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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE

and

RELIABILITY AND PRA SUBCOMMITTEE

+ + + + +

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

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

*Present via telephone

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.

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

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

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

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

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

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

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

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

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

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

So I think I'll turn it back.

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

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

MR. MURRAY: Dr. Corradini, this is Mike

Murray.

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

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

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

CO-CHAIR CORRADINI: Okay.

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

MR. HARRISON: Yes.

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

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

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

CO-CHAIR CORRADINI: Okay.

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

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

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

CO-CHAIR CORRADINI: Sure. Go ahead.

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

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

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

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

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

MR. SCHULZ: Okay. This is Wes Schulz.

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

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

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

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

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

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

In the first case scenario --

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

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

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

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

MR. SCHULZ: That is correct.

CO-CHAIR CORRADINI: Okay. Keep on going.

MR. SCHULZ: Yes.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MR. HARRISON: This is Wayne Harrison.

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

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

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

CO-CHAIR CORRADINI: Okay. But --

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

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

MR. SCHULZ: This is Wes Schulz.

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

CO-CHAIR CORRADINI: Okay. So with that, my next question, since I don't have Dr. Shack on the line and I'm trying to remember his question, is this now counted as a failure in the probability, in the RoverD? Or is this not considered at all?

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

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

MR. SCHULZ: Ernie can jump in here.

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

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

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

CO-CHAIR CORRADINI: Okay. Well, I'm going to let him continue and I'm going to come back. Because unless I misunderstand the RoverD approach, although the probability of single train operation is small, it still is non-zero. And so, with that, if I have that with a given pipe size, et cetera, then this sort of possibility should exist in your fail category in your RoverD calculation. That's what I'm trying to get at.

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

MR. HARRISON: This is Wayne Harrison again.

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

This is in the risk-informed portion. It's, again, appropriate to consider from the standpoint of the debris loading and the chemical effects, that the chemical effects to not have this, are overestimated in the deterministic case so we're using a more realistic value of the chemical effects to access the potential for failure through head loss.

Does that make sense?

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

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

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

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

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

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

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

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

So, so why don't you continue and then we'll come back. I want to make sure that at least for question one we're very clear that at least factually this was not calculated before. It's now a new piece of information for us to understand. And unless I misunderstand, if, if I got to the condition of single train operation with these various loadings, that should be a fail. I just want to make sure that's properly accounted for in the risk-informed approach or not.

So keep on going.

MR. SCHULZ: Okay. This is Wes Schulz.

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

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

CO-CHAIR CORRADINI: But again, let me make sure the five cases you have in here. These are all, when you did the RoverD, which of these -- or were all of these considered in some fashion? Now I'm not sure. None of them were considered, as far as I understand it. They were essentially based on break size and a scaling off of break size and location as to what particulate would fall into one sump, whether it's single or double or two-train. Is that correct?

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

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

CO-CHAIR CORRADINI: But --

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

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

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

Another way to think of this is for single train operation it may not be 96, it may be 94 of 92. But that's not how it was done. Ninety-six was used with single-train operation. And anything that was under 96 was a success, anything over 96 was a, was a failure in the RoverD calculation. Do I have that right?

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

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

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

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

Keep on going. Sorry.

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

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

sorry, I didn't mean to --

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

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

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

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

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

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

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

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

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

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

But you can still do that in a risk-informed approach. For each of the seven configurations you would have an unacceptable amount of fiber loading, which translates to a particulate break size, which translates to a particular frequency. And you would have seven probabilistically weighted frequencies that you can then add to your risk-informed acceptance criteria. That would be a systematic risk-informed approach.

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

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

However, if I had assurance of some numbers about how much can be generated for single train, you know, I was sort of looking at those results to give me a little bit confidence that even under the worst of the three two-train cases you'd probably still have one train available, which meets your risk -- your PRA success criteria for most of the LOCAs. So that's, that's one of the reasons, other than the sort of philosophical making sure you have all of the combinations in place.

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

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

I'm done, Mike. Thanks.

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

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

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

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

And in our sump case for the strainers we did a bounding test in 2008 where we tried to throw everything imaginable at the strainer to increase head loss to ensure that the equipment would continue to run with highest flow rate we could come up with.

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

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

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

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

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

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

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

MR. KEE: This is Ernie Kee. Yes, it's what we call success criteria in the PRA. And that's correct. If we ran many thousands of simulations and looked at each one of those simulations, which in fact we have done in a realistic way, what we find is we never see failure at the strainer, so.

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

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

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

John, are you done?

CO-CHAIR STETKAR: Yes.

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

CO-CHAIR STETKAR: I would only mention for the staff's benefit so we get it on the record that, given this conversation, you know, you did the independent calculation using the -- for the break size 9.34 inches or 6 inches or something like that. That would also change a little bit over the break.

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

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

CO-CHAIR STETKAR: Got you.

CO-CHAIR CORRADINI: Yes?

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

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

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

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

MR. FONG: Yes, sir.

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

CO-CHAIR CORRADINI: Okay. Dick?

MEMBER SKILLMAN: Yes. This is Dick Skillman.

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

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

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

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

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

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

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

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

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

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

CO-CHAIR CORRADINI: Okay. Any other

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

(No response.)

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

MR. KEE: This is Ernie Kee. Sorry.

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

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

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

CO-CHAIR CORRADINI: Okay.

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

CO-CHAIR CORRADINI: All right.

CO-CHAIR STETKAR: Just, just if you're going to -- only thing I, again a subcommittee meeting so this is my own -- consider if you're going to make any changes to the SER, and I don't know whether you are or not, as I said, I started down this single train path partially because of the common atorics of the seven different combinations, but indeed more along the lines of it wasn't clear to me that the particular two-train case that they selected, A and C, was indeed the hydraulically bounding two-train case.

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

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

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

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

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

Go ahead, South Texas.

MR. KEE: This is Ernie Kee.

On question two we were asked to, we, STP explain the reason why delta PDF decreased for continuum model case to single train operation between supplement two and three.

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

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

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

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

CO-CHAIR CORRADINI: I know.

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

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

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

(No response.)

CO-CHAIR CORRADINI: Okay. On to three.

MR. RICHARDS: Drew Richards, South Texas Project.

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

That answers the pressure question.

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

Any questions?

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

CO-CHAIR CORRADINI: Yes, I was going to say from our standpoint at least I thought it was an informational one. I didn't think there was an issue.

MR. RICHARDS: Okay.

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

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

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

MR. KEE: This is Ernie Kee.

So what we need to be able to say is the success criteria is -- or where that success criteria is met. And we don't have any more information than, than what we've provided. So you're right, we could easily bound it. We have in our application the success frequency for single train operation is almost insignificant to our, to our conclusions. So you could look at it as a bound.

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

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

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

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

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

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

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

MR. HARRISON: This is Wayne Harrison.

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

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

MR. HARRISON: I understand.

CO-CHAIR CORRADINI: Even though you're the pilot. So I want to make sure I understand how the pilot made it through the hurdles and the obstacles. And this one piece on single train operation is a bit fuzzy.

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

MR. KEE: This is Ernie Kee.

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

CO-CHAIR STETKAR: Okay.

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

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

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

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

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

And if this is --

CO-CHAIR CORRADINI: Or additional things.

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

CO-CHAIR CORRADINI: Okay.

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

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

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

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

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

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

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

MEMBER BLEY: We'll have the transcript.

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

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

CO-CHAIR CORRADINI: Okay. Okay. Let

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

(No response.)

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

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

CO-CHAIR CORRADINI: Go ahead.

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

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

Any other comments from the phone line?

(No response.)

CO-CHAIR CORRADINI: Okay. Hearing

none, let's close the public phone line.

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

Member Ballinger?

MEMBER BALLINGER: No comment.

CO-CHAIR CORRADINI: Member Skillman?

MEMBER SKILLMAN: No further comment. Thank you.

CO-CHAIR CORRADINI: Bley?

MEMBER BLEY: No further comments. Thank you.

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

MEMBER MARCH-LEUBA: No comment.

CO-CHAIR CORRADINI: Joy.

MEMBER REMPE: I have no comment.

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

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

CO-CHAIR CORRADINI: Okay. So, so let's at least discuss for the full committee meeting. I think we have an extra fun session arranged. I think we have more than a couple hours, I think we have a little more than a couple hours, two-and-a-half, three hours of time to go through this with the other members. Because I don't think even at the last subcommittee we had a majority of the members, and they're going to want to learn about this.

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

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

And leave ample time, and assuming we have, just to pick some numbers, assuming we have three hours during the full committee, leave ample time for discussion, a good half an hour at least of the three hours, so that the committee members can ask questions.

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

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

CO-CHAIR CORRADINI: Right.

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

CO-CHAIR CORRADINI: Right. And this is just my own personal comment. I personally think STP did a service to doing this as the pilot plant for this. Because I do think their general approach to me is very intriguing and useful.

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

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

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

CO-CHAIR CORRADINI: I am.

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

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

MS. REGNER: This is Lisa Regner.

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

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

MS. REGNER: And I can pass that on.

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

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

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

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

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 ΔCDF 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),

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

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

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.

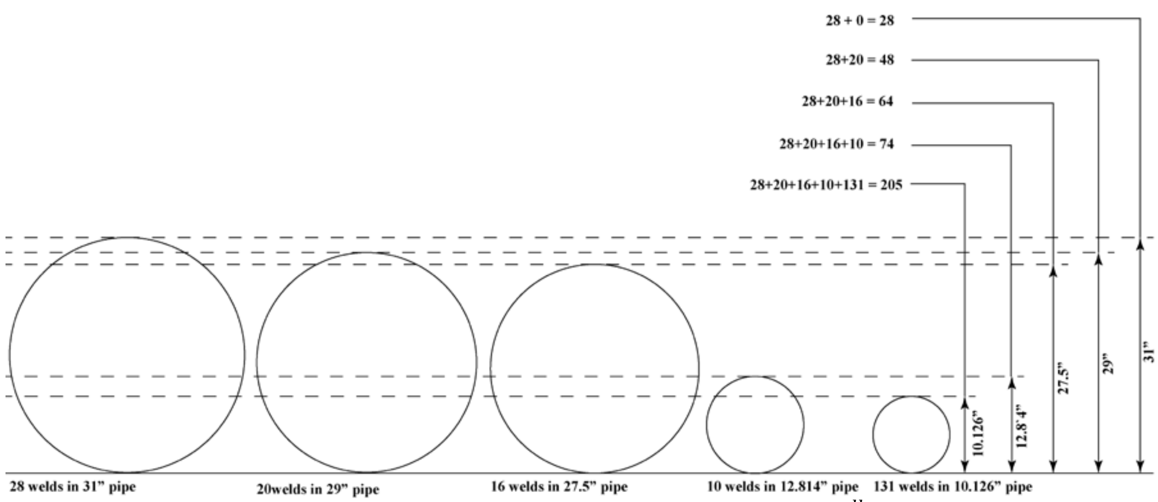

Figure 1. A graphical representation of the categories ($TW_{Cat(D_i^{small})}$) in STP Class 1 pipes showing the categories above the smallest D_i^{small} = 9.34" (Supplement 3).

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^{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, $f(D_i^{small})$ behaves as expected according to the break size reductions going from Supplement 2 to Supplement 3. That is, $f(D_i^{small})$ 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) = 1.09E-06 and *f*(9.34) = 1.136E-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) = 5.32E-09 (Supplement 2) and F(9.55) = 5.52E-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) = 9.66E-07 and *f*(9.76) = 1.05E-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) = 1.31E-08 (Supplement 2) and F(9.76) = 5.31E-09 (Supplement 3).

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

Value, Continuum Model, Geometric Mean). Similarly, when added, the Supplement 3 $F(D_i^{small})$ 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	$f(D_i^{small})$	$F(D_i^{small})$	D_i^{small}	Weld Count	$f(D_i^{small})$	$F(D_i^{small})$
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).