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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE

and

RELIABILITY AND PRA SUBCOMMITTEE

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TUESDAY

APRIL 18, 2017

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear
Regulatory Commission, Two White Flint North, Room
T2B1, 11545 Rockville Pike, at 10:45 a.m., Michael
Corradini and John Stetkar, Co-Chairs, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Co-Chair

JOHN W. STETKAR, Co-Chair

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

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JOSE MARCH-LEUBA, Member

JOY REMPE, Member

GORDON R. SKILLMAN, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

WILLIAM SHACK*

DESIGNATED FEDERAL OFFICIAL:

DEREK A. WIDMAYER

ALSO PRESENT:

STEVE BLOSSOM, STPNOC*

VIC CUSUMANO, NRR

C.J. FONG, NRR

WAYNE HARRISON, STPNOC*

JOSH KAIZER, NRR

ERNIE KEE, STPNOC*

DOMINIC MUNOZ, Alion*

MICHAEL MURRAY, STPNOC*

ANDREW RICHARDS, STPNOC*

LISA REGNER, NRR

TIM SANDE, Enercon, Public Participant*

WES SCHULZ, STPNOC*

STEPHEN SMITH, NRR

ANDREA D. VEIL, Executive Director, ACRS

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*Present via telephone

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P R O C E E D I N G S

(10:45 a.m.)

CO-CHAIR CORRADINI: The meeting will now come to order.

This is a joint meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Thermo-hydraulics and Reliability and PRA. My name is Mike Corradini, Chair of the Thermo-hydraulics Subcommittee.

ACRS members in attendance for the moment are Ron Ballinger, Dick Skillman, Dennis Bley, John Stetkar, Jose March-Leuba, and Joy Rempe. We may be joined by others.

Also, we should have Dr. Bill Shack, ACRS consultant joining us by telephone. Derek Widmayer of the ACRS staff is the designated federal official for this meeting.

The purpose of today's meeting is to continue our discussions on the South Texas Project's Risk-Informed Approach to Resolve GSI-191 that was held in our joint subcommittee meeting on April 5th, two weeks ago. The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for consideration by the full committee.

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1 The ACRS was established by statute and
2 is governed by the FACA. That means that the
3 committee can only speak through its published letter
4 reports. And we hold meetings to gather information
5 to support our deliberations. Interested parties who
6 wish to provide comments can contact our offices
7 requesting time after the Federal Register Notice for
8 the meeting is published. That said, we also tend
9 to set aside -- we will set aside time for
10 extemporaneous comments from members of the public
11 who are listening to our meetings. Written comments
12 are also welcome.

13 The ACRS section of the USNRC's public
14 website provides our charter, bylaws, letter reports,
15 and full transcripts at all full and subcommittee
16 meetings, including all slides presented at the
17 meeting. Detailed proceedings for conduct of the
18 ACRS meetings were previously published in the
19 Federal Register Notice of -- in the Federal Register
20 Notice.

21 The meeting is open to public attendance.
22 And we have received no requests for time to make
23 oral statements.

24 Today's meeting is being held over a
25 telephone bridge line with participants from South

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1 Texas on the phone. And I will come back to who I
2 think is on the phone, just to verify that we have
3 our speakers ready and willing. A transcript of
4 today's meeting is being kept. Therefore, we request
5 that meeting participants on the bridge line identify
6 themselves each and every time they speak, and speak
7 with sufficient clarity and volume so they can be
8 readily heard.

9 Participants in the meeting room should
10 use the microphones located throughout the meeting
11 room when addressing a subcommittee. I understand
12 there may also be participants on the bridge line
13 besides our consultant and some folks from South
14 Texas. We request those participants on the bridge
15 line keep their phones on mute until they are called
16 upon to speak during the public comment period at the
17 end of the subcommittee meeting.

18 At this time I ask attendees in the room
19 to please silence all cell phones and other devices
20 that make noises or other sort of interesting
21 disruptions. I also remind speakers at the front
22 table to turn on the microphone indicated by the green
23 light with the push button at the bottom when
24 speaking. And, likewise, turn of the microphone when
25 you're not speaking.

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1 We will proceed now, I think I will turn
2 to Lisa to start us off. I'm sorry, Lisa or Vic. I
3 apologize.

4 MR. CUSUMANO: Yeah, this is Vic
5 Cusumano. I took over from Stu Bailey as chief of
6 the branch managing GSI-191. I'm still not sure who
7 I annoyed to get that. But about three years ago
8 when I started this there was a lot of work to be
9 done. There's still some work to be done. I
10 appreciate your time on this.

11 I understand your questions are going to
12 be for South Texas to reply to. But we are prepared
13 at the front table and in the room to provide staff
14 perspectives as needed and requested.

15 So I think I'll turn it back.

16 CO-CHAIR CORRADINI: Okay. So I think
17 the first thing on the list is to go to the folks of
18 South Texas. Let me -- I assume you guys have been
19 unmuted. And what I've been told is the potential
20 speakers are Mike Murray, Steve Blossom, Wes Schulz,
21 Ernie Kee, Drew Richards, Wayne Harrison, and Dominic
22 Munoz from Alion.

23 So, Ernie or Wes, who of you are going to
24 kick this off on the South Texas side?

25 MR. MURRAY: Dr. Corradini, this is Mike

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1 Murray.

2 CO-CHAIR CORRADINI: Sorry, Mike. I
3 should have, I should have said you first.

4 MR. MURRAY: That's, that's quite okay.
5 We're good with that.

6 And also in the room with us is Rob Ing
7 and Steve Blossom from South Texas.

8 CO-CHAIR CORRADINI: Okay.

9 MR. MURRAY: And, Wayne, you were already
10 introduced; correct?

11 MR. HARRISON: Yes.

12 MR. MURRAY: Okay. So what, what our
13 plan is then is we'll have Wes Schulz go through
14 question number one. And I assume you have
15 questions, the white papers in front of you; is that
16 correct?

17 CO-CHAIR CORRADINI: We have your
18 responses, yes. That's correct.

19 MR. MURRAY: All right. And then Ernie
20 will take us through question number two. And then
21 question number three will be Drew Richards.

22 CO-CHAIR CORRADINI: Okay.

23 MR. MURRAY: So that is, that is our
24 plan.

25 So with that, if it's okay with you, we

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1 will turn it over to Wes Schulz to go through question
2 number one and ask -- and answer any additional
3 questions the ACRS may have.

4 CO-CHAIR CORRADINI: Sure. Go ahead.

5 MR. SCHULZ: This is Wes Schulz at STP.
6 Question number one asks about single train operation
7 and what is the NTS base margin with we have CS pumps
8 and ECCS pumps in operation.

9 CO-CHAIR STETKAR: Wes, can you get a
10 little bit closer to the mike? We're having a little
11 trouble picking you up for the transcript.

12 MR. SCHULZ: Sure. This is Wes Schulz.
13 Does that sound better? I hope that sounds better.

14 CO-CHAIR CORRADINI: It just depends on
15 our recorder.

16 CO-CHAIR STETKAR: The closer you are to
17 the mike, the better.

18 MR. SCHULZ: Okay. This is Wes Schulz.

19 For two-train operation our total
20 strainer flow for sump is 7,020 gpm. And that comes
21 from the low head SI pump of 2,800; the high head SI
22 pump for 1,620 gpm; and a CS pump for 2,600.

23 And that's what our July 2008 strainer
24 head loss test was based on, a total flow of 7,020
25 gpms per sump.

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1 For single train operation we have the CS
2 pump flow rate is higher, which yields a total
3 strainer flow about 200 gpm higher, so we get 7,220
4 gpm because the CS pump is 2,800 gpm now.

5 So the question was asked about the NPSH.
6 And in particular, the NPSH table we provided, the
7 containment spray pump at a particular temperature,
8 212 degrees, had the smallest difference between our
9 NPSH margin and what the total strainer head loss
10 was.

11 And so, we took that case and examined
12 that for the single strain evaluation with a higher
13 sump strainer flow rate. And that's what's presented
14 here in this table here. We took the table from a
15 previous submittal. And then in the middle there for
16 the single strain case we have -- we adjusted the
17 NPSH required, which goes up because the flow rate's
18 a little bit higher. NPSH available went down
19 because we had more friction loss.

20 And then the calculated NPSH margin. And
21 then we compared that to our strainer head loss, which
22 is flow adjusted for the higher flow rate.

23 In the first case scenario --

24 CO-CHAIR CORRADINI: So, so can I just
25 stop you there.

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1 So where is this single train analysis
2 located that I couldn't find it in the submittal?

3 MR. SCHULZ: We did not explicitly
4 calculate that or provide it in the submittal.

5 CO-CHAIR CORRADINI: Okay. So this is
6 calculated for the answering our question but it's
7 nowhere documented?

8 MR. SCHULZ: That is correct.

9 CO-CHAIR CORRADINI: Okay. Keep on
10 going.

11 MR. SCHULZ: Yes.

12 So for that particular case there, our
13 NPSH margin is less than the total strainer head loss
14 which is based on all the flow chemical loading.

15 So we look at that. And our strainer
16 tests in July said about half the load was due to
17 chemicals and the other half was due to particulates
18 and fiber. So if we assume no chemicals, then we
19 have a margin that's greater than our total strainer
20 head loss.

21 Then the next row we used half of the
22 chemicals and our margin is still greater than our
23 total strainer head loss.

24 CO-CHAIR CORRADINI: So let me stop you
25 there.

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1 The no or the half are simply
2 sensitivities. But that's not following the rules
3 of the game. Is that fair?

4 MR. SCHULZ: Well, no. I wouldn't say
5 that's fair. We're, in single strain case we're
6 using not our deterministic design basis case. So
7 that's why. And the chemicals were very conservative
8 so that's why we want to present that here.

9 CO-CHAIR CORRADINI: Okay. But I don't
10 mean to press on you, but unless I misunderstand the
11 rules of the game, the rules of the game are you were
12 going to take your 2008 -- so let me clarify. Dr.
13 Shack actually is the one that is -- I'm hoping is
14 going to speak up because I will misrepresent his
15 question to me about clarification.

16 You are, you are using at the case which
17 is 212 degrees Fahrenheit and full, full flow with
18 all the chemicals, you're referring back to the 2008
19 test where 96 pounds of chemicals is the equivalent
20 break point between fail and no fail; right?

21 MR. SCHULZ: Not 96 pounds of chemicals,
22 no.

23 CO-CHAIR CORRADINI: I'm sorry. I said
24 96 pounds of chemicals. I meant to say, excuse me,
25 96 pounds of particulate, part of which is full

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1 chemical loading. Fiber.

2 MR. SCHULZ: Fibers. But fibers are
3 acceptance criteria for, for success.

4 CO-CHAIR CORRADINI: But what I'm trying
5 to get at is the chemical loading is consistent with
6 your 2008 test because the way I read your response
7 is you're saying that chemical, those chemicals are
8 conservative but they're still according to the
9 procedure you used everywhere else in the, in the
10 analysis based on your testing. Is that not correct?

11 MR. SCHULZ: I'm not sure I understand
12 that. We --

13 CO-CHAIR CORRADINI: So, so I may defer
14 to Dr. Shack. I don't have his question in front of
15 me.

16 Dr. Shack, are you online? There's
17 silence.

18 Otherwise we'll let you continue and I'll
19 go find his question and get back to you on it. Why
20 don't you keep on going.

21 MR. HARRISON: This is Wayne Harrison.

22 You're correct in pointing out that our,
23 our risk-informed methodology was based on a
24 comparison with our deterministic testing. I think
25 that was what you were saying, Dr. Corradini.

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1 And the -- what Wes was pointing out was
2 this situation with -- what we tested was two trains
3 because that's our, that's our design basis. That's
4 our deterministic design basis.

5 The single train case is not a
6 deterministic design basis. We consider the single
7 train configuration as part of the risk-informed
8 scope.

9 CO-CHAIR CORRADINI: Okay. But --

10 MR. HARRISON: So that is why we, why it
11 is appropriate to use more realistic values for the
12 chemical effects.

13 CO-CHAIR CORRADINI: Okay. But let me
14 just get to my point. Let's not -- you, you use the
15 words "more realistic." What I'm trying to get at
16 is what you did in the calculation where it shows
17 that you get 5.4, which is not okay with required
18 5.0. That still follows all the assumptions from the
19 two-train, just essentially extended to the single
20 train. There's no change in the assumptions?

21 MR. SCHULZ: This is Wes Schulz.

22 Yes, that's true. That's correct.

23 CO-CHAIR CORRADINI: Okay. So with
24 that, my next question, since I don't have Dr. Shack
25 on the line and I'm trying to remember his question,

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1 is this now counted as a failure in the probability,
2 in the RoverD? Or is this not considered at all?

3 MR. SCHULZ: I would say we would call
4 it acceptable. We wouldn't -- because we want to
5 use, in the single train case we want to use a more
6 realistic chemical debris loading.

7 CO-CHAIR CORRADINI: Okay, but you're
8 not answer --

9 MR. SCHULZ: Ernie can jump in here.

10 CO-CHAIR CORRADINI: Okay. But I don't
11 want to pick on you but that isn't an answer to my
12 question. My question is you're showing a fail. Is
13 that fail counted?

14 MR. KEE: This is Ernie Kee. We, we do
15 not count as failure cases where, scenarios where the
16 debris loading is less than roughly 96 pounds made up
17 of fine fiber. That was based on, based on the
18 assumption that at that level of fiber loading we
19 would have success at that and lower amounts.

20 So, I think that -- I guess that answers
21 your question. And you'll probably have more
22 questions for Wes after I said that.

23 CO-CHAIR CORRADINI: Okay. Well, I'm
24 going to let him continue and I'm going to come back.
25 Because unless I misunderstand the RoverD approach,

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1 although the probability of single train operation is
2 small, it still is non-zero. And so, with that, if
3 I have that with a given pipe size, et cetera, then
4 this sort of possibility should exist in your fail
5 category in your RoverD calculation. That's what I'm
6 trying to get at.

7 But maybe I'm asking incorrectly. I'm
8 going to look for help. Because I'm not a strainer
9 expert, I'm just trying to properly ask the question.
10 So why don't you continue and I'll --

11 MR. HARRISON: This is Wayne Harrison
12 again.

13 Let me perhaps fill in what I think was
14 a gap between those two comments with my comment.
15 What Ernie is saying is that we calculated the
16 contribution of the single train case. It
17 contributes to the risk. There are, of course, some
18 single train configurations that go to failure, and
19 there are other single train configurations that
20 succeed.

21 This is in the risk-informed portion.
22 It's, again, appropriate to consider from the
23 standpoint of the debris loading and the chemical
24 effects, that the chemical effects to not have this,
25 are overestimated in the deterministic case so we're

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1 using a more realistic value of the chemical effects
2 to access the potential for failure through head
3 loss.

4 Does that make sense?

5 CO-CHAIR STETKAR: Wes, no, it doesn't.
6 This is John Stetkar.

7 What you didn't do is you did not do a
8 systematic risk-informed assessment of your
9 configuration at South Texas according to your 2008
10 tests, period. You're trying to now rationalize why
11 one particular case that we now know would not have
12 passed is kind of sort of okay for you because of
13 other things.

14 The same chemical and same particulate
15 loading on the strainers is used explicitly in all of
16 those thousands of calculations that you did with
17 two-train and the single train conditions in your
18 licensing submittal. That is a fact. I don't need
19 any explanation about that.

20 So now you're going to change the game
21 because you say, well, now that we've discovered that
22 something is wrong in this one particular case, now
23 we can take credit for that extra stuff that we call
24 chemicals that we had in our tests. You could have
25 done that for the two- and the three-train cases.

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1 You could have done it for the three different two-
2 train cases that exist in the real world that may
3 have much different hydraulic conditions and much
4 different straining loading. You chose not to do
5 that because you could get away with those
6 numerically.

7 So, I'm not compelled about your back-
8 fitting all of these qualitative rationale about
9 being conservative. I'm further not compelled
10 because after you did the tests you discovered you'd
11 had different quantities of some particulates and
12 chemicals in the containment compared to what you did
13 in the tests. You said, yeah, yeah, but we can
14 account for the fact that what did we did in the tests
15 was conservative, so despite the fact that we
16 discovered other stuff, that's okay too.

17 It's pretty specious. You could have
18 done it right. You chose not to.

19 CO-CHAIR CORRADINI: That's not my
20 question. But I think, I was waiting for John to
21 step in.

22 So, so why don't you continue and then
23 we'll come back. I want to make sure that at least
24 for question one we're very clear that at least
25 factually this was not calculated before. It's now

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1 a new piece of information for us to understand. And
2 unless I misunderstand, if, if I got to the condition
3 of single train operation with these various
4 loadings, that should be a fail. I just want to make
5 sure that's properly accounted for in the risk-
6 informed approach or not.

7 So keep on going.

8 MR. SCHULZ: Okay. This is Wes Schulz.

9 Another aspect of this is, okay, besides
10 the chemical loading is to look at are NPSH available
11 and with this composed of how much water level is on
12 the floor of the containment. So if we use, rather
13 than using the minimum calculated deterministically
14 water level, we use a more nom -- a nominal water
15 level that would give us about 1.5 feet more.

16 So in that case our NPSH margin is
17 sufficient to account for the total strainer head
18 loss with all the chemical loading. That's another
19 aspect of this.

20 CO-CHAIR CORRADINI: But again, let me
21 make sure the five cases you have in here. These are
22 all, when you did the RoverD, which of these -- or
23 were all of these considered in some fashion? Now
24 I'm not sure. None of them were considered, as far
25 as I understand it. They were essentially based on

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1 break size and a scaling off of break size and
2 location as to what particulate would fall into one
3 sump, whether it's single or double or two-train. Is
4 that correct?

5 I keep on saying debris, I should say
6 fiber. Excuse me. I'm sorry.

7 MR. SCHULZ: Our criteria was -- this is
8 Wes Schulz -- our criteria was fiber-generated for a
9 given size break. And when we calculate NPSH we, we
10 could use a minimum calculated water level on the
11 floor or we could use a nominal water level on the
12 floor.

13 CO-CHAIR CORRADINI: But --

14 MR. SCHULZ: I'd point out here that the
15 nominal level gives an acceptable NPSH margin
16 compared to the strainer head loss.

17 CO-CHAIR CORRADINI: Right. But so let
18 me try it a different way and then I'll stop, I'll
19 stop beating this horse.

20 Ninety-six is not the right number for
21 single train operation. That's what I'm hearing you
22 tell me. At 96 you get a fail where you count it as
23 a success.

24 Another way to think of this is for
25 single train operation it may not be 96, it may be 94

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1 of 92. But that's not how it was done. Ninety-six
2 was used with single-train operation. And anything
3 that was under 96 was a success, anything over 96 was
4 a, was a failure in the RoverD calculation. Do I
5 have that right?

6 MR. SCHULZ: Yes. This is Wes. That is
7 right.

8 CO-CHAIR CORRADINI: But nowhere in the
9 calculation do you discriminate from these five
10 possible nuances of this. But in all of these cases
11 only, the way you did it, it essentially used 96 as
12 the pass/no pass point. Independent of these
13 conditions that we now are looking at.

14 MR. SCHULZ: That's the way we did it,
15 yes.

16 CO-CHAIR CORRADINI: Okay. All right,
17 good. Then at least I think I've got that right.

18 Keep on going. Sorry.

19 MR. SCHULZ: Well, there are two aspects
20 of looking at this. One's, you know, a realistic
21 look at how much chemical debris is generated or a
22 realistic look at what the sump water level is. And
23 either of those two considerations will give us an
24 acceptable result.

25 CO-CHAIR CORRADINI: Are you done? I'm

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1 sorry, I didn't mean to --

2 MR. SCHULZ: That would be our response.
3 That's how these different cases were developed. I'm
4 done.

5 CO-CHAIR STETKAR: This is Stetkar. Let
6 me -- I sort of telegraphed stuff in my rant about
7 five minutes ago. But what, what bothers me about
8 this is not so much trying to split three significant
9 figure hairs over pounds of chemicals or pounds of
10 fiber or pounds of anything. It's the fact that
11 you're characterizing this submittal as a risk-
12 informed submittal.

13 In my experience doing risk assessment,
14 risk assessment is a systematic process of asking
15 what can happen, how likely is it, and what are the
16 consequences? It's pretty simple.

17 So if I have three trains of things there
18 are seven possible combinations of what might be
19 operating. I can have A and B and C operating. I
20 can have A and B only. I can have A and C only. I
21 can have B and C only. I can have A only, B only,
22 and C only. Those are seven conditions. That's what
23 can happen.

24 Each of those has an associated
25 probability: how likely is it? The A and B; A and

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1 C; and B and C may or may not have symmetric
2 probabilities. It kind of depends on support
3 systems, all kinds of stuff. But there is a
4 probability. You can calculate that from your risk
5 models. And, in fact, you have in a very simplified
6 way, because you have weighting factors for what's
7 the likelihood of two or three trains running versus
8 the likelihood of one and only one. And you use
9 those numbers in your risk-informed approach.

10 The unacceptable amount of fiber loading
11 once you've run that test to determine the pass/fail
12 criteria, the unacceptable amount of fiber loading
13 might be different for each of those seven cases
14 because of the hydraulic configuration of the sumps
15 in your particular plant.

16 You assumed in your two-train case that
17 you had A and C running, which is the best, in my
18 mind, configuration.

19 A and B running. B is partly shielded
20 by A.

21 B and C running looks worse to me because
22 it looks like almost everything has to flow past C to
23 get to B.

24 But you can still do that in a risk-
25 informed approach. For each of the seven

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1 configurations you would have an unacceptable amount
2 of fiber loading, which translates to a particulate
3 break size, which translates to a particular
4 frequency. And you would have seven
5 probabilistically weighted frequencies that you can
6 then add to your risk-informed acceptance criteria.
7 That would be a systematic risk-informed approach.

8 South Texas might be okay, if we get out
9 to the three significant figures of all the pounds
10 and all of that kind of thing. If this is to be a
11 template for the way future applicants who are going
12 to use this methodology are going to approach the
13 world and the way that the staff is going to approach
14 that submittals I, personally, have real problems
15 with that.

16 And that's, that's where I was headed to.
17 Because one of the reasons I was so concerned about
18 the single train case is it's not clear to me that
19 the two-train case that you selected is the most
20 limiting of the three possible two-train cases. I
21 think that B and C alone might be the most limiting
22 in terms of hydraulics and fiber loading of the three
23 possible hydraulic configurations.

24 However, if I had assurance of some
25 numbers about how much can be generated for single

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1 train, you know, I was sort of looking at those
2 results to give me a little bit confidence that even
3 under the worst of the three two-train cases you'd
4 probably still have one train available, which meets
5 your risk -- your PRA success criteria for most of
6 the LOCAs. So that's, that's one of the reasons,
7 other than the sort of philosophical making sure you
8 have all of the combinations in place.

9 And that's sort of the process that any
10 applicant who is going to use the simplified risk-
11 informed approach could address -- should use to
12 address the issue. Systematically go through the
13 combinations, assign probabilities to each
14 combination, look at the amount of fiber loading that
15 is necessary for success or failure -- whatever your
16 criterion is called -- and what is the associated
17 frequency with that, that fiber loading?

18 Someone who goes through that process,
19 fine, you've got the process, you either win or lose.

20 I'm done, Mike. Thanks.

21 MR. KEE: This is Ernie Kee. I just want
22 to comment on the kind of configurations that were
23 enumerated. And in truth there's many more
24 combinations than what, what we might imagine at
25 South Texas Project, and probably at other plants.

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1 So, we talked briefly about that at the
2 meeting a couple weeks ago. And I mentioned that not
3 all single train cases are like you may imagine as
4 having one piece of equipment operating on one train.
5 You could have the same combination of equipment
6 running on three different trains, like a low head,
7 high head, and containment spray each on a strainer.

8 So, each one of these kinds of
9 configurations will produce their own unique flow
10 pattern, Reynolds numbers, you know, transport
11 situations that turn into effectively infinitely
12 complex problems, especially if you follow all the
13 possible trajectories that require some sort of
14 support with computational fluid dynamics for the
15 transport in the pool, so on and so forth, for all
16 the different kinds of cases you can imagine.

17 And then a test -- we ran into this issue
18 with getting some kind of bounding test for each one
19 of these kind of configurations. So what we have
20 done and why we call it risk over deterministic is we
21 tried to appeal to prior understandings of how these
22 kinds of decisions have been made. And that is a
23 test for success is typically performed. That's done
24 in core for like, for example, in WCAP-16793.

25 And in our sump case for the strainers we

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1 did a bounding test in 2008 where we tried to throw
2 everything imaginable at the strainer to increase
3 head loss to ensure that the equipment would continue
4 to run with highest flow rate we could come up with.

5 So we tried to bound, we tried to bound
6 in these cases, we tried to bound the worst
7 performance I guess you could say. So we're ensured,
8 we've very sure that we could succeed with the levels
9 that we're asserting as being deterministically
10 determined. And we're very sure that we'll exceed
11 at much higher levels for the reasons that Wes Schulz
12 has articulated in his response.

13 CO-CHAIR CORRADINI: Okay. But, Ernie,
14 then if I might just go back in. John is much more
15 the risk analyst than I am. I don't pretend to be.

16 But since we now have five calculations
17 that show one of the five calculations is a fail,
18 that tells me that 96 is not the go/no go number for
19 single train operation. It's a lower value. So --

20 MR. KEE: Okay. This is Ernie Kee again.
21 I don't -- I understand the question. And the truth
22 of the matter is I'm kind of with you guys on this
23 that you should not go back and reset your success
24 criteria based on some finding. That, I can accept
25 that.

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1 I just, what we can say is we're sure,
2 darn sure that the single train case will succeed
3 under a realistic conditions. And so from RoverD
4 perspective we need to, as you rightfully say, have
5 a deterministic limit that is established. And that
6 is an input into this whole analysis. And if it's
7 not correct, then you're right, then we have to re-
8 look at it.

9 CO-CHAIR CORRADINI: Okay. Because,
10 again, this is not the risk person talking. I --
11 John, John tutored me before the meeting so that I
12 can ask this question intelligently. But the way I
13 think is going on here is 4 out of 10,000 chances of
14 single train operating, but in those 4 out of 10,000
15 the break point is not going to be what you assume.
16 It's going to be a tad lower. So that under any
17 water, chemical loading that you refer to, it's
18 conservatively what's success or fail.

19 Conversely, the thing that's the 9,996
20 times out of 10,000 that are successful, that one is
21 going to dominate probably. And your numbers will
22 probably be okay. It's just that these numbers
23 aren't exactly right.

24 MR. KEE: This is Ernie Kee. Yes, it's
25 what we call success criteria in the PRA. And that's

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1 correct. If we ran many thousands of simulations and
2 looked at each one of those simulations, which in
3 fact we have done in a realistic way, what we find is
4 we never see failure at the strainer, so.

5 CO-CHAIR CORRADINI: Yes, I understand.
6 Okay.

7 MR. KEE: Yes. So that's the case of
8 that we, we have done that exercise. We know what
9 the answer is. And so we -- that gives us confidence
10 that we're okay. But we needed, as the staff has
11 pointed out, we needed to look at this single train
12 case more carefully than possibly we had looked at in
13 terms of the flow rate and the combinations of
14 materials that would be on the strainer.

15 CO-CHAIR CORRADINI: Okay. I think, I
16 think I understand your response. I'm done asking.

17 John, are you done?

18 CO-CHAIR STETKAR: Yes.

19 CO-CHAIR CORRADINI: Any other members?
20 I think we're done with question one, unless the other
21 members have a question.

22 CO-CHAIR STETKAR: I would only mention
23 for the staff's benefit so we get it on the record
24 that, given this conversation, you know, you did the
25 independent calculation using the -- for the break

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1 size 9.34 inches or 6 inches or something like that.
2 That would also change a little bit over the break.

3 I don't know how much smaller it would
4 need to be to generate however fewer pounds they would
5 need, but.

6 MR. CUSUMANO: South Texas projects as a
7 pilot provided lessons learned not only to industry
8 but also to the staff.

9 CO-CHAIR STETKAR: Got you.

10 CO-CHAIR CORRADINI: Yes?

11 MR. FONG: Mr. Stetkar, this is C.J. Fong
12 from NRR.

13 I can just add, absolutely the 9.34 might
14 be 8 or something like that. Don't know. I would
15 point out that our consultant also ran number
16 sensitivity studies, including one where we assumed
17 that for single train all breaks 2 inches or larger
18 went to failure.

19 They did it for the, you know, what the
20 impact would be on risk. And, of course, it does
21 increase the risk on the sensitivity study but still
22 met the acceptance guideline, so.

23 CO-CHAIR STETKAR: Yes. But you said,
24 C.J., that's -- make sure I understand -- that was 2
25 inches?

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1 MR. FONG: Yes, sir.

2 CO-CHAIR STETKAR: Yeah, that clearly
3 would be a bad thing. We're probably talking about,
4 you know, something in the range of 8 to 9 inches, if
5 not even a little over 9.

6 CO-CHAIR CORRADINI: Okay. Dick?

7 MEMBER SKILLMAN: Yes. This is Dick
8 Skillman.

9 My question is how has instrument error
10 been accommodated both on the sump level and on the
11 flow rates?

12 MR. SCHULZ: Instrument error, these are
13 calculated, you know, levels based on volume. And
14 the flow rate is calculated -- well, based on the
15 system.

16 MEMBER SKILLMAN: Here's why I'm asking
17 the question. On the last two cases of single train
18 at 212 Fahrenheit you're showing NPH margin, MPSH
19 margin of 6.5 feet based on 8.3 if nominal sump level,
20 not minimum.

21 I've dealt with nominal sump levels. I
22 know what it's like to have a LOCA, and I know what
23 it's like to have so many feet of water on the floor
24 of the building. But I also know how sensitive that
25 level may be to the accuracy of that instrument.

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1 And so when you claim you might have 8.3
2 NPSH available, that might be a good number if you
3 know for certain that that instrument is accurate
4 under those conditions. So if you're going to peddle
5 212 single train with 8.3 NPSH available, you need to
6 know that the instrument that's providing that level
7 is accurate.

8 MR. SCHULZ: This is Wes Schulz. I
9 understand your question. But that's at calculated
10 levels. We're not using any instrumentation to
11 measure that. But, again, it's just based on volumes
12 and areas and equipment things.

13 MEMBER SKILLMAN: I'm just going to make
14 one more --

15 MR. SCHULZ: I mean it's not a basis for
16 any operator action or anything like that.

17 MEMBER SKILLMAN: Believe me, I
18 understand how the system functions. If your
19 building's about 130 feet in diameter, if it's 129.6
20 feet and you're assuming so many feet a level, you
21 may be surprised. That's all I'm saying.

22 MR. SCHULZ: Okay. This is Wes Schulz.
23 Yeah, we considered that when we did our, you know,
24 water level calculations.

25 CO-CHAIR CORRADINI: Okay. Any other

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1 questions on, any other comments or questions from
2 the committee on the response for question one?

3 (No response.)

4 CO-CHAIR CORRADINI: All right, why
5 don't you guys go on to question two, please.

6 MR. KEE: This is Ernie Kee. Sorry.

7 CO-CHAIR CORRADINI: I'm sorry, Ernie.
8 Hang on.

9 John, did you want to ask the staff
10 something or wait till the end to ask the staff? I
11 know you had some questions of the staff. Or do you
12 want to wait?

13 CO-CHAIR STETKAR: Actually I didn't
14 particularly have any questions.

15 CO-CHAIR CORRADINI: Okay.

16 CO-CHAIR STETKAR: On number one I think
17 I, you know, said everything I had to say.

18 CO-CHAIR CORRADINI: All right.

19 CO-CHAIR STETKAR: Just, just if you're
20 going to -- only thing I, again a subcommittee meeting
21 so this is my own -- consider if you're going to make
22 any changes to the SER, and I don't know whether you
23 are or not, as I said, I started down this single
24 train path partially because of the common atorics of
25 the seven different combinations, but indeed more

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1 along the lines of it wasn't clear to me that the
2 particular two-train case that they selected, A and
3 C, was indeed the hydraulically bounding two-train
4 case.

5 So I was also trying to use the single
6 train information to give me confidence that what
7 they did for the two -- the two-train case is clearly
8 bounding for all three-trains operating. I'll give
9 them that. It's not clear that the particular two-
10 train case they selected is bounding for all of the
11 three two-train cases.

12 And if it's not, then you get into what's
13 the likelihood of each combination. So I, as I said,
14 think if you're going to massage the SER, kind of
15 think about that part of --

16 MR. CUSUMANO: And even if we don't,
17 whether we considered it before, you know what, based
18 on our conversations here, we'll certainly be more
19 sensitive to it with the follow-up plans.

20 CO-CHAIR STETKAR: I get it. Thank you.

21 CO-CHAIR CORRADINI: Okay. So go ahead
22 to question two. I'm sorry, I held you on that.

23 Go ahead, South Texas.

24 MR. KEE: This is Ernie Kee.

25 On question two we were asked to, we, STP

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1 explain the reason why delta PDF decreased for
2 continuum model case to single train operation
3 between supplement two and three.

4 So we provided kind of a summary of that
5 case. We showed the equation that we solved to
6 obtain those frequencies. And then in a table we
7 illustrated some details and discussion about why the
8 modeling behaved in that way.

9 And I guess I'll just pause there if
10 there's any questions about that. Otherwise I'll go
11 on and just say that the reason is as explained in
12 this response.

13 CO-CHAIR CORRADINI: John. I'm going to
14 limit it to Member Stetkar since I, the math was
15 overtaking me.

16 CO-CHAIR STETKAR: Multiplication and
17 addition is always difficult.

18 CO-CHAIR CORRADINI: I know.

19 CO-CHAIR STETKAR: No, I'm good, Ernie.

20 Thanks.

21 It's just interesting, you know, it's an
22 interesting phenomenon because of your distribution
23 of pipe sizes. I appreciate the math.

24 CO-CHAIR CORRADINI: Any other questions
25 from the members?

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1 (No response.)

2 CO-CHAIR CORRADINI: Okay. On to three.

3 MR. RICHARDS: Drew Richards, South
4 Texas Project.

5 If you look at the last paragraph of the
6 response we sent you summarizes the response to your
7 questions. But after we get to mode four from mode
8 three, we maintain reactor coolant system pressure
9 between 325 and 400 pounds per square inch. And we
10 do have tech spec limits on pressurizer core this set
11 point. The maximum level of this set point is
12 approximately 740 pounds per square inch gauge.

13 That answers the pressure question.

14 As far as required strains in operation,
15 a three low intact ejection plus two are required to
16 be operable, or high intact ejection plus two or three
17 are required to be operable but only one of those is
18 allowed to have a breaker rack in.

19 Any questions?

20 CO-CHAIR STETKAR: No. I'm good.
21 Thanks, I appreciate that. I don't need to go into
22 why I asked all of those questions. I'm happy with
23 the answer.

24 CO-CHAIR CORRADINI: Yes, I was going to
25 say from our standpoint at least I thought it was an

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1 informational one. I didn't think there was an
2 issue.

3 MR. RICHARDS: Okay.

4 CO-CHAIR CORRADINI: There could have
5 been but there's wasn't.

6 Okay. So let's take us back, since where
7 I'm struggling is now what? Because now I'm going
8 to characterize this and I'm going to let South Texas
9 correct me, but there is embodied in this an error in
10 the submittal that has to be fixed. Because single
11 train -- and so I wrote it down, so I think I've got
12 it right -- if for a single train operation the 96
13 pound limit is not the right limit, or a bounding
14 calculation has to be done that says given the limit
15 might have uncertainty in it because of a lot of
16 chemicals and saturated water and low sump level,
17 we're still okay.

18 So my question to South Texas is, how are
19 you going to fix it? Or bound it or something?

20 MR. KEE: This is Ernie Kee.

21 So what we need to be able to say is the
22 success criteria is -- or where that success criteria
23 is met. And we don't have any more information than,
24 than what we've provided. So you're right, we could
25 easily bound it. We have in our application the

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1 success frequency for single train operation is
2 almost insignificant to our, to our conclusions. So
3 you could look at it as a bound.

4 Or we could agree that the single train
5 case criteria would be different than -- the
6 conditions would be different than for the two-train
7 case.

8 I will say that the two-train case is
9 indeed bounded by the -- the three-train case is
10 bounded by the two-train case no matter what
11 assumption you take on. But I don't know where we
12 are with that thinking. And maybe Wes has some more
13 to say on that with regard to the success criteria on
14 single train.

15 MR. MURRAY: So, Dr. Corradini, this is
16 Mike Murray.

17 I would suggest that we owe you that
18 answer. Because I don't want to say how to close
19 that gap just now till we think through the best way
20 to close that gap.

21 CO-CHAIR CORRADINI: Okay. And so let
22 me, this is a single member's opinion, but my opinion
23 is I think you guys are okay. You just, there's
24 fuzziness in why you're okay and how you're okay for
25 single train operation and how it fits into your

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1 calculation. That's my way of thinking about it.

2 I think Member Stetkar's comments are
3 more generic, which is if this approach is used by
4 others -- this is my interpretation; I'm sure he'll
5 correct me -- is that if others are going to start
6 using this approach we have to be much more rigorous
7 in all the possibilities. But for your case under
8 how you did it, it just seems to me this has got to
9 be properly corrected and documented. And staff has
10 got to look at it and make sure they're kosher with
11 it.

12 And then I have a feeling you're still
13 okay. But that's just a feeling.

14 MR. HARRISON: This is Wayne Harrison.

15 I guess I would say that probably for the
16 two-train plant their complexity is much less than
17 ours. They don't, they don't have this quite the
18 same.

19 CO-CHAIR CORRADINI: Right. But to be
20 honest and on the record, I don't care about anybody
21 else but you guys. You're in front of us.

22 MR. HARRISON: I understand.

23 CO-CHAIR CORRADINI: Even though you're
24 the pilot. So I want to make sure I understand how
25 the pilot made it through the hurdles and the

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1 obstacles. And this one piece on single train
2 operation is a bit fuzzy.

3 So, somehow you guys have got to decide
4 how to unfuzzy it and then let the staff look at it
5 and make sure they're okay with it.

6 MR. KEE: This is Ernie Kee.

7 This is a little bit unique to STP as
8 well. We have a common spray header. I think most
9 plants, I know some plants, let me not say most, have
10 individual spray headers for each pump, so this
11 wouldn't arise normally. Yes.

12 CO-CHAIR STETKAR: Okay.

13 MR. MURRAY: So we'll -- this is Mike
14 Murray -- so what we'll do is we'll put together our
15 approach for resolution of this question and share
16 that with the project manager Lisa, as well as
17 feedback to ACRS.

18 MR. KEE: Okay. I'm going to turn to
19 the staff because I kind of took the controls here
20 maybe a bit too much. So does the staff want to say
21 anything at this point or are they happy?

22 MR. CUSUMANO: Unless C.J. wants to jump
23 in first. If not, but --

24 MR. FONG: I think we're satisfied. I
25 don't think we have any additional comments at this

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1 time.

2 MR. CUSUMANO: Yeah, and I agree. I
3 don't think we've heard anything that would change
4 the outcome of our decision based on the small impact
5 this could have. They did provide written responses
6 to your questions. We'll engage with them as, you
7 know, as Lisa feels is appropriate to figure out how
8 to get this on the docket, if it's not already.

9 And if this is --

10 CO-CHAIR CORRADINI: Or additional
11 things.

12 MR. CUSUMANO: If this or anything else
13 they want to send us is already on the docket and
14 we've already reviewed it internally and considered
15 it, if we feel we need to change the SE, we will. If
16 we don't, we probably won't. But I'm just happy
17 knowing this is on the docket. The error has been
18 identified, quantified. And we're aware of it going
19 forward to the other plants.

20 CO-CHAIR CORRADINI: Okay.

21 MR. CUSUMANO: If that's acceptable to
22 you guys, that's how I'd like to proceed.

23 CO-CHAIR CORRADINI: So I know that Dr.
24 Shack is finally on the line because he was off
25 walking his dog or mowing the lawn or I don't know

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1 what.

2 So, Dr. Shack, do you have any comments
3 since you at least have been listening for part of
4 this last hour.

5 MR. SHACK: I heard the very last
6 summary. So I have no comment.

7 CO-CHAIR CORRADINI: Do you think --
8 Well, let me put you on the spot, Bill. What sorts
9 of things would satisfy you about trying to clarify
10 this? Did I approximately get it right as to what
11 you heard me summarizing?

12 MR. SHACK: I heard what you summarized.
13 What I didn't hear was the explanation for what was
14 really going on in those single train tests and what
15 was the actual test criteria. I missed all that. So
16 I can't say anything.

17 CO-CHAIR CORRADINI: Okay. All right.
18 Well, with all due respect, we'll repeat it to you
19 later but not now.

20 MEMBER BLEY: We'll have the transcript.

21 CO-CHAIR CORRADINI: Yeah, there's a
22 wonderful transcript coming your way. Okay.

23 MR. SHACK: I'm looking forward to seeing
24 the transcript because the response was confusing.

25 CO-CHAIR CORRADINI: Okay. Okay. Let

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1 me now go to public comments. So could we get -- I
2 don't think, is there anybody in the room that has,
3 wants to make a comment?

4 (No response.)

5 CO-CHAIR CORRADINI: Hearing none, can
6 we get the phone line open, Therone, and see if we
7 can have. Are there comments available? Is anybody
8 online from the public that wants to make a comment?

9 MR. SANDE: This is Tim Sande from
10 Enercon. I would like to make a comment.

11 CO-CHAIR CORRADINI: Go ahead.

12 MR. SANDE: Yeah. So I thought it was a
13 good discussion about the CS pump failure looking at
14 single train cases. But my question or my comment
15 is, if you did have that failure that would be a
16 failure of just the containment spray function and
17 not the high head or low head safety injection pump.
18 So it seems to me like that particular case wouldn't
19 actually go to core damage.

20 CO-CHAIR CORRADINI: Okay. All right.
21 Take note of that. Thank you very much. I'm sure
22 South Texas will welcome that differentiation.

23 Any other comments from the phone line?

24 (No response.)

25 CO-CHAIR CORRADINI: Okay. Hearing

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1 none, let's close the public phone line.

2 Let's go around to the members if we have
3 comments because I want to get to how we're going to
4 arrange for the full committee meeting in two weeks.

5 Member Ballinger?

6 MEMBER BALLINGER: No comment.

7 CO-CHAIR CORRADINI: Member Skillman?

8 MEMBER SKILLMAN: No further comment.

9 Thank you.

10 CO-CHAIR CORRADINI: Bley?

11 MEMBER BLEY: No further comments.

12 Thank you.

13 CO-CHAIR CORRADINI: I'm skipping
14 Stetkar; he's had enough. Jose?

15 MEMBER MARCH-LEUBA: No comment.

16 CO-CHAIR CORRADINI: Joy.

17 MEMBER REMPE: I have no comment.

18 CO-CHAIR CORRADINI: All right. Back to
19 Member Stetkar.

20 CO-CHAIR STETKAR: I feel
21 disenfranchised and honored that you'd let me speak.
22 No, I don't have anything more to say.

23 CO-CHAIR CORRADINI: Okay. So, so let's
24 at least discuss for the full committee meeting. I
25 think we have an extra fun session arranged. I think

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1 we have more than a couple hours, I think we have a
2 little more than a couple hours, two-and-a-half,
3 three hours of time to go through this with the other
4 members. Because I don't think even at the last
5 subcommittee we had a majority of the members, and
6 they're going to want to learn about this.

7 I would hope that South Texas would get
8 their clarification of their calculations to the
9 staff so they can review it and we can hear from both
10 sides at the full committee about this, however you
11 want to organize it.

12 My suggestion is, and this is just a
13 suggestion, I look for the members to chime in, is
14 I'd kind of apportion it since we have new members
15 that weren't at the subcommittee nor were having all
16 this fun for many, many, many, many, many years, that
17 maybe subdivide the full committee meeting into
18 somewhat of a background of what's going on with the
19 problem, the generic issue, then how the strainer
20 loads and associated analyses were done, as well as
21 the in-vessel analyses, somewhat equally done so we
22 can kind of march through it.

23 And leave ample time, and assuming we
24 have, just to pick some numbers, assuming we have
25 three hours during the full committee, leave ample

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1 time for discussion, a good half an hour at least of
2 the three hours, so that the committee members can
3 ask questions.

4 Beyond, in other words, don't assume
5 50/50. I'd assume 40/60 in terms of presentation 40
6 percent, discussion 60 percent in the available time.
7 Otherwise I think we're going to get rushed.

8 CO-CHAIR STETKAR: And again, this is
9 Stetkar for the benefit of people out on the phone
10 line, despite the kind of animated discussions we've
11 had about the single train case and the numbers there,
12 don't react -- don't overreact to that. Don't ignore
13 it but don't overreact to it. Because, as Mike said,
14 the full committee membership, it's much more
15 important that the full committee understands the
16 basic process that was used in this submittal.

17 CO-CHAIR CORRADINI: Right.

18 CO-CHAIR STETKAR: And that's, that's
19 paramount. The nuances of this single train case and
20 whether or not you may pass or fail under certain
21 conditions are, are that, they're nuances, for the
22 benefit of the full committee.

23 CO-CHAIR CORRADINI: Right. And this is
24 just my own personal comment. I personally think STP
25 did a service to doing this as the pilot plant for

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1 this. Because I do think their general approach to
2 me is very intriguing and useful.

3 So all our criticisms and questions
4 aside, I appreciate South Texas, and I thank the staff
5 for what they've done.

6 So that's how I'd suggest organizing the
7 full committee meeting. Other members' comments?
8 Otherwise --

9 MEMBER REMPE: I have a question. Are
10 we expecting the resolution from South Texas to come
11 in before the full committee meeting?

12 CO-CHAIR CORRADINI: I am.

13 MEMBER REMPE: Okay. Just wanted to
14 make sure. I would, too, but I didn't hear that.

15 CO-CHAIR CORRADINI: Well, I mean I never
16 know what happens in the next day, but I'm expecting
17 that will happen.

18 MS. REGNER: This is Lisa Regner.

19 I'm sure they'll give us the schedule in
20 the next day or two.

21 CO-CHAIR CORRADINI: Okay. Okay,
22 because --

23 MS. REGNER: And I can pass that on.

24 CO-CHAIR CORRADINI: Okay, that's fine.

25 And I want to make all attempts to try to

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1 write something up for the members to react to
2 eventually. And so that's going to be depending on
3 what I hear from all of this. Okay?

4 Okay. All right, with that, I think we
5 can adjourn the subcommittee meeting. Thank you.

6 (Whereupon, at 11:39 a.m., the
7 subcommittee was adjourned.)

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Question #1: For single train operation, what is the NPSH margin with full flow from the CSS and ECCS pumps?

Response: For two train operation the total strainer flow per sump is 7020 gpm (LHSI pump 2800; HHSI pump 1620; and CS pump 2600). The July 2008 strainer head loss test was based on a total flow of 7020 gpm per sump. For single train operation, the CS pump flow is higher, which yields a total strainer flow for the sump of 7220 gpm (LHSI pump 2800; HHSI pump 1620; and CS pump 2800).

This table is from Supplement 2 August 2015 (Page 63 of 95 in Attachment 1-2) and shows results for the two train case. The sump temperature of 212°F for the CS pump has the smallest difference between the NPSH Margin and the Total Strainer Head Loss of all the pumps. Rows have been added for the single train case for this temperature.

Containment Spray Pump				
Sump Temperature, °F	NPSH Required, ft	NPSH Available, ft	NPSH Margin, ft	Total Strainer Head Loss, ft
267 Start of Recirculation 24 minutes	1.4	7.2	5.8	3.8
226 Hot Leg Switchover 5.5 hours	1.4	7.2	5.8	4.6
215	1.4	7.2	5.8	5.0
212	1.4	7.2	5.8	5.1

Single Train 212	1.6	6.6	5.0	5.4 Not OK Uses all chemicals
Single Train 212	1.6	6.6	5.0	2.7 OK if use no chemicals
Single Train 212	1.6	6.6	5.0	4.1 OK if use half chemicals
Single Train 212	1.6	8.3 if use nominal sump level not min	6.5	5.4 OK using all chemicals
Single Train 212	1.6	8.3 if use nominal sump level not min	6.5	2.7 OK using no chemicals

210	1.4	8.4	7.0	5.1
206	1.4	10.8	9.4	5.2
200	1.4	15.1	13.7	5.4
190	1.4	19.8	18.4	5.8
171 24 hours	1.4	27.6	26.2	6.5
128 30 days	1.4	36.7	35.3	9.2

As shown in the table, the single train case gives an unacceptable result if 100% of the maximum chemical debris loading is used. This is most conservative since STP specific testing shows that chemical effects have a small impact. This is discussed on Page 74 of the Staff's draft SE:

“Subsequent to the July 2008 strainer head loss testing and corresponding chemical effects evaluation, the licensee also performed extensive additional chemical head loss experiments (CHLEs) at the University of New Mexico in support of the risk-informed resolution approach that was eventually superseded by the current RoverD approach. Although the NRC staff is not relying on the CHLE test results, the CHLE suite of tests provides additional evidence that the STP plant-specific chemical effects would be much less severe than those simulated in the 2008 strainer testing.”

For the single train case, the NPSH results are acceptable if only half of the maximum chemical debris loading is assumed as shown in the table.

Another conservatism of the NPSH evaluation is using the worst case minimum calculated sump water level. The post-LOCA water level ranges from 38 inches off the floor to 79 inches. As shown in the Table, the use of a nominal water level between the minimum and maximum values would increase the NPSH Margin value so that this would be acceptable even if the maximum chemical debris loading is used.

So for the single train case, it is appropriate to use a chemical debris load smaller than the maximum or to use the nominal sump water level. Either one of these considerations gives an acceptable result.

Question #2:

Can STP explain the reason why the delta CDF decreased for continuum model (Case 2 single train operation) between Supp. #2 and #3?

STP Response

The Δ CDF values are reported correctly and the behavior accurately follows the methodology provided in the STP applications from 2015 and 2016, ML15246A127, (Supplement 2 to the STP application), and ML16302A015 (Supplement 3 to the STP application), as described in Attachment 1-3, Section 4 LOCA Frequencies (both Supplements). As shown in the STP application, frequencies are allocated according to the equations shown, (3) and (4),

$$F(D_i^{small}) = \frac{f(D_i^{small})}{TW_{Cat(D_i^{small})}}, \quad (3) \text{ from Supplement 3,}$$

$$\Phi = \sum_{n=1}^{NP} \sum_{i \in R_n} F(D_i^{small}), \quad (4) \text{ from Supplement 3,}$$

that involve discrete pipe sizes. The change in D_i^{small} from Supplement 2 to Supplement 3 brought in a different pipe size (weld category.) A detailed inspection of intermediate results is provided in the following.

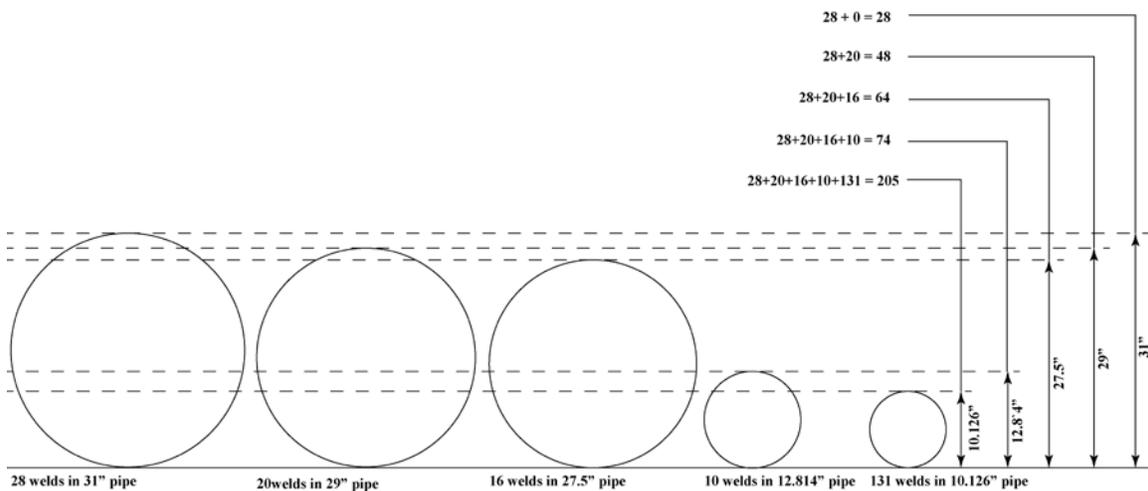


Figure 1. A graphical representation of the categories ($TW_{Cat(D_i^{small})}$) in STP Class 1 pipes showing the categories above the smallest $D_i^{small} = 9.34''$ (Supplement 3).

Because pipe sizes are built in discontinuous diameters, the potential for a break at any size will inherently reflect this discontinuity. Figure 1 is an illustration of how the $Cat(D_i^{small})$ are formulated for the extent of break sizes relevant to the Case 2 results.

Table 1 summarizes all the Class 1 weld sizes and counts in the STP RCS and connected systems considered in the RoverD analysis.

Table 1. Weld size and count summary

Weld Diameter	Count of welds	Total Welds in Categories
		Largest pipe in STP = 31
31	28	28
29	20	48
27.5	16	64
12.814	10	74
10.126	131	205
8.5	30	Smallest $D_i^{\text{small}} = 9.34$
6.813	54	
5.187	88	
3.438	90	
2.624	26	
2.125	6	
1.687	85	
1.338	9	
0.815	3	
0.612	32	

Table 2 below implements (3) and (4) in Supplement 2 and Supplement 3 as an illustration of the behavior of the Single Train operation case (Case 2). Table 2 is created from a spreadsheet to show the primary inputs used to arrive at the results. As shown in the table, $f(D_i^{\text{small}})$ behaves as expected according to the break size reductions going from Supplement 2 to Supplement 3. That is, $f(D_i^{\text{small}})$ increases in an expected way between Supplements 2 and 3. Observe the first entry for example that goes from break size 9.55 down to break size 9.34, $f(9.55) = 1.09\text{E-}06$ and $f(9.34) = 1.136\text{E-}06$. These numbers can be looked up directly from the mean values in Section 4, Table 6, that are values taken from Table 19 in NUREG 1829. Implementing (4) (Attachment 1-3 Section 4.1 in the STP applications) for the same entries produces $F(9.55) = 5.32\text{E-}09$ (Supplement 2) and $F(9.55) = 5.52\text{E-}09$ (Supplement 3) as expected.

Now for example look at the 10th entry in the table, one of thirteen similar examples. Observe the break size goes from 10.17 down to 9.76 from Supplement 2 to Supplement 3 and therefore the category changes to pipes having diameter less than 10.126 (and greater than 8.5). $f(10.17) = 9.66\text{E-}07$ and $f(9.76) = 1.05\text{E-}06$ in the expected way. However, note the Weld Count increases from 74 (Supplement 2) to 205 (Supplement 3). As a consequence, (4) results in evaluations of $F(10.17) = 1.31\text{E-}08$ (Supplement 2) and $F(9.76) = 5.31\text{E-}09$ (Supplement 3).

When the Supplement 2 entries in the table below for $F(D_i^{\text{small}})$ are summed as shown in the STP application, Section 4.1, the sum yields $6.18\text{E-}07$ (as given in Table 9, Mean

Value, Continuum Model, Geometric Mean). Similarly, when added, the Supplement 3 $F(D_i^{\text{small}})$ values yield 5.9E-07 as given in the STP application, Table 9.

Table 2. Detailed inputs for calculating the frequency according to RUFF

Entry	Break Location	Supplement 2				Supplement 3			
		D_i^{small}	Weld Count	$f(D_i^{\text{small}})$	$F(D_i^{\text{small}})$	D_i^{small}	Weld Count	$f(D_i^{\text{small}})$	$F(D_i^{\text{small}})$
1	16-RC-1412-NSS-8	9.55	205	1.09E-06	5.32E-09	9.34	205	1.13E-06	5.52E-09
2	31-RC-1102-NSS-1.1	9.89	205	1.02E-06	4.99E-09	9.56	205	1.09E-06	5.31E-09
3	31-RC-1102-NSS-RSG-1A-ON-SE	9.89	205	1.02E-06	4.99E-09	9.56	205	1.09E-06	5.31E-09
4	31-RC-1202-NSS-1.1	9.96	205	1.01E-06	4.92E-09	9.65	205	1.07E-06	5.22E-09
5	31-RC-1202-NSS-RSG-1B-ON-SE	9.96	205	1.01E-06	4.92E-09	9.65	205	1.07E-06	5.22E-09
6	31-RC-1302-NSS-RSG-1C-ON-SE	9.98	205	1.00E-06	4.90E-09	9.7	205	1.06E-06	5.17E-09
7	12-RC-1221-BB1-11	10.016	205	9.97E-07	4.86E-09	9.72	205	1.06E-06	5.15E-09
8	12-RC-1221-BB1-9	10.016	205	9.97E-07	4.86E-09	9.72	205	1.06E-06	5.15E-09
9	12-RC-1125-BB1-9	10.036	205	9.93E-07	4.84E-09	9.75	205	1.05E-06	5.12E-09
10	29-RC-1101-NSS-RSG-1A-IN-SE	10.17	74	9.66E-07	1.31E-08	9.76	205	1.05E-06	5.11E-09
11	29-RC-1101-NSS-5.1	10.18	74	9.64E-07	1.30E-08	9.78	205	1.04E-06	5.09E-09
12	29-RC-1401-NSS-3	10.12	205	9.76E-07	4.76E-09	9.81	205	1.04E-06	5.06E-09
13	12-SI-1315-BB1-8	10.126	205	9.75E-07	4.76E-09	9.84	205	1.03E-06	5.03E-09
14	29-RC-1301-NSS-4	10.1	205	9.80E-07	4.78E-09	9.84	205	1.03E-06	5.03E-09
15	12-RC-1322-BB1-1	10.126	205	9.75E-07	4.76E-09	9.9	205	1.02E-06	4.98E-09
16	29-RC-1101-NSS-4	10.16	74	9.68E-07	1.31E-08	9.9	205	1.02E-06	4.98E-09
17	31-RC-1302-NSS-1.1	10.21	74	9.58E-07	1.29E-08	9.9	205	1.02E-06	4.98E-09
18	29-RC-1301-NSS-5.1	10.23	74	9.54E-07	1.29E-08	9.92	205	1.02E-06	4.96E-09
19	29-RC-1301-RSG-1C-IN-SE	10.22	74	9.56E-07	1.29E-08	9.92	205	1.02E-06	4.96E-09
20	12-RC-1322-BB1-1A	10.126	205	9.75E-07	4.76E-09	9.93	205	1.01E-06	4.95E-09
21	12-RC-1125-BB1-11	10.126	205	9.75E-07	4.76E-09	9.94	205	1.01E-06	4.94E-09
22	29-RC-1201-NSS-4	10.19	74	9.62E-07	1.30E-08	9.94	205	1.01E-06	4.94E-09
23	29-RC-1201-NSS-5.1	10.3	74	9.40E-07	1.27E-08	9.99	205	1.00E-06	4.89E-09
24	29-RC-1201-RSG-1B-IN-SE	10.29	74	9.42E-07	1.27E-08	9.99	205	1.00E-06	4.89E-09
25	31-RC-1202-NSS-2	10.29	74	9.42E-07	1.27E-08	9.99	205	1.00E-06	4.89E-09
26	12-RC-1125-BB1-10	10.126	205	9.75E-07	4.76E-09	10.006	205	9.99E-07	4.87E-09
27	12-RC-1221-BB1-12	10.126	205	9.75E-07	4.76E-09	10.016	205	9.97E-07	4.86E-09
28	29-RC-1401-NSS-RSG-1D-IN-SE	10.39	74	9.22E-07	1.25E-08	10.03	205	9.94E-07	4.85E-09
29	29-RC-1401-NSS-4.1	10.4	74	9.20E-07	1.24E-08	10.04	205	9.92E-07	4.84E-09
30	12-RC-1322-BB1-2	10.126	205	9.75E-07	4.76E-09	10.066	205	9.87E-07	4.81E-09
31	31-RC-1102-NSS-2	10.34	74	9.32E-07	1.26E-08	10.07	205	9.86E-07	4.81E-09
32	12-RC-1221-BB1-10	10.126	205	9.75E-07	4.76E-09	10.106	205	9.79E-07	4.77E-09
33	12-RC-1112-BB1-1	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
34	12-RC-1125-BB1-12	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
35	12-RC-1125-BB1-13	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
36	12-RC-1125-BB1-8	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
37	12-RC-1221-BB1-13	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
38	12-RC-1221-BB1-14	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
39	12-RC-1322-BB1-3	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09

Entry	Break Location	Supplement 2				Supplement 3			
		D_i^{small}	Weld Count	$f(D_i^{small})$	$F(D_i^{small})$	D_i^{small}	Weld Count	$f(D_i^{small})$	$F(D_i^{small})$
40	12-RC-1322-BB1-4	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
41	12-SI-1315-BB1-10	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
42	12-SI-1315-BB1-7	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
43	12-SI-1315-BB1-9	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
44	29-RC-1101-NSS-3	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
45	29-RC-1201-NSS-3	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
46	29-RC-1301-NSS-3	10.126	205	9.75E-07	4.76E-09	10.126	205	9.75E-07	4.76E-09
47	31-RC-1302-NSS-2	10.39	74	9.22E-07	1.25E-08	10.14	74	9.72E-07	1.31E-08
48	31-RC-1402-NSS-1.1	10.57	74	8.86E-07	1.20E-08	10.22	74	9.56E-07	1.29E-08
49	31-RC-1402-NSS-RSG-1D-ON-SE	10.57	74	8.86E-07	1.20E-08	10.22	74	9.56E-07	1.29E-08
50	16-RC-1412-NSS-7	10.74	74	8.52E-07	1.15E-08	10.41	74	9.18E-07	1.24E-08
51	31-RC-1402-NSS-2	10.83	74	8.34E-07	1.13E-08	10.54	74	8.92E-07	1.21E-08
52	16-RC-1412-NSS-9	10.97	74	8.06E-07	1.09E-08	10.69	74	8.62E-07	1.16E-08
53	29-RC-1401-NSS-2	10.98	74	8.04E-07	1.09E-08	10.7	74	8.60E-07	1.16E-08
54	16-RC-1412-NSS-6	11.04	74	7.92E-07	1.07E-08	10.74	74	8.52E-07	1.15E-08
55	31-RC-1202-NSS-8	11.33	74	7.34E-07	9.92E-09	10.88	74	8.24E-07	1.11E-08
56	27.5-RC-1303-NSS-1	11.18	74	7.64E-07	1.03E-08	10.91	74	8.18E-07	1.11E-08
57	27.5-RC-1203-NSS-1	11.18	74	7.64E-07	1.03E-08	10.93	74	8.14E-07	1.10E-08
58	27.5-RC-1103-NSS-1	11.27	74	7.46E-07	1.01E-08	10.99	74	8.02E-07	1.08E-08
59	31-RC-1202-NSS-4	11.22	74	7.56E-07	1.02E-08	11	74	8.00E-07	1.08E-08
60	31-RC-1102-NSS-8	11.53	74	6.94E-07	9.38E-09	11.09	74	7.82E-07	1.06E-08
61	31-RC-1102-NSS-4	11.34	74	7.32E-07	9.89E-09	11.1	74	7.80E-07	1.05E-08
62	31-RC-1302-NSS-4	11.4	74	7.20E-07	9.73E-09	11.17	74	7.66E-07	1.04E-08
63	31-RC-1302-NSS-8	11.75	74	6.50E-07	8.78E-09	11.28	74	7.44E-07	1.01E-08
64	31-RC-1202-NSS-3	11.57	74	6.86E-07	9.27E-09	11.31	74	7.38E-07	9.97E-09
65	31-RC-1102-NSS-3	11.64	74	6.72E-07	9.08E-09	11.37	74	7.26E-07	9.81E-09
66	31-RC-1302-NSS-3	11.61	74	6.78E-07	9.16E-09	11.38	74	7.24E-07	9.78E-09
67	31-RC-1202-NSS-9	12	74	6.00E-07	8.11E-09	11.48	74	7.04E-07	9.51E-09
68	31-RC-1102-NSS-9	11.98	74	6.04E-07	8.16E-09	11.49	74	7.02E-07	9.49E-09
69	31-RC-1302-NSS-9	12.17	74	5.66E-07	7.65E-09	11.67	74	6.66E-07	9.00E-09
70	16-RC-1412-NSS-5	12.334	74	5.33E-07	7.21E-09	11.96	74	6.08E-07	8.22E-09
71	27.5-RC-1403-NSS-1	12.41	74	5.18E-07	7.00E-09	12.07	74	5.86E-07	7.92E-09
72	31-RC-1402-NSS-3	12.54	74	4.92E-07	6.65E-09	12.21	74	5.58E-07	7.54E-09
73	31-RC-1402-NSS-4	12.62	74	4.76E-07	6.43E-09	12.35	74	5.30E-07	7.16E-09
74	31-RC-1402-NSS-8	13.46	64	3.08E-07	4.81E-09	13.01	64	3.98E-07	6.22E-09
75	31-RC-1402-NSS-9	14.17	64	1.98E-07	3.10E-09	13.7	64	2.60E-07	4.06E-09
76	29-RC-1101-NSS-1	24.38	64	9.56E-08	1.49E-09	15.95	64	1.80E-07	2.82E-09
77	29-RC-1101-NSS-RPV1-N1ASE	24.55	64	9.39E-08	1.47E-09	15.95	64	1.80E-07	2.82E-09
78	29-RC-1201-NSS-1	24.78	64	9.16E-08	1.43E-09	15.95	64	1.80E-07	2.82E-09
79	29-RC-1201-RPV1-N1BSE	24.87	64	9.07E-08	1.42E-09	15.95	64	1.80E-07	2.82E-09
80	29-RC-1301-NSS-1	24.4	64	9.54E-08	1.49E-09	15.95	64	1.80E-07	2.82E-09
81	29-RC-1301-RPV1-N1CSE	24.51	64	9.43E-08	1.47E-09	15.95	64	1.80E-07	2.82E-09
82	29-RC-1401-NSS-1	24.23	64	9.71E-08	1.52E-09	15.95	64	1.80E-07	2.82E-09

Entry	Break Location	Supplement 2				Supplement 3			
		D_i^{small}	Weld Count	$f(D_i^{small})$	$F(D_i^{small})$	D_i^{small}	Weld Count	$f(D_i^{small})$	$F(D_i^{small})$
83	29-RC-1401-NSS-RPV1-N1DSE	24.28	64	9.66E-08	1.51E-09	15.95	64	1.80E-07	2.82E-09
84	27.5-RC-1103-NSS-RPV1-N2ASE	23.6	64	1.03E-07	1.62E-09	22.57	64	1.14E-07	1.78E-09
85	27.5-RC-1203-NSS-5	23.66	64	1.03E-07	1.61E-09	22.61	64	1.13E-07	1.77E-09
86	27.5-RC-1203-NSS-RPV1-N2BSE	23.73	64	1.02E-07	1.60E-09	22.68	64	1.13E-07	1.76E-09
87	27.5-RC-1203-NSS-4	26.34	64	7.59E-08	1.19E-09	24.65	64	9.29E-08	1.45E-09
88	27.5-RC-1103-NSS-6	26.68	64	7.25E-08	1.13E-09	24.94	64	9.00E-08	1.41E-09
89	27.5-RC-1103-NSS-7	27.26	64	6.66E-08	1.04E-09	25.41	64	8.52E-08	1.33E-09
90	27.5-RC-1303-NSS-RPV1-N2CSE	27.5	64	6.42E-08	1.00E-09	26.78	64	7.14E-08	1.12E-09
91	27.5-RC-1303-NSS-6	27.5	64	6.42E-08	1.00E-09	26.82	64	7.10E-08	1.11E-09
92	27.5-RC-1303-NSS-5	27.5	64	6.42E-08	1.00E-09	27.5	64	6.42E-08	1.00E-09
93	27.5-RC-1403-NSS-5	27.5	64	6.42E-08	1.00E-09	27.5	64	6.42E-08	1.00E-09
94	27.5-RC-1403-NSS-6	27.5	64	6.42E-08	1.00E-09	27.5	64	6.42E-08	1.00E-09
95	27.5-RC-1403-NSS-RPV1-N2DSE	27.5	64	6.42E-08	1.00E-09	27.5	64	6.42E-08	1.00E-09
96	12-RC-1212-BB1-1					10.126	205	9.75E-07	4.76E-09
97	12-RC-1221-BB1-8					10.126	205	9.75E-07	4.76E-09
98	12-RC-1312-BB1-1					10.126	205	9.75E-07	4.76E-09
99	12-RC-1312-BB1-8					10.126	205	9.75E-07	4.76E-09
100	16-RC-1412-NSS-1					12.814	74	4.37E-07	5.91E-09
101	16-RC-1412-NSS-PRZ-1-N1-SE					12.814	74	4.37E-07	5.91E-09

Question #3: For the Tech. Specs. modifications, what is the Pressure coming out of Mode 3 into Mode 4 and the required number of trains needed in operation ?

During a normal plant cooldown, Mode 4 is reached when 2 of 4 Reactor Coolant System (RCS) average temperature indications are less than 350°F. Prior to entering Mode 4, the Cold Overpressure Mitigation System (COMS) is armed which sets the lift settings of the two pressurizer PORVs to within the limits established in Technical Specification 3.4.9.3 (Overpressure Protection Systems). At 350°F, the maximum allowable pressurizer PORV lift setpoint is approximately 740 psig; procedurally the pressurizer PORV lift setpoints are 730 psig and 660 psig at 350°F.

Shortly after entering Mode 4:

- non-ECCS sources of high pressure injection (i.e., charging pumps) are racked out to comply with Technical Specification 3.4.9.3 – one centrifugal charging pump remains in service for RCS inventory and reactivity control;
- two (of three) High Head Safety Injection (HHSI) pumps are racked out to comply with Technical Specification 3.5.3.1 (ECCS Subsystems – T_{avg} Less Than 350°F); other than its breaker being racked out, one of these two HHSI pumps must remain Operable. The third HHSI pump shall be Operable with its breaker racked in; and
- two (of three) Low Head Safety Injection pumps shall remain Operable to comply with Technical Specification 3.5.3.1.

Also, just after Mode 4 is entered, when RCS temperature is between 330°F and 349°F, RCS pressure is lowered to between 325 psig and 350 psig and one train of Residual Heat Removal (RHR) is placed into service. After available RHR train suction valves have been opened, RCS pressure is maintained between 325 psig and 400 psig.

In summary, RCS pressure is maintained between 325 and 400 psig in Mode 4 after RHR is placed into service. To mitigate an overpressurization event, the maximum allowable pressurizer PORV lift setpoints are approximately 740 psig. Per Technical Specifications, two (of three) LHSI pumps are required to be Operable and two (of three) HHSI pumps are required to be Operable (but only one HHSI pump is allowed to have its breaker racked in).