about, how is it that they can get the 15 rems
18 per channel? Or how would anybody be able to do it with
19 these strainers?

20 MR. SMITH: I don't think we actually have
21 the answer to that yet. I think that's something that
22 we need to get from STP. They had some methodologies
23 they were using to show that there were alternate flow
24 paths for water to get into the core. If they got above
25 15 grams, the fiber -- that was --

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1 CHAIRMAN BANERJEE: The PWROG is trying to
2 come back to us in October with that.

3 MR. SMITH: I think the PWROG methodology
4 is a little bit more complex. I think they were just
5 looking at water spilling back over the steam generator
6 tubes. The PWR Owners Group is actually looking at
7 bypass flow paths internal to the reactor. I'm not sure
8 where STP is going to end up with that.

9 CHAIRMAN BANERJEE: Yes, okay. So I think
10 I was just asking your opinion, because already the
11 latent debris sets a limit more or less. I mean, we've
12 seen this with other plants, very clean plants. I mean,
13 there's no fiber anywhere, right?

14 MR. SMITH: Right. I agree we need to
15 understand how the in-vessel analysis was done.

16 CHAIRMAN BANERJEE: Okay. But you
17 haven't looked at that? Well, there's been no
18 submission?

19 MR. SMITH: There's no submission for
20 RoverD. We were looking at it for the other submission,
21 and I suspect it may be similar. And probably someone,
22 another staff member would be better to talk about it
23 because it's a lot of thermal hydraulic analysis that
24 I didn't look at. I think Glenn Ward, the guys in his
25 branch were looking at that.

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1 CHAIRMAN BANERJEE: Yes, they were looking
2 at that. Lenning did some work as well?

3 MR. SMITH: He was working on the BWR fuel
4 testing, and he's not anymore. Now Ben Parks is working
5 that.

6 CHAIRMAN BANERJEE: Okay.

7 MR. KLEIN: I think that overall though the
8 PWROG is probably confident they can get above that
9 15-gram limit that's in the current SE. So that remains
10 to be seen as we get into that review, but we've
11 certainly been following the program and observing
12 tests, and they do appear to have a path to get above
13 that 15 grams that is in the current safety evaluation
14 for WCAP 16793.

15 MR. MURRAY: Mr. Chairman, in thinking
16 about how Stevie came in and helped us, I think Bruce
17 had something like to offer them the clean plant versus
18 fiber discussion.

19 MR. LETELIER: Only to say that South Texas
20 --

21 MEMBER WIDMAYER: Name, please?

22 MR. LETELIER: Bruce Letelier from Alion
23 Science. I only wanted to add that South Texas does
24 have strainer-specific testing for the penetration, the
25 downstream collected mass. And Ernie Kee will present

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1 that data in the RoverD discussion.

2 The staff has not had a chance to review it
3 in detail. That's the reason for the --

4 CHAIRMAN BANERJEE: Fine. I mean, this is
5 just informational this morning, so that's fine.

6 MR. SMITH: Yes, we did have a chance to
7 review -- there was a correlation that was developed
8 from testing that was done, and we had a chance to review
9 that. And the way it was implemented in CASA we had some
10 questions about that. So if that methodology is
11 maintained, we'll have to get answers to those
12 questions. We had Southwest Research doing some
13 independent validation of how that testing was
14 implemented in CASA. They just made a different model
15 just to make sure that it looked right. And there's
16 questions about various things associated with that, so
17 we don't have the full story on it.

18 CHAIRMAN BANERJEE: Right.

19 MR. SMITH: I will say we were trying to
20 finish up with the strainer testing more quickly than
21 was in the schedule because we thought it would be more
22 interesting for you guys to talk about the newer aspects
23 of RoverD. So I'm glad we were able to finish up a
24 little bit of --

25 (Simultaneous speaking)

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1 CHAIRMAN BANERJEE: Yes, I think that's
2 fine. I think if we need to get back to you with more
3 questions later in the day, we will. Because we may
4 have some questions following the RoverD.

5 MR. SMITH: Okay.

6 CHAIRMAN BANERJEE: So thanks very much
7 and we'll turn it back I guess to you to move forward.

8 MR. MURRAY: So this is where South Texas
9 is getting back into the presentation. We'll start at
10 slide No. 44.

11 So, Ernie, if you could, when you move to
12 a slide, mention the slide number, please, sir.

13 MR. KEE: Yes, sir. And one other point is
14 64 should be ignored. That's not the right total count.

15 We are on slide 44 and the objective of this
16 next series of slides is to over what we call risk over
17 deterministic, or RoverD test-based debris risk
18 assessment.

19 Just to go over some of the motivation for
20 this approach, and I think it's probably been mentioned
21 earlier, but I'm just going to cover that again. In our
22 work over the last couple, three years we've struggled
23 with the epistemic uncertainty that is engendered in
24 correlations, especially new ones. And the review has
25 taken a lot of time on the part of the staff and so forth

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1 because of the complexity, as has been acknowledged
2 earlier. And so we wanted to reduce some of that
3 complexity, and we feel like that our approach we're
4 taking now in RoverD should make the analysis far more
5 transparent.

6 So that leads to a scope reduction on the
7 part of the staff and it also helps out other people that
8 are involved in the pilot activity. We used
9 deterministic test data to screen out many scenarios.

10 MEMBER SCHULTZ: Can I say this
11 differently, Ernie, because what we just heard is there
12 was an intention to demonstrate through the February
13 testing that all was well and good, but the testing that
14 was done in July was based upon the smaller zone of
15 influence evaluation. And so, you also want to find a
16 way in which to use that information in the overall
17 evaluation approach without going into the complexity
18 of correlations. Is that the case or --

19 MR. KEE: So, I guess the notion is that
20 we've -- as Wes described, we created in July of 2008
21 a pretty challenging test with a lot of chemicals, a lot
22 of precipitates, even some that we don't have in the
23 plant today, excessive amounts of corroding material
24 like aluminum, running the containment spray much
25 longer than we ever believe we would, so on and so forth.

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1 So we've challenged the strainer like that. And we want
2 to understand what kind of -- out in the tails, if you
3 will, how much risk is remaining, acknowledging as well
4 that in our testing that we've done over the last couple,
5 three years, we do not see significant production of the
6 kinds of materials that cause the most head loss. As
7 Wes pointed out, approximately half of the head loss
8 that we experience is coming from the chemicals that
9 were added, which are more than we would ever expect to
10 see.

11 MR. MURRAY: So let me add, your
12 characterization, I captured it as accurate the way you
13 were applying it. I think you had it characterized.
14 Ernie's taking us more in depth in the details.

15 MEMBER SCHULTZ: Which we'll get to in --

16 MR. MURRAY: Right, we'll get to.

17 MEMBER SCHULTZ: -- the application.

18 MR. MURRAY: But I think the way you
19 entered it was, yes, we're looking for a way to use that
20 information and bring it into the process.

21 CHAIRMAN BANERJEE: But from what you
22 said, I understood, maybe wrongly, that all the
23 scenarios that produce up to the testing limit you can
24 handle in a sense deterministically because it doesn't
25 matter; it will cause no problems. So you essentially

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1 forget those scenarios. I think that's the way I look
2 at it. Maybe not exactly, but what's important are the
3 scenarios that will lead to material coming through the
4 strainers above your 193 pounds or whatever.

5 MR. HARRISON: Right, we're using fine
6 fibrous debris as the --

7 CHAIRMAN BANERJEE: Yes, so --

8 MR. HARRISON: -- metric.

9 CHAIRMAN BANERJEE: And those are the
10 scenarios that you're going to look at the risk
11 significance of the impact to risk.

12 MR. KEE: Correct.

13 CHAIRMAN BANERJEE: Is that in broad terms
14 what you're trying to do?

15 MR. KEE: Correct.

16 CHAIRMAN BANERJEE: Okay. Is that
17 consistent with what you understand, too, John?

18 CHAIRMAN STETKAR: Yes, and your hope is
19 that the uncertainties in the use of this test data can
20 be resolved more expeditiously than you could resolve
21 the uncertainties in the models that you'd developed
22 previously.

23 MR. KEE: That's correct. Or another way
24 to put it is by applying very challenging conditions we
25 believe that we've bounded these uncertainties that

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1 have been kind of plaguing our analysis over the last
2 period of time.

3 And another point is by doing this we are
4 putting things kind of in a more familiar setting. Like
5 for example, fuel testing has these limits that have
6 been set. The only nuance is that we're examining now
7 the risk of that. It may be beyond the uncertainty
8 that's been included in the test conduct.

9 CHAIRMAN BANERJEE: Yes, so you don't know
10 the uncertainties associated with these tests because
11 that would require -- yes, so you just sort of said that
12 these are pretty bounding tests in terms of chemical
13 additions, whatever. And I think the staff and ACRS has
14 looked at a lot of these tests in the past and we
15 understand that these are bounding assumptions for the
16 amounts of material we're talking about. But if you get
17 more than that, of course you're in a different sort of
18 situation where I guess you have to find out --

19 (Simultaneous speaking)

20 MEMBER SHACK: This is bullet three.

21 CHAIRMAN BANERJEE: Yes.

22 MR. KEE: So we talked about -- recall that
23 we never expect to see any of these kinds of materials
24 in close LOCA sump water at South Texas. And that's
25 based on testing. So we've actually kind of looked at

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1 what is the -- as I mentioned, the amount of uncertainty
2 that's captured in these tests is quite a significant
3 amount.

4 MR. MURRAY: So what we've done is we've
5 not ignored any of the learnings we've had over the
6 years. We've continued to use those and understand
7 where those conservatisms are because of previous
8 tests. But as you see as we go through this, we're not
9 crediting so much those -- we know they're there. We've
10 seen them and proved them, but we're staying focused on
11 what was the results of the 2008 test and what is the
12 debris generated in the different locations and does
13 that exceed? So that's the focus. We have learned a
14 lot and we've not ignored what we've learned in that
15 going through this process. We're just trying to keep
16 it in a -- answering the deterministic questions yes/no,
17 does it generate more than we had tests results that can
18 support. We leave these conservatisms in, these
19 chemical effects in, these results from 2008 tests into
20 the equation and take it through that process. And I
21 think that's what we'll show you as we go through this.

22 CHAIRMAN BANERJEE: All right. Let's
23 move on.

24 MR. KEE: Yes, so by assumption we relegate
25 all the scenarios that would occur that have more than

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1 the amount of fine debris tested to core damage. And
2 we've already said that the deterministic test
3 challenges the strainer performance.

4 MR. MURRAY: So we're on slide 46.

5 MR. KEE: Yes, slide 46. Sorry.

6 MEMBER BLEY: Are you going to talk more in
7 your later slides about the second box here where you
8 --

9 MR. KEE: The top box or the bottom box?

10 MEMBER BLEY: It starts at the top,
11 deterministic test. The next box is examine the
12 individual break locations and equivalent fines. And
13 then are the fines above or below what you had in that
14 test? That second box is kind of a crucial one, how you
15 partition these scenarios. And it seems as if it's one
16 that you and the staff haven't quite agreed on how that
17 partition ought to go because that's linked to your zone
18 of influence. And that seems to be a place that you're
19 not in agreement yet.

20 The place I'm wondering is when you get all
21 done with this and you reach agreement on that box, what
22 if the ones that go up here to guaranteed core damage,
23 the frequency of that bunch is higher than you wanted
24 it to be.

25 MR. KEE: I think that would be

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1 problematic.

2 MR. HARRISON: We need to go back for just
3 a second. You said this is with regard to the zone of
4 influence. Ernie can elaborate on it, but the break
5 -- or excuse me, the testing assumed a load is based on
6 a 7D. What it did is it gives us a baseline quantity
7 --

8 MEMBER BLEY: Yes.

9 MR. HARRISON: -- of material.

10 MEMBER BLEY: Yes.

11 MR. HARRISON: And when we go do this
12 evaluation that's in this second box, all the debris
13 generated in that evaluation was based on using a 17D
14 zone of influence.

15 MEMBER BLEY: Oh, it is?

16 MR. HARRISON: So all we're doing is
17 comparing it to --

18 MEMBER BLEY: Okay.

19 MR. HARRISON: -- the total amount of
20 material that was in the test --

21 MEMBER BLEY: Okay.

22 MR. HARRISON: -- that's really the
23 important value at that point.

24 MR. KEE: So let me address that --

25 MEMBER BLEY: Okay. So that helps.

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1 MR. KEE: -- concern, which is how are we
2 certain, I think you're asking, that we get the right
3 amount of debris in the sump that we're doing this
4 determination on?

5 MEMBER BLEY: Yes, are you getting an
6 amount you can agree with the staff?

7 MR. KEE: Agree on. And so I think we
8 presented in February initial results, and we didn't
9 have agreement, as a matter of fact, with -- but that
10 with some additional information that's been provided
11 and worked through I believe we're in agreement now, or
12 very close. That's one point.

13 And the second point is the way we do this
14 work of determining the amount of debris that arrives
15 in the sump follows the guidance that is common to
16 everyone in terms of the logic trees and the ZOI --

17 MEMBER BLEY: The NEI guidance.

18 MR. KEE: -- that NEI has published and the
19 staff's looked at. So those are very -- there's no
20 funny -- there's no uncertainty in there. It's a
21 straight up calculation. Here's the debris generated,
22 here's the transport logic, here's what arrives in the
23 sump, here's what's eroded, here's what's in the latent
24 fiber, and so on and so forth. So that methodology with
25 which we arrive at the amount of debris in the sump is

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1 familiar and is similar to what was done back in 2008
2 with the exception of the size of the ZOI. But that's
3 just a nuance of the detail.

4 MR. MURRAY: So clarifying one item is that
5 what the staff is seeing in the RAI, will see in the RAI
6 responses; we're currently taking through signature
7 process, will be that piece that they're anxious to see
8 on how do you determine the amount of debris in the
9 different areas? So that's where that information --

10 MEMBER BLEY: And if I understand where
11 you're headed with RoverD here, the last vestige of
12 risk-informed is a calculation of the frequency of these
13 scenarios that go to greater than 182 pounds, or
14 whatever it is.

15 MR. KEE: More or less, yes.

16 MEMBER BLEY: Okay.

17 MR. MURRAY: So we're probably four or five
18 slides ahead. Mr. Chairman, you had a question?

19 CHAIRMAN BANERJEE: No, I was just saying
20 that the issues that you're dealing with, at least in
21 the opening remarks that were made, have to do with
22 getting clarification with the CAD diagram and so on so
23 that you can get good estimates of the effect of the 17
24 ZOI on different breaks in different locations of
25 different sizes, right? So that you can come to some

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1 agreement about how much debris is generated in each of
2 the scenarios you are examining.

3 MR. MURRAY: That's a fair summary.

4 CHAIRMAN BANERJEE: But you're using, if I
5 understood it, always the 17 ZOI in all cases?

6 MR. KEE: For low-density fiber, yes.

7 CHAIRMAN BANERJEE: For everything you've
8 using it, but now you're trying to look at different
9 welds and different sizes and how much debris is going
10 to be generated, but within the 17 ZOI.

11 MR. KEE: Yes, sir.

12 CHAIRMAN BANERJEE: That's what you're
13 doing right now?

14 MR. KEE: Yes, sir.

15 CHAIRMAN BANERJEE: And you're examining
16 different break locations, different break sizes,
17 whatever it is.

18 MR. KEE: Again, this is a familiar
19 methodology.

20 CHAIRMAN BANERJEE: Yes.

21 MR. KEE: When you look to the worst
22 location, you have to do this kind of exercise.

23 CHAIRMAN BANERJEE: And so then you are
24 just binning it into two. One is if the debris is below
25 the July testing limit, then that's deterministic. If

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1 it is above, then you have to do some fancy footwork on
2 that.

3 MR. KEE: Exactly.

4 CHAIRMAN BANERJEE: Okay.

5 MR. KEE: So maybe we've exhausted this
6 slide.

7 CHAIRMAN BANERJEE: Yes.

8 MR. KEE: We can move to No. 47.

9 CHAIRMAN BANERJEE: That's pretty clear.
10 And Dennis' question was related to the second box,
11 exactly what you're doing. And that we will see
12 ultimately once the staff has pored over it and what
13 their recommendation --

14 (Simultaneous speaking)

15 MR. KEE: So we're on slide No. 47 then.
16 So one kind of a bit of a nuance here now is that we use
17 this CASA Grande code to -- I saw exhaustively -- I'm
18 speaking of hundreds of thousands of samples of break
19 size, orientation and so forth, which we've gone over
20 in the February discussion, so that at each location the
21 objective is to find out for all these thousands of
22 scenarios what amount of debris at what break size
23 arrives in the sump, the amount of fine debris generated
24 and transported for all these.

25 CHAIRMAN BANERJEE: So you don't assume

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1 that all the latent debris always gets to the sump?

2 MR. KEE: We do --

3 CHAIRMAN BANERJEE: I mean, all 200
4 pounds?

5 MR. KEE: -- assume that the 15 -- is it 15
6 percent?

7 CHAIRMAN BANERJEE: Fifteen pounds of
8 fiber.

9 MR. SCHULZ: Fifteen percent. Thirty
10 pounds.

11 MR. KEE: Thirty pounds is automatically
12 put in every time and --

13 CHAIRMAN BANERJEE: Yes, so it doesn't
14 matter. This is size independent. Doesn't matter.

15 MR. KEE: And the eroded amount is put in
16 instantaneously. So that's a conservatism, if you
17 will. And what these sub-bullets say. We sum up
18 all --

19 CHAIRMAN BANERJEE: The fine debris from
20 the latent debris being instantaneously put in is fine.
21 I don't understand what you mean, the amount of debris
22 from fiber erosion.

23 MR. KEE: Sure.

24 CHAIRMAN BANERJEE: What do you mean by
25 that?

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1 MR. KEE: Yes, sir. So as water from the
2 break or potentially containment spray washes over -- or
3 I suppose it can even take place in the smalls that are
4 down in the sump. These are all analyzed known kind of
5 relationships that you assign. And I said wrongly last
6 time -- I think it's roughly 10 percent of the larges
7 and smalls; Bruce, correct if I'm -- are assigned to fine
8 debris, erode to fine debris.

9 CHAIRMAN BANERJEE: Where is this erosion
10 taking place?

11 MR. KEE: Everywhere throughout the plant
12 and wherever there's large -- so some of the destroyed
13 insulation, if you will, is just big chunks. And they
14 stay in place. They don't transport.

15 MR. HARRISON: I was going to say, if it
16 helps, Wes touched on that when he was talking about what
17 he put in for his deterministic test. I think it was
18 one percent of the fibrous, or erosion. So you're
19 carrying that assumption through to apply here as well
20 so it's consistent with --

21 MEMBER SHACK: Stuff just breaks up after
22 you hit it with the initial blast, it generates fines.
23 Some of the smaller chunks then break up later producing
24 more fines. So they're totaling up the amount of fines.

25 MR. KEE: We just put that in. And we sum

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1 it all up. That's what we --

2 CHAIRMAN BANERJEE: There's some
3 assumption you make there. That's what I'm after.

4 MEMBER SHACK: That comes from the NEI
5 document, so it's all agreed upon.

6 CHAIRMAN BANERJEE: Yes. What is that
7 number?

8 MEMBER SHACK: Right or wrong.

9 CHAIRMAN BANERJEE: Is that one percent
10 or --

11 MR. KEE: I'm sorry, is it one?

12 MR. SCHULZ: One percent.

13 CHAIRMAN BANERJEE: All right.

14 MR. SCHULZ: And Ernie pointed out that's
15 instantaneous, too. It goes over time. We assume it
16 all goes in.

17 MR. KEE: Let's dwell on this for just a
18 moment, because there was a lot of discussion about,
19 well, how much of this that got put in the test -- how
20 much of that fine stuff got on the strainer, right? I
21 mean, did it settle? Here we say it all gets there. So
22 there's no question about transport. That's gone. We
23 put it and we say it all hits.

24 MR. LETELIER: If I could --

25 MR. KEE: We're looking for that 191.78

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1 that was tested.

2 MR. LETELIER: If I could clarify. The
3 source term is what's introduced to the test and it's
4 also what's introduced to the containment pool.

5 MR. KEE: That's correct.

6 MR. LETELIER: So we have an equal
7 comparison of our scenarios to the initial condition of
8 the test. We're counting on the test to provide
9 representative transport, representative settling.

10 MR. KEE: So the point is we're not
11 assuming any --

12 CHAIRMAN BANERJEE: Well, in the test
13 there's a chance for settling, but effectively they said
14 -- they call it the turbulence level that would
15 -- settling of fines.

16 MR. KEE: Yes. So maybe I mis-spoke
17 there.

18 MR. MURRAY: Did Bruce's explanation help?
19 I want to make sure we're as clear as we --

20 (Simultaneous speaking)

21 CHAIRMAN BANERJEE: I think the
22 clarification is you introduced that amount in the
23 tests, into the test flume. And then whatever is
24 transported gets transported.

25 MR. KEE: And then at each location where

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1 we've looked at thousands of samples at each location
2 we find out if the amount of fine fiber transported to
3 the sump is more than was tested. So if not, then that
4 amount will be a double-ended guillotine break. When
5 we look at each location, if it's a double-ended
6 guillotine break. And we say basically it's a
7 deterministic category and what's the margin to the 192
8 pounds at that location? And so for all those locations
9 we know what the margin is, how much remains below the
10 tested amount. And if it's more than the tested amount,
11 we look for the smallest break size. From all the
12 samples we look for the smallest break size that
13 exceeded the tested amount, and that's thrown into a
14 risk-informed category. So if that's clear. So we
15 look for the smallest break that exceeds the tested
16 amount for risk-informed. So there was some --

17 MEMBER SHACK: Well --

18 MR. HARRISON: That establishes the
19 maximum risk, or the maximum frequency of the break
20 size.

21 MEMBER SHACK: But you include all of the
22 breaks above that size.

23 MR. HARRISON: Yes.

24 MEMBER SHACK: Right. That's what
25 stopped me there a little bit.

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1 MR. KEE: So we're looking --

2 MEMBER SHACK: It's the cumulative
3 frequency above that break size that you're looking at.

4 MR. HARRISON: Yes.

5 MR. KEE: Exactly.

6 (Off microphone comment)

7 MEMBER SHACK: Yes, well, that's a
8 different question, but it is important to have the
9 whole cumulative frequency, which is what they've got.

10 MR. KEE: It's possible that there are some
11 angles and sizes that would not exceed, that are larger
12 than the smallest break size, right? It's possible.
13 It's not very likely. But by finding the smallest one
14 and then relegating all the rest into that category,
15 then would take care of all that. That's a
16 simplification that we make.

17 MEMBER SCHULTZ: To say it in reverse, if
18 you break the pipe and pipe size and you don't create
19 enough debris, or you create low debris so that you can
20 fit into the deterministic category, you're done.

21 MR. KEE: That's correct.

22 MEMBER SCHULTZ: If it breaks and you
23 create more debris, then you have the opportunity to go
24 down in size and figure out the smallest size that also
25 will pass deterministically.

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1 MR. KEE: Yes, sir.

2 MEMBER SCHULTZ: And the rest of it you
3 have to put into the risk-informed category, the larger
4 sizes.

5 MR. KEE: Precisely.

6 MEMBER SCHULTZ: Okay.

7 MR. KEE: So moving to slide 48 then, there
8 is some fair amount of discussion about how many trains
9 were tested and what about the ones that aren't tested
10 and so on and so forth? So the test that we performed
11 in 2008, as Wes already described, looked at two trains
12 with kind of the maximum condition, the deterministic
13 basis for those kind of tests which has full flow through
14 those strainers. And as Wes described, South
15 Texas Project has three independent trains, so there's
16 really three strainer trains that could be involved.
17 As we know from our risk analysis, the most likely
18 condition is all three trains start and run. And if
19 they do, the containment spray pump on one of those three
20 will be secured as a conditional action step in the
21 emergency operating procedures by the operators shortly
22 after the initiation of the event, assumingly actually
23 containment spray of nine-and-a-half pounds.

24 Okay. And then so the two-train scenario
25 actually, if we think about it for a moment, bounds the

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1 three-train case the mostly likely one. There will be
2 less debris, probably less even than a thin bed on all
3 three trains than the two trains that were tested. And
4 additionally, on one of those trains there will be less
5 head loss because there will be less flow through that,
6 almost 40 percent less flow because the containment
7 spray pump is quite a large draw. It is similar to the
8 low-head injection pump in terms of flow rate.

9 So on those two or three-train scenarios in
10 the deterministic and risk-informed categories 628
11 Class 1 weld locations that were analyzed. Forty-five
12 locations fell into the risk-informed category. Five
13 hundred and eighty-three were in the deterministic
14 category. So there's 583 double-ended guillotine
15 breaks that don't exceed the amount of fiber that we
16 tested. And so we can see that this -- instead of
17 examining 628 welds, we now will examine 45 for --

18 (Simultaneous speaking)

19 CHAIRMAN BANERJEE: Just a question.
20 This is all related to the sump, right? So it can be
21 that for scenarios where you have less fiber generated,
22 more fiber may possibly pass through because the fiber
23 bed itself has a filtering effect. So the downstream
24 effects could actually be more severe in some cases
25 where a fiber bed doesn't do any filtering.

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1 MR. KEE: That is a possibility. We
2 examine that.

3 CHAIRMAN BANERJEE: So you have a
4 relationship related to how much fiber passes through
5 as a function of the amount of fiber generated?

6 MR. KEE: We actually have measure test
7 data for an actual strainer module that we conducted at
8 all the labs.

9 CHAIRMAN BANERJEE: You have data on the
10 pass-through --

11 (Simultaneous speaking)

12 MR. KEE: And we'll show that later.

13 CHAIRMAN BANERJEE: Okay. So you're
14 covering that aspect of it?

15 MR. KEE: Correct.

16 CHAIRMAN BANERJEE: And I want to point out
17 that the single-train scenarios, while they're very
18 unlikely, like on the order of total frequency, it's
19 something like four or five to the minus eight per year,
20 reactor-year. We still include those and add the risk
21 to this analysis.

22 CHAIRMAN STETKAR: Ernie, tell me more
23 about this single train, because ultimately this comes
24 down to a Reg. Guide 1.174 delta CDF and delta LERF
25 calculation. The baseline risk for the South Texas

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1 Project, my recollection; correct me if I'm wrong, is
2 based on success criteria that says any one of the three
3 trains gives you success. Is that correct?

4 MR. KEE: It's possible. Not all of them
5 do.

6 David, is it 60/40?

7 MR. JOHNSON: David Johnson, ABS. Yes, in
8 a deterministic world one train is successful, but if
9 one train is in a broken loop, for example, it's not
10 successful. Okay? So, yes, only about 40 percent of
11 the -- or 60 percent of the single-train cases are
12 possible for success. We included --

13 (Simultaneous speaking)

14 CHAIRMAN STETKAR: Okay. So we're
15 talking roughly a factor of two?

16 MR. JOHNSON: Yes.

17 CHAIRMAN STETKAR: So the baseline risk
18 with in about a factor of two or so, is determined by
19 single train? What I'm trying to get to is if the test
20 data are developed based on a two-train running loading
21 condition, and the baseline risk is determined largely
22 by a single train success criterion, are you measuring
23 a delta with too little fiber on your strainers because
24 any condition in the current risk model with two trains
25 running is guaranteed success?

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1 MR. JOHNSON: I think this, Ernie --

2 (Simultaneous speaking)

3 CHAIRMAN STETKAR: Sixty percent of the
4 time when you got one train running it's guaranteed
5 success.

6 MR. JOHNSON: Yes, this David. I would
7 object to the "guaranteed" word here. There's
8 determined to be success.

9 CHAIRMAN STETKAR: Quantified in the PRA.
10 The baseline. I don't care, 10 to the minus X has that
11 contribution to it, and now you're measuring a delta on
12 10 to the minus X.

13 MR. JOHNSON: Let him get to the point
14 where how he's calculating the delta.

15 CHAIRMAN STETKAR: Okay.

16 MR. KEE: Yes, I think we --

17 (Simultaneous speaking)

18 MEMBER SHACK: Could I just go back to
19 Sanjoy's question again? Everything I've seen here
20 seems to say that you use that fiber, 192 pounds, as the
21 single criterion for binning these things as either
22 risk-informed or deterministic. But there's some
23 question -- so I mean, it somehow seems to me an implicit
24 assumption somewhere in your model that everything that
25 meets the 192 pounds is also going to meet the in-core

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1 situation.

2 MR. KEE: Actually, it's explicitly shown.

3 MEMBER SHACK: It's explicitly shown?

4 MR. KEE: Yes.

5 MEMBER SHACK: Okay. So his scenario
6 where it's worse you're saying is not correct? It's
7 always better to have less fiber in your model?

8 MR. KEE: Including the carryover test
9 data.

10 MR. KEE: That's correct.

11 MEMBER SHACK: I mean, certainly that's
12 true for the strainer. The question is whether it's
13 true for the in-core results.

14 CHAIRMAN BANERJEE: What passes through
15 the strainer?

16 MEMBER SHACK: You don't have the
17 filtering effect of the bed. You need to get more
18 pass-through and you --

19 MR. KEE: There are several questions that
20 have to be answered, right?

21 CHAIRMAN BANERJEE: Yes, we'll see what
22 you've got there. You're going to talk about that,
23 right, at some point, or --

24 MR. KEE: Yes, sir, we can talk even
25 further --

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1 CHAIRMAN BANERJEE: -- downstream
2 effects.

3 MR. KEE: -- about some of these downstream
4 --

5 MEMBER SHACK: It's true that there's a
6 single criterion, which is the amount of fine produced.

7 MR. KEE: No.

8 MEMBER SHACK: No?

9 MR. KEE: It's not totally true.

10 MEMBER SHACK: It's not totally true?
11 Okay.

12 MR. KEE: There's --

13 (Simultaneous speaking)

14 MR. KEE: Well, let's clarify that the
15 amount of fiber fines --

16 MEMBER SHACK: Is important.

17 MR. KEE: -- is important in terms of
18 assigning a category, either risk-informed or
19 deterministic. After that you need to make sure other
20 things are satisfied.

21 MEMBER SHACK: Okay.

22 MR. KEE: So Wes has already pointed out
23 all the things that were satisfied for the test that was
24 done. It had 192. But in the risk-informed category,
25 right, we have to look at other things. So we'll talk

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1 about that.

2 CHAIRMAN BANERJEE: I guess with the 192,
3 are there other qualifications that you then examine to
4 see if it's -- truly 100 qualifies or not, like
5 downstream effects and --

6 MR. KEE: Of course the test was conducted
7 with 192 pounds of fine fiber, but that's kind of a
8 simplification of the test condition we had, all these
9 other materials that were included in the test. So you
10 have to -- well, you don't have to, but it's I think
11 useful to continue to think in terms of, well, that's
12 how much fiber transported to the strainer.

13 Again, this should be familiar. Like in WCAP
14 16793, now it turns out how much fiber is on the bottom
15 of the fuel? Oh, that's 15 grams for fuel assembly.
16 Above that you fail. Below that you're okay for
17 cooling. This is a very similar notion. We looked at
18 that. But those tests included chemical effects.
19 Particulates were all thrown in. All the same kinds of
20 things that we've done here were done there.

21 So that's the same kind of context. They
22 find some kind of a performance index, which I think has
23 kind of been settled out in regulatory thinking or
24 -- that the fiber is the thing to look for. The
25 transportable fiber is the thing we need to be careful

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1 about. So then tests for the other materials in a
2 deterministic scope.

3 MR. MURRAY: So I wanted to go back to when
4 we were looking at that box of concern, because that is
5 the box that comes into the deterministic versus
6 probabilistic that was on page 46. Now, correct me if
7 I'm wrong as I say this, but I think I'm correct. There
8 are two criteria we look at on a deterministic box, not
9 just the performance of the head for the pumps, but we
10 also look at the in-core effects as a pass on that,
11 right? So I want to make sure that's clear. So that's
12 the other part of it. We have to look at both to define
13 is there a failure on in-core effects or is there a
14 failure on the sump? I wanted to make sure we were clear
15 on that.

16 MEMBER SHACK: Okay. So there's two
17 criterion --

18 MR. MURRAY: Really you have to have a
19 pass/pass to get the yes line. Okay? So in the way we
20 treat it I think we've looked at that. Bruce and Ernie,
21 am I incorrect with that?

22 MR. KEE: No, we'll get to that --

23 MR. MURRAY: Okay.

24 MR. KEE: -- to show that --

25 MR. MURRAY: But I think that helps is move

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1 --

2 (Simultaneous speaking)

3 MR. KEE: -- kind of at a higher level.

4 CHAIRMAN BANERJEE: Well, it would be
5 helpful to make this into -- depending on the procedure
6 you use into two of them, because what you're saying it
7 has to pass one criteria first and then it has to pass
8 the other. And to pass the other it's not obvious that
9 193, or whatever that number is, will pass that other
10 criteria.

11 MR. KEE: That's clear.

12 MEMBER SCHULTZ: So the simple chart is not
13 as simple as it looked.

14 MR. KEE: It's almost that simple.

15 MEMBER SCHULTZ: Well, yes, but you're
16 saying there are two criteria to pass the deterministic
17 block. One is listed and one is not.

18 MR. MURRAY: I think I'm using the right
19 logic here. It's not an or gate to pass. It's an and
20 gate to pass. But you have to have success on the
21 strainer and success on the core to be able to take it
22 right through to deterministic. Is that correct? So
23 that's another way of saying it.

24 CHAIRMAN BANERJEE: Yes, so you could
25 generate less fiber, in theory at least; I don't know,

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1 I haven't seen your data, and pass one of those, but not
2 pass the other one?

3 MR. KEE: That may be possible.

4 MR. MURRAY: Yes, you could.

5 CHAIRMAN BANERJEE: Yes.

6 MR. MURRAY: You could is the right answer.

7 CHAIRMAN BANERJEE: Yes. All right. We
8 need to go into this of course when this really comes
9 in front of us in infinite detail.

10 MR. KEE: I mean, we have that in mind.
11 We're looking at that. So that's a consideration in the
12 results.

13 So, should we move to the next slide, No.
14 49? So we have the big picture. And Wes eloquently
15 described all the considerations that went into the
16 deterministic part of these analysis. And now we're
17 looking at the R part, if you will. So the RoverD, the
18 R, the risk.

19 And on this figure you see we have the
20 risk-informed block. And that block requires or asks
21 for these scenarios which we've talked about that are
22 screened by the amount of fine fiber that arrives in the
23 sump to be evaluated for risk. That requires the
24 probabilistic risk assessment, the model of record that
25 we have in place. And Reg. Guide 1.174 guidance is what

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1 we've always used. And all the scenarios that have
2 arrived in the risk box are relegated to failure. And
3 this is in the interest of reducing complexity and scope
4 of review.

5 So we think about this, the risk, as
6 basically conceptually like an initiating event
7 frequency that has a likelihood of failure, if you will,
8 of one. All these scenarios go to core damage, so
9 that's the increase in risk due to the concerns
10 associated with GSI-191. And we determine a weighted
11 frequency for that. It's nominally centered around
12 NUREG-1829.

13 We look at the delta CDF initially as a
14 basic pass. Is it in Region III of the Reg. Guide 1.174
15 guidance or not? And if it is, then we move onto check
16 the probabilistic risk assessment to assess core damage
17 frequency and LERF. Those two numbers from the PRA
18 model of record orient you on the -- I always get these
19 confused -- it's either the abscissa or the -- I believe
20 it's the abscissa of the phase planes of delta CDF-CDF
21 and LERF and LERF. These are very familiar. And as
22 long as you have appropriate levels of CDF and LERF and
23 double CDF and double LERF, then you can make a
24 determination of where you are in Region III-123. And
25 we find actually that we're in Region III. And so the

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1 debris mitigation is acceptable at a very high level.
2 That's the whole picture on this diagram.

3 So moving to slide 50 --

4 MR. JOHNSON: Ernie, if I could -- this is
5 David Johnson. If I could get back to Mr. Stetkar's
6 question, the RoverD approach effectively decouples the
7 calculation of the deltas from the baseline. Okay? So
8 we don't use the PRA to calculate the deltas of CDF or
9 LERF.

10 CHAIRMAN STETKAR: You do though to the
11 extent that -- let me get back to -- suppose I had one
12 and only one train running. Could I get into trouble
13 with less than 192 pounds total release --

14 MR. JOHNSON: Yes.

15 CHAIRMAN STETKAR: -- if I had -- okay.
16 You're not doing that calculation, though.

17 MR. KEE: Actually I am.

18 CHAIRMAN STETKAR: You are? Okay. I
19 want to understand how you're doing that, because that's
20 --

21 MR. KEE: Yes, okay. We --

22 CHAIRMAN STETKAR: -- that gets back to
23 -- as long you're doing the delta okay for that case.
24 I understand how all the other deltas are done.

25 MR. KEE: Yes, sir. Yes, we'll -- and if

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1 you have further questions when we get to --

2 CHAIRMAN STETKAR: For that lower debris
3 release, if you will.

4 MR. KEE: So we'll go to slide 50. And
5 this has probably been made clear earlier, that we use
6 the deterministic strainer test data and we note the
7 amount of fine debris, debris from the CASA calculation
8 that uses accepted methods, acknowledging we still are
9 working through and making sure that's understood
10 jointly with the staff.

11 And then we're using, as I mentioned
12 already, deterministic core fiber loading data. That
13 means the 15 grams for fuel assembly which has
14 considered with it, as I mentioned, chemical effects of
15 debris, particulate debris and so on and so forth. But
16 what's important here is -- maybe I should mention this
17 is also somewhat of a conservatism since it's double
18 counted, the chemicals and the particulate are double
19 counted here.

20 But nevertheless, we use 15 grams for fuel
21 assembly as a core cooling limit and we ensure that the
22 amount that's -- this is a question that's been asked,
23 that the amount in the deterministic -- below that
24 deterministic threshold collected on the core is less
25 than the core cooling limit. And we'll talk about the

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1 fact that we need to think in two different regimes here,
2 cold leg break and hot leg break.

3 I think we've said this. Obtain the
4 smallest break size from CASA generation and transport
5 methodology at each weld location that produces more
6 fine fiber in the sump in the strainer test used.
7 They're the risk-informed scenarios. And then we
8 derive a total failure frequency based on the smallest
9 break sizes from NUREG-1829 to assign to delta CDF.
10 Notionally this is an initiating event frequency -- is
11 the way we think about it. Then we check to make sure
12 delta CDF is in Region III of Reg Guide 1.174. Then we
13 do the other checks, delta LERF-LERF is in Region III.
14 And defense-in-depth and safety margin requirements,
15 all that has to be in that as well. I we've responded
16 to some of those kinds of discussions earlier, but we're
17 also looking at all that in the context of RoverD.

18 CHAIRMAN STETKAR: Ernie, are you going to
19 talk a little bit more; I don't think you are, about the
20 -- you said you used the LOCA frequencies from
21 NUREG-1829. Back in our last meeting we had some
22 questions about the method that was being used at that
23 time to interpolate the data from NUREG-1829 versus
24 other schemes that might apply. And at that time that
25 was only one element of the entire picture. So is it

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1 important? Well, it's equally important with many
2 other elements. My sense is it becomes much more
3 important now because this is essentially your only part
4 of the risk information, the quantification of the
5 frequency as a function of break size on the uncertainty
6 in that frequency now determines your delta CDF, and to
7 a lesser extent your delta LERF for reasons we'll get
8 to. But are you still retaining that former
9 interpolation methodology with the -- whatever they
10 are, the Johnson probability distributions and so
11 forth?

12 MR. KEE: Okay. We're not.

13 CHAIRMAN STETKAR: You're not? Okay.

14 MR. KEE: We have --

15 CHAIRMAN STETKAR: That's good enough for
16 now.

17 MR. KEE: We've retained the linear
18 interpolation.

19 CHAIRMAN STETKAR: You have retained the
20 linear-linear interpolation?

21 MR. KEE: Yes, but we're agnostic on that
22 point. I mean, I guess the point is we're --scenario

23 CHAIRMAN STETKAR: It depends on the break
24 size range that becomes important, but I mean, how
25 important that interpolation methodology is depends on

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1 where you are --

2 MR. KEE: Correct. And so, uniformly --

3 CHAIRMAN STETKAR: Frequent breaks, if I
4 call them that.

5 MR. KEE: Yes, sir. And so my observation
6 is, because we've studied this to some extent, that if
7 you use log or log-log interpolation, the frequencies
8 realized would be lower, uniformly lower than using
9 log-linear, or linear-linear.

10 CHAIRMAN STETKAR: As I said, it kind of
11 depends on where those breaks are that you're targeting.

12 MR. KEE: I might mention that all the
13 breaks -- so all our breaks are large, very large, that
14 result in this kind of loading on the strainer. I don't
15 know if that helps.

16 CHAIRMAN STETKAR: I'll think about it.
17 But you are retaining the linear to linear?

18 MR. KEE: Yes.

19 CHAIRMAN STETKAR: Your original linear?

20 MR. KEE: In all the results I show
21 here --

22 CHAIRMAN STETKAR: Okay.

23 MR. KEE: -- we used linear-linear
24 interpolation.

25 CHAIRMAN STETKAR: Okay. Thanks.

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1 That's good enough to help for now. Thank you.

2 MR. KEE: So moving to slide 51, I just want
3 to review -- and I think we've seen this before, but as
4 Wes mentioned, there's three trains of emergency core
5 cooling that's also piggybacked, if you will, with
6 containment spray. So shown on the figure on the left
7 is the view of that system in the containment. What is
8 showing is the three strainers in the lower left of that
9 figure. And so here we see the three strainers and, as
10 I said, there's a mass that collects, a mass of fiber
11 that collects on these strainers and we have a pool here
12 that has a mass of fiber in it, and a volume, okay?

13 And you can follow any one of these -- let's
14 just follow the A train of total flow through the
15 strainer. So that's a low-head pump, a high-head pump
16 and a containment spray pump, as Wes mentioned. And
17 some of that flow notionally; we don't have the pump
18 shown, goes up to containment spray and comes right back
19 to the sump. So it goes through the strainer, goes up
20 and right back.

21 Some of the flow however that -- the flow
22 coming from the high-head/low-head pumps goes directly
23 into the reactor coolant system. And if unfortunately
24 that single train were to be on this location right here,
25 it would just go straight out the break. That's why

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1 it's such a low probability of success. Otherwise, it
2 would go in one of these three legs. I think that's all
3 we can talk about there.

4 And then on the right side of the figure we
5 have a notional representation of the flows through the
6 reactor vessel. And you see that the flow split shown
7 of the ECCS that goes here into the legs, we call that
8 flow split. The amount that goes to spray is gamma, so
9 the one line that's gamma makes it into the RCS.

10 Well, we're talking about cold leg breaks,
11 and what happens in cold leg breaks is the -- a lot of
12 water because we pump in a heck of a lot water. A lot
13 of it just goes right back out the breaks and just gets
14 recirculated and goes around through the strainers
15 again and again. But some of it, luckily, nicely -- we
16 shouldn't say luckily, but on purpose goes through the
17 core to cool it. And this is where we're talking about
18 the 15 grams for fuel assembly. If it exceeds that
19 amount, we can no longer cool the core.

20 So in the past something that we've
21 abandoned -- we've always talked about two criteria for
22 success at the core. Inlet for fiber loading. One of
23 them was seven-and-a-half grams per fuel assembly,
24 which we adopted as a limit for boric acid
25 precipitation. We've abandoned that. We no longer

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1 have that. We do a deterministic evaluation for hot leg
2 switchover timing. That's all that amounts to with no
3 criteria on the core.

4 It could be completely blocked for all -- we
5 don't want it to be, but it could be completely blocked
6 and we would still meet our boric acid precipitation hot
7 leg switchover timing. But if we exceed 15 grams for
8 fuel assembly, we'd no longer be able to cool the core.
9 That's pretty much the information on this break. And
10 hot leg breaks and small breaks in fact are treated
11 differently. As I mentioned earlier, all we have in the
12 risk-informed category are large breaks.

13 So moving to slide 52, just to summarize
14 what we've talked about is shown on the previous slide,
15 the fiber mass is conserved at three locations, the sump
16 pool, the strainers and the core. The flow network that
17 supports the mass conservation we'll see in the next
18 slide, but it can be described as a set of time-dependent
19 mass conservation equations.

20 The other kind of odd thing about all this
21 is because of the filtration function associated with
22 the measure data that we took with the strainer's
23 ability to capture and retain debris, they turn out to
24 be non-linear, a non-linear set.

25 And then the filtration function form is

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1 shown on slide 53. Bit of a busy slide. So the alpha
2 train total flow goes through the strainer where we have
3 this filtration function we mentioned.

4 MR. MURRAY: So we've got that slide.

5 MR. KEE: Yes, and you'll see that.

6 MR. MURRAY: That picture is blown up for
7 a better look at --

8 MR. HARRISON: That will be the next slide.

9 MR. KEE: Correct. And where we have this
10 filtration that goes on as the pool -- whatever the
11 concentration is in the pool passes through according
12 to the flow. Some is captured. Some is released. And
13 that's what goes down stream. And then recall that some
14 of it goes right back to the pool. That's that gamma
15 that we initially mentioned. The gamma goes straight
16 back to the pool. And then some goes on to the core,
17 but remember that some -- we're looking at cold leg
18 breaks. Some goes right back to the pool again because
19 it flows out the breaks. So the only amount that's
20 really demanded by the core is that required to meet
21 decay heat load.

22 CHAIRMAN BANERJEE: Typically in most
23 -- everybody does this. It's about 60 percent of the
24 -- typically for cold leg breaks, his statement, is
25 getting to the core. I may be wrong with that number,

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1 but it's close to that, right, for the cold leg break?
2 Is the cold leg break limiting for the core, or is it
3 the hot leg break?

4 MR. KEE: Well, I think we've talked about
5 this previously, but we show that we can completely
6 block the core and maintain cooling in hot leg breaks,
7 and in fact small breaks, so with complete blockage of
8 all the flow channels that either bypass or go straight
9 through the fuel assemblies. We also showed some
10 results for -- if you didn't happen to block up all the
11 channels --

12 (Simultaneous speaking)

13 CHAIRMAN BANERJEE: Just remind me, how
14 was it that with the hot leg break you kept that name?

15 MR. KEE: Sure. So when we go to
16 recirculation switchover -- so there's a period of time,
17 20 minutes or so in a large break when we're pulling
18 water from the RWST. Then we switch over to
19 recirculation, ECCS sump recirculation. At that point
20 in time we say that we've blocked the core. We did this
21 as a screening -- very early we've done this as a
22 screening calculation. Totally blocked the core and
23 the core bypass. So that's some kind of a theoretical
24 worst case.

25 CHAIRMAN BANERJEE: Yes.

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1 MR. KEE: And of course we're pumping in a
2 lot of water and it has to go somewhere. And the only
3 choice it has is to go back up through the steam
4 generators, through these channels that we mentioned,
5 those cooling channels to the upper head that we
6 reviewed, that they were slightly larger than we'd
7 modeled and so forth. That's the mechanism is that if
8 it doesn't block the core, then it goes through the core.
9 If it blocks the core, it goes around. The water has
10 to go somewhere and those are the only choices it has.
11 And so when it goes --

12 CHAIRMAN BANERJEE: You've done this
13 calculation with --

14 (Simultaneous speaking)

15 MR. KEE: Yes. Yes, sir.

16 CHAIRMAN BANERJEE: And you have the
17 results? Okay.

18 MR. KEE: Yes, sir.

19 CHAIRMAN BANERJEE: And you've submitted
20 this with staff to look at?

21 MR. KEE: Yes, sir. Len Ward has been
22 -- we actually worked closely with Len Ward and Ashley
23 Guzzetta to clarify --

24 CHAIRMAN BANERJEE: They are going to look
25 at this and see --

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1 (Simultaneous speaking)

2 MR. KEE: Yes, I think that's an ongoing
3 review.

4 CHAIRMAN BANERJEE: Okay.

5 MR. KEE: Or it may be finalized. I'm not
6 sure where they are on that.

7 CHAIRMAN BANERJEE: But that's the way
8 around the 15 grams of fiber?

9 MR. KEE: Oh, no. No, for cold leg break
10 we don't get around that.

11 CHAIRMAN BANERJEE: No, no, cold leg -- but
12 the 15 grams --

13 MR. KEE: For hot leg break.

14 CHAIRMAN BANERJEE: -- is for the hot leg
15 break, right?

16 MR. KEE: Yes, sir.

17 CHAIRMAN BANERJEE: The cold leg break is
18 a little bit higher, yes. If I remember --

19 (Simultaneous speaking)

20 MR. SMITH: Yes, this is Steve Smith.
21 Cold leg break I think was okay with 18 grams.

22 CHAIRMAN BANERJEE: Yes, 18 grams.

23 MR. SMITH: So using 15 is okay. It sounds
24 good to me. And I think that depending on the plant the
25 percentage of fiber that gets into the core on a cold

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1 leg break widely varies depending on what your ECCS flow
2 is. So since they have a high ECCS flow, they have
3 relatively low fraction getting into the core.

4 MR. KEE: Yes, we'll show that.

5 CHAIRMAN BANERJEE: Yes, so the devil here
6 is in the details on this, yes.

7 MR. KEE: Yes, sir. So as I mention here,
8 we have these measured data that we took --

9 MEMBER SCHULTZ: Ernie, before you go
10 on --

11 MR. KEE: I'm sorry.

12 MEMBER SCHULTZ: -- just for my
13 clarification, could you back up a couple slides to 51?
14 The title of the slide is "Fiber Penetration Uncertainty
15 Analysis." Why is uncertainty analysis chosen as a
16 descriptor?

17 MR. KEE: So it took me several slides to
18 get to the point where I actually show that --

19 MEMBER SCHULTZ: Okay.

20 MR. KEE: -- but you'll notice --

21 MEMBER SCHULTZ: I looked ahead several
22 slides, but I didn't see it yet. But --

23 MR. KEE: Oh, well, if --

24 MEMBER SCHULTZ: -- if you're going to come
25 to it and it will be clear, then I'll wait.

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1 MR. KEE: Yes, I'll show what I mean, but
2 I just wanted to lay conceptually the ground work of
3 where that comes from. So part of it is the hot leg
4 break where we've taken a very extreme position. And
5 then the cold leg break we've measured some things. And
6 those data of course are uncertain. And so we look at
7 bounds of that. And that's what's coming.

8 MEMBER SCHULTZ: That's sort of a title for
9 the forthcoming four or five slides. I got you. I'll
10 wait. Thank you.

11 MR. KEE: Yes, so first and foremost is
12 that measured data, as we all know, have uncertainty.

13 MEMBER SCHULTZ: We're on slide 54?

14 MR. KEE: I'm sorry, we went to 54. And so
15 now we're talking about putting fiber in on a strainer
16 and actually measuring in small quantities how much gets
17 through. We just keep adding it and adding it and
18 adding it so that we know how much was collected and how
19 much was passed through.

20 So we actually did these tests on a
21 full-size module at Alden and made these measurements.
22 And it can be shown or whatever that these data can be
23 bounded by these lines that are bounding the low
24 filtration efficiency and the high filtration
25 efficiency. So when it reaches one, the filtration

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1 efficiency equals one, that means 100 percent
2 filtration efficiency.

3 This looks like it gets to one. I don't
4 believe it ever gets to one because we actually used
5 -- the bounding function on these two bounds ends in an
6 exponential. You can see it more clearly on the lower
7 bound.

8 CHAIRMAN BANERJEE: Strainer mass means
9 the amount on the strainer?

10 MR. KEE: The amount collected. And this
11 is collected on a single module, so these results have
12 to be scaled to the full plant. So as we already
13 mentioned, there's 20 of these modules, so you have to
14 be careful to realize that this is what got collected
15 on one. And so there's 20, and so there's actually
16 -- whatever gets through one, 20 times that much gets
17 through.

18 CHAIRMAN BANERJEE: Well, what tends to
19 happen of course is that you've blocked these
20 sequentially. What happens is you block one and things
21 are bypassing it through the others and it just goes on.
22 So until you -- it doesn't happen like all of them
23 blocked together.

24 MR. KEE: Yes, sir. So that kind of
25 behavior has been observed on some strainer designs.

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1 CHAIRMAN BANERJEE: Large strainers.
2 Areas get blocked and --

3 MR. KEE: But these particular strainers
4 that are installed, that we had installed at South Texas
5 are designed particularly to avoid that type of loading.
6 They're called uniform loading and they're designed
7 specifically to ensure that they load up uniformly. So
8 that's how come --

9 CHAIRMAN BANERJEE: You have evidence to
10 that effect?

11 MR. KEE: Okay. I'm going to have to look
12 at Wes, because that was done by --

13 MR. SCHULZ: PCI, right.

14 MR. KEE: -- PCI.

15 MR. SCHULZ: That's evidence from our
16 tests we've done and that we've done -- other folks have
17 done, too, yes. That's a feature of this advanced
18 design strainer.

19 MR. KEE: They're literally designed to do
20 that.

21 CHAIRMAN BANERJEE: So a test on one
22 strainer can be carried over to multiple strainers,
23 right?

24 MR. KEE: I think that's something we need
25 to --

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1 MR. SCHULZ: For uniform loading?

2 MR. KEE: Yes.

3 MR. SCHULZ: I mean, that's the feature of
4 the PCI design, yes.

5 CHAIRMAN BANERJEE: Well, that's a claimed
6 feature.

7 MR. KEE: Claimed or shown.

8 (Simultaneous speaking)

9 CHAIRMAN BANERJEE: Well, I think you
10 should show that this is consistent also with the amount
11 that they collected downstream in your experiments,
12 right, because they did -- I understood from what Steve
13 was saying that they did collect what was happening
14 -- what went through downstream. They didn't separate
15 it into fiber and particulate, but you have the total
16 amounts.

17 MR. KEE: Okay. So just to clarify on
18 this, this is only fiber that we're looking at --

19 CHAIRMAN BANERJEE: Right, right.

20 MR. KEE: -- passing through.

21 CHAIRMAN BANERJEE: But everything has to
22 hang together. You've got experiments with real
23 debris, I mean mixed debris, at least some
24 representative experiments which you did July 2008 and
25 in February 2008 and --

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1 MR. KEE: But we didn't do bypass. I
2 just --

3 (Simultaneous speaking)

4 CHAIRMAN BANERJEE: I thought Steve was
5 saying they collected what was happening downstream.

6 MR. KEE: I don't --

7 (Simultaneous speaking)

8 MR. SCHULZ: We did collect bypass in 2008,
9 yes.

10 MR. KEE: Like this?

11 MR. SCHULZ: We have data, some data, yes.

12 MR. KEE: Oh, I think it's pretty limited.

13 MR. SMITH: This is Steve Smith. The way
14 the bypass was collected during those tests, they didn't
15 -- during these tests they did full filtration to be sure
16 they knew everything that came through the strainer
17 because it's much easier and much more accurate
18 quantification. For testing that they did in 2008 they
19 took grab samples. So they were only getting grab
20 samples to determine how much they were getting passed
21 at each moment in time on --

22 (Simultaneous speaking)

23 CHAIRMAN BANERJEE: So you feel that fiber
24 only in place of fiber plus particulates is conservative
25 in terms of the pass-through?

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1 MR. SMITH: I didn't understand.

2 CHAIRMAN BANERJEE: In other words, if you
3 have particulates it's a better filter for fiber for the
4 -- so the real situation this could be conservative.

5 MR. SMITH: It's probably a better filter
6 with particulate.

7 CHAIRMAN BANERJEE: Yes. Well, it would
8 be nice to see those grab samples, what they found.
9 This was done where, in Alden, too?

10 MR. SMITH: Yes.

11 CHAIRMAN BANERJEE: With fiber only?
12 With only single discs?

13 MR. KEE: Well, the module, a full module.

14 CHAIRMAN BANERJEE: Oh, a full module?

15 MR. SMITH: It was the same setup.

16 CHAIRMAN BANERJEE: Okay. Same setup.
17 All right. No, I got confused.

18 MR. KEE: We showed that picture, so if we
19 need to, we could go back.

20 CHAIRMAN BANERJEE: No, no. I know what
21 it said.

22 MR. KEE: Okay.

23 CHAIRMAN BANERJEE: Fine.

24 MR. KEE: So, yes.

25 CHAIRMAN BANERJEE: With a full module?

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1 MR. KEE: Yes, sir.

2 CHAIRMAN BANERJEE: And what this shows is
3 that low loadings you get about 40 percent going
4 through?

5 MR. KEE: Roughly.

6 CHAIRMAN BANERJEE: As it loads up, less
7 and less goes through, yes.

8 MR. KEE: Just like your air-conditioning
9 filter.

10 CHAIRMAN BANERJEE: Yes.

11 MR. KEE: That you always forget to change.

12 CHAIRMAN BANERJEE: This is the point I was
13 making earlier, that when you have less fiber, more goes
14 through.

15 MR. KEE: Correct. Absolutely. Yes,
16 sir, that's physically -- meaning it makes sense.
17 Right.

18 CHAIRMAN BANERJEE: Right.

19 MR. KEE: Fortunately or unfortunately we
20 have plenty to stop it from going on.

21 CHAIRMAN BANERJEE: So we should add fiber
22 to our plants, right, to get rid of the downstream
23 effects?

24 MR. KEE: This is what the risk kind of
25 perspective brings. They're competing effects, right?

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1 So I want to just move to slide 55, if we're
2 done with that. So we've reposited these equations in
3 RoverD and we've solved them. The staff is familiar
4 with an explicit method that has a lot of reliance on
5 time dependence. We now have redone that work in
6 implicit solver. That doesn't suffer from time step
7 effects. And these are the differential equations that
8 we solved. They're there for people to look at.

9 MEMBER BALLINGER: Oh, it's lsoda? I know
10 lsodi and lsode. Never heard of lsoda.

11 MR. KEE: David, did I make a typo there?

12 MEMBER BALLINGER: The "i" is the
13 implicit. The "e" is the explicit. It's just a sparse
14 matrix solver, right?

15 MR. KEE: No, it's an ADAMS method
16 implicit solver for -- yes.

17 CHAIRMAN BANERJEE: But you still have to
18 solve, if it's implicit, a matrix --

19 MEMBER BALLINGER: It's basically a matrix
20 inverted, yes. But it's a sparse matrix inverted.

21 CHAIRMAN BANERJEE: Then why would you
22 have to do that for an explicit method?

23 MEMBER BALLINGER: You can do it either
24 way.

25 CHAIRMAN BANERJEE: Yes, but you wouldn't

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1 need to. Anyway, this is --

2 MR. KEE: Yes, it's just a point that we're
3 not doing it explicitly any more.

4 CHAIRMAN BANERJEE: Some ode solver.

5 MEMBER BALLINGER: Those two routines we
6 love to hate.

7 CHAIRMAN BANERJEE: I have no doubt that
8 they were solved accurately.

9 MR. KEE: It was several decimal places.
10 The mass balance is accurate. That's something we
11 checked.

12 So this is what we get out of this solution
13 to those equations. And this is the final point to
14 answer the question about the --

15 (Simultaneous speaking)

16 CHAIRMAN BANERJEE: The uncertainty, was
17 that that band you showed in the previous slide?

18 MR. KEE: There's more included here than
19 that.

20 CHAIRMAN BANERJEE: Oh, okay.

21 MR. KEE: So I looked around the area where
22 we passed with the deterministic method. We ran cases
23 where we had a lot of debris with very little water
24 volume. These actually can't happen this way, but to
25 really bound it, if you assume that basically a more than

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1 large amount of debris is in the sump in the small water
2 volume, that represents a high concentration. And then
3 solve that at the upper band and lower band of the data,
4 the measured data. And then do that the opposite, the
5 upper and lower bands of the measured data. And these
6 are the kind of results that we obtained with that kind
7 of uncertainty or bounding analysis, if you will.

8 CHAIRMAN BANERJEE: I'm trying to
9 understand. I understood the bounds of the data that
10 you showed in the previous slide. And you do these
11 calculations using those uncertainties, but you also
12 propagate that into the concentration field, is that it?

13 MR. KEE: That we did not do here. We
14 could do that, and we do that in CASA in fact, but again,
15 there was some uncertainty as to how that was being done.
16 So in this case we looked at explicit bounds. So we
17 looked at the lower bound of the data, the upper bound
18 of the data.

19 CHAIRMAN BANERJEE: Of the filtration
20 data?

21 MR. KEE: The filtration data. And then
22 we looked at low-concentration and high-concentrations
23 in the pool. Like I think you were alluding to, well,
24 what about a low concentration and a high concentration?
25 Is that going to be a bad result?

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1 CHAIRMAN BANERJEE: Right.

2 MR. KEE: And so what this shows is if you
3 take all those kinds of questions and pose them --

4 CHAIRMAN BANERJEE: Okay. So you
5 effectively answered the question I had.

6 MR. KEE: Yes, sir.

7 CHAIRMAN BANERJEE: Yes.

8 MR. KEE: That was what I was trying to --
9 (Simultaneous speaking)

10 CHAIRMAN BANERJEE: Can you lead us
11 through this very slowly, because I was confused by
12 these --

13 MR. KEE: Do we need to go back?

14 CHAIRMAN BANERJEE: No, no. I understood
15 what you did. So here, what do these --

16 (Simultaneous speaking)

17 MR. KEE: So these concentrations, they're
18 funny units; I acknowledge that, but we just kind of
19 looked at this in terms of native units.

20 CHAIRMAN BANERJEE: Yes.

21 MR. KEE: So we put a more than -- put in
22 500 pounds, the equivalent of roughly 500 pounds, I
23 believe that was put in for debris and the small break
24 pool volume. So we had a large amount, a very large
25 break with a very small break pool volume, which was

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1 around 300,000 gallons.

2 Do you recall that number, Bruce? Anyway,
3 it reduces to the -- the high one is 0.832 grams per
4 gallon in terms of the C sub-p that we showed on the
5 previous full concentration. So that's what's being
6 pulled through the strainer in terms of the
7 concentration initially. And that will attain
8 whatever it will attain as time goes by in the mass
9 conservation. And what that produces at the lower
10 bound of the filtration function is 441 grams on the
11 core. And what it produces on the upper band of the
12 filtration function, the better filtration is 247
13 grams. This is what really drives everything.

14 Then looked at it with very little debris,
15 less than the 192 pounds of fine fiber and with a very
16 large volume in the pool, so very low concentration of
17 fiber in the pool, high and low bands of the filtration
18 function. And these are the time-dependent results
19 from that set of differential equations that were shown.

20 CHAIRMAN BANERJEE: So what's the most
21 sensitive there? How much bypasses the core?

22 MR. KEE: Well, the filtration efficiency
23 is huge, right?

24 CHAIRMAN BANERJEE: Yes, that --

25 MR. KEE: And then the next probably

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1 highest one is the concentration in the pool. You see
2 there's maybe 10 percent. And I also looked at
3 different flow rates, because we can do that, and that
4 was really uninteresting. So instead of making this
5 thing very complicated with different flow rates, those
6 can be examined, but they don't produce any kind of
7 significant change in the results. I mean, the point
8 is we're looking at like two --

9 (Simultaneous speaking)

10 CHAIRMAN BANERJEE: You've got a number of
11 parameters in your model, right?

12 MR. KEE: Yes, sir.

13 CHAIRMAN BANERJEE: One is gamma
14 superscript a, gamma superscript b, gamma superscript
15 c. And then you've got -- I assume lambda is another
16 parameter?

17 MR. KEE: Yes, sir. Well, we don't
18 actually need lambda. You'll see that the algebra gets
19 rid of that.

20 CHAIRMAN BANERJEE: But you use gammas.
21 They're what you call gamma superscript k. How do you
22 select those?

23 MR. KEE: Okay. So the k refers to the
24 train. So there's three trains. K is a, b, c.

25 CHAIRMAN BANERJEE: Right, a, b, c. Yes.

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1 MR. KEE: And the gamma of course is the
2 fraction of flow that is fraction of flow that goes to
3 containment spray. And lambda is the fraction that
4 goes to the core, but you don't need that. The algebra
5 gets rid of that. And so all you need is to -- this
6 second equation does the weighting. That flow network,
7 as you recall, all the flows come together in the reactor
8 coolant system that arrived there. And then they each
9 have their individual concentration that needs to be
10 appropriately applied to the flow --

11 (Simultaneous speaking)

12 CHAIRMAN BANERJEE: Right, I think one of
13 the most -- certainly one important would be gamma
14 superscript b because that determines the split of the
15 flow that goes to the core in the bypass, right?

16 MR. KEE: You would --

17 CHAIRMAN BANERJEE: How sensitive is it
18 to --

19 MR. KEE: It's not sensitive, really.

20 CHAIRMAN BANERJEE: It's not sensitive to
21 gamma b?

22 MR. KEE: No. But I mean that's totally
23 -- we can run those cases. I ran several different
24 scenario and --

25 CHAIRMAN BANERJEE: So typically what

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1 people will do is they will simply assume some fraction
2 is going to the core and some fraction bypasses?

3 MR. KEE: Oh.

4 CHAIRMAN BANERJEE: And then they'll say
5 60 percent of the fiber goes to the core because --

6 MR. LETELIER: If I could interject. This
7 is Bruce Letelier from Alion. The choice of a gamma
8 will change the time behavior of those figures --

9 CHAIRMAN BANERJEE: Yes.

10 MR. LETELIER: -- but it won't change the
11 ultimate accumulation.

12 MR. KEE: Maybe that's the point is what I
13 wrote here was like after many, 150 minutes, what it
14 achieved after a long -- couple or three hours.

15 CHAIRMAN BANERJEE: Ultimately all the
16 water gets filtered. Is that -- so it --

17 MR. KEE: At some long time, yes. Yes.
18 Yes, sir. It builds up fairly rapidly so you see that
19 it drops off the rate that it builds in.

20 CHAIRMAN BANERJEE: Yes.

21 MR. KEE: And with regard to the flow
22 split, we treat that directly as --

23 CHAIRMAN BANERJEE: I can see that it --

24 MR. KEE: The Q --

25 CHAIRMAN BANERJEE: -- gives you the time

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1 constant.

2 MR. KEE: There you go. Q as a function of
3 time is there, yes. Which is just a decay heat demand,
4 which is well known.

5 CHAIRMAN BANERJEE: Okay. So I think
6 that's great. Comes up with a very positive result.
7 What we might want to do is, if you've finished with
8 this, take a break now, because you're now going on to
9 things which are more in the delta CDF and all these
10 things.

11 Our distinguished Chairman, won't you
12 after lunch take over a little bit?

13 (Laughter)

14 (Simultaneous speaking)

15 CHAIRMAN BANERJEE: Anyway, so I think it
16 would be a good point to take a break for lunch. We all
17 agree? Whether we fight with each other and decide
18 who's going to be chairing it, that's an internal -- so
19 what about a lunch break for an hour? Let's come back
20 at 1:15.

21 (Whereupon, the above-entitled matter went
22 off the record at 12:05 p.m. to reconvene at 1:15 p.m.
23 this same day.)

24

25

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A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

9

(1:16 p.m.)

10

CHAIRMAN BANERJEE: We are back in session

11

and we will continue from where we were. Before we go

12

to the next step, I just had a little question related

13

to the previous thing, just a matter of clarification

14

When we looked at this little diagram on page 53, or

15

slide 53, you say the core acts as a fiber mass sink.

16

MR. KEE: Yes, sir.

17

CHAIRMAN BANERJEE: Do we have a

18

filtration function for the core there?

19

MR. KEE: Hundred percent.

20

CHAIRMAN BANERJEE: Everything comes out

21

there?

22

MR. KEE: Anything that goes to the bottom

23

of the core is -- it's a little bit of a conservatism,

24

but that's what we have assumed, yes.

25

CHAIRMAN BANERJEE: Okay. And then what

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1 accumulates in the core is shown where?

2 MR. KEE: M sub-c is --

3 CHAIRMAN BANERJEE: Right, but you showed
4 us in slide 56 --

5 MR. KEE: Yes, the --

6 CHAIRMAN BANERJEE: -- is that the amount
7 that's going into the core over time?

8 MR. KEE: Yes, sir. The second equation,
9 yes.

10 CHAIRMAN BANERJEE: This is a --

11 MR. KEE: Well, the amount that's
12 accumulated of course is the rate of change of that.

13 CHAIRMAN BANERJEE: So the total core
14 fiber mass, that assumes 100 percent coming out in the
15 core, whatever goes to that core?

16 MR. KEE: A hundred percent of what -- that
17 split in the cold leg break, yes, goes to the bottom of
18 the core. Actually, this is pretty much what everybody
19 does now even.

20 CHAIRMAN BANERJEE: So everything that
21 goes to the core stays in the core?

22 MR. KEE: That's what we assume, yes, sir.

23 CHAIRMAN BANERJEE: Okay. So that
24 basically is the cumulative amount which is captured in
25 the core?

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1 MR. KEE: Yes, sir. The final answer,
2 these are -- if I had labeled this graph, it would have
3 said mass of fiber on core, M sub-c.

4 CHAIRMAN BANERJEE: M sub-c?

5 MR. KEE: That means these graphs as a
6 function of time, yes.

7 CHAIRMAN BANERJEE: Great.

8 MEMBER SHACK: Well, you have total core
9 fiber, which is close.

10 MR. KEE: Is that what it says?

11 MEMBER SHACK: Yes, after you squint
12 enough.

13 (Simultaneous speaking)

14 MR. KEE: It used to be bigger. Oh, yes,
15 there it is. Total core. Yes.

16 CHAIRMAN BANERJEE: Yes, so just to clear
17 things up, the strainer removes the rest of it
18 effectively, right?

19 MR. KEE: Yes, sir. Yes, these are the
20 only two places where filtration occurs. On the
21 strainer is -- according to those data. And the core
22 is 100 percent by assumption.

23 CHAIRMAN BANERJEE: So I'm just trying to
24 picture this. Flow goes through the strainer.
25 Initially 60 percent of that material is caught on the

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1 strainer right away, whatever the flow was. And then
2 some fraction of that flow goes through the core.

3 MR. KEE: Yes, sir.

4 CHAIRMAN BANERJEE: And some fraction goes
5 elsewhere. And the fraction that goes through the core
6 has 40 percent of that liquid left, right, in there? I
7 mean, 40 percent of the fiber left. Whatever goes
8 through the core. And that's taken out right away.

9 MR. KEE: Roughly, but of course there's
10 -- recall that some -- if you're referring to the figure
11 on the left --

12 CHAIRMAN BANERJEE: Yes.

13 MR. KEE: -- that some returns directly.
14 The gamma --

15 CHAIRMAN BANERJEE: Right, the --

16 MR. KEE: -- splits. So it's right back to
17 the sump and then -- yes.

18 CHAIRMAN BANERJEE: Yes, and it goes
19 through it again?

20 MR. KEE: Through it again.

21 CHAIRMAN BANERJEE: So I'm just trying to
22 visualize what's happening. So 40 percent is passing
23 through typically right at the beginning.

24 MR. KEE: Right away at the start, very
25 start, the first --

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1 CHAIRMAN BANERJEE: Yes.

2 MR. KEE: Yes.

3 CHAIRMAN BANERJEE: So, and that 40
4 percent is split into two parts, or whatever.

5 MR. KEE: Right.

6 CHAIRMAN BANERJEE: One part goes through
7 the core, is captured, and the rest is outside the core?

8 MR. KEE: Correct.

9 CHAIRMAN BANERJEE: And it builds up that
10 slowly?

11 MR. KEE: Yes, we haven't examined the time
12 --

13 (Simultaneous speaking)

14 CHAIRMAN STETKAR: -- is a big fraction.
15 Gamma is a large fraction.

16 MR. KEE: That's another point.

17 CHAIRMAN BANERJEE: What is gamma-a and
18 gamma-b, to be clear?

19 MR. KEE: As I mentioned earlier, that
20 gamma refers to the containment spray and it's -- real
21 rough numbers, 3,500 gallons per minute. Then the high
22 head is like 1,500-1,600. And then low heads, rough,
23 35, 38, some number like that. So it's, as I recall,
24 like 40 percent total of the flow.

25 CHAIRMAN STETKAR: For a large LOCA, but as

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1 you get smaller, it's going to be a larger fraction,
2 right?

3 MR. KEE: That's true. For a small LOCA it
4 will be a larger fraction.

5 CHAIRMAN STETKAR: For a small LOCA it's a
6 heck of a lot fraction.

7 MR. KEE: Yes, sir. Yes, because low head
8 won't --

9 CHAIRMAN STETKAR: Low head won't be
10 delivering flow.

11 MR. KEE: Shut-off head -- dang, I was
12 trying to come up with that. It's roughly 400 PSI.

13 CHAIRMAN BANERJEE: Okay. So the picture
14 you show here is -- for what case are you running, a
15 double-ended cold leg break, or what is it?

16 MR. KEE: Well, in general any cold leg
17 break.

18 CHAIRMAN BANERJEE: Any cold leg break
19 does this?

20 MR. KEE: Yes, sir. Because the flow
21 rates -- well, we can generalize it to any break size,
22 but I looked at large breaks.

23 CHAIRMAN BANERJEE: So the case that you
24 show here is for the --

25 MR. KEE: For a large break, yes.

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1 CHAIRMAN STETKAR: This has got a large
2 break?

3 MR. KEE: Medium-large. And that's what
4 we're looking at.

5 CHAIRMAN STETKAR: Okay.

6 CHAIRMAN BANERJEE: And how much fiber?
7 Is this 17 ZOI?

8 MR. KEE: No. Well, so nominally I'm
9 looking around the 190 pounds, right, that we're
10 concerned with. This is --

11 (Simultaneous speaking)

12 CHAIRMAN BANERJEE: This is for 190
13 pounds?

14 (Simultaneous speaking)

15 MR. KEE: -- much lower.

16 CHAIRMAN BANERJEE: Is this for the 190
17 pounds?

18 MR. KEE: So these --

19 CHAIRMAN BANERJEE: The picture that
20 you're showing?

21 MR. KEE: Oh, sorry. So these fractions
22 that are shown, the high and low, one's much lower than
23 192. One's much higher. And then the volume in the
24 pool, as I mentioned earlier, doesn't -- it's kind of
25 illogical because the pool volume -- to get a maximum

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1 concentration you would assume a small break. So pool
2 volume with a larger break LOCA double the amount of
3 fibers, what was --

4 (Simultaneous speaking)

5 CHAIRMAN BANERJEE: Well, what did you use
6 here --

7 MR. KEE: Double.

8 CHAIRMAN BANERJEE: -- 193 pounds of
9 fiber?

10 MR. KEE: Oh, no, no, no, no. Which, the
11 top? For the high --

12 CHAIRMAN BANERJEE: Yes.

13 MR. KEE: -- that fraction is like 300,000
14 gallons in the pool and roughly 500 pounds of fiber.

15 CHAIRMAN BANERJEE: For the high?

16 MR. KEE: High. So looking at a really
17 high, I actually thought -- oh, it does. That one makes
18 the most. And then for low I pick a very -- 500,000.
19 All of it's in there. I think I did more than that,
20 550,000, and divide it by less than 192 pounds to get
21 a very low estimate of the concentration in the pool.
22 That's what matters in the --

23 CHAIRMAN BANERJEE: Okay. So it's --

24 MR. KEE: But we can look at this as much
25 as we want.

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1 CHAIRMAN BANERJEE: Yes.

2 MR. KEE: It's very --

3 CHAIRMAN BANERJEE: So I think the staff is
4 setting up an independent confirmation --

5 MR. KEE: Oh, good. Yes.

6 CHAIRMAN BANERJEE: -- calculation,
7 right? Is that right?

8 MR. WIDMAYER: Yes.

9 CHAIRMAN BANERJEE: Yes. So, it's
10 interesting. I'm surprised that so little fiber is
11 coming out in the core given so much fiber. I mean, the
12 physics is not clear because you've got two screens.
13 One is the strainer and the other is the core. And so,
14 why is it distributing in this rather unexpected way?

15 MR. KEE: Yes. So, I don't know that we'll
16 answer anything right here, but this Q-c is a function
17 of time. The earliest that that -- the largest value
18 that would be seen by these equations for that number
19 which is based on decay heat requirements is on the large
20 break LOCA, like 20 minutes, half an hour in. So by then
21 of course decay heat is very low. As a fraction of the
22 total amount of flow, it's small. Like I mentioned, an
23 enormous amount of flow goes through these emergency
24 core cooling and containment spray systems. So a lot
25 of it's going around the strainer, getting collected on

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1 the strainer and some of it's going down through the
2 core, sure, and getting caught there. I think I'm just
3 --

4 (Simultaneous speaking)

5 CHAIRMAN BANERJEE: So there's
6 circulation around the strainer which is not going to
7 the core?

8 MR. KEE: Correct. Yes. So, a lot is
9 spilling out the break because it's not being demanded
10 by the core boil off. A lot is being recirculated by
11 the containment spray part. We can vary all those.
12 And like I mentioned, we did look at sensitivities on
13 flows, but without doing a huge matrix it became obvious
14 that what the driver was the filtration function
15 primarily in the concentration in the pool. But we made
16 a solver that's completely general so --

17 CHAIRMAN BANERJEE: Yes, so the innovation
18 here basically compared to other studies is that
19 filtration function is made a function of the loading
20 on the filter. Otherwise, you can just assume 40
21 percent goes through --

22 MR. KEE: Ah.

23 CHAIRMAN BANERJEE: -- or something.

24 MR. KEE: Yes.

25 CHAIRMAN BANERJEE: So that's the --

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1 MR. KEE: And that would just be a --

2 CHAIRMAN BANERJEE: That's the
3 innovation, yes.

4 MR. KEE: -- pure exponential kind of
5 decay. Yes.

6 CHAIRMAN BANERJEE: Okay.

7 MEMBER SCHULTZ: This is with a full
8 complement of the filtration system? I mean, all the
9 strainers are in play?

10 MR. KEE: Yes, sir. So we're trying to
11 look at downstream.

12 MEMBER SCHULTZ: Yes.

13 MR. KEE: So mostly coming from all of them
14 in operation.

15 CHAIRMAN BANERJEE: Okay. So, I've think
16 we've clarified things, so you can now continue with
17 your delta CDF.

18 MR. KEE: So, this is slide --

19 (Simultaneous speaking)

20 MR. MURRAY: So, let me recap one thing,
21 because I wanted to make sure it was clear. We had
22 talked about we can look at both, we do look both on that
23 and gate. When we ran through it, all of the -- and I
24 think Ernie just hit it, was that what we found, those
25 that went to failure was dominated by the filtration.

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1 So the in-vessel effects we didn't have a failure or one
2 that went to failure on the in-vessel effects. That
3 correct?

4 CHAIRMAN BANERJEE: Well, we haven't
5 talked about the hot leg, but you're saying there's some
6 calculations that you've done which suggest that the hot
7 leg break is not limiting, right?

8 MR. VAGHETTO: Excuse me, Mr. Chairman, is
9 the phone line open? We have some people who aren't
10 able to join.

11 MR. WIDMAYER: Let's open it. I can do
12 that if you --

13 CHAIRMAN BANERJEE: Yes, let's do that.

14 PARTICIPANT: Well, you're talking about
15 just to listen in, correct?

16 CHAIRMAN BANERJEE: Oh, the --

17 (Simultaneous speaking)

18 CHAIRMAN STETKAR: To listen in, it should
19 be open now.

20 PARTICIPANT: Listen in? Okay. I
21 thought you wanted them to talk.

22 CHAIRMAN STETKAR: Derek, don't open it.

23 MR. WIDMAYER: Okay.

24 CHAIRMAN BANERJEE: No, but let's verify.
25 Can you check that they can hear? Can they send you an

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1 email that they can hear?

2 PARTICIPANT: Oh, we muted. They can't
3 hear.

4 MEMBER REMPE: Yesterday that happened
5 with Mike's line several times, that he couldn't hear.

6 MR. MURRAY: So, your question was before
7 we went to the phone?

8 CHAIRMAN BANERJEE: The hot leg is never
9 limiting. That's what you're saying?

10 MR. MURRAY: From in-vessel?

11 CHAIRMAN BANERJEE: Yes.

12 MR. MURRAY: That's what the results are.

13 CHAIRMAN BANERJEE: Because you've got
14 things coming back in your RELAP calculations?

15 MR. MURRAY: That's correct. Ernie, the
16 question is on the hot break why did hot leg break not
17 carry us to core damage? And it's again what we already
18 discussed.

19 MR. KEE: Yes. So if we can just look at
20 this figure, in the hot leg break of course nothing's
21 going out really from the cold leg side. All of the flow
22 is going through. There's no split of this lambda.
23 It's all going up through.

24 CHAIRMAN BANERJEE: Yes.

25 MR. KEE: And so, once again we assume it

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1 all blocks up on the core. And then we look at the
2 thermal hydraulics for that situation at the time of
3 recirculation switchover and verify that as I mentioned
4 that the overwhelming amount of emergency core cooling
5 flow will go up and over instead of --

6 (Simultaneous speaking)

7 CHAIRMAN BANERJEE: Well, you calculated
8 with RELAP, right?

9 MR. KEE: We calculate, yes.

10 CHAIRMAN BANERJEE: I mean you take the
11 whole circuit --

12 MR. KEE: Yes.

13 CHAIRMAN BANERJEE: -- when you do the
14 calculation with the hot leg break? It's a proper
15 calculation --

16 MR. KEE: Yes, sir.

17 CHAIRMAN BANERJEE: -- with the resistance
18 in the core that builds up as you get material in there?

19 MR. KEE: Okay. So just to describe that,
20 summarize it, we assume a theoretical limit to -- so we
21 assume that it's blocked when we go to recirculation.
22 It's as if all the material that comes to the core blocks
23 it all.

24 CHAIRMAN BANERJEE: But I guess most of the
25 analysis that we've seen in the past, what they do is

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1 they put a K factor in the core. It can be varied.

2 MR. KEE: That would be nice, yes.

3 CHAIRMAN BANERJEE: And --

4 MR. KEE: More flow can go through then.

5 CHAIRMAN BANERJEE: -- you can get some
6 flow through it.

7 MR. KEE: Yes.

8 CHAIRMAN BANERJEE: But what they're
9 looking for typically is to keep the flow above an amount
10 which leads to extended dry-out above the core. So
11 there's a limit to which --

12 (Phone dialing)

13 CHAIRMAN BANERJEE: -- tell me what it is.
14 But there's a temperature limit which is set --

15 (Bridge line interference)

16 MEMBER SCHULTZ: Ernie, just to confirm,
17 on slide 56 the values that are shown there
18 demonstrating that the maximum will not be reached,
19 those correspond to 192 pounds.

20 MR. KEE: These actually are limiting
21 cases for much more and more less for --

22 MEMBER SCHULTZ: Much more and much less?
23 Okay.

24 MR. KEE: Basically in terms of the
25 concentration, let me put it that way.

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1 MEMBER SCHULTZ: Okay.

2 MR. KEE: Yes. So what matters to this is
3 what's the concentration in the pool, right?

4 MEMBER SCHULTZ: Understood.

5 MR. KEE: What we start with.

6 CHAIRMAN BANERJEE: So you started with
7 either much higher than 192 pounds in the pool or much
8 lower. Okay. And this is how it looks, what ends up
9 in the core.

10 The calculation for the hot leg I was
11 talking about typically would look at what goes into the
12 core and loss related to that. So it's not necessary
13 to completely block the core. It's only necessary to
14 block it enough to get extended dry-out so that if you
15 get say quality of -- let's take a number. I don't want
16 to tell you what tell you what other people are doing,
17 but if they have 50 percent quality, that can exit
18 quality, that could lead to regions of dry-out which is
19 sufficient to give problems.

20 So there is flow still. So it's just a
21 pressure loss criteria that you set, the K factor.
22 There's some flow. It's not completely blocked off.
23 And that in some way got translated back to a criterion,
24 if you wish, of 15 grams per channel. But if you're
25 doing a more elaborate calculation, all sorts of flow

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1 paths and all, then you might want to do this properly
2 with a K factor in the core due to blockage. If you
3 completely block the core off, then of course you're
4 going to get everything drying out on top, right?

5 MR. KEE: Well, it's kind of a limiting
6 case that's --

7 CHAIRMAN BANERJEE: Yes, it's very much a
8 limiting case.

9 MR. KEE: -- extreme. But the truth is I'm
10 not familiar, but we don't -- Rodolfo, do you recall the
11 worst case void fractions for the large double-ended hot
12 leg complete blockage?

13 MR. VAGHETTO: This Rodolfo from Texas
14 A&M. You are asking like the void fraction after the
15 full core blockage at the bottom of the core?

16 MR. KEE: Right.

17 CHAIRMAN BANERJEE: No, no, no. All I'm
18 asking is if you block the core completely, then you're
19 going to dry out everything above the blockage anyway,
20 which is a worst case scenario?

21 MR. KEE: Actually that --

22 (Simultaneous speaking)

23 CHAIRMAN BANERJEE: -- take that?

24 MR. KEE: We do analyze that case, exactly
25 that case at the time of recirculation switchover and

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1 we don't get dry-out, I don't thin.

2 MR. VAGHETTO: No, what we have observed
3 too during the simulations is that at the time you block
4 the core, of course you see a peak cladding temperature
5 increasing. But because we three injecting trains
6 available in the cold leg side, what happens, the water
7 start like -- the pumps start filling the vessel from
8 the cold side and the first injection of water happens
9 very quickly through the flow path to the vessel
10 entrance with the upper plenum. So sadly you have water
11 arriving to the core at the top of the core from what
12 we have mentioned the last time being what we call the
13 upper plenum spray. And after there is an additional
14 --

15 (Simultaneous speaking)

16 CHAIRMAN BANERJEE: Upper plenum what?

17 MR. VAGHETTO: Last time we mentioned
18 these holds all the way around. We call it the upper
19 plenum sprays.

20 CHAIRMAN BANERJEE: Okay.

21 MR. VAGHETTO: And the core basically sees
22 the most immediate like flow from the cold side. And
23 then after, depending again on the break size, you may
24 also get the steam generator and have an additional flow
25 from the steam generator spill. So you do see an

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1 increase in the peak cladding temperature, but then at
2 some point when you start to like filling the
3 -- replacing the evaporation rate, then that peak
4 cladding temperature stabilizes, and it stabilizes at
5 a level below the 800 Fahrenheit we used as a
6 figure --

7 (Simultaneous speaking)

8 MR. KEE: And do you recall, do we achieve
9 50 percent void fraction in that case as it lowered? I
10 thought it was --

11 CHAIRMAN BANERJEE: No, quality. The
12 question is what is the quality?

13 MR. KEE: Quality?

14 CHAIRMAN BANERJEE: Yes.

15 MR. KEE: Wow.

16 MR. VAGHETTO: Honestly I don't recall
17 after the core blockage, but I mean based on what I see
18 in the peak cladding temperature, you have to -- I mean,
19 the peak cladding temperature stabilizes, so you have
20 to have a --

21 MR. KEE: And we're looking for like 800
22 degrees as an acceptance for these cases on the peak
23 clad.

24 CHAIRMAN BANERJEE: That's correct. Yes.
25 Okay. So I think you're going to discuss this at a later

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1 point, all these RELAP calculations and things, right?

2 MR. KEE: We didn't plan on getting into
3 that in detail, because last session we --

4 CHAIRMAN BANERJEE: You went through it.
5 I remember those holes and the things, yes.

6 MR. KEE: Yes. So those results that we
7 were relying on then we rely on today, continue to.

8 CHAIRMAN BANERJEE: Okay.

9 MR. KEE: And as we mentioned, the staff
10 has all those input decks. Everything that we used in
11 the November submittal we've provided to Len Ward and
12 Ashley Guzzetta.

13 MR. MURRAY: Mr. Chairman, were you
14 talking about talking about it more today or in the
15 future? What was your thoughts?

16 CHAIRMAN BANERJEE: Not today.

17 MR. MURRAY: Okay.

18 CHAIRMAN BANERJEE: Yes.

19 MR. MURRAY: That's what I wanted to make
20 clear.

21 MR. KEE: Oh, okay.

22 MR. MURRAY: Okay. I wanted to make sure
23 Ernie was clear on that.

24 CHAIRMAN BANERJEE: Yes.

25 MR. MURRAY: So, okay.

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1 CHAIRMAN BANERJEE: Eventually we'll get
2 the staff's calculations as well as yours.

3 MR. MURRAY: Sure. Okay.

4 CHAIRMAN BANERJEE: So I think we can go
5 back to delta CDF now.

6 MR. MURRAY: I think we're ready. I think
7 this is slide 57.

8 MR. KEE: So we move to slide No. 57. So
9 this is kind of a recap that -- first of all, the RoverD
10 screening stage. At each weld location with a break
11 producing more fine fiber in the sump than what was
12 tested, we record the smallest break size at that
13 location. And then we realized that some -- and as
14 we've talked, these 530-some-odd locations don't even
15 create that much fiber at double-ended guillotine size
16 break.

17 We use NUREG-1829 as a basis to determine
18 frequencies for these breaks that we assign to changing
19 core damage. We basically observe two principles kind
20 of that we wanted to follow in doing so, and they're
21 written here. In the limiting case for which ever weld
22 and every break above the smallest diameter; call it X,
23 or whatever, is considered bad; that is at that break
24 size more comes to the sump than what were tested, more
25 fines, the break frequency should be just exactly

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1 NUREG-1829. The exceedance frequency is X. So we're
2 looking at exceedance frequencies at these breaks
3 sizes, which are the smallest at each location that
4 exceeds the amount that was tested.

5 And the second kind of guiding principle is
6 RoverD should depend on the number of welds in the RoverD
7 risk-informed category. So the number of locations now
8 we're talking about in the risk-informed category. And
9 in particular the frequency should increase if new welds
10 are added to the set that we had before, bad welds. And
11 this in fact you can see happens with the single-train
12 case.

13 Then the way we do this and what we refer
14 to this as is what we call top-down adherence to
15 NUREG-1829 published frequencies. So notionally we're
16 coming up with an initiating event frequency that we
17 basically assign to delta CDF.

18 There are some equations here. We wrote
19 kind of in a very general form on the slide that was the
20 risk part of the RoverD. So we had some weighting
21 times, these frequencies, right? So now we're adhering
22 to these principles that we wrote down where for at any
23 particular category we call this now of breaks we look
24 at -- examine all the locations where a size that
25 occurred could -- wherever the location is that that

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1 size failure could occur or larger, we count up all of
2 them. So that's the total number of opportunities in
3 that range of break possibilities.

4 We divide that into all the -- each one, one
5 by one, the smallest break size at each location where
6 the weld -- where the fiber fines were exceeded. So the
7 category of D-i-small is a pipe category. So this is
8 written here. If category 1 is one-inch pipes,
9 category 2 is two-inch pipes, then for a break of 1.75
10 inches, the category is 2, because the opportunities are
11 in the two-inch size. So in this way we go look at each
12 category the same way competitively, and some, all those
13 frequencies then will get some frequency that is -- will
14 -- in the limit, any kind of a limit will match the
15 exceedance frequency for NUREG-1829, realizing we have
16 to interpolate. And that's for kind of one set of
17 scenarios. So let's conceptually think this applies to
18 the two or more train cases.

19 So if we have two states now, we're going
20 to wind up -- and I guess at this point I should mention
21 how we look at the single-train case. I think I
22 mentioned earlier that of course -- and somebody brought
23 this up, well, if there's just one train running,
24 there's going to be a lot more fiber collected given even
25 concentration in the pool. And that's true. It's

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1 probably conservative to assume the same amount because
2 the velocities would be a lot lower, but let's for the
3 moment presume that that's how that goes. So with two
4 trains you have X amount of debris that gets on the
5 strainers for the threshold, which was 191.78. And for
6 one train in operation, well, you better only allow half
7 that much to accumulate because all the fiber is on one
8 strainer now, not spread over -- the same amount of fiber
9 is on one strainer instead of being spread over two.

10 So what does that do? That means for the
11 single-train case the break sizes that correspond to
12 that case are much smaller, or they're still large, but
13 they're smaller than for the two-train or three-train
14 case.

15 CHAIRMAN STETKAR: Okay. So you actually
16 do adjust the break sizes for the single-train case
17 versus the two or more?

18 MR. KEE: Yes, sir. Exactly. So then all
19 the other assumptions that go with the two-train test
20 and so forth, they more or less apply if you accept that
21 scaling. So it goes in the right direction. It kind
22 of behaves the way you want it to.

23 And so, the only thing that remains is how
24 do we deduce what fraction of the single-train should
25 -- what fraction of the cases should have the

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1 single-train frequency? What fraction should have two
2 or more? And so, we just divide the success frequencies
3 out, and that's the weight.

4 CHAIRMAN STETKAR: About 75 percent should
5 have the single-train success, and about -- 75 percent
6 of the breaks regardless of the size you should win if
7 you have a single train. Any break in loop D you can
8 win with a single train, so that's 25 percent there, and
9 two-thirds of the breaks on loops A, B and C. It's
10 simple math. Seventy-five percent of the time you win
11 with a single train.

12 MR. KEE: Well, yes, assuming
13 conditionally that that's where it will let you have,
14 right? But the frequency with which you realize a
15 single train is very small. It's on order of four to
16 the minus eight per year, whereas the two or more train
17 case, that's -- I don't recall the frequency exactly.
18 Ten to the minus -- but it's like 97-98 percent of the
19 cases are the two or more trains in operation. That's
20 the most likely case.

21 MEMBER BLEY: But you still account for
22 them?

23 MR. KEE: Sure, by the frequency that you
24 realize two or more trains and the frequency you realize
25 one train. And we already kind of mentioned that we

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1 over-count that success because we're looking at the
2 frequency that we come through to
3 recirculation --

4 (Simultaneous speaking)

5 CHAIRMAN STETKAR: But this frequency,
6 Ernie, are you just looking at a fault tree model that
7 says what fraction of this fault tree -- that says X and
8 what fraction of X has two trains running, three trains
9 running and one training, or are you actually looking
10 at the plant model for breaks and dividing the breaks
11 among loops and dividing the injection flows among loops
12 and seeing what fraction of all of the successes is one
13 and only one train running versus two or three trains
14 running? You say words like you divide all the --

15 (Simultaneous speaking)

16 MR. KEE: Almost --

17 CHAIRMAN STETKAR: -- but I can divide it
18 several ways.

19 MR. KEE: Yes, sure. So almost what you
20 said the first time is what we're doing, but of course
21 we're looking at an event tree and we look at the success
22 states that we get. When we come to recirculation with
23 a single train, how often does that happen? That
24 happens like very infrequently. How often do we come
25 through recirculation with two or more trains? That

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1 happens almost all the time. And that's the DVI we're
2 doing here.

3 CHAIRMAN STETKAR: Okay. I'll have to
4 think about that.

5 MR. KEE: So we've already published in our
6 November submittal these frequencies, so I mean they're
7 -- you can just look them up. And you can see that the
8 single train frequency is very low. It'll be a small
9 fraction of the -- a very small fraction of the time do
10 we see a single train go to LOCA with a single train in
11 operation. Am I saying that right, David?

12 CHAIRMAN STETKAR: Well, okay. I'm still
13 thinking. I can think and listen at the same time.

14 PARTICIPANT: All right. Okay. So let's
15 move to slide 60.

16 MR. KEE: Oh. So, yes, so that last
17 equation just sums up those DVI'd frequencies.

18 And then we ran several cases. And so this
19 is what we refer to as delta CDF uncertainty. And some
20 of these questions have arisen in the course of time,
21 so there's some history behind why would you look at
22 continuum break? Why would you look at double-ended
23 guillotine break? Why do you look at the 5th, 95th?
24 And so, just on the right-hand side of this figure --

25 PARTICIPANT: Use your mouse.

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1 MR. KEE: Oh, yes. Mr. Mouse is my friend.

2 And we've talked about arithmetic and
3 geometric aggregation in the NUREG-1829 elicitation.
4 All these kinds of permutations that you can imagine and
5 extremes of the elicited values are reduced in this
6 table. And the important number I guess to focus on is
7 the geometric mean, and a phi-hat is what I refer as the
8 -- with a single train included case. So it's slightly
9 larger than case two or case one.

10 And so, that's as you can see, in Region
11 III, if we review the double-ended guillotine only
12 approach. So we assume all these breaks. We don't
13 look at the smallest. We say they all go to failure.
14 Then we have a lower number, and that's kind of a result
15 of the fact that all those frequencies associated with
16 the double-ended guillotine break are larger. So
17 there's all the results we have for all those different
18 possibilities.

19 CHAIRMAN BANERJEE: They're reflecting,
20 so you should carry on.

21 MR. KEE: Yes. So on slide 61, remember
22 that we have to look at delta LERF. And one of the kind
23 of endearing design features of the South Texas Project
24 containment; and I think this is shared by most PWR
25 designs, is that the reactor containment fan coolers,

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1 we call them, are independent of any of the concerns
2 related to GSI-191. By that, I mean they don't clog up
3 as a result of debris. They don't have any issues with
4 debris. The cooling water to those is independently
5 supplied from complement cooling water, if that happens
6 to be the same supply, to what we call the RHR heat
7 exchangers. That's what low head is pumping through.

8 So even though you lose those heat
9 exchangers, you don't lose the reactor containment fan
10 cooler heat exchangers. And that will keep containment
11 pressure and temperature well below any design limits.
12 Of course you're relying on your last barrier of defense
13 at this point, but the change in LERF is simply -- all
14 it is is strictly proportional to the change in core
15 damage frequency at that point.

16 Then we examined those. We didn't do a lot
17 of work there, but looked at the arithmetic, geometric
18 means. And I just put the results for including the
19 single-train case here.

20 MR. HARRISON: On slide 62.

21 MR. KEE: On slide 62. I'm sorry. And I
22 think we've already talked about arithmetic mean
23 aggregation produces like almost -- well, in this case
24 more than order of magnitude higher estimates for
25 frequencies. They're still borderline above the

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1 Region III/Region II boundary, right, which is 1E to the
2 minus 7. So this is 1.3E to the minus seven for kind
3 of a worst case.

4 CHAIRMAN BANERJEE: Do you guys have some
5 questions?

6 MEMBER BLEY: We're just looking at the one
7 that Ernie didn't mention is it's often closed.

8 (Laughter)

9 MR. KEE: Is what?

10 CHAIRMAN STETKAR: Ninety-nine point nine
11 percent of the way to -- nine point nine nine times ten
12 to the minus eight. That's a --

13 MR. KEE: And every significant digit's --

14 CHAIRMAN STETKAR: That's a very, very
15 precise estimate of --

16 MR. KEE: Absolutely.

17 CHAIRMAN STETKAR: -- a very uncertain
18 value.

19 MR. KEE: Absolutely. So something we
20 didn't do here, and we can do, we can go back and do this,
21 or usually, is include the distributions that we've been
22 using, the so called Johnson -- now the Johnson
23 distributions to estimate uncertainties in a continuous
24 fashion. But we just chose to look at these elicited
25 quantiles.

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1 CHAIRMAN STETKAR: Ernie, it's time for me
2 ask you the same question again. You earlier said
3 you're sticking to the linear interpolation because
4 your assertion is that a different interpolation will
5 always give you lower frequencies. I mean, to me that's
6 not clear.

7 MR. KEE: It's not intuitively obvious.
8 So the --

9 CHAIRMAN STETKAR: Especially because
10 I've done other interpolations and they seem to give
11 high depending on where you are in the break range.

12 MR. KEE: Yes, let's get into that. So
13 where are we in the break range? We're at the very high
14 -- the last two categories.

15 CHAIRMAN STETKAR: Yes.

16 MR. KEE: Which fall off roughly by an
17 order of magnitude between the --

18 (Simultaneous speaking)

19 CHAIRMAN STETKAR: And that's true also
20 for the single-train stuff?

21 MR. KEE: Yes, sir.

22 CHAIRMAN STETKAR: I mean, you're still up
23 in the -- I don't know if you remember --

24 MR. KEE: I believe the smallest -- this is
25 published in our RAI response, but I believe it was nine

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1 inches and change.

2 CHAIRMAN STETKAR: Even for the
3 single-train?

4 MR. KEE: Correct, yes. Yes, sir.

5 CHAIRMAN STETKAR: Okay. That makes a big
6 -- okay.

7 MR. KEE: Does that clear it up, the
8 question then right there?

9 CHAIRMAN STETKAR: Yes.

10 MR. KEE: Okay.

11 CHAIRMAN STETKAR: Because you're only
12 looking now at 9 up to what, 13 or 14, in practice?

13 MR. KEE: They're larger than that. Some
14 of them go up to the full --

15 CHAIRMAN STETKAR: So you actually will
16 get some --

17 MR. KEE: I think 13 inches is the
18 smallest.

19 CHAIRMAN STETKAR: Yes, so you're going to
20 trip over one of those inflection points. Okay.

21 MR. KEE: Yes, between --

22 CHAIRMAN STETKAR: Yes, I mean as long as
23 you're --

24 MR. KEE: -- 7 to 14 -- there's an elicited
25 7-inch, an elicited 14-inch --

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1 CHAIRMAN STETKAR: Right.

2 MR. KEE: -- a 14-inch and a 31-inch.

3 CHAIRMAN STETKAR: Right.

4 MR. KEE: Those are all the large and
5 they're all going down by decade each.

6 CHAIRMAN STETKAR: Right, but my concern
7 is I just look at the inflection points and that linear
8 --

9 MR. KEE: Oh.

10 CHAIRMAN STETKAR: And you're only really
11 spanning over one of those points, which reduces the
12 sensitivity to what I was concerned about. So, okay.

13 MR. KEE: Yes, sir. I think it is almost
14 guaranteed to overestimate. Not a lot, because they're
15 -- as long as they're behaving --

16 (Simultaneous speaking)

17 CHAIRMAN STETKAR: I wouldn't play that
18 card too strong, but --

19 MR. KEE: Oh, well. At any quantile
20 maybe. Yes, I agree. Not necessarily for -- there's
21 at least one point in that doesn't, yes, play right.
22 But that's in small, small breaks.

23 So I just flipped to slide 63. And I think
24 we talk about this, mentioned it earlier. We've gone
25 over ad nauseam the cooling effectiveness for fiber

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1 blockage in cold leg breaks and hot leg breaks needs to
2 be assessed. And we did that in two ways. Cold leg
3 breaks we looked at the 15 grams for fuel assembly
4 requirement.

5 And for the hot leg breaks, as we talked
6 about, we did a limiting thermal hydraulics analysis.
7 And we used to have a limit of seven-and-a-half grams.
8 That was for boron precipitation. So we decided to
9 eliminate any notion of the possibility that we have
10 lower plenum mixing and so on and so forth. We're using
11 a deterministic calculation to arrive at the hot leg
12 switchover time to meet that requirement. So the
13 analysis isn't dependent on lower plenum mixing.

14 And then we've already mentioned that
15 -- and we've talked about this previously in this forum,
16 that thermal hydraulic analyses for adequate cooling
17 for all hot leg breaks and small cold leg breaks when
18 their bounding blockage scenarios are met. And that's
19 800 degrees. So we're only talking about medium-large
20 cold leg breaks that need to be examined closely for
21 these fiber issues. And we've shown sensitivity
22 analyses on how much of the fiber that was assumed in
23 the strainer test around those values down lower is less
24 than 15 grams for fuel assembly. So that's not a
25 concern.

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1 So just to wrap up on slide 64, what we've
2 talked through, there are 45 locations which we
3 discretize as spaces/welds. And the risk that arrived
4 in the risk-informed category when we did the screening,
5 the RoverD screening, with the exception of one all of
6 those, are on RCS loop piping. We have one weld
7 location on the pressurizer surge line. That's the
8 smallest break that we have, which is roughly a 13-inch
9 break and it's a double-ended guillotine break. That
10 corresponds to maximum frequency as well.

11 MR. MURRAY: Yes, it would be a good
12 opportunity to talk about those particular welds as far
13 as like the one we just mentioned that's got weld overlay
14 on it as well. So it's been mitigated.

15 MR. KEE: Maybe we should talk about -- so
16 some are transitioned welds. And actually you're
17 right, the safe ends on the pressurizer have been
18 mitigated with weld overlays. And this one just
19 happens to be a -- it's not a transition location, but
20 that's correct, we've done that. We've also replaced
21 all the steam generator -- the other, with the exception
22 of the reactor vessel nozzle welds, have been replaced
23 with Alloy 690. So when we replaced the steam
24 generator, we mitigated those. So the ones that remain
25 are the reactor vessel nozzle welds that have not been

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1 mitigated, but at double-ended guillotine break they
2 don't exceed the 192 or 94 pounds criteria.

3 MR. HARRISON: And that's because their
4 location and the type of insulation that's adjacent.

5 MR. KEE: So that's bullet No. 4. All
6 welds that exceed the tested amount of fiber have either
7 been mitigated or replaced.

8 Then all results using quantiles from
9 NUREG-1829 geometric mean aggregation, both the RoverD
10 continuum break model or double-ended guillotine
11 break-only model -- so that's 5th to the 95th all the
12 way across that spectrum. None of those exceed Region
13 III. That's pretty stunning, actually. And that
14 applies to delta LERF as well. The only quantiles that
15 -- well, I called -- that's bad terminology here. The
16 mean and the 95th exceed 1E to the minus 6 and put us
17 in Region II, just barely, if we adopt the arithmetic
18 mean aggregation, which we don't.

19 CHAIRMAN BANERJEE: So above what size
20 roughly do you have to go to produce more than the 193
21 pounds?

22 MR. KEE: What size is the smallest one
23 or --

24 CHAIRMAN BANERJEE: Yes.

25 MR. KEE: Thirteen inches break. Twelve

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1 point one two.

2 CHAIRMAN BANERJEE: That gives you more
3 than --

4 MR. KEE: All those are significant, too.

5 CHAIRMAN BANERJEE: That's above the
6 smallest size?

7 MR. KEE: That is the --

8 CHAIRMAN STETKAR: That's for two-train.

9 MR. KEE: Well, that's the smallest size in
10 the two or three-train case. Then I believe it's the
11 same location, but it's only nine inches. No. Yes, I
12 believe that's nine --

13 CHAIRMAN STETKAR: So single-train is
14 somewhere in the 9 to 10-inch --

15 MR. KEE: Yes, 9 to 10. Yes. I can't
16 remember the exact number. We have that. We've
17 written that down. So these are pretty large breaks
18 that we're talking about here, which is why the numbers
19 are so low.

20 CHAIRMAN BANERJEE: So this is a large
21 break LOCA-limited timed, right?

22 MR. KEE: Large break, yes, sir.

23 CHAIRMAN BANERJEE: So that's --

24 MR. MURRAY: Are we ready to transition?

25 CHAIRMAN BANERJEE: Sorry?

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1 MR. MURRAY: Are we ready to transition
2 into the next area?

3 CHAIRMAN BANERJEE: My colleagues here are
4 the bosses here.

5 MEMBER SCHULTZ: Before you do, Mike, you
6 had mentioned -- and I was behind you -- you had
7 mentioned that on item 4, the mitigations associated
8 with all welds -- what has been done there? Could you
9 repeat that?

10 MR. KEE: So, at the steam generator safe
11 transition weld, safe ends, you might say, those all
12 have been replaced with Alloy 690 that's not susceptible
13 to primary water stress erosion cracking. Now, on the
14 pressurizer safe ends those have been treated with what
15 they call the weld overlay that makes the pipe -- the
16 wall thickness much thicker. And I believe; Wes will
17 know this -- no, he doesn't know? I believe they also
18 apply a compressive stress, so it's like torquing a
19 pole to -- before you can get any strain, you have to
20 overcome the contraction.

21 MR. MURRAY: I believe it's also an Alloy
22 690 overlay.

23 MEMBER SCHULTZ: Right, and so --

24 MR. KEE: Oh, yes.

25 MEMBER SCHULTZ: -- this is a statement of

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1 what has been done, not as a result of this program we've
2 gone and done all of these things?

3 MR. KEE: No, you might say it's
4 serendipity, but --

5 MEMBER SCHULTZ: Yes, a condition based
6 upon programs.

7 MR. KEE: But I think it bears on the fact
8 that whenever the opportunity presents itself you do
9 take care of these kinds of things.

10 MEMBER SCHULTZ: They have been taken care
11 of for other reasons?

12 MR. MURRAY: That's right, for other
13 reasons. We don't credit those in our break
14 frequencies, is that correct?

15 MR. KEE: It's for LOCA.

16 MR. MURRAY: Right.

17 MR. KEE: That's what this is all about.

18 MR. MURRAY: Right, but we did those --

19 MR. KEE: That we've mitigated those to
20 prevent --

21 MR. MURRAY: -- for LOCA purposes. Right.
22 Did we answer your question?

23 MEMBER SCHULTZ: Yes. Thank you.

24 CHAIRMAN BANERJEE: Any other questions on
25 this part? Corradini, are you there?

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1 (No response)

2 CHAIRMAN STETKAR: He can't talk.

3 MR. WIDMAYER: Well, he's supposed to have
4 a private line. Mike, can you say something?

5 (No response)

6 CHAIRMAN STETKAR: Perhaps he is saying
7 something but perhaps the private line is also muted
8 coming in.

9 CHAIRMAN BANERJEE: All right. So I think
10 we'll leave Corradini to --

11 MEMBER SHACK: Can you go back to slide 58
12 again?

13 MR. KEE: Wow, that's way back there.

14 MEMBER SHACK: That's way back. Explain
15 to me this argument again about the categories and the
16 sizes. Are you -- sort everything into a DEBG in this
17 slide? Is that why the category 1.75 equals 2?

18 MR. KEE: It's kind of notional. So these
19 categories are defined by the extent of the pipe IDs.
20 So starting with the smallest pipe, that would be -- so
21 from -- it's zeroed. It's --

22 MEMBER SHACK: Well, no, let me just take
23 a big pipe. I could have a break anywhere from one inch
24 to a full DEGB. When you talk about break size, as a
25 D-small-i, are you looking at a diameter or are you

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1 looking at true break size?

2 MR. KEE: Those Ds need to be thought of as
3 the Ds -- and I'll say they're exactly -- they're not
4 the multiplied by the square root of two. For DEGBs
5 we're using the exact pipe ID. But below that pipe ID
6 they are the -- exactly the numbers that you look at on
7 the ordinate, abscissa, the x-axis of the NUREG-1829
8 frequency. Well, if that was plotted that way. If you
9 think of it like that.

10 CHAIRMAN STETKAR: So a 14-inch diameter
11 pipe, the two-inch D sub-i includes a 2-inch equivalent
12 diameter break in that 14-inch pipe?

13 MR. KEE: Exactly. Yes, sir.

14 CHAIRMAN STETKAR: Is that what you're
15 asking, Bill?

16 MEMBER SHACK: Yes, but I guess that's
17 saying that the frequencies of the two-inch break is
18 sort of independent of the diameter?

19 MR. KEE: It's strictly dependent on it.

20 MEMBER SHACK: I mean, I could have a
21 two-inch pipe break and I could have a two-inch pipe
22 break in a 14-inch pipe. Do those both have the same
23 frequency in this -- the way this is done?

24 MR. KEE: Yes, they do.

25 MEMBER SHACK: Okay. Now that's not the

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1 assumption that really underlies 1829. I mean the
2 experts there, if -- when you did the -- back in the
3 Appendix L table they did the elicitation by component.
4 And then they had one-inch breaks, two-inch breaks in
5 various size pipes. And those were not the same as the
6 agglomerated ones that you did overall, right?

7 MEMBER SCHULTZ: They created a matrix.

8 MEMBER SHACK: And I'm not quite sure why
9 -- and again, when -- I mean, the Fleming and Lydell
10 report tried to deal with that. It seems to me you're
11 getting rid of all of that now, but I'm not sure how
12 you're scaling the overall 1829 results now to each
13 break.

14 MR. KEE: So if we adopted -- and that's
15 what we have in the past, adopted that hybrid approach
16 is what we call it, and we in that approach we still match
17 the NUREG-1829 frequencies. But here's what we do.

18 MEMBER SHACK: Yes, that's because you
19 sort of smeared them out to match that. And that I
20 understand. I mean, that one -- it's this one I'm
21 having a harder time understanding, because that one at
22 least preserves the notion that a 2-inch break in a
23 2-inch pipe has a different frequency than a 2-inch
24 break in a 14-inch pipe.

25 MR. KEE: Not what we did. Not what we

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1 did.

2 MEMBER SHACK: I think the weighting
3 factor does that for you.

4 MR. KEE: It was based on the weld
5 category, and that's the weld type. What really drove
6 those results was the weld --

7 MEMBER SHACK: Well, but that also was
8 associated with pipe size. I mean, there were
9 categories --

10 MR. KEE: Okay. But these are all large
11 pipes, so we're talking about the same kind of mix here.

12 MEMBER SHACK: Yes. Now maybe that's true
13 if I only think that I'm really looking at one category
14 of pipe on one end.

15 MR. KEE: But here's something --

16 MEMBER SHACK: And that doesn't bother me
17 so much.

18 MR. KEE: And one other point to consider,
19 if we did adopt that hybrid method where we DVI'd -- one
20 more DVI is on the type of weld, then what would happen
21 is those eight welds on the reactor vessel would come
22 into play as much higher frequency locations. Then
23 when we do the DVI, it would reduce the frequency on the
24 mitigated welds. Now that's appropriate, but it's
25 -- it wouldn't be huge, but it would -- that's the total

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1 effect that that would have. All the other welds would
2 be treated identically the same. They would have
3 -- they would just be -- the frequency would be reduced,
4 those 600 --

5 MEMBER SHACK: Well, I mean, I'm trying to
6 stay in 1829 world. Now in Fleming and Lydell they do
7 try to take credit for their failure rate, which they
8 change because of the mitigated weld. What I'm
9 concerned about at the moment is just the 1829 notion
10 that the different break sizes in different diameter
11 pipes have different frequencies and preserving that
12 versus what I think you've done here is preserve the
13 overall break frequency for a size. But that's somehow
14 independent completely of the pipe, which means that
15 you're not getting the same frequency if you were
16 associating that break with a location where it's
17 generating debris. And you're going to get different
18 answers from the two of them.

19 MR. FONG: Yes, this is C.J. Fong with NRR
20 Division of Risk Assessment. We had a very similar
21 question. When we read 1829, we saw the comment that
22 all things being equal a break of a given size is more
23 likely to come from a complete break of that pipe versus
24 a partial break of a larger pipe. So we asked the
25 question, too.

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1 MEMBER SHACK: Well, it's more than just a
2 comment on that. The nine experts that gave the
3 component-by-component breakdowns gave the frequencies
4 they thought we would get for category 1, 2, 3, 4, 5,
5 6 in the different pipe diameters. So I mean, there's
6 data -- no, data is the wrong word. There are
7 elicitation results that describe that.

8 MR. FONG: Right, and we asked in an RAI
9 about that, and that's -- part of the response we got
10 to the round 1 RAI was the double-ended guillotine only
11 approach, which is I guess one attempt to sort of satisfy
12 some of that NUREG-1829 guidance. We're still looking
13 at though. We have a round 2 RAI as well.

14 MEMBER SHACK: Right, because it's
15 dominated by the DEGB.

16 MR. FONG: It's kind of an extreme case.

17 MEMBER SHACK: Yes.

18 MR. FONG: Right.

19 MR. KEE: And that's what I tried to show
20 in here. That's why that appeared here. Now, maybe
21 that doesn't -- I was hoping to satisfy everyone's
22 concern on DEBG-only where we say we don't care.

23 MEMBER SHACK: Well, what I'm worried
24 about is putting the right size break in the right
25 location. And if that break is more likely to occur in

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1 this pipe, it's more likely to occur in that location.
2 And I think that I'm losing some of that with this
3 approach is my concern. At least I think -- I'm still
4 confused somewhat.

5 MR. KEE: So just to be clear, the pipe
6 sizes we're talking about are 16-inch. These are all
7 thick-walled, or RCS loop piping that are forgings that
8 are 272, 29-inch, 31-inch and the surge line, that one
9 location, is 16-inch. These are all big pipes.

10 MEMBER SHACK: Yes, okay.

11 MR. KEE: They're pretty much made the same
12 way.

13 MEMBER SHACK: Yes, and I think that --

14 CHAIRMAN STETKAR: I think the concern
15 would be a lot more if we were talking about three,
16 four-inch pipe sizes, which is why I've been trying to
17 push them on a single train down into that regime of pipe
18 sizes, but it won't push that far.

19 MEMBER SHACK: If we only have big pipes,
20 then big cracks can only occur in big pipes.

21 CHAIRMAN STETKAR: In big pipes. So
22 maybe --

23 MEMBER SCHULTZ: But your question about
24 location is still something that needs to be at least
25 addressed in terms of is there anything with regard to

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1 that part of the question that's completely responded
2 with the assumption here? I think it is, but I think
3 it needs to be addressed.

4 MEMBER BLEY: But the only other piece to
5 that is when you're doing 17D, take it to real small.
6 That covers a big hunk of the containment. And if it's
7 here or over there, it's still the same kind of stuff
8 --

9 (Simultaneous speaking)

10 CHAIRMAN STETKAR: The precise location
11 might -- I mean, given the volume of pipe that's that
12 size, it may not make too much of a difference.

13 MEMBER SCHULTZ: And they're likely in
14 similar types of locations.

15 MEMBER BLEY: And that would have made the
16 CASA work a lot more complicated, I suppose, if you were
17 tracking this.

18 CHAIRMAN STETKAR: I think as long as
19 you're in that pipe size range, the results might not
20 be all that sensitive --

21 MEMBER SCHULTZ: I agree --

22 CHAIRMAN STETKAR: -- until you get down a
23 smaller one.

24 MEMBER SCHULTZ: -- that they might not be.
25 I just think it needs to be a few paragraphs or a sentence

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1 --

2 (Simultaneous speaking)

3 CHAIRMAN STETKAR: A good argument.

4 MEMBER SCHULTZ: -- written to draw that
5 argument forward just for completeness.

6 MR. KEE: Okay. Yes, we can address that.

7 MR. LETELIER: If I could interject. This
8 is Bruce Letelier from Alion. The CASA model does track
9 those locations. And under the old implementation with
10 the hybrid bottom-up we were accounting for those
11 proportionalities between break types.

12 MEMBER BLEY: Now did it make a difference?

13 (Simultaneous speaking)

14 MR. LETELIER: -- under RoverD.

15 MEMBER BLEY: There's the key question.

16 MR. KEE: It doesn't make a difference.

17 MEMBER BLEY: Did it make a difference?

18 MR. KEE: No.

19 MR. LETELIER: We did both the -- we did the
20 hybrid bottom-up weighting and we did the double-ended
21 guillotine extreme and showed that the double-ended
22 guillotine actually reduces failure frequencies
23 because you're no longer allowing small breaks to exist
24 in regions of high insulation density. When we spread
25 the breaks out uniformly, small breaks supported on

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1 large pipes, you tend to introduce breaks in those
2 regions that have a lot of insulation. And that's
3 what's leading to the break -- the failures on Ernie's
4 list.

5 MEMBER SHACK: Okay. But then your
6 approach would also make the frequency of those breaks
7 somewhat higher than it would be if I did a component
8 by -- so it's actually somewhat conservative approach.

9 (Simultaneous speaking)

10 MR. FONG: There's been a lot of discussion
11 whether -- this is C.J. Fong with NRR again. There's
12 been a lot of discussion on whether the continuum
13 approach is more conservative than the so-called
14 double-ended guillotine-only approach. And I really
15 think; I look at this a lot, it depends. It's very
16 location-specific.

17 MEMBER SHACK: But if I put the 4-inch
18 break in the 31-inch pipe where it hits a lot of stuff,
19 then giving it the same frequency as I would the same
20 size break in a smaller pipe which is higher but happens
21 to be in a place where I don't have a lot of stuff, then
22 it's conservative. Now, you're probably going to go
23 through the whole CASA Grande analysis to figure out
24 whether in fact that's true or not, but at least I see
25 an argument.

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1 MR. FONG: That's one of the many competing
2 effects. And if you look at slide 60, you'll actually
3 see that the aggregation scheme, arithmetic versus
4 geometric, flips the whole thing around. So under the
5 geometric scheme the continuum approach is more
6 conservative. But if you use the arithmetic scheme,
7 the double-ended guillotine approach is more
8 conservative or produces a higher --

9 (Simultaneous speaking)

10 MEMBER SHACK: Well, I didn't quite
11 understand that.

12 MR. FONG: There's multiple degrees of
13 failure depending how you model it. And so trying to
14 say up front one's more conservative than the other, you
15 really can't do that. You have to run the actual
16 numbers. And that's what we're asking the licensee to
17 do so the staff has some confidence.

18 MR. KEE: So that's what we've tried to do
19 in here. That's why we've done all those numbers. But
20 it's still a -- it's very slight nuance in any case. I
21 mean, if we were having four-inch breaks that exceed
22 this tested amount, we wouldn't be here talking about
23 this.

24 MR. MURRAY: Right. Yes. So what I got
25 out of that is we need to make sure that when staff gets

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1 what they need to get the confidence and then state it
2 in such a way that it can be understood by ACRS when they
3 look at it. Is that correct?

4 CHAIRMAN BANERJEE: Are we ready to move on
5 to the regulatory --

6 (Simultaneous speaking)

7 MR. WIDMAYER: We've got lots of time.

8 CHAIRMAN BANERJEE: It's better to finish
9 early than to --

10 (Laughter)

11 MR. WIDMAYER: I agree.

12 CHAIRMAN STETKAR: That's why you're the
13 Chairman of this meeting.

14 (Simultaneous speaking)

15 (Laughter)

16 CHAIRMAN BANERJEE: Okay.

17 MR. HARRISON: The regulatory
18 implementation hasn't changed a whole lot with this
19 RoverD. We're still talking about exemptions and
20 amendment to the license. That's the same type of
21 exemptions that we had talked about previously, and that
22 would be to 10 CFR 50.46 Delta, the ECCS other
23 requirements. We're not requesting an exemption to 10
24 CFR 50.46 Bravo for long-term cooling, but we're asking
25 for an exemption to how you calculate the cooling.

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1 We're using a risk-informed method. It's the
2 methodology, not the phenomena itself.

3 Same thing with General Design Criterion
4 35, 38 and 41. The exemptions would apply to allow us
5 to use a risk-informed methodology instead of the
6 prescriptive deterministic methodology that's present
7 in the General Design Criterion. And it would apply for
8 that scope of breaks that would generate sufficient
9 debris to exceed what was tested. So that's how we
10 picked the exemptions.

11 With regard to a license amendment, the
12 application that's currently on the docket, the
13 November 2013 application, only has the first dash
14 there, the risk-informed approach is a methodology
15 change per 10 CFR 50.59. It currently does not have a
16 proposed change to the technical specifications,
17 however after some further dialogue with the staff and
18 to address some questions with regard to really not
19 wanting to use risk to determine operability, we think
20 we can clarify that with actions in the technical
21 specifications for the emergency core cooling system
22 and the containment spray technical specification. We
23 picked those two because they're the only two systems
24 that rely on the strainers as a support system for their
25 operability. And we simply would tie that to the -- say

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1 operability is determined by limiting the containment
2 debris quantities to be less than what's in the STP
3 debris analysis.

4 And if you exceed that amount of debris, you
5 would take some action to implement compensatory
6 actions. And those would be things like if you have the
7 maintenance -- if you're doing maintenance on the
8 emergency core cooling system, you would see if you
9 could back out of that maintenance or not schedule
10 maintenance on the emergency core cooling system,
11 maintain your emergency systems at an escalated
12 readiness, if you will. Brief operators, remind them
13 of what their actions are in case you had a
14 debris-related event. And then within -- the 90 days
15 is bracketed, but based on the low frequency of this
16 event, we would expect to have a long restoration
17 period, somewhere in the order of 90 days to restore this
18 to operable status or take your normal tech spec action.

19 We're still in discussion with the staff on
20 how we frame that allowed outage time, that completion,
21 if you will. We'll work our way through that, but we
22 expect it to be a fairly extensive time.

23 CHAIRMAN STETKAR: Wayne, one of the -- I
24 was reading something, so forgive me. You said one of
25 the compensatory actions might be to have the operators

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1 be vigilant that the ECCS systems are more ready or
2 something like that?

3 MR. HARRISON: No, I said just if you know
4 that you have a debris-related issue that you would
5 brief your operating crews on, okay, if we have the LOCA,
6 remember here are the things you need to look for with
7 respect to symptoms of debris and how you would --

8 (Simultaneous speaking)

9 CHAIRMAN STETKAR: What could they do
10 about that, though? I mean, there's nothing that I can
11 do sitting in the control room to go suck out debris.

12 MR. HARRISON: Well, we have an emergency
13 response organization obviously that they're relying
14 on. There are some things that we can --

15 (Simultaneous speaking)

16 CHAIRMAN STETKAR: You mean get ready for
17 the melt?

18 MR. HARRISON: Not necessarily.

19 (Laughter)

20 CHAIRMAN STETKAR: When you talk about
21 these compensatory actions, it's what can I do as an
22 operator?

23 MR. HARRISON: And the objection of your
24 compensatory action is just at that point in time what
25 can I do to reduce my station risk to be more ready? If

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1 I have a diesel scheduled for maintenance, maybe I don't
2 want to go do that maintenance right now. These are
3 judgmental and --

4 CHAIRMAN STETKAR: But if I have the debris
5 in there, it's more than the analysis shows, it doesn't
6 make any difference. If all the diesels work and
7 everything works --

8 MR. HARRISON: Well the first thing you're
9 going to go --

10 CHAIRMAN STETKAR: -- I'm in trouble.

11 MR. HARRISON: Well, obviously the first
12 thing you're going to go do -- most cases we see of this
13 where it's occurred is it's transient stuff, and you go
14 in and you take it out.

15 CHAIRMAN STETKAR: That I can get.

16 MR. HARRISON: See, that's not --

17 (Simultaneous speaking)

18 CHAIRMAN STETKAR: That one I understand.
19 I can go along with that.

20 MR. HARRISON: That's not a compensatory
21 action, obviously. That's one that you -- but that's
22 your reaction, I'm going to go --

23 CHAIRMAN STETKAR: Clean it up.

24 MR. HARRISON: -- clean it up, take out
25 this transitory stuff. I'm going to do --

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1 CHAIRMAN STETKAR: Compensatory actions
2 might be to make sure you refill the RWST --

3 MR. HARRISON: Right. That's right.

4 CHAIRMAN STETKAR: -- a lot and pump a lot
5 of clean water in there. That I can understand.

6 MR. HARRISON: Right. That's exactly
7 right. But again, these were just thoughts at this
8 point. We haven't --

9 (Simultaneous speaking)

10 CHAIRMAN STETKAR: But minimizing diesel
11 maintenance, that one I don't get.

12 MR. HARRISON: It's just have your standby
13 systems ready for standby so they are available.

14 CHAIRMAN STETKAR: But that doesn't solve
15 the problem if all of the operating systems, regardless
16 of whether they're all operating, are going to fail
17 because you have too much debris. It doesn't make any
18 difference. They could be 100 percent operable and
19 immediately available and they're going to fail because
20 you have too much debris in there. So trying to make
21 them more available doesn't help the situation, does it?

22 MR. KEE: Can I say --

23 CHAIRMAN STETKAR: Yes.

24 MR. KEE: As we've discussed -- let's talk
25 about a couple things: One is that tested case we had

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1 full flow through two strainers. What do we do -- what
2 is the most likely case? We'll have three strainers in
3 operation. If we have a diesel available, we have a
4 loop or whatever, then we're -- what Wayne's trying to
5 say is the availability of those three trains is maybe
6 made more certain. Or we get out of an extended outage
7 on a diesel, or something like that, I don't know. But
8 what can you do? Knowing the most likely case is three
9 trains, we've talked about, well, what if you forget to
10 shut

11 -- what if you forget to dump the third containment
12 spray? So if you have three trains, that opportunity
13 is front of the operator and he be briefed on that.

14 CHAIRMAN STETKAR: Okay.

15 MR. KEE: He can be briefed on alternative
16 flow paths that are already in our EOPs and so on and
17 so forth that talk about, for example, the volume
18 control tank that's in the -- and our charging pumps are
19 safety-related, so they can be brought in. So there are
20 things that can be briefed and be made ready, or
21 anticipation.

22 MR. HARRISON: And again, the main purpose
23 of the technical specification change was to make sure
24 the operators knew where they were in technical
25 specification. I mean tech space with regard to

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1 operability. If you have this much debris, you're
2 okay. If you have more than this much debris, you need
3 to be in the action state. That's really where this
4 -- the clarity that the technical specification change
5 provides for cooperations.

6 The last thing I have on my set of slides
7 is -- on slide 67, we will have accompanying changes to
8 the updated final safety analysis report with respect
9 to how we comply with the General Design Criteria. We
10 will discuss RoverD and the way that works in Chapter
11 6 of the UFSAR. We will accommodating changes to the
12 bases for the technical specifications for emergency
13 core cooling system and containment spray system. And
14 it will just help clarify the design basis. I think
15 most of these changes should be pretty straightforward
16 once we get underway with them.

17 And that completes my part of this and I'm
18 ready to turn it over to Mike.

19 MR. MURRAY: So go to slide 68, please. So
20 are ready for conclusions, Mr. Chairmen?

21 CHAIRMAN BANERJEE: Yes.

22 MR. MURRAY: So in conclusion, we feel that
23 the RoverD process incorporates all the aspects of the
24 debris issue: generation transport, in-core effects,
25 deterministic testing of fiber and chemical effects,

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1 and the risk-informed evaluation portion. And
2 continued, as we had mentioned before, as we've gone
3 through this thee results continued to demonstrate very
4 small risk in accordance with Reg. Guide 1.174. So
5 those are our conclusions.

6 MEMBER BLEY: Mike, I have a question.

7 MR. MURRAY: Yes, sir?

8 MEMBER BLEY: Early on I think you said in
9 your next submittal that will include all of this you're
10 going to attach the probabilistic methodology that you
11 had before. Did I hear that right? And if so, I'm
12 wondering kind of why, because you're not using it.

13 MR. HARRISON: I don't think we -- I don't
14 recall that we said that.

15 MEMBER BLEY: I thought I heard that this
16 morning. If I didn't --

17 (Simultaneous speaking)

18 MR. HARRISON: That currently is not our
19 intent. It will be what is needed to support RoverD.

20 MEMBER BLEY: Okay.

21 MR. HARRISON: What I've said is we've not
22 ignored anything we've used up to this -- that may have
23 been what you heard.

24 But, Bruce, did you have something to add?

25 MR. LETELIER: No, only that they stated

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1 that they would append the RoverD methodology to this
2 submittal so that you have all the details available for
3 --

4 (Simultaneous speaking)

5 CHAIRMAN STETKAR: RoverD methodology to
6 the submittal answering the RAIs in March?

7 MR. LETELIER: Correct, the --

8 (Simultaneous speaking)

9 CHAIRMAN STETKAR: As opposed to the
10 revised LAR in June.

11 MR. HARRISON: Actually, there will be
12 RoverD in both of those submittals.

13 CHAIRMAN STETKAR: Yes.

14 MR. HARRISON: But the staff will see the
15 description in detail that we just went through today
16 on the docket. It may be signed now.

17 CHAIRMAN STETKAR: But it's in response to
18 the --

19 MR. HARRISON: Correct.

20 CHAIRMAN STETKAR: -- open RAIs right now?

21 MR. HARRISON: Yes.

22 MR. MURRAY: And we appreciate the
23 clarifying question if there was --

24 (Simultaneous speaking)

25 CHAIRMAN BANERJEE: Who dreamt up RoverD?

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1 That's quite a -- it's nice, R over D, right?

2 MR. HARRISON: There were a number of
3 people.

4 (Laughter)

5 MR. HARRISON: And we'll leave it at that.

6 (Laughter)

7 CHAIRMAN BANERJEE: All right. So does
8 that conclude your presentation, Mike?

9 MR. HARRISON: That concludes our
10 presentation. Yes, sir.

11 CHAIRMAN BANERJEE: Thank you very much.
12 I'm going to of course ask the staff to conclude, if
13 anybody wants to make any remarks from the staff.

14 MR. MARKLEY: I'd like to make a comment.

15 CHAIRMAN BANERJEE: Yes, please.

16 MR. MARKLEY: This is Mike Markley. I'm
17 the chief of the Plant Licensing Branch 4 in DORL. And
18 some of these things that they've talked about today,
19 particularly the tech spec change at the end, those are
20 fairly new to us, in fact very new, have been part of
21 the discussions over the past four years, so we have some
22 questions to sort through. And certainly we have a
23 context for operability that's not consistent with what
24 they're describing here. So just want to let you know
25 this is very early in the process for some of us in what

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1 they're changing.

2 CHAIRMAN BANERJEE: Thank you. Before I
3 do the --

4 MEMBER SHACK: Can I just ask one more
5 question?

6 CHAIRMAN BANERJEE: Yes, of course.

7 MEMBER SHACK: Did anyone do one of these
8 filtration calculations where you kept a number like
9 0.65, which I would assume would correspond to a
10 strainer with lots of sort of open area to see how much
11 of it would end up on the --

12 MR. KEE: We've implemented -- I'm not sure
13 -- we haven't done that. The answer to that -- short
14 answer is no, but it's certainly obviously something we
15 could do.

16 MEMBER SHACK: It just would strike me as
17 sort of interesting to see what would happen, because
18 we've worked so hard to get people to get big strainer,
19 which drives that filtration number down to like 0.6.

20 CHAIRMAN BANERJEE: We realize the risks
21 of doing that, too.

22 MEMBER SHACK: Yes, well, you can actually
23 quantify it here --

24 CHAIRMAN BANERJEE: But I think the --

25 MEMBER SHACK: -- unless you tape up parts

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1 of the strainer.

2 MEMBER SCHULTZ: So, Ernie, I thought you
3 had done that range of -- just the ends with regard to
4 the --

5 MR. KEE: So he's asking a different
6 question. So we would abandon our data and adopt a
7 single number as sensitivity or something to say, okay,
8 it's always -- it doesn't matter how much is
9 on --

10 MEMBER SHACK: But just it would
11 correspond to something with a big open area on the --

12 CHAIRMAN BANERJEE: Well, it may also
13 -- because there's been a lot of questions about the size
14 of the fiber and all that and how that affects the size
15 distributions, the amount that goes through. Clearly
16 there are issues that -- because the size relative to
17 the hole size matters, how you distribute the fiber. So
18 it's always interesting to know what the bounding
19 effects are.

20 MR. KEE: Yes, and that's easy to do.

21 CHAIRMAN BANERJEE: Yes. I think before
22 we ask for comments though, I should open the discussion
23 to public comments. So, Derek, are we able to receive
24 public comments?

25 MR. WIDMAYER: We can from the room.

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1 CHAIRMAN BANERJEE: Well, yes, so let's
2 start first with the room. Are there any members of the
3 public who wish to comment? Not question. Just
4 comment.

5 (No response)

6 CHAIRMAN BANERJEE: So now anybody on the
7 phone who's a member of the public, please identify
8 yourself and please comment if you wish to. Is there
9 anybody out there who would like to?

10 (No response)

11 CHAIRMAN STETKAR: Let me try something.
12 For those of you who are not familiar with our high
13 technology system, if there's anyone out there
14 listening in, could you do us a favor and just say hello.

15 MEMBER CORRADINI: Hello from Corradini.

16 (Laughter)

17 CHAIRMAN STETKAR: Believe us, this is the
18 only way we can actually confirm that we can hear you.

19 CHAIRMAN BANERJEE: Thank you.

20 MEMBER CORRADINI: I just got the separate
21 line open.

22 CHAIRMAN STETKAR: Okay. But I heard a
23 second -- someone else. Somebody else said hello.

24 PARTICIPANT: Hello again.

25 CHAIRMAN STETKAR: Good. Thanks. Thank

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1 you.

2 (Laughter)

3 CHAIRMAN BANERJEE: So hearing no comments
4 from the public, I would like to now turn this over back
5 to the Committee for comments. So we'll start with
6 -- you want to leave that open? I mean, close the
7 comments back to us. So, Steve, why don't we start with
8 you?

9 MEMBER SCHULTZ: I appreciate the
10 presentations today. I have had the opportunity to
11 listen to some of the previous discussions with the
12 Committee and I've liked what I've heard today in terms
13 of a revised approach. And we've had a number of
14 questions answered. And we've got more information
15 that's going to be flowing in, including the revised
16 documentation for it.

17 So my only closing comment would be that I
18 would encourage you not to presume -- as you write that
19 June report, or application as it were, to presume that
20 everyone understands what's been done over the past four
21 years, but rather focus -- because I think this is very
22 important work. And in order for it to be reviewed in
23 a timely fashion as well as be used going forward in the
24 very best way, the write-up ought to be done in a fashion
25 that it captures this methodology and all of the aspects

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1 of it and doesn't -- when Dennis asked his question about
2 are you going to attach what was done before, I'm glad
3 to hear that you're not.

4 (Laughter)

5 MEMBER SCHULTZ: All I'm saying is try to
6 leave that behind and don't presume that everyone
7 understands what's been done before, but rather capture
8 it all in one place of this methodology and do it in an
9 integrated fashion so it's well understood. That's my
10 comment.

11 CHAIRMAN BANERJEE: Thanks. Dennis?

12 MEMBER BLEY: I do appreciate the
13 briefings today. They helped me understand a little
14 better how you're doing this and look forward to seeing
15 the submittals. I'm personally a little disappointed
16 that we abandoned the other approach, but I can
17 understand why that's happened. I guess that's all.

18 CHAIRMAN BANERJEE: John?

19 CHAIRMAN STETKAR: Yes, I don't have
20 anything to add. I'm a little surprised by what I heard
21 today in terms of the conclusions, but I have to think
22 about that. Not in terms of the overall conclusions.
23 I'm surprised that smaller breaks don't give you
24 problems, especially with the single-train operating.
25 But I don't understand enough about the debris

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1 generation and I don't understand enough about the
2 locations. So as Steve, I want to make sure that the
3 overall summary makes that pretty clear so that there's
4 confidence that you've actually looked at the entire
5 spectrum of break sizes and locations and in particular
6 the effects on that single train, because that's kind
7 of an extrapolation, I think. Other than that, thanks.

8 CHAIRMAN BANERJEE: Ron?

9 MEMBER BALLINGER: Nothing really to add.
10 I'm got to go back and try to understand better than
11 -- well, as well as some of the other people in the room
12 about how you get to the amount of debris that's
13 produced. And that's something I have to go read about
14 that. But it was a great presentation. Thank you.

15 CHAIRMAN BANERJEE: Bill?

16 MEMBER SHACK: It was a very interesting
17 day. I think one thing that would be nice to see would
18 be a few more results of the analyses to show how debris
19 was generated by certain kinds of breaks placed around
20 -- just for illustrative purposes to -- then we can go
21 off to the big breaks that make lots of stuff. But I
22 think it would be sort of interesting to see that
23 spectrum a little bit.

24 MR. KEE: Yes, we took that out.

25 (Laughter)

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1 MR. KEE: That's a lot.

2 MEMBER SHACK: Well, I'm sure -- I mean,
3 you've done it. It's only a matter of writing it up.

4 MR. KEE: And you'll see those for both the
5 single-train case and the two-train case in the
6 submittal. Not the submittal. The RAI response, yes.

7 CHAIRMAN BANERJEE: Joy?

8 MEMBER REMPE: For the part I was here for
9 I have no additional comments.

10 (Laughter)

11 MEMBER REMPE: I had another commitment
12 this morning.

13 CHAIRMAN BANERJEE: You only turned up for
14 the afternoon.

15 MEMBER SHACK: Mike sends his comments in
16 that he was out for class a good portion of the time,
17 but he was -- sort of echoes Steve's comments that he'd
18 like to see sort of a -- one coherent presentation of
19 the results without sort of assuming that you're
20 familiar with the whole gory history.

21 CHAIRMAN BANERJEE: Right.

22 CHAIRMAN STETKAR: Well, and in truth if I
23 have to be candid, the last report looked like it was
24 a bunch of white papers authored by individual
25 consultants slapped together with a title page on it.

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1 It didn't hang together all that well.

2 MEMBER BLEY: Which is part of the reason
3 there were so many ambiguities.

4 CHAIRMAN BANERJEE: But I think it's
5 becoming more coherent and the story seems to hang
6 together. And I'd like to join my colleagues in
7 thanking you, and also thanking the staff, for making
8 a clear and very, very useful presentation. I think
9 it's really taken us forward a lot. We're beginning to
10 understand what you're trying to do and the approach is
11 beginning to gel. You can see it coming together now.
12 And it will be very useful if it actually -- between you
13 and the staff you work out a position which allows you
14 to go forward on this. There will be many plans to look
15 at this and follow I think.

16 It's very important that the sequence of
17 exactly what you're doing be put together in a logical
18 whole; not an H-O-L-E, but a W-H-O-L-E --

19 (Laughter)

20 CHAIRMAN BANERJEE: -- so that we really
21 understand the steps of how everything relates to
22 everything else and all hangs together. There's RELAP
23 5 calculations going on. There's all sorts of
24 -- there's a little model here which is circulating the
25 stuff, taking it out. There's a big jigsaw puzzle. So

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1 it all needs to sort of fit together.

2 And I'm sure that the staff will be doing
3 confirmatory calculations of all the more critical
4 paths and getting things checked independently so that
5 when we see it eventually we will have a lot of technical
6 confidence in what's going on, which is very important
7 because some of the results are surprising and it's in
8 a way that others have tried and not been able to
9 succeed. So we want to understand why you're
10 successful in doing something, like relieving some of
11 these limits and so on. So at the moment it all seems
12 promising. So let's follow up.

13 I don't when you're going to come back to
14 us next. I guess --

15 MEMBER BLEY: August.

16 CHAIRMAN BANERJEE: Is it August? Okay.
17 And that will still be just informational, right?

18 MR. WIDMAYER: Yes.

19 CHAIRMAN BANERJEE: But then we won't have
20 the SE. It will be what --

21 MR. WIDMAYER: That's correct.

22 CHAIRMAN BANERJEE: Yes, it will be
23 another year or so down the road. Okay. But I think
24 it will be good to keep us informed about what's going
25 on. Okay?

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1 And so with that, I think I'd just like to
2 thank everybody once again and adjourn the meeting.

3 (Whereupon, the above-entitled matter was
4 adjourned at 2:48 p.m.)

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ACRS Subcommittee Meeting

NRC Staff Review Status of South Texas Project Risk-Informed Approach for Resolution to Generic Safety Issue - 191

March 18, 2015

Introduction

Lisa M. Regner

**Senior Project Manager
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation**

STPNOC Background

- Risk-Informed approach as a pilot plant
- Pre-licensing public meetings in 2011 and 2012
- Licensing Action Submittals
 - January 2013, Exemption request for risk-informed approach
 - June 2013, Revised exemption request and license amendment
 - November 2013, Revised submittal to correct errors
 - June 2015, Revised submittal to change methodology
- Requests for Additional Information
 - April 2014, Round 1
 - March 2015, Round 2

Status and Schedule

- Recent Public Meetings
- Regulatory Audits
- Environmental Assessment
- Upcoming STP Submittals
- ACRS Meetings

Outstanding Technical Issues

- Application completeness and consistency
- Unanalyzed accident scenarios
- Use of correlations
- Debris generation and transport
- Validation of models

Questions?



STP Risk-Informed Approach to GSI-191

ACRS Joint Thermal Hydraulic Phenomena
and Reliability and Probabilistic Risk
Assessment Subcommittee Meeting
March 18, 2015

STP Agenda

- Introduction of Risk over Deterministic (RoverD) Assessment
- Deterministic Element
- Risk Element
- Regulatory Basis
- Conclusions

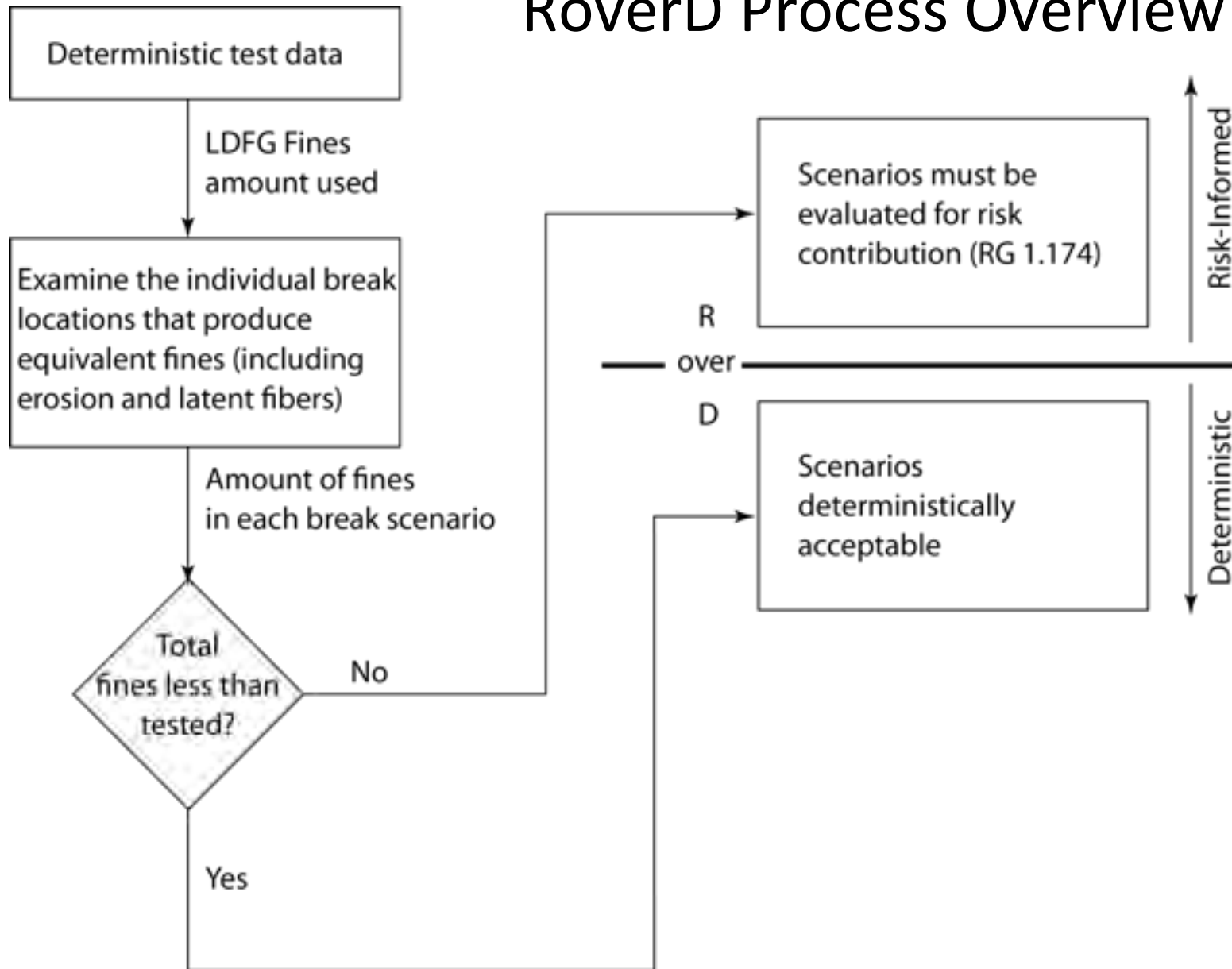
Introduction to RoverD Assessment

- Revised STP methodology uses a deterministic baseline and shows that the risk above that baseline is very small (RoverD)
 - Deterministic plant-specific testing establishes baseline for addressing debris effects identified in GSI-191 and GL2004-02
 - Risk-informed element relegates to failure LOCAs not bounded by the deterministic testing
 - Uses NUREG 1829 to quantify Δ CDF
 - Application of RG 1.174 criteria shows risk is very small
- RoverD is a less complex approach than original submittal and easier to use

High Level Overview

- Assume all breaks that can introduce more fine fiber than tested lead to core damage
- Screen the spectrum of break scenarios at all weld locations
- Find set of smallest breaks that introduce more fine fiber to the pool than was tested
- Assume all larger breaks at the same location will also exceed fine-fiber limit
- Add cumulative frequency of these events to determine CDF

RoverD Process Overview



Deterministic Elements of Risk Over Deterministic Analysis (RoverD)

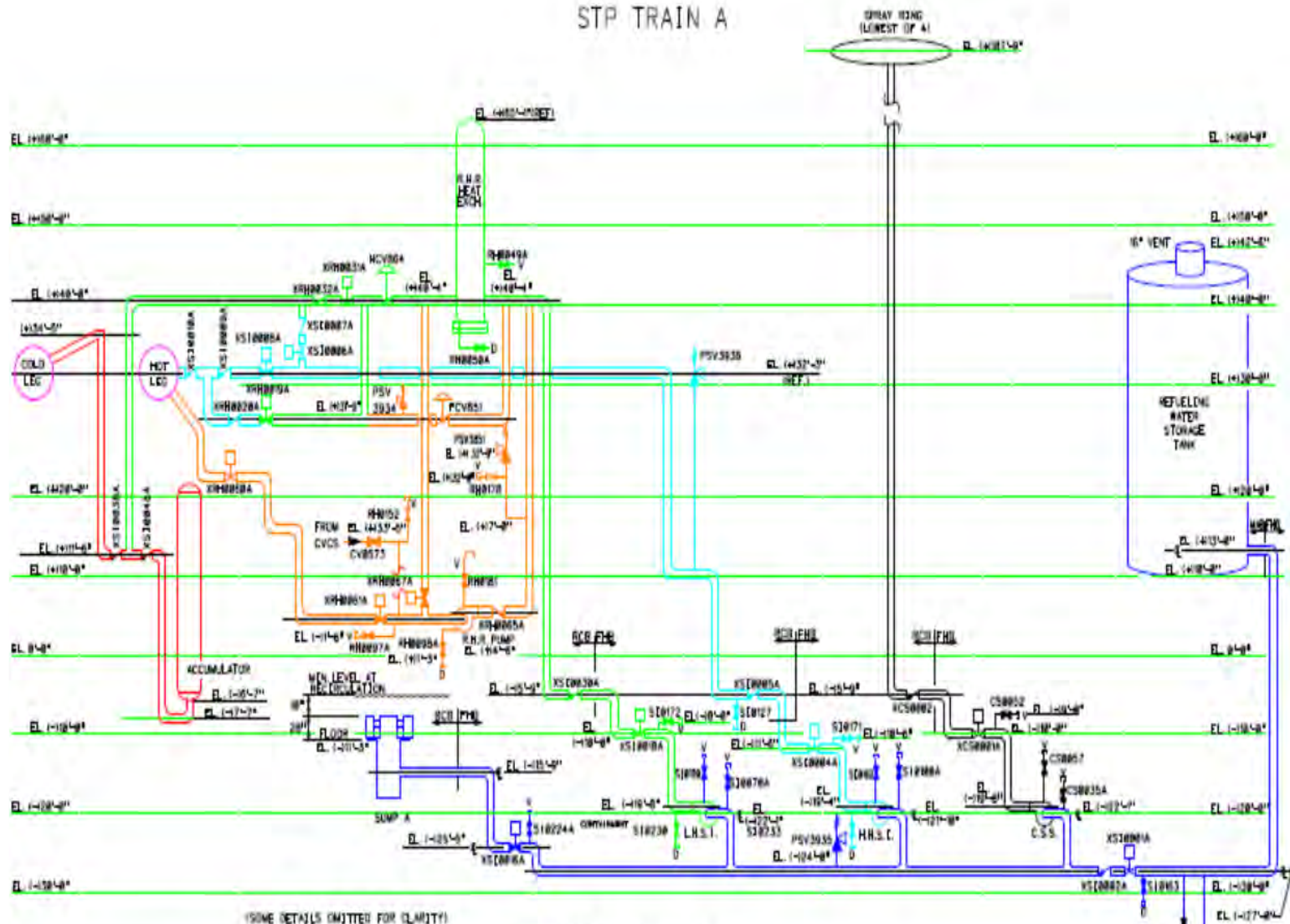
Wes Schulz

South Texas Project Nuclear
Operating Company

Overview

- STP Background
- Role of Flume Testing
- Deterministic Analysis Overview
 - Elements of GL 04-02 Response Content Guidance
 - Emphasize chemical surrogate treatment
- Test Configuration and Results
- Interpretation / Application of Test Results

STP TRAIN A



(SOME DETAILS OMITTED FOR CLARITY)

RCB - REACTOR CONTAINMENT BUILDING
 FHB - FUEL HANDLING BUILDING
 MAB - MECHANICAL AUXILIARY BUILDING
 RWST - REFUELING WATER STORAGE TANK
 CVCS - CHEMICAL AND VOLUME CONTROL

— SAFETY INJECTION SUCTION
 — HIGH HEAD SAFETY INJECTION DISCHARGE
 — LOW HEAD SAFETY INJECTION DISCHARGE
 — SAFETY INJECTION ACCUMULATOR INJECTION
 — RESIDUAL HEAT REMOVAL (RHRT) DOWN COOLING
 — REACTOR COOLANT SYSTEM
 — CONTAINMENT SPRAY SYSTEM









2-SI-0010B
OR FURTHER RESEARCH AND DEVELOPMENT
CONDUCTED BY THE USER OF THIS FACILITY
DATE: 10/10/88

SIP Unit 2

RC-2214-X-8-6-119-92
Lot BS-5-88

RC-123

UNIT 2
RC-2214-X-8-6-119-92
Lot BS-5-88
No. 4942

UNIT 2
RC-2214-X-8-6-119-92
Lot BS-5-88
No. 4942

UNIT 2
RC-2214-X-8-6-119-92
Lot BS-5-88
No. 4942

UNIT 2
RC-2214-X-8-6-119-92
Lot BS-5-88
No. 4942

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UNIT 2
RC-2214-X-8-6-119-92
Lot BS-5-88
No. 4942

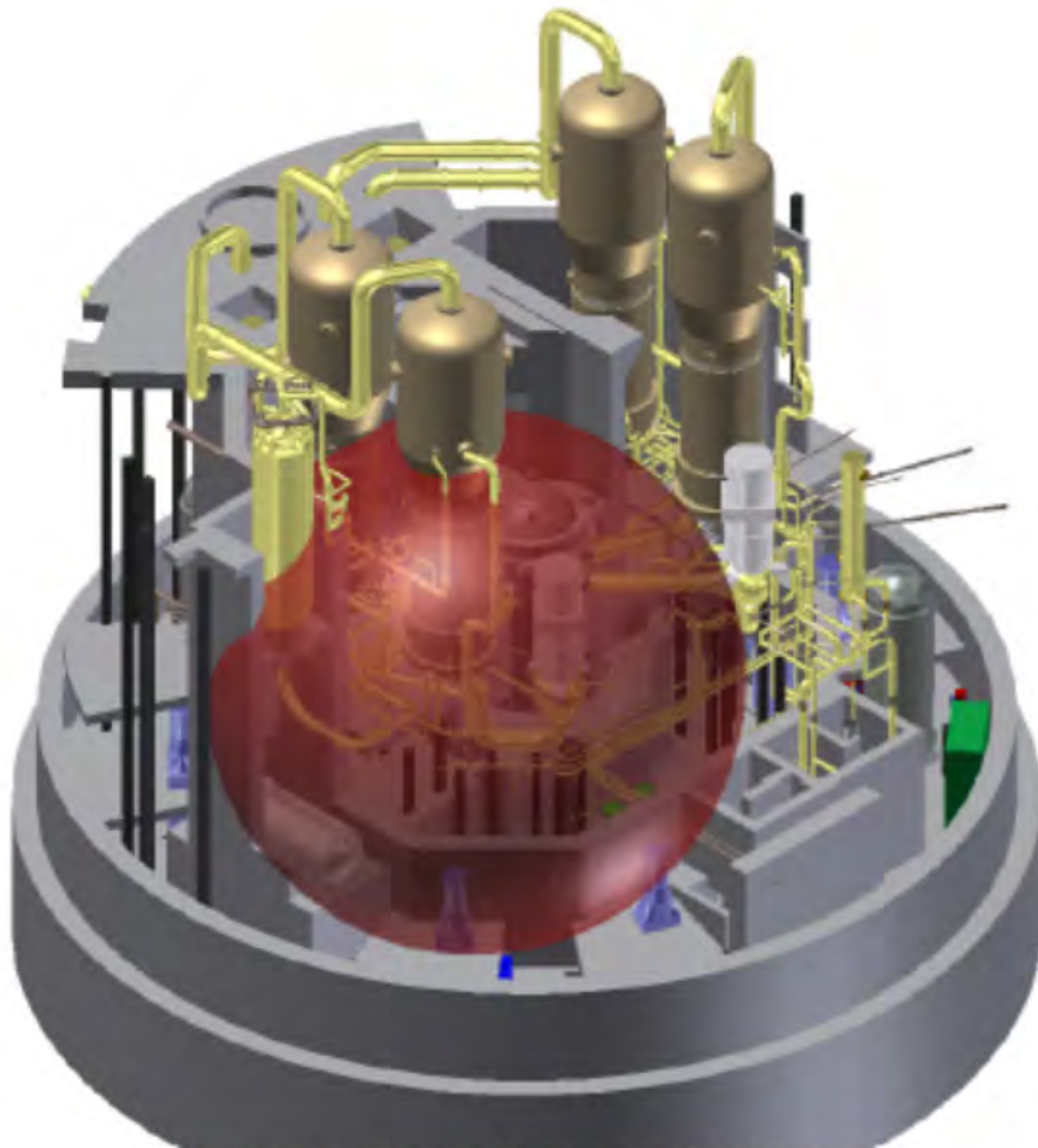


Figure 5.4.1 – Illustration of 17D Nukon ZOI for a 31" DEGB

Role of Flume Testing

- Available strainer performance testing addresses majority of failure concerns deterministically
- July 2008 flume tests designed to satisfy GL-04-02
 - Challenging fiber load on 2 trains only
 - Conservative particulate
 - 30-day WCAP chemicals (with continuous spray)
- Successful test satisfies failure concerns up to the level of the tested debris loading
- Direct comparison of break spectrum to test results eliminates need for head-loss correlation

Purpose of STP Flume Testing

- Demonstrate replacement strainer performance under design basis debris loads
- Deterministic guidance of NEI 04-07 largely used to establish loads and performance goals
 - Review each element of response guidance
- Original “test for success” objective now interpreted on spectrum of LOCA event frequency
- Focus on July 2008 STP-specific test

Basis for STP-Specific Testing

- Approved engineering calculations were prepared to address each element of the GL-response content guidance
- Quantitative strainer-performance metrics were established for each element of the guidance
- Flume tests of full-scale strainer module were performed using representative of STP-specific debris under large break conditions

Elements of Nov 2007 GL 04-02

Response Content Guidance

1. Break Selection
2. Debris Generation (ZOI)
3. Debris Characteristics
4. Latent Debris
5. Debris Transport
6. Head Loss and Vortexing
7. Net Positive Suction Head
8. Coatings Evaluation
9. Debris Source Term
10. Screen Modification Package
11. Sump Structural Analysis
12. Upstream Effects
13. Downstream Effects
14. Chemical Effects

Analysis Methods Overview

1. Break Selection

NEI 04-07 break criteria were used to define debris loads used in the July 2008 Test

Break Criteria

- 1) Breaks in the RCS with the largest potential for debris
- 2) Large breaks with two or more different types of debris
- 3) Breaks in the most direct path to the sump
- 4) Medium and large breaks with the largest potential particulate debris-to-fibrous insulation ratio by weight
- 5) Breaks that generate an amount of fibrous debris that, after transport to the strainer, could form a uniform layer (approx 1/8" thick) that could subsequently filter sufficient particulate debris to create a relatively high head loss referred to as the "thin-bed effect"

Analysis Methods Overview (cont)

2. Debris Generation ZOI

- Nukon and Thermal Wrap are the largest contributors
 - 7D ZOI contributed approximately 192 lbm of fine fiber
- Important parameter for the RoverD assessment is the amount of fine fibrous debris used in the test

Analysis Methods Overview (cont)

3. Debris Characteristics

- Debris characteristics analyzed for July 2008 testing did not deviate from NRC approved guidance.

4. Latent Debris

- Latent debris amounts used during July 2008 testing were assessed from Unit 1 and Unit 2 walk downs following the protocol of NEI 02-01.
 - Debris in each building was found to be less than 165 lbm
 - 200 lbm was conservatively assumed
 - 15% of latent material found was assumed to be fiber

Analysis Methods Overview (cont)

5. Debris Transport

- Transport methodology used to determine debris amounts available to the sump was based on NEI 04-07 guidance, and refinements suggested in the SER.
 - 95% of generated fines transported (ML083520326 Table 21)
 - 1% of destroyed large and small pieces were added as eroded fines

Analysis Methods Overview (cont)

6. Head Loss and Vortexing

- PCI performed strainer qualification calculations (TDI-6005-07) with DBA flow rates and concluded
 - No vortexing will occur
 - Air ingestion will be less than 2%
 - Void fraction will be equal to or less than 3%

7. Net Positive Suction Head

- Calculations were performed by STPNOC (MC-6220) and PCI (TDI 6005-06) that used max flow rates and standard assumptions to determine:
 - NPSH Available (which excludes the strainer and debris) and NPSH Required for the LHSI and HHSI and CS Pumps
 - Clean Strainer Head Loss
 - Debris Head Loss is based on the Strainer Testing
 - NPSH Margin (defined as $NPSHA - NPSHR$) is greater than the Total Strainer Head Loss. At the start of recirculation (267°F), the CS Pump has the lowest NPSH Margin of 5.6 ft. compared to the other pumps which is still more than the Total Strainer Head Loss of 3.8 ft.

Analysis Methods Overview (cont)

8. Coatings Evaluation

- Qualified coatings damaged from Loop C 31” DEGB on the RCS crossover line was chosen for the July 2008 test (ALION-CAL-STPEGS-2916-002 Rev. 3.)
 - Break was selected because of the large amounts of steel coatings destroyed at this location
 - Qualified coatings were examined with a ZOI radius of 5D based on WCAP-16568-P.
 - Destroyed as 10- μ m particulates and epoxy chips
 - Acrylic surrogate used during testing

Analysis Methods Overview (cont)

9. Debris Source Term

- STPNOC procedure to maintain containment integrity with respect to potential sump debris sources. Visual inspection of the affected areas at completion of every containment entry at power to verify no loose debris
- STPNOC design change process ensures new insulation material that differs from the initial design is evaluated. Process also looks at coatings used inside containment, evaluation of added metals such as aluminum, evaluation of impacts on post-LOCA recirculation flow paths

Analysis Methods Overview (cont)

10. Screen Modification Package

- Sump screen above each pit was removed and replaced with strainers
- Each sump has two 5-module assemblies; one 4-module assembly and one 6-module assembly
- New strainers have 1818.5 sq ft per sump (old design was 155.4 sq ft)
- Only modifications to the plant were new strainers and removal of Marinite insulation

11. Sump Structural Analysis

- Strainer and strainer component seismic design margins are adequate using code allowables

Analysis Methods Overview (cont)

12. Upstream Effects

- Upstream flow conditions were evaluated for the possibility of upstream coolant flow choke points
 - Most insulation is located above the 19' elevation
 - The majority of debris will be trapped at this elevation
 - This elevation will not become a choke point because fluid flow has potential graded flow paths from this elevation
 - Flow in the recirculation pool will not be choked because the flow path around the secondary shield wall to the sumps is open

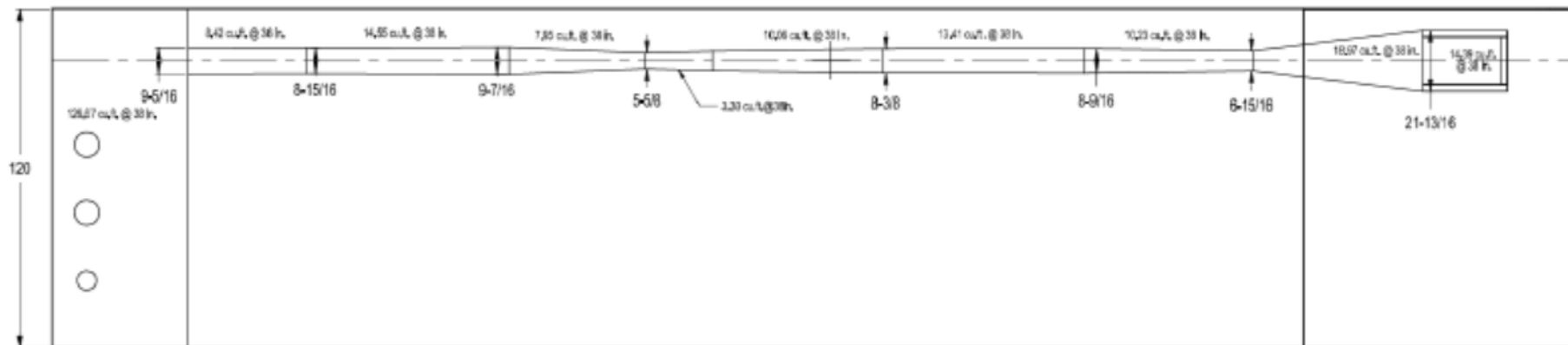
Analysis Methods Overview (cont)

13. Downstream Effects

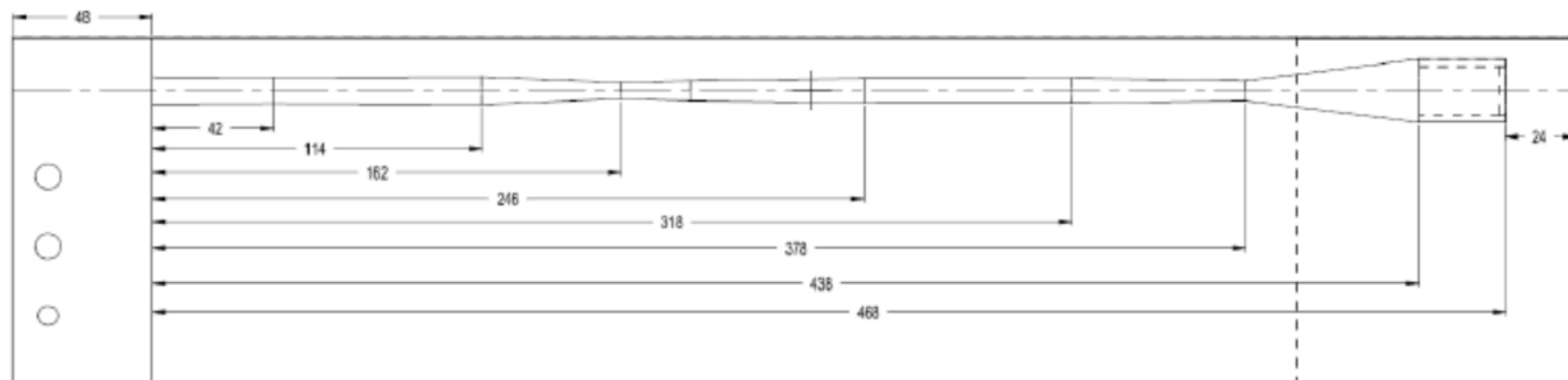
- Evaluation for blockage and degradation of components downstream of the sump was performed in accordance with WCAP-16406-P-A.
- It was determined that all ECCS and CSS components evaluated for STP can accommodate debris bypass without blockage

STP Flume Test Description

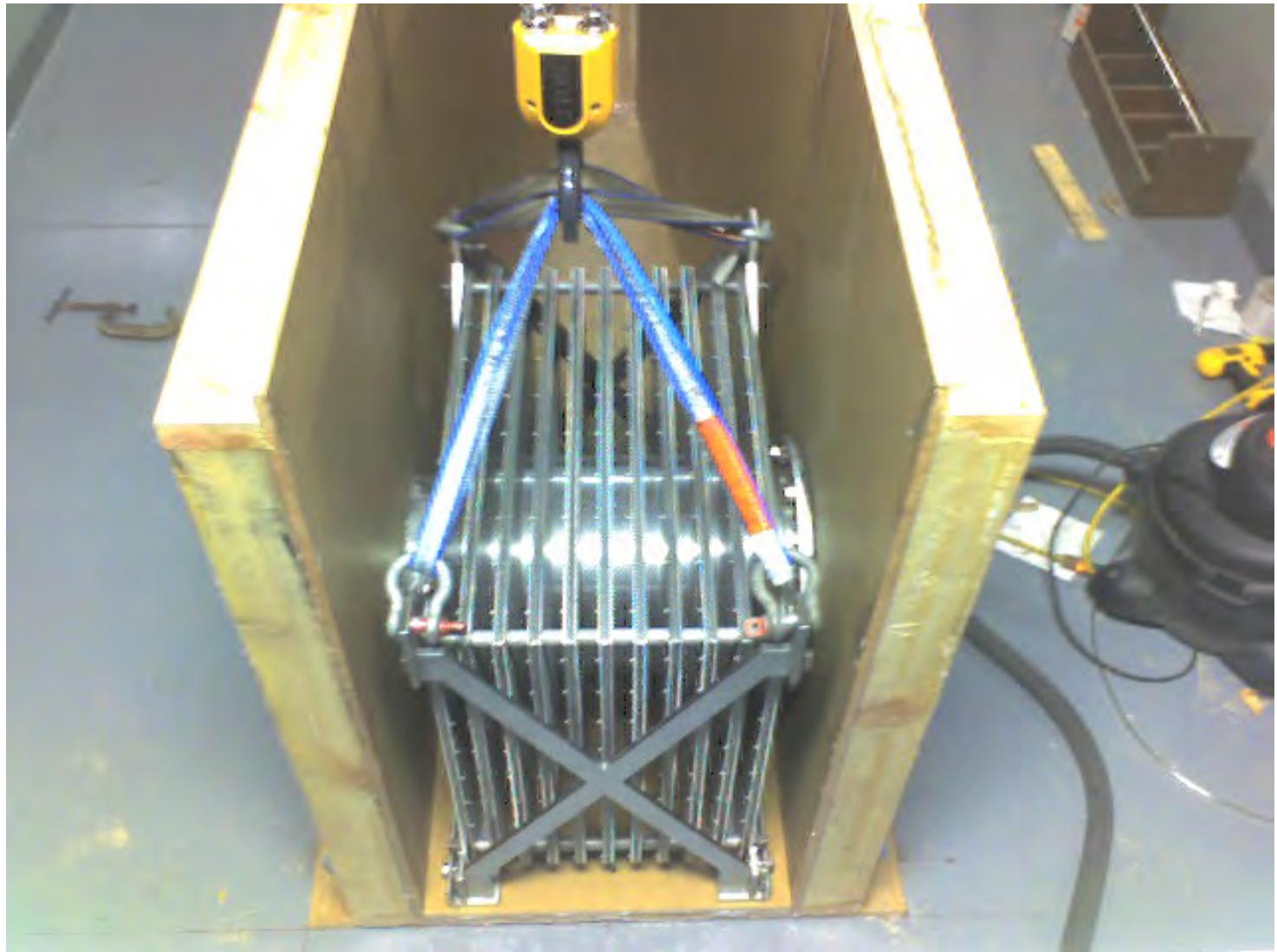
- July 2008 flume test at Alden Research Laboratory
- One full-scale STP strainer module at maximum flow
- Fiber, particle, and chemical loads scaled for 2 trains (out of 3) operating
- Flume channel designed to emulate approach velocity and turbulence



Lengthwise Dimensions



Widthwise Dimensions











STP ECCS strainer test parameters

- ① LDFG fine (191.78 lbm) and small (380.35 lbm) fibers
 - ▶ 24.96 lbm latent fine fiber
 - ▶ 166.82 lbm insulation fine fiber
 - ▶ 380.35 lbm smalls (with fines removed)
- ② Particulates, Microtherm[®] and Marinite[®] board particulates, latent dust and dirt
 - ▶ 33 lbm Microtherm[®] powder
 - ▶ 182.7 lbm powdered Marinite[®] board
 - ▶ 141.1 lbm dust and dirt
- ③ Chemical precipitates representing 30 days of containment spray operation (1,934 lbm chemical precipitates)
 - ▶ 1,575 lbm AlOOH , (1,432 lbm $\text{NaAlSi}_3\text{O}_8$, 143 lbm AlOOH)
 - ▶ 359 lbm CaPO_4
- ④ Coatings, zinc, epoxy, polyamid primer, alkyds, baked enamel
 - ▶ 1,368 lbm zinc powder
 - ▶ 582 lbm acrylic powder
 - ▶ 106 lbm acrylic chips ($1/64'' - 1/4''$)

Debris Preparation

- Fiber
 - Debris preparation with water jet separation
- Particulates
 - Calcium Silicate (Marinite) insulation present in test has since been removed from the containment building
 - Latent debris as described
 - Failed coatings as described

Surrogate Chemical Products

- Tested inventory exceeds total estimated using WCAP-16530-NP for predicted scenarios
- Continuous spray for 30 days (vs 6.5-hr nominal)

Chemical debris	lb _m		
	Strainer testing Design Basis	WCAP-16530-NP Max Volume (30 day spray)	WCAP-16530-NP Min Volume (30 day spray)
Sodium Aluminum silicate	1432	1432	1098
Aluminum Oxy hydroxide	143	79	143
Calcium Phosphate	359	359	291
Total load	1934	1870	1532

Flume Test Head Loss

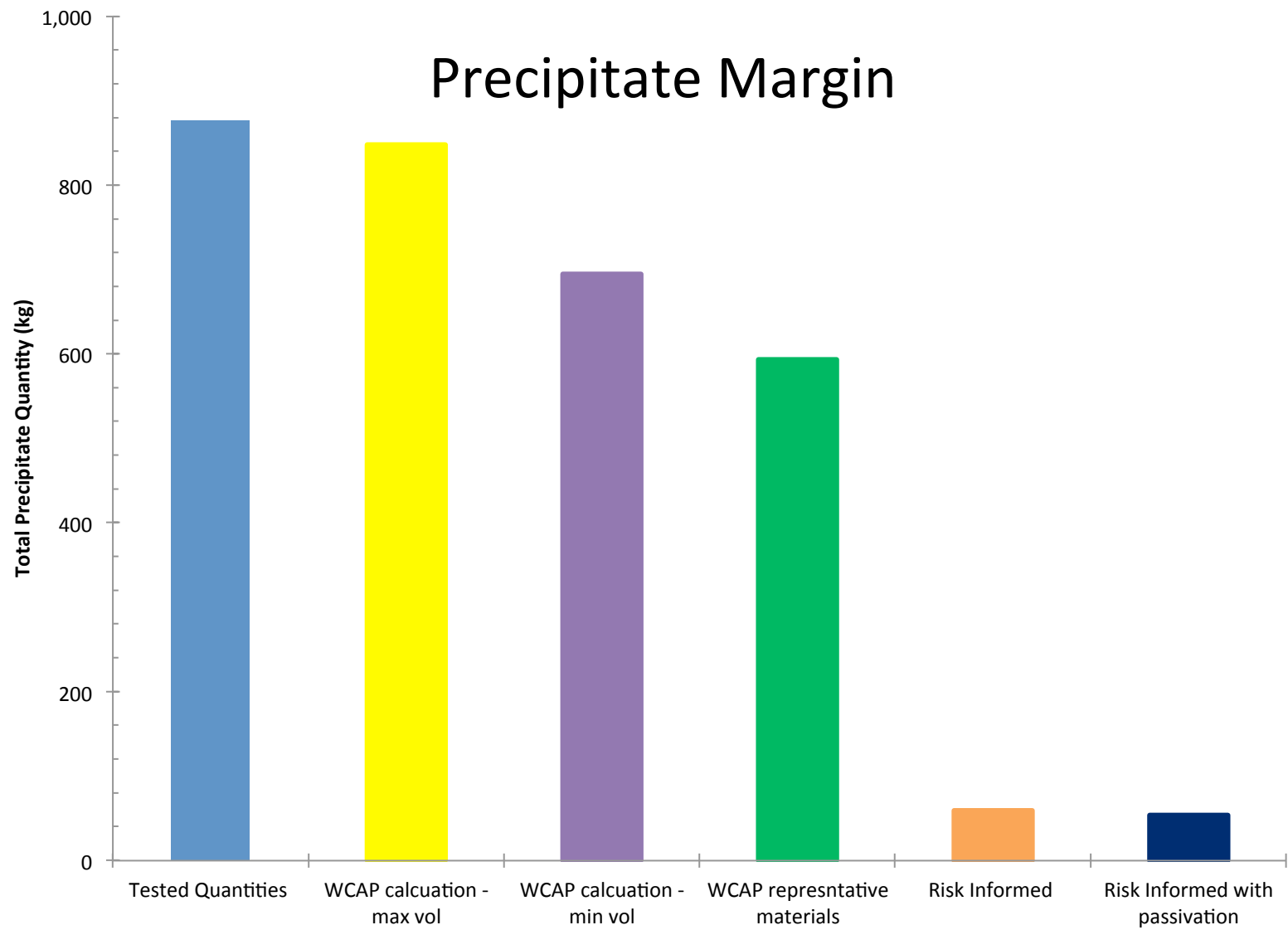
- Tested debris head loss stabilized at 9.1 ft with full flow at 116°F
- Approximately half of head loss was due to chemical precipitates

Observations

- All performance goals set by engineering analysis were met
- Representative settling of debris allowed fine fiber to arrive at strainer
- Large quantity of particulate in combination with chemical load caused thin-bed filtration conditions
- Debris preparation and introduction procedures acceptable

STP-Specific Chemical Test Results

- Long-term corrosion tank testing under STP prototypical conditions show no evidence of chemical precipitation from bulk solution
 - ICET-2 and recent CHLE series, both at UNM
- Quantities of chemical surrogate projected and tested are extremely unlikely to occur
 - No credit taken for this under risk-informed resolution



Application of Test Results

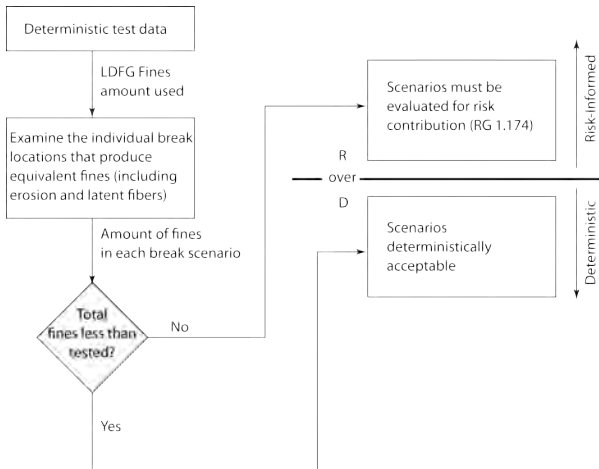
- Assume all breaks that can introduce more fine fiber than tested lead to core damage
- Screen the spectrum of break scenarios at all weld locations
- Find set of smallest breaks that introduce more fine fiber to the pool than was tested
 - Consider debris generation, transport to pool and erosion in pool
- Assume all larger breaks at the same location will also exceed fine-fiber limit
- Add cumulative frequency of these events to determine CDF

STP Risk over Deterministic (RoverD):
Test-Based Debris Risk Assessment

RoverD motivation

1. Reduce reliance on analysis
 - ▶ Correlations may have epistemic uncertainty that is difficult to quantify
 - ▶ Complexities in the engineering analysis may make results less 'transparent'
2. Reduce scope of review
 - ▶ Deterministic test data used to screen out many scenarios
 - ▶ Risk-based review scope limited to fewer scenarios
 - ▶ Use of test data consistent with (for example) fuel testing approach by establishing a limit for debris loading
3. Add confidence to conclusions regarding risk significance
 - ▶ Relegates *ALL* failures above the deterministic threshold to core damage
 - ▶ Deterministic test produces a conservatively high threshold

RoverD flow charts



Results of break location & debris analysis

1. CASA Grande is used to exhaustively sample break size & orientation at each location and sum:
 - ▶ The amount of fine debris generated and transported
 - ▶ The amount of fine debris from latent debris
 - ▶ The amount of debris from fiber erosion
2. For each location, find out if the amount of fine fiber transported to the sump is more than the tested amount:
 - ▶ If not, record the amount created for a DEGB case for margin analysis (Deterministic category)
 - ▶ If so, record the smallest break size that exceeded the tested amount for risk analysis (Risk-informed category)

Results of break location & debris analysis

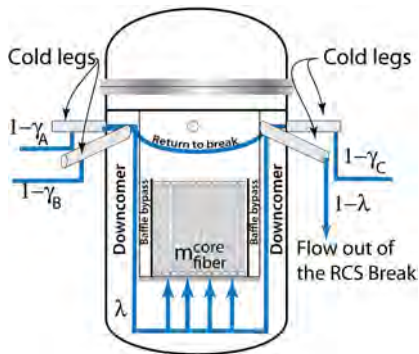
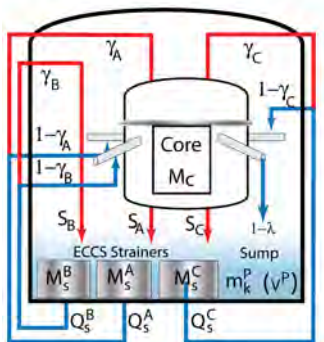
1. Two- or three-train scenarios in the deterministic and risk-informed categories (628 total Class 1 weld locations analyzed):
 - ▶ 45 locations are in the risk-informed category
 - ▶ 583 locations are in the deterministic category
2. Single train scenarios are also included in the evaluation

RoverD method overview

1. Use deterministic strainer test data
 - ▶ Coatings failure, chemical effects head loss, fiber loading head loss consistent with deterministic approaches
 - ▶ Note amount of fine debris from break, latent fiber, and erosion
2. Use deterministic core fiber loading data
 - ▶ Coatings failure, chemical effects head loss, fiber loading head loss consistent with deterministic approaches
 - ▶ Determine the amount of fiber (based on the amount available from above) bypassed to the core
 - ▶ Ensure the amount bypassed and collected on the core is less than the acceptable tested amount
3. Obtain the smallest break size from the CASA Grande generation and transport methodology at each weld that produces more fine fiber in the sump than in the strainer test (these are the risk-informed scenarios)
4. Derive a total failure frequency based on the smallest break sizes from NUREG 1829 to assign to Δ CDF and ensure the total Δ CDF is in Region III of RG 1.174
 - ▶ Ensure Δ LERF (using the PRA with the Δ CDF) is in Region III of RG 1.174
 - ▶ Ensure defense in depth and safety margin requirements of RG 1.174 are met

Fiber penetration uncertainty analysis

Containment flow paths and nomenclature

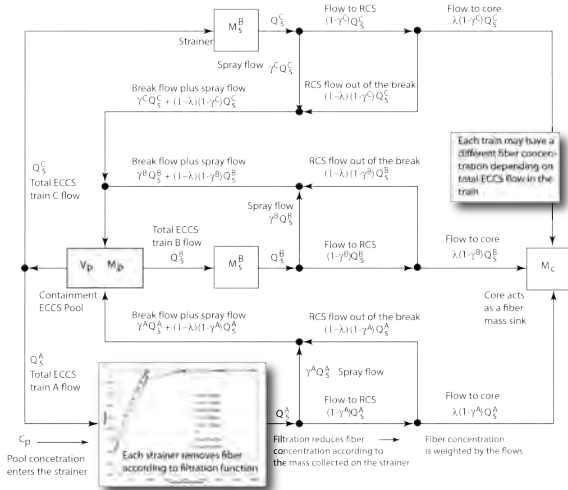


Fiber mass conservation

As showing the previous slide, the fiber mass is conserved at three locations, the ECCS sump pool, the strainers, and the core. The flow network that supports the mass conservation is shown on the following slide and can be described with time-dependent mass conservation equations shown in further slides.

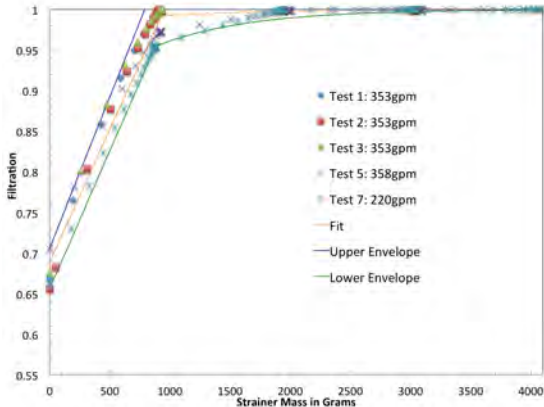
Because of the filtration function associated with the strainers' ability to capture and retain debris, the conservation equations are non-linear. The filtration function shown in graphical form as well.

Fiber mass conservation



Fiber penetration measured data

The filtration efficiency was measured for a prototypical module and the data are shown plotted against accumulated strainer fiber with bounds of uncertainty



Fiber mass conservation

Fiber mass conservation equations (based on previous figure).
Equations are implemented in a Python routine that uses “lsoda”
from the `scipy.integrate.ode` class library.

$$\frac{d}{dt} M_s^k(t) = Q_s^k(t) C_p(t) f(M_s^k(t)),$$

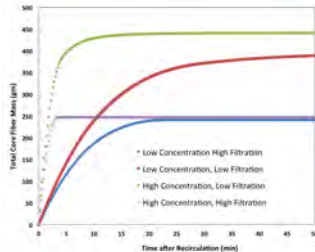
$$\frac{d}{dt} M_c(t) = Q_c(t) C_p(t) \frac{\sum_k [(1 - f(M_s^k(t))) (1 - \gamma^k) Q_s^k(t)]}{\sum_k [(1 - \gamma^k) Q_s^k(t)]},$$

$$0 = \frac{d}{dt} M_p(t) + \frac{d}{dt} \sum_k M_s^k(t) + \frac{d}{dt} M_c(t).$$

Fiber penetration sensitivity

Upper lower and limits of fiber concentration were tested at the high bound of filtration uncertainty and low bound of filtration uncertainty. Uncertainty calculations show that the maximum (15 gm/FA) will not be reached (441 gm)/(193 FA) $\ll 15 \text{ gm/FA}$

$C_p(t = 0) \text{ gm/GAL}$	lower: $f(M_s^k(t = 150 \text{ min.}))$	upper: $f(M_s^k(t = 150 \text{ min.}))$
High (0.832)	441	247
Low (0.158)	400	241



Δ CDF

1. RoverD screening stage: For each weld location with a break producing more fine fiber in the sump than tested, record the smallest break size (note that some locations may not have a scenario exceeding the tested fiber fines)
2. Determine Δ CDF from NUREG 1829 LOCA frequencies based on the following principles:
 - ▶ In the limiting case for which every weld and every break above (smallest) diameter x is considered “bad” (that is, at that break size, more fines come to the sump than were tested), the break frequency should equal to the NUREG 1829 exceedence frequency at x ,
 - ▶ RoverD should depend on the number of welds in the RoverD risk-informed category. In particular, frequency should increase if welds are added to the set of “bad” welds.
3. We refer to this as “top-down” adherence to NUREG 1829 published frequencies

Plant ΔCDF analysis (strainer)

For any weld i in pipe a category (indexed by n) with a smallest break size D_i^{small} the frequency for all pipe categories, each having TW_n total locations:

$$F(D_i^{small}) = \frac{f(D_i^{small})}{TW_{Cat(D_i^{small})}}.$$

$Cat(D_i^{small})$ is the pipe category corresponding to D_i^{small} . For example, if Category 1 is 1-inch pipes and category 2 is 2-inch pipes, then for a break of 1.75in, $Cat(1.75in) = 2$.

If R_n is the set of all welds in the risk-informed category associated with pipes of category n then, the frequency of unacceptable events due to weld breaks in pipes of category n can be written as:

$$\sum_{i \in R_n} F(D_i^{small}).$$

The overall frequency (Φ) of events in the risk-informed category for a plant state is given by:

$$\Phi = \sum_{n=1}^{NP} \sum_{i \in R_n}^I F(D_i^{small}).$$

Plant ΔCDF - plant states

Example of two plant states; two or more trains in operation and; one train operation:

If f_2 is the success frequency for two or more trains operating and f_1 is the success frequency for single train operation, the total frequency, $\hat{\Phi}$, for both operating states:

$$w_j = \frac{f_j}{\sum_j f_j}; j = 1, 2,$$

$$\Phi_j = w_j \sum_{n=1}^{NP} \sum_{i \in R_n}^I F(D_i^{small}),$$

$$\hat{\Phi} = \sum_j \Phi_j.$$

ΔCDF uncertainty analysis

ΔCDF was checked at all quantiles for Geometric aggregation and Arithmetic aggregation given in the NUREG 1829 tables. In addition, the frequency at DEGB-only for the same quantiles was assessed

Continuum Break Model						
Quantile	Case 1 GM	Case 1 AM	Case 2 GM	Case 2 AM	$\hat{\Phi}$ (GM)	$\hat{\Phi}$ (AM)
5 th	2.64E-10	6.47E-09	3.68E-09	2.36E-08	3.08E-10	6.69E-09
50 th	7.50E-09	1.68E-07	8.30E-08	4.92E-07	8.47E-09	1.72E-07
95 th	3.43E-07	4.79E-06	1.81E-06	1.24E-05	3.62E-07	4.89E-06
Mean	1.17E-07	1.56E-06	5.10E-07	3.93E-06	1.22E-07	1.59E-06
DEGB-Only Model						
5 th	9.83E-11	8.18E-09	1.14E-09	1.66E-08	1.12E-10	8.29E-09
50 th	2.86E-09	2.07E-07	2.64E-08	3.90E-07	3.16E-09	2.09E-07
95 th	1.47E-07	7.06E-06	6.85E-07	1.21E-05	1.54E-07	7.13E-06
Mean	5.12E-08	2.06E-06	2.03E-07	3.61E-06	5.32E-08	2.08E-06

Plant $\Delta LERF$ analysis (strainer)

1. The STP RCFCs are capable of maintaining containment cooling without dependency on ECCS
2. Independence of containment failure from the concerns raised in GSI-191 allow an accurate estimate of $\Delta LERF$ based on ΔCDF :

$$\Delta LERF = LERF_{MOR} \left(\frac{\Delta CDF}{CDF_{MOR}} \right)$$

where values of CDF_{MOR} and $LERF_{MOR}$ are the average values obtained from the PRA model of record

3. IF $\Delta LERF$ is in Region III of RG 1.174, THEN the (strainer) risk related to $\Delta LERF$ is acceptable

Plant $\Delta LERF$ analysis results

The $\Delta LERF$ values for the geometric mean model for both continuum break and DEGB-only assessments are substantially below 1E-07. However, the values for the arithmetic mean are higher as expected due to the very high estimates that result from the arithmetic mean aggregation in NUREG-1829.

Model	$\Delta LERF$ using $\hat{\Phi}$ (GM)	$\Delta LERF$ using $\hat{\Phi}$ (AM)
Continuum break model	7.67E-09	9.99E-08
DEGB-only model	3.34E-09	1.31E-07

In-vessel analysis

1. The risk due to core loading effects needs to be assessed against strainer penetration test data
 - ▶ Cooling effectiveness for fiber blockage
 - ▶ Boron precipitation for blockage from the lower plenum
2. Thermal-hydraulic analysis for adequate cooling for all hot-leg breaks and small cold leg breaks under bounding blockage scenarios
3. At the amount of the fiber assumed in the strainer test, the amount that penetrates the strainer and arrives in-vessel is less than 15 gm/FA (WCAP-16793)

RoverD analysis results

1. There are 45 locations (welds) in the risk-informed category and with the exception of one, all are in the RCS loop piping
2. The maximum frequency (smallest break size that exceeds the tested amount of fiber) is a DEGB of the 16 inch surge line
3. In-vessel fiber loading is not exceeded for any scenarios equal to, or less than, the tested fiber amount using bounds of the data measurements
4. All welds that exceed the tested amount of fiber have been either mitigated or replaced
5. All results using quantiles from NUREG 1829 geometric mean aggregation, both the RoverD continuum break model or DEGB-only break model Δ CDF are less than $1\text{E-}06$ (RG 1.174 Region III)
6. Using quantiles from NUREG 1829 arithmetic aggregation, the mean and 95th quantiles exceed $1\text{E-}06$ (RG 1.174 Region II)

Regulatory Implementation

- Exemptions required for LOCAs that can generate debris that is not bounded by plant-specific testing
- Exemption would permit use of risk-informed approach instead of prescribed deterministic methodology
 - 10CFR50.46(d) ECCS “other requirements”
 - GDC 35 ECCS
 - GDC 38 Containment Heat Removal
 - GDC 41 Containment Cleanup
- Exemptions apply only for the effects of debris

Regulatory Implementation

- Amendment to the license

- Risk-informed approach is a methodology change per 10CFR50.59
- STP is proposing new actions to be added to the ECCS and the Containment Spray TS

Reactor Containment Building emergency sump shall be OPERABLE by limiting the containment debris quantities to be less than or equal to the STP debris analysis assumptions.

With less than the required [ECCS or Containment Spray] Systems OPERABLE due to potential effects of debris, perform the following:

- a. immediately initiate action to implement compensatory actions,
and
- b. within [90 days] restore the affected system(s) to OPERABLE status,

OR

Be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours,

Regulatory Implementation

- UFSAR changes
 - Ch. 3 GDC description
 - Ch. 6 Engineered Safety Features
- Technical Specification Bases
 - ECCS
 - CSS

Conclusions

- The RoverD process incorporates all aspects of the debris issue
 - Debris generation and transport
 - In-core effects
 - Deterministic (testing for fiber and chemical effects)
 - Risk-informed evaluation
- RoverD demonstrates very small risk per RG 1.174



STP Deterministic Strainer Testing

**ACRS T/H and Risk-Informed
Subcommittees March 18, 2015**

**Steve Smith
Office of Nuclear Reactor Regulation**

STP Background

- High Fiber Plant
 - Nukon and Thermal Wrap
 - Little other insulation material
 - Very small amount of microporous insulation (Microtherm)
- PCI Uniform Flow Strainer
 - 3 trains of ECCS each with its own strainer
 - 2 trains required for operability
 - 1818.5 ft² strainer area per train
 - 0.0086 ft/sec strainer face approach velocity
- STP GL 2004-02 deterministic submittal at ML083520326
 - Discusses strainer testing and other GL 2004-02 areas

Test Assumptions and Application

- Test geometry
- Debris generation/surrogates
 - Debris sizing/characteristics
- Transport/debris amounts
 - Limiting debris load (including thin bed and full debris load)
 - Debris addition sequence
- Maximum flow velocity
- Submergence/vortexing/flashing
- Chemical effects (WCAP 16530-NP-A method)
- Termination criteria
- Viscosity correction

STP Test Methods

- Testing per NRC staff guidance (ML080230038)
 - Allowed near field settling
 - Staff conducted significant discussions with PCI regarding credit for near field settling in testing
 - Added controls on debris preparation, addition methods, and addition sequence
 - Significant evaluation of flow and turbulence fields
 - Staff evaluated debris that settled in the flume
 - Other PCI test methods similar to other vendor testing
 - Test module was 91.44 ft² (about 2.5% of two trains)
 - 100% of debris predicted to transport included in test

STP Head Loss Test

Key Results

- NRC staff observed two tests in 2008
- 2008 trip reports are available:
 - February – ML080920398
 - July – ML083470317
- February test resulted in excessive head loss before chemicals were added to the test
- July test resulted in acceptable head loss
 - Maximum head loss about 9 ft (at 110-120 °F) including chemicals

STP Test Observations

- February 2008 Test Observations
 - Test with only fine fiber and particulate resulted in very high head loss
 - Test that allow debris to transport to strainer without agitation result in very high head losses if enough fine fiber transports

STP Test Observations

- July 2008 Test
 - Differences from February Test
 - Non-zinc coatings were represented by actual paint instead of walnut shell flour
 - Some coatings were added as chips
 - Fibrous debris reduced (7D vs 17D ZOI, about 14x volume difference)
 - Marinite powder used instead of cal-sil
 - Conclusions
 - Lower head loss due to reduction in fibrous debris
 - Other test surrogates may have had some effect
 - First batches of chemical precipitate had a large effect

STP Head Loss Testing Summary

- February 2008 Test
 - Test included debris based on staff approved ZOIs
 - STP determined that debris amount must be reduced to achieve acceptable head loss results
- July 2008 Test
 - Repeat of February test with reduced fibrous debris amount
 - Based on a 7D ZOI vs. staff approved 17D ZOI
 - 7D ZOI jet tests were subsequently not accepted by the staff
 - Therefore the July test fiber quantity was not considered bounding for the STP plant condition
 - Test was conducted with accepted methods and assumptions
 - Debris preparation and introduction met staff guidance
 - Can be used to establish a debris limit for STP



The End

- Questions
- Discussion