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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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AP1000 SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

SEPTEMBER 17, 2014

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Harold D. Ray, Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD D. RAY, Chairman
RONALD G. BALLINGER, Member
SANJOY BANERJEE, Member
DENNIS C. BLEY, Member
CHARLES H. BROWN, JR., Member
MICHAEL CORRADINI, Member*
JOY REMPE, Member
PETER C. RICCARDELLA, Member
STEPHEN P. SCHULTZ, Member
GORDON R. SKILLMAN, Member
JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

PETER WEN

ALSO PRESENT:

LARRY BURKHART
MIKE CORLETTI
JOE DONOGHUE
TIM DRZEWIECKI
DON HABIB
BOB KITCHEN
JOHN McKIRGAN
RICHARD OFSTUN
TERRY SCHULZ
BOYCE TRAVIS

C-O-N-T-E-N-T-S

P R O C E E D I N G S

1:03 p.m.

CHAIRMAN RAY: (presiding) The meeting will now come to order.

This is a meeting of the ACRS AP1000 Subcommittee. I am Harold Ray, Chairman of the Subcommittee.

ACRS members in attendance are Sanjoy Banerjee, Charles Brown -- John Stetkar will join us shortly -- Joy Rempe, Dick Skillman, Steve Schultz, Dennis Bley, Ron Ballinger, and Pete Riccardella. Mike Corradini will follow the presentations by phone, and I will invite any questions or comments from him at times during the presentation separate from when I ask for public comment.

Peter Wen of the ACRS staff is the Designated Federal Official for this meeting.

The purpose of this meeting is to review a departure and exemption request regarding the Levy Nuclear Plant Units 1 and 2 COLA resulting from a design change involving a containment condensate return to the in-containment refilling water storage tank, or IRWST.

A design change constitutes a Tier 1 deviation from the approved AP1000 Design Control Document Revision 19, which was the basis for the AP1000

Design Certification Amendment Final Rule in December 2011.

I have asked the staff to include in their opening remarks a review of the issue history using slides 27 and 28 from their presentation, as I feel this provides important context relating to where we are today and the expectations going forward.

Suffice it to say it is critical that we be as transparent as possible concerning these expectations, owing to the number of ongoing activities that can be affected. In that regard, based on review of available information at the September full Committee meeting, we expect that a summary of today's meeting will be presented at the October full Committee meeting and that a Committee letter may result. Such a letter could either be specific to this review or generic.

Now this Subcommittee was briefed by Westinghouse on the technical issues involved in a meeting on April 9th of this year, a little over five months ago. In fact, review of today's presentation slides, which were received yesterday, indicates that a large number of them, both those to be presented by Westinghouse and by Duke Energy are identical to those we reviewed on April 9th. Nevertheless, there have been several changes in results that are important to note, and it is necessary to provide context for them.

I ask that, in the interest of time and efficient closure on this matter, presenters focus on what has changed in these many slides and assume that the Subcommittee is at least generally familiar with the material presented previously.

Also in the interest of efficiency, I suggest thinking about the changes described in what I will now refer to as the Levy Advanced Safety Evaluation, forwarded to members on August 25th, as having three elements as follows:

First, technical adequacy of the design following implementation of the departure from the DCD. And this element is always our first concern.

Second, process issues related to the implementation of 10 CFR Part 52, including the use of a COL departure from a DCD where such departure is for the purpose of resolving issues in the design or analyses which are described in the DCD, or the status of COL holders who are similarly affected by the cause of the departure.

And finally, compliance with the requirements of 10 CFR Part 21 relative to the reasons for the departure from the DCD.

Third and finally, root-cause and extent-of-condition issues are a third category, such as, what would the expected performance of the affected systems be in the absence of the COL departure; why was the need for the changes described in the COL departure not identified earlier; what else may be similarly affected by the same or similar root cause, and what implications of this experience are there for matters such as the uncertainty which should be associated with the functioning of passive safety systems?

Our greatest interest may be in the last category I mentioned; that is, what are the lessons that we should draw from this experience? In any case, I would like to defer as many of the process issues as possible for discussion in the second open session we will have today.

Based partly on the desire to separate process issues from the technical review and partly on a member's schedule conflict later this afternoon, I am going to modify the agenda you have before you and ask that, other than their opening remarks, the staff presentation take place in the second open session shown, and that the closed session commence immediately following the open session presentations by Duke and Westinghouse.

We will provide opportunity for public comment, both at the end of the first open session prior to going into closed session and at the end of the second open session open session, following the staff presentation and before taking member comments.

A portion of the meeting will be closed in order to discuss information that is proprietary to Westinghouse, pursuant to 5 USC 552(b)(c)(3) and (4). Attendance at this portion of the meeting dealing with such information will be limited to the NRC staff, Westinghouse, and those individuals and organizations who have entered into an appropriate confidentiality agreement with Westinghouse.

Consequently, we will need to confirm that we have only eligible observers and participants in the room and confirm the closure of the public phone line for that portion of the meeting. At the time of meeting closure, I will indicate the approximate time when we expect to be able to resume the open meeting.

Because the Subcommittee meeting will involve both open and proprietary sessions, and the members will not always be able to parse their questions so that full responses can be given in an open session, respondents will need to tell us when part or all of a response must be deferred.

The rules for participation in today's meeting have been announced as part of the notice for this meeting previously published in The Federal Register. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume, so that they can be readily heard.

We will now proceed with the meeting, and I call upon Mr. Larry Burkhart of NRO to begin.

MR. BURKHART: Thank you, Chair, and thank you, AP1000 Subcommittee, for giving us the opportunity to show you and discuss our evaluation with you. Of course, the Applicants will provide a description of the change, and you have already got a look at that from the April 9th Subcommittee meeting.

So, why are we here? We are here, as the Chair said, to discuss a design change that was submitted by Levy in support of their combined license application.

Just to go a little bit back, we completed our Final Safety Evaluation Report on the initial AP1000 standard design in 2005. It was certified in 2006.

This portion of the issue that we are talking about goes back to that far, and there's even some base in the AP600 review. So, the amendment that was certified in 2011 didn't affect what we are talking about today. So, that goes to may some of the issues that the Chair was talking about in No. 3, which we kind of I think discussed throughout our presentation and at anytime you would like.

This change was submitted to us now. We have to recognize that we already have a letter from the full Committee, ACRS Committee, from December of 2011. So, this change is coming now because it is of a significance that it should be reviewed and we should have an evaluation before we go to the Final Safety Evaluation Report and we go to any mandatory hearing and issue any license.

So, the guidance we have about this sort of change and what changes need to come to the staff before licensing decisions are made are what we call Interim Staff Guidance 11. And that is what you see in the second bullet.

So, the Applicant, Duke, did, I would say, an adequate job in doing this evaluation, with, of course, help from their contractor. So, that is why we have this design in front of us and that is why we are here today.

So, what you see, the rest of this slide and the next slide, is just a little bit of the history on when we received some documents from Duke Energy, some audits that the staff did.

And if you go to the next slide, you can just see a progression of activity. I can say that what that shows is the complexity of the analysis that you will hear about to justify the change, the condensate return into the IRWST, given losses to various factors. And you will hear more details as we go along.

So, I think that highlights that it wasn't necessarily a simple, straightforward change to identify and, then, to do the calculations to back it up. Likewise, the staff took a lot of time in reviewing those documents.

CHAIRMAN RAY: Larry, is there anything you can say about the period July-October 2013 there?

MR. BURKHART: Yes.

CHAIRMAN RAY: It is perhaps not as remarkable, but, yes, the need to incorporate further modifications, and so on.

MR. BURKHART: Yes. Duke and Westinghouse can get into more details, but I do remember this: there was a time when I believe

Westinghouse wanted to have a third-party review of the four calculations that you will hear about in detail. And there was modification to make sure that they captured the condensate that was lost in the polar crane girder which wasn't previously accounted for. So, there was a need to do a design change, and it was the right thing to do to capture the condensate that is caught in the polar crane girder.

Again, you will hear more details in the technical evaluations. So, there is a reason for why they delayed.

CHAIRMAN RAY: Yes. Well, I wanted to lay out this timeline because, when you are talking about technical issues, it is a little hard at that point to put them in some kind of a time sequence because you are trying to understand what the technical subject is.

MR. BURKHART: Right.

CHAIRMAN RAY: And this has had the history that you have outlined, and I thought it was important for the Subcommittee to understand that.

MR. BURKHART: Yes. I mean, this is the first time we have had a change that tripped the ISG-11 criteria for the AP1000s anyway. So, that kind of tells you what the significance is.

With that said, then you will hear more

about -- you mentioned Part 21, and there was a Part 21 evaluation done, and it was decided that it didn't trip the criteria to make that report.

CHAIRMAN RAY: Okay. That will be after in the session later on --

MR. BURKHART: Yes, sir. Yes, sir.

CHAIRMAN RAY: -- when people have satisfied themselves about the technical issue. I didn't want to get into that now --

MR. BURKHART: Yes, sir.

CHAIRMAN RAY: -- but I am glad that you are going to be prepared for that.

MR. BURKHART: So, that is a summary of basically the schedule to date. And, of course, we're here, and now the schedule right now is to have the Final Safety Evaluation Report completed by March of next year, barring no other design changes. And that may go to one of the other questions you have, Mr. Chair, about the extent of condition and what other issues might be out there.

CHAIRMAN RAY: Okay.

MR. BURKHART: So, that is our current schedule.

CHAIRMAN RAY: Good. Well, we will look forward to seeing the staff up after the closed session.

MR. BURKHART: Yes.

CHAIRMAN RAY: Do you have anything else?

MR. BURKHART: No, sir.

CHAIRMAN RAY: All right.

MR. BURKHART: Thank you very much.

CHAIRMAN RAY: Then, I guess we have Duke Energy and Westinghouse. Are you going in series or together.

MR. KITCHEN: No, we are going together.

CHAIRMAN RAY: All right. That is what we had hoped. Thank you.

How are you, Bob?

MR. KITCHEN: I'm good.

Chairman Ray and Members of the ACRS, just one clarification on the sequence. We had planned to do the open discussion, and the staff will do their open discussion and, then, we would be closed. Is that, to understand, we are still going to stick with that approach --

CHAIRMAN RAY: No.

MR. KITCHEN: -- to the closed session?

CHAIRMAN RAY: And the reason is we want to get the closed discussion that you'll present done earlier.

MR. KITCHEN: Okay.

CHAIRMAN RAY: And this is the only way I can do it.

MR. KITCHEN: All right.

CHAIRMAN RAY: Okay?

MR. KITCHEN: No problem.

Okay. I'm Bob Kitchen with Duke Energy, Licensing Manager. Terry Schulz with Westinghouse is with me. He will be presenting portions of this open session. And then, for the closed discussion, a more detailed discussion of the analysis that was done, Terry and Rick Ofstun will be presenting that. It was really the Westinghouse analysis and details.

And I know that you will tell me if I need to move on. So, we are going to try to make sure we cover the things that you need to hear, but --

CHAIRMAN RAY: Take your time. Just as I said, these aren't so much the case, but later on there is stuff we have seen and it has not changed at all.

MR. KITCHEN: Right.

CHAIRMAN RAY: But take your time here, whatever you want.

MR. KITCHEN: Okay. Well, our intent here is to present to make sure that we're all on the same page, so to speak, in terms of how the system works, what are the issues, and what has been done to this point. But, then, we will go into more detail about the particular analyses in the second, the closed portion, and go into quite a bit of detail. We will modify this approach as needed, and then, some discussion on testing, although you have seen most of what we have there.

Just on the system briefly, the system is designed to support probably really non-LOCA operation in the containment refilling water storage tank, which is shown here. It contains the passive RHR heat exchanger which rejects the heat to the IRWST. So, after a period of time in circulation, that water in IRWST reaches saturation and starts to vent into containment, which is the discharge of steam and containment creates the condensate and, thus, the return that we are talking about.

This is showing the containment in total. I think you're probably very familiar with this slide. It shows the containment with the cooler water which comes down over the containment is the heat rejection for containment. The IRWST is shown in the lower left corner of that drawing. It is quite a large tank, quite a bit of heat reject capability. But, as you can see, that tank, as we described, vents into containment.

And then, the condensate literally forms on the containment walls and runs down the walls, and is captured by a containment system which existed but has been expanded due to recognition of features in the containment that have a bigger contribution to condensate and needed to be directed back to the IRWST.

So, that is really the gist of what has been done there. It is a very complex analysis. As we talk through that, I know it will be apparent. But it is very simplistic in terms of the design approach, which is basically to put in a catchment system of gutters and drains to return water to the IRWST.

Safe shutdown is a feature we need to talk about a bit. The safe shutdown is a goal to achieve with the passive RHR heating exchanger system. Safe shutdown was defined in the AP1000 as 420 degrees and achieved in 36 hours. That temperature is not a regulatory requirement. Really, the key is that we achieve a safe, stable operation with the system. And there is some variation in that temperature. It is not a hard requirement.

In fact, in doing our analysis, as Terry will talk about later, really there are two key analyses that support that. One is to demonstrate, we'll call it the Chapter 15 analysis for the Final Safety Analysis Report, which is rigid design-basis accident analysis conditions, to demonstrate that the system can achieve safe, stable shutdown and maintain for at least 72 hours. That is all with the typical safety analyses, conservative, very limiting assumptions.

The longer-term operation of safe shutdown is demonstrated with conservative, but not bounding analyses. And we will talk more about that. But that is to show that we can maintain, and with that analysis, we show that we can achieve the 420 in less than 36 hours and maintain it for a considerable length of time.

As always, the system also has the capability -- in fact, it automatically occurs -- 22 hours into an accident sequence if there is no operator action. This is another topic we will discuss a bit. But, without operator action, at 22 hours the system would automatically actuate ADS and depressurize. And that achieves very quickly the cooldown and sustains indefinitely.

So, basically, as Larry can describe the sequence, it became apparent that Westinghouse, as part of the design finalization detail and, then, as Larry indicated, questions from the UK regulator, the need to go back and relook at the technical basis for the condensate return.

I think the value that was in use at that time was 90 percent, and it was also assumed to be a fixed 90 percent. As with a lot of things, it is not that simple. That was an overly-optimistic number, and it also determined that the condensate return value varies with time. It is not a fixed value. It is going to vary. As the plant depressurizes, this condensate, just the return rate varies.

So, there was significant effort to go back and look at what additional mechanisms occurred to cause this. Quite a bit of the detailed analysis centers around that. You know, at what point does the condensate stop raining from the roof of the containment and adhere to the liner -- or excuse me -- the walls of the containment? How do you model and analyze the impact of attachments to the containment wall, which early, early in the design may not have even been recognized to be needed?

So, we will talk a bit about what complexities were there. As Larry said, it took quite a while to work through those and to find them.

That required a study to go back and do testing, and Westinghouse did a very thorough testing evaluation using full-scale mockups of their facility to look at and characterize these behaviors as the condensate characteristics.

CHAIRMAN RAY: Bob, before you move on, this is maybe, well, it is mostly a process question. Therefore, I am going to say that upfront and say I want to put it off until later in terms of exploring it in detail.

But, so that I don't ask you to come back later unnecessarily, can you just answer a simple question for me, which would be, under Part 52, do you, as the COL holder or Applicant, have an Appendix B role here when this sort of thing occurs, to determine what the reason was for this problem existing, the problem being an assumption about condensate return, which was determined to be unconservative? I'll choose those words, maybe not too carefully. But, in any event, did you guys feel, as you would under Part 50, I believe, a need to get engaged in how did this happen, what is the extent of condition, that sort of thing?

MR. KITCHEN: We certainly have an Appendix B role to make sure that we develop a change to our license application that is correct and complete and reflects what is needed. To go back and do, as you described, basically, an investigation of that cause, we have not and did not see that as a role of the utility.

CHAIRMAN RAY: Fair enough. I just wanted to get that clarified. There is no point in asking you to come back up and talk about something that you didn't see as an obligation or a requirement.

MR. KITCHEN: Yes, but, I mean, a fundamental change here that I know you recognize is that our application is built on a certified design.

CHAIRMAN RAY: Right. That's what I meant by --

MR. KITCHEN: As we go forward, a change to that certified design becomes our application. So, there is a definite switch with this.

CHAIRMAN RAY: I know, but I think you can see -- you don't need to agree with me -- but I think you can see there is a transition there. Whereas, you don't have the responsibility for the certified design, you do have the responsibility for the change in the certified design under Appendix B. And it is that difference that I am trying to understand. Okay?

MR. KITCHEN: Right.

CHAIRMAN RAY: Okay, go ahead.

MR. KITCHEN: Okay. So, that is up through the development test program, and there will be more discussion on that in the closed session.

I have touched on a lot of this already, but basically the testing revealed, just as we have described, the condensate return was not what we thought in terms of the amount. It was considerably lower, and significantly lower, in fact, enough to affect the results, which is why we are talking about it.

It was evaluated by Westinghouse in terms of safety and determined not to have a safety impact. But the safe shutdown temperature evaluation would not be bounding. In other words, the assumptions there were couldn't do the analysis to meet that analysis.

MEMBER SKILLMAN: Would you repeat, please, what you just said?

MR. KITCHEN: The Part 21 analysis showed that the plant was still safe. In other words, there was not damage to the plant. But the analysis with the assumptions were not bounding for those results. In other words, it is not a safety issue, but we couldn't demonstrate, as you would normally in an FSAR, the results.

CHAIRMAN RAY: Well, let's not try to decide what is a safety issue or not in that respect. The point is that you couldn't comply with the licensing basis.

MR. KITCHEN: Right.

CHAIRMAN RAY: And whether that is safe or unsafe is a discussion maybe for later, another day, or something. But that is the issue.

And we will come back to that again as a process question about Part 21, what does it really say, and so on. But I don't want to get off on that sidetrack now.

MR. KITCHEN: Okay.

MEMBER BLEY: Well, we blow right past this, I just want to make sure I understood what you said and what you implied. And that is, when you did an analysis, under the assumptions that turned out to be wrong and accounted for wherever the water was going, it wasn't where you expected, you didn't get the core damage for a Design Basis event?

MR. KITCHEN: Correct, using best estimate values.

MEMBER BLEY: Okay.

MEMBER BANERJEE: But you didn't satisfy your licensing basis?

MR. KITCHEN: That's correct.

MEMBER BANERJEE: And now, you are going to talk about the improvements. If I remember, you said 90 percent of the water was assumed to return. And then, you found that this became a function of time, or Westinghouse did. I am saying "you" as them.

CHAIRMAN RAY: Sanjoy, speak up just a

bit, please.

MEMBER BANERJEE: Sorry.

How much water is now returning after all these modifications have been made?

MR. KITCHEN: Well, I'm sure Terry will show that when he --

MR. SCHULZ: Yes, I think we should defer that to --

MEMBER BANERJEE: Do you want to hold that until the closed session?

MR. SCHULZ: The closed, yes.

MEMBER BANERJEE: All right. So, let's table that question. It will be interesting to know. I mean, there's a lot of detail there. But I want to just know how much water is returning and what the rate of change is from that, just as a number, compared to the 90 percent.

MR. KITCHEN: Okay. So, basically, with the results of the testing, we have shown that there is significantly less return, and the decision was made to improve the design, to improve catchment, particularly since we are around the polar crane girder and attachment plate areas, to improve that.

The bottom line is we show that the safe shutdown objectives are met with these changes. So, we do comply with our license basis and requirements.

As I mentioned earlier, there really are two analyses that are key to this. One is the Chapter 15 analysis. I guess one note is that the Design Basis accident analysis with the indefinite operation, or basically no loss that was of significance, achieved or demonstrated previously, resulted in as soon as you could show that you achieved your conditions for stable plant operation, the analysis stopped.

So, one of the things that the staff required, it was asked in terms of the review to go back and demonstrate by the Chapter 15 bounding analysis through the entire 72-hour period that, with passive RHR and closed loop cooling, that the requirements were met. So, that was a change in analysis duration, let's say, but not in terms of the methodology.

CHAIRMAN RAY: And that was part of the RAI submitted?

MR. KITCHEN: It was an RAI question.

CHAIRMAN RAY: So, that sort of helps me understand what took place during that period of time.

MR. KITCHEN: Right.

CHAIRMAN RAY: Okay.

MR. KITCHEN: Terry can speak to it better, but that is very complex, to extend that analysis out.

The other was to look at safe shutdown temperature analysis and basically the achievement of less than 420 degrees in 36 hours. That is done with a conservative, but not bounding analysis, in fact. So, not all the required conservatisms in a Chapter 15 analysis are imposed on safe shutdown for the long-term operation, to demonstrate this cooldown in less than 36 hours.

The other was, as we have indicated, the FSAR -- excuse me -- the DCD stated that the passive RHR and closed loop could operate indefinitely, which was a bad choice of words and, also, not correct. Really, when we ran through the analysis, it shows that we have run significantly longer than 14 days. I think the analysis shows close to 20 days, but that we have changed our license basis to reflect that safe shutdown operation can achieve 420 in 36 hours and maintain it for at least 14 days, which is a very conservative period of time to restore and be able to use active systems, if you needed to.

The other thing to also realize is that we can also actuate ADS to depressurize and go into open loop cooling, if that were required, although it is certainly not desired. So, this whole thing was an attempt here to show our closed loop capability.

It is no change to our methods that were used before with the DCD, but it is a change in the results.

MEMBER SCHULTZ: You are, then, differentiating between the methods and the assumptions that are used as input --

MR. KITCHEN: Right.

MEMBER SCHULTZ: -- for the evaluation?

Okay. Thank you.

MEMBER BANERJEE: That was my question, too. Your assumptions are different now for the safe shutdown analysis. Are they different from what you had previously?

MEMBER SCHULTZ: You indicated they were no longer bounding?

MR. KITCHEN: Well, we are using, of course, the condensate return results. I don't remember all of the -- the design assumptions I can't say for sure they were all the same as the DCD, but they were for the most part conservative. And the most significant that were nominal were decay heat values were used or the core design values as opposed to a similar value..

MR. SCHULZ: I think with the safe

shutdown analysis, the same method was used in terms of the LOFTRAN code. The assumptions on decay heat were the same as the DCD Rev 19 as we are doing now.

Obviously, we changed the condensate return input --

MEMBER BANERJEE: That's the only thing or was there anything else that you --

MR. SCHULZ: That's my understanding, yes. The issue with the previous analysis was it used 90 percent constant return. And as we learned how the plant really operated and did our testing and analysis on condensate return losses, we determined that that condensate return was not only less than 90 percent, it varied with time. So, we had to modify the input to the LOFTRAN analysis to be consistent with the modified design and our understanding of how that worked.

MEMBER BANERJEE: No other assumptions have changed? Or at least none that was so important that you remember?

MR. SCHULZ: Yes. Correct.

MR. KITCHEN: And then, this just summarizes the COL impact. So, basically, there's a number of sections there. There were changes to figures and descriptions to show the type of gutter system and routings and, also, that it affected some Tier 1 table to reflect additional components, which, of course, the impact of Tier 1 are in ITAAC, which lists systems that need to be verified or installed as built, affects Tier 1, and would require an exemption, which is why that alone drove us to do an exemption.

MEMBER BANERJEE: So, sorry. Just to go back to those assumptions, I am sure the staff will comment on that as well, if they saw any significant change other than condensate return calculation. So, any other assumptions, we would look for validation or verification of that. That is an important point to make, that it didn't change other things.

CHAIRMAN RAY: Okay.

MR. KITCHEN: I'm sorry?

CHAIRMAN RAY: I was just going to make sure, Sanjoy, if you had anything more you wanted us to keep track of or anything.

MEMBER BANERJEE: No, not right now.

CHAIRMAN RAY: Bob, do you have more you want to talk about?

MR. KITCHEN: Just the lesser questions on this. The tech specs, we changed the bases only to reflect components that needed to be included in the surveillance, which is in the tech specs, but it didn't change the surveillance requirement at all.

The departures and exemption, obviously, were included to reflect the changes from this installation of piping and guards. And then, the ITAAC was affected because the component is not what is done in the ITAAC, but what we have to look at. So, that is really the extent of the changes to the COL itself.

CHAIRMAN RAY: Okay. But, again, we are off into pretty procedural stuff at this point in time. And I want to keep the focus here, if we can, on -- and we are going to have Terry talk now, I guess, is that right --

MR. SCHULZ: Yes.

CHAIRMAN RAY: -- on the technical aspects without getting into which chapters, and so on and so forth.

Is the line open now?

We have a bridge line. There are many people on it, I can tell. But I am only going to ask an ACRS member who couldn't be with us today, who I believe is on the line, Mike Corradini.

Mike, are you there?

MEMBER CORRADINI: Yes, sir.

CHAIRMAN RAY: Do you have any questions for Duke?

MEMBER CORRADINI: No, I thin Sanjoy has asked most of them. I think most of them are procedural. I want to wait until we get to the calculations about the basis for the change and how they meet the condition.

CHAIRMAN RAY: Okay. We're going to close the line again now and proceed on with Westinghouse.

MEMBER CORRADINI: Okay, and I will send a note to Joy or --

CHAIRMAN RAY: That's fine. You can send it to Joy.

And by the way, it sounds like you're on a cell phone or something. It is cutting in and out. So, why don't you just go ahead from here on until we get into closed session and send any questions you have to Joy, and I will ask if she has got anything from you?

(Laughter.)

Anything that she can talk about in the open meeting. Okay.

Nothing else for Duke at this point?

(No response.)

Okay. Terry?

MR. SCHULZ: Okay. What I am going to be talking about here, first, and this is where we hope we can get to it in terms of conclusions, having talked about the changes that we have made and making sure we understand those, talking about the testing and analysis that we have done, to show that those changes work.

And then, of course, the staff will talk about their audit and review. The last time we talked, we were really just in the middle of that, and now we are basically through that.

In terms of the agenda, the next thing I will talk about is the systems and operation of the plant. One thing that we have tried to do here is identify things that are different from the previous presentation in terms of highlighting them in sort of a light blue text. And so, when you see a slide like this that doesn't have any of that light blue text on it, it is telling you and me that nothing really changed.

CHAIRMAN RAY: Right.

MR. SCHULZ: And this slide, basically, says, kind of as Bob had said, the passive RHR is what we rely on to remove decay heat in non-LOCA accidents, but that the passive safety injection features can operate in a passive feed-and-bleed mode and provide a backup to the passive RHR in non-LOCA events. So, that is one of the things that is part of our defense-in-depth capabilities of the AP1000.

This is a semi-animated-type slide. It just reminds you where all the steam can go. After leaving the IRWST, some of it is going to stay in the containment atmosphere because the containment gets pressurized during this event. Some of it will condense on structures, steel and concrete walls that are inside containment. And that condensate doesn't get back into the IRWST.

Some of it, of course, in most of it we like to get to the containment vessel and drain it back into the IRWST. But, you know, some of that will splash off and not get into the IRWST. And we will talk more about, especially in the closed session, exactly what those losses are and how we quantified them.

Another thing that we discovered -- and we talked in the last session -- is that the condensate that is lost, the bulk of that will drain down into the bottom of the containment. And after enough accumulates, it will contact the outside of the reactor vessel, which will still be hot in this situation. And that will create steam in the bottom of the containment, which will have consequences in terms of heating up structures that might not heat up as fast due to the fact that our IRWST release point is above the operating deck, and there is a tendency for the containment to stratify.

And that is one of the things we were, say, wrestling with earlier on in this process. We finally recognized that this steaming will go on low in the containment. So, the loop compartment areas and those areas below the operating deck will see fresh steam generation due to this contact with the reactor vessel, which will eventually heat up all those structures that are low in the containment. It also has some beneficial effects where that steam will tend to get up into the upper part of the containment, and some of it will work its way back into the IRWST.

This is a detail -- again, nothing really changed here -- showing a cross-section of the passive RHR. The operating deck is above it. It is a seed-tube type design, normally covered with water.

When the passive RHR starts, of course, that water is covering the heat exchanger. And as we just talked about, over the long-term there are condensate losses that will eventually drop the level in the IRWST. As that level drops, as long as it is above the top of the tubes, again, we impact on the performance of the passive RHR.

Later on, as time goes by, the level will drop down below the top of the tubes. You will start to uncover tubes. You will lose effective heat transfer surface area, and that will reduce the performance of the passive RHR.

Now, given that this takes a good amount of time to happen, decay heat is also dropping during this timeframe. We will show you a plot later on of, versus time, the water level in the IRWST and the temperature in the reactor coolant system. And eventually, it does start going back up again, but --

MEMBER BANERJEE: What goes back up again?

MR. SCHULZ: The RCS temperature. Okay? In the plot I will show you it is around 16 days it starts going back up. It takes another four days to get back up to 420. So, it goes up fairly slowly because the passive RHR doesn't stop working. It just starts falling behind decay heat, and that gap, that delta, starts going into heating up the water and steel in the reactor coolant system.

MEMBER BANERJEE: So, is this a period when all the tubes are uncovered or is there some covered?

MR. SCHULZ: No, there are still some covered. What you will see is, when the water level in that particular case gets down near to the bottom horizontal section, when you start uncovering in that area, you start falling behind decay heat. So, in that case, you substantially uncover a lot of the tubes.

MEMBER BANERJEE: So, the vertical spots, and, of course, the top, is uncovered at this point, and you are starting to uncover the bottom part?

MR. SCHULZ: The bottom part, right.

MEMBER SKILLMAN: Terry, in this scenario, I presume that you are making up to the reactor coolant system from some source?

MR. SCHULZ: The makeup is from the core makeup tank.

MEMBER SKILLMAN: Okay.

MR. SCHULZ: Okay? Yes.

MEMBER SKILLMAN: Can you speak to the non-condensable vapor content, such that by making up to the reactor coolant system, you are actually getting into gas binding on the top of this tube bundle?

MR. SCHULZ: Well, the core makeup tanks have no gas in them. They are not like accumulators. Okay?

Depending on the duration of the event, you actually may get some accumulator water in. The accumulators will not empty in any of the scenarios.

The pressure doesn't get that low in the reactor coolant system.

So, it would be a little bit of nitrogen that would come in with the accumulator water which would be very late in the process here. And the way the passive water piping goes, it goes up to a high point that is 6 or 7 feet above what you see there. So, it goes above the operating deck and comes back down again. And it is a big pipe. It is 14-inch, a nominal size.

So, even if you accumulated a little bit of gas at the top, it would tend to stay there. The flow rates in the long-term are very low because decay heat has dropped off. You have started uncovering tubes on the IRWST side. So, the heat removal and, therefore, the actual circulation flows slow down considerably. And I think in the whole effort that we put into on gas accumulation in passive system piping, looked at some accumulation of gas up there that would stay and not get swept into the heat exchanger.

MEMBER SKILLMAN: Thank you.

MR. SCHULZ: Okay?

This is, again, a table we showed you. We actually have revised this a little bit. When we talk about 420, we talk about a T-average of 420. T-hot will actually be a little bit above that, of course, in an active circulation situation. Our calculations indicate that it is on the order of 20 degrees Fahrenheit higher than the T-average and that, if you are talking about what is the pressure in the reactor coolant system in those conditions, it will tend to be saturated pressure at T-hot. Now that is not going to the case very shortly after passive RHR, but in the longer-terms of interest here you will lose heat from the pressurizer and you will come down to a saturated condition. So, that will be this pressure as indicated.

And then, I have just shown a range of conditions. The 490, you will see later on, is one of the temperatures of interest that we show in our 72-hour conservative Chapter 15 extension condition at --

MEMBER BANERJEE: So, 490 at the core outlet, is that the temperature?

MR. SCHULZ: The T-hot.

MEMBER BANERJEE: The T-hot?

MR. SCHULZ: Yes.

MEMBER BANERJEE: So, it would be off of the core, right?

MR. SCHULZ: Yes, yes.

MEMBER BANERJEE: And it is still single phase at that point or is there some boiling? I don't know what the pressure is in the system.

MR. SCHULZ: Well, we expect the pressure to come down to saturation. We don't have pressurizer heaters.

MEMBER BANERJEE: So, it will just --

MR. SCHULZ: It will --

MEMBER BANERJEE: The head and the pressurizer will keep it from boiling?

MR. SCHULZ: Yes, and you also have, of course, in these later timeframes, you know, you just have decay heat. And it is a low amount of decay heat because you are in this case out --

MEMBER BANERJEE: Uh-hum.

MR. SCHULZ: -- a couple of days, a couple three days. So, the heat transfer rates through the fuel are low, much lower than at-power kind of conditions.

I can't answer whether there's --

MEMBER BANERJEE: Well, it is just a question of whether it reaches saturation temperature under conditions where you can get some boiling and some core uncovery or a vapor bubble sitting there, which is unlikely, right?

MR. SCHULZ: Yes, I don't see there being a challenge there. You've got lots of water. Your decay heat levels are low. So, if you had any --

MEMBER BANERJEE: Well, in any long-term coolant problem, we are always worried about core uncovery or that it happens, you know.

CHAIRMAN RAY: Well, I think this one where you need to help me a little bit because some of these numbers double.

MR. SCHULZ: Well, because we were looking at some higher temperatures than we did in the past, and it was pretty arbitrary what we picked. The reason why I was saying that we picked this 490, which is considerably higher than what we showed before --

CHAIRMAN RAY: Right.

MR. SCHULZ: -- was because we had done the 72-hour conservative Chapter 15 extension case. And with the very conservative decay heat that is in that, that is primarily the big driver and difference in terms of what happens in that 72-hour Chapter 15 case versus our more expected case with best estimate decay heat, is that it drives the RCS temperature higher. It doesn't come down.

Again, you still meet all the Chapter 15 analysis criteria in terms of we don't fill the pressurizer, the core is cooled, no DNB. All those kinds of conditions are satisfied, even with the higher. And so, the RCS pressure, yes, it is higher, but it is driven by the fact that we were now looking at a higher T-hot, T-average T-hot.

CHAIRMAN RAY: Right. I mean, I think that is the -- and what I am trying to do, and I have just passed my presentation over to Sanjoy -- because I realize you pick numbers there, and that drives what appears to the right. But, on the other hand, to somebody like myself, that implies something that I'm trying to get a better understanding of.

And you are saying it is the duration extension of the analysis?

MR. SCHULZ: The reason we are showing this slide at all is to give you a feeling for the percent of RCS pressure that we are getting to. Part of the claiming the plant is safe is that not only is it stable, the core being cooled, but that the change of having a subsequent pipe break is low.

CHAIRMAN RAY: Yes, and I certainly would agree that that is the case here. But, like I say, I noticed that the percent of the RCS pressure has gone from 13 to 28 --

MR. SCHULZ: Yes.

CHAIRMAN RAY: -- that sort of thing. So, it is not something that is just a refinement. It is reflecting --

MEMBER BANERJEE: I guess your question is -- I didn't have this slide --

CHAIRMAN RAY: I know, but I am giving it to you now --

MEMBER BANERJEE: Yes.

CHAIRMAN RAY: -- so you can ask whatever question --

MEMBER BANERJEE: Yes.

CHAIRMAN RAY: -- I would ask if I were smart enough to do it.

MEMBER BANERJEE: Well, you obviously noticed it; I didn't.

So, I guess Harold's and my question would be, what caused you to revise that table and bring up to 490? What was the discovery you made between the time you presented that to us in April, or whenever it was, and what you are showing now? Because the limit has gone from 440 to 490, the T-average that you are showing here.

MR. SCHULZ: The primary thing that happened was that the staff had asked us some questions about what the Design Basis was, what was the licensing commitment, what were the safety requirements. And as a result of all of that, we came up with what Bob Kitchen showed.

It was basically a dual approach. One leg of the approach was -- and it was new because we hadn't done this before -- was an extension of Chapter 15 for 72 hours using completely bounding Chapter 15 assumptions. So, high decay heat and all that.

MEMBER BANERJEE: No, that is clear, yes.

MR. SCHULZ: That is the case that came up with the 490.

MEMBER BANERJEE: That is where it came from?

MR. SCHULZ: That is where it came from.

MEMBER REMPE: So, when you interacted with the staff -- and this is from Mike Corradini -- I assume you provided plots --

MR. SCHULZ: Yes.

MEMBER REMPE: -- and they have reviewed it and they do audit calculations?

MR. SCHULZ: You would have to ask them. I think so. They're nodding their heads yes.

And in the closed session I will actually show you a plot that Westinghouse did for this 72-hour Chapter 15 extension case.

MEMBER REMPE: And I elaborated on some of his question.

MEMBER BANERJEE: Yes, I guess the confusion is coming because you are calling this the safe shutdown. And sort of what Bob Kitchen did is he divided things into two, right? He said there was an FSAR Chapter 15 Design Basis --

MR. SCHULZ: Uh-hum.

MEMBER BANERJEE: -- for 72 hours. And then, he said there is the safe shutdown analysis. And when you have got this safe shutdown, in that you have to have conditions that say nominally less than 420 in less than 36 hours.

So, is this calculation you are presenting here related to that trying to get to 420 in 36 hours or is it related to the 72 hours? I am a little bit confused about that.

MR. SCHULZ: Okay. Well, the reason why we have got this table at all --

MEMBER BANERJEE: Yes.

MR. SCHULZ: -- is because we have been saying that 420 is not a cliff; it is not a safety requirement. So, if --

MEMBER BANERJEE: I understand that.

MR. SCHULZ: Okay. And that is the whole purpose of this, is to show that it is not a cliff.

MEMBER BANERJEE: Okay.

MR. SCHULZ: The other thing about the 490 is, if we didn't put it on there, you would have asked us about it, you know, what the pressure was at 490.

(Laughter.)

So, it was preemptive to show you that, even in the very conservative bounding Chapter 15 extension case, which is probably on the order of a 10-to-the-minus-8 kind of probability of occurrence -- and we have actually put some numbers on that --

MEMBER BANERJEE: So, you are using the Chapter 15 calculations to sort of indicate that 490 is still gives you relatively --

MR. SCHULZ: It is still a low chance of having subsequent failures, yes.

CHAIRMAN RAY: And the calculations back in April were best estimate, right?

MR. SCHULZ: They're not best estimate. They are still bounding, except for basically decay heat. That is the key one. It was best estimate.

CHAIRMAN RAY: Okay.

MR. SCHULZ: And we are still using that in our demonstration of meeting 420, that approach. Okay? And with those inputs and assumptions, we do achieve 420. We are not 430 or 460, or especially 490.

We are still --

MEMBER BANERJEE: But this is based on actually the calculations you did for the first part of the Chapter 15?

MR. SCHULZ: That is where the 490 comes from.

MEMBER BANERJEE: This still is coming from that, which is conservative?

MR. SCHULZ: Yes. Right, very conservative.

MEMBER BLEY: And it is not just the 490. All the other numbers are higher because they did it under different assumptions?

MR. SCHULZ: Yes, it is more "what if?"

MEMBER BLEY: Yes.

MR. SCHULZ: You know, we don't really have a calculation that comes out at 430. It was more, what if it was 430; what if it was 460?

MEMBER BLEY: Right.

MR. SCHULZ: This just shows you where you would be in terms of percent of RCS design pressure.

MR. CORLETTI: Terry, this is Mike Corletti.

This is a parametric assessment?

MR. SCHULZ: Yes.

MEMBER SCHULTZ: And you were hoping that this would show us that there is a safety margin that is associated with the overall evaluations, and even at 490, you have these conditions which should be acceptable?

MR. SCHULZ: Yes. Yes.

MEMBER SCHULTZ: That was your goal?

MR. SCHULZ: Yes.

(Laughter.)

MEMBER SCHULTZ: Thank you.

MEMBER BANERJEE: But, I mean, it is almost, then, an obvious conclusion in the sense that all you are doing is saturation pressure at 490. It is just a steam table, right?

MR. SCHULZ: Yes. Well, it is actually 510 because you have to add a little bit on for T-average to T-hot. But, yes, it is very simple. This table is just a steam table kind of thing, but it is trying, again, to demonstrate that, if you go a little above 420, there is not a cliff.

MEMBER BANERJEE: Yes, you are just trying to say 420 is not a magic number. But is that part of your licensing basis, that you have to achieve 420, or what is the --

MR. SCHULZ: Well, what we were saying in

April was that 420 was a safety criteria. Okay? And our argument --

MEMBER BANERJEE: What does that mean exactly?

MR. SCHULZ: That we would have to meet it showing conservative bounding assumptions, okay, typically. But we weren't. So, we had to put an argument together that had four or five legs, that passive RHR is fully safety-related and automatic. We had safety-related feed-and-bleed backing that up. We did a little probability study that showed the probability of losing offsite power and not getting it back in 24 hours, and having decay heat be above best estimate. All those things occurring, it is like 10-to-the-minus-8 probability.

So, it seemed justifiable and reasonable to us that the approach of using best estimate decay heat was appropriate for a safety criteria. But, after discussions with the staff, they were uncomfortable with that. And so, we kind of went back and forth, and we adopted a slightly different approach, which is to have a Chapter 15 extension to 72 hours with fully bounding analysis, but it didn't meet 420.

Then, we had another case that was not considered to be a safety requirement, but it was still a licensing requirement for the plant. It was 420, but it didn't have to use the safety bounding analysis.

So, we are doing both now. And Bob tried to sort of outline that in one of his slides.

MEMBER BANERJEE: So, if you use, let's say, the bounding analysis, you end up with some number which is more like 490. Is that it?

MR. SCHULZ: yes.

MEMBER BANERJEE: That's why the 490 has appeared?

MR. SCHULZ: That's right.

MEMBER BANERJEE: Okay.

MR. SCHULZ: That's all.

MEMBER BANERJEE: Yes, that is what I was trying to understand.

CHAIRMAN RAY: Yes, and again, I want to emphasize that our first threshold of understanding and basis for moving forward is that we are now doing what the licensing basis says we are going to do, regardless of whether we are still a long way from the safety problem, or whatnot.

MR. SCHULZ: Uh-hum.

CHAIRMAN RAY: We had this discussion during the amendment process of how important is it to be rigorous on something that is a very remote safety issue. And as far as I'm concerned, anyway, the answer is you've got to do what you say you are going to do. If you can't, change what you say you are going to do.

MR. SCHULZ: Yes.

CHAIRMAN RAY: Okay?

MR. SCHULZ: Yes.

CHAIRMAN RAY: And you can also say, "And, by the way, I'm still very safe." But the first measure is to say I have to change what I said I'm going to do.

MR. SCHULZ: And that is part of what we are doing here, is to make very clear what we claim the plant is doing and, then, demonstrate that in a consistent way, that it does do that.

MEMBER BLEY: I have a point of clarification, and, Sanjoy, it is related to things you are interested in. I think I understand from this discussion not about this slide, but back in April when you showed us the best estimate, almost best estimate --

MR. SCHULZ: Yes.

MEMBER BLEY: -- with the one change in it, they mean something different from best estimate than we usually mean or we usually mean best estimate with uncertainty.

In that case, for the best estimate

factors, you would take kind of the most likely condition that you are in, not something that addresses the uncertainty of that. Correct?

MR. SCHULZ: That would be -- and that is why we actually don't use the term "best estimate" when we talk about the 420 in 36 hours.

MEMBER BLEY: That's good.

MR. SCHULZ: Because we have had that internal confusion, and we were trying to stay away. So, we have talked about that analysis as being conservative, but not bounding. And it is not bounding principally because the decay heat is more of a nominal value, but everything else in the analysis, virtually everything as far as I know, the initial conditions, RCS water levels and pressurizer pressures, the passive RHR tube plugging, is conservative. It is not nominal.

So, there are many bounding conservative assumptions in the 420, in the analysis that we used to demonstrate 420 in 36, but decay heat is a principal exception.

MEMBER BANERJEE: So, the principal difference is the decay heat then?

MR. SCHULZ: Yes, which is important.

MEMBER BANERJEE: Well, it was very important.

MR. SCHULZ: Yes, yes.

MEMBER BANERJEE: Dominant.

MR. SCHULZ: Yes.

CHAIRMAN RAY: Okay. We have stuck you here on this table for long enough. We probably should move on.

MR. SCHULZ: Okay. This slide is doing something similar to the previous slide. And again, nothing really changed here. It is trying to deal our use of the word "indefinite". This is one of the changes we are proposing to make to the FSAR, is to remove the word "indefinite" from passive RHR operation and to use something like -- it's not something like -- to use 14 days. And this is the basis for that.

Again, we are going to have a two-legged approach which says Chapter 15 extension, conservative, is 72 hours, and then, this on a conservative non-bounding basis would be 14 days. And this basically gives us and the utilities a high confidence that you wouldn't really have to use ADS in a reasonable approach, event.

Okay.

MEMBER BANERJEE: This is based on what, the pressure, or what is the reason this -- temperature is what, 490, or whatever it is?

MR. SCHULZ: Well, no. In the 14-day case, again, you are back to the conservative, but not bounding. So, you do get down to 420. You actually drift below 420. In our analysis, when you get above 420, we have an objective to have that be longer than 14 days.

So, you know, even when that happens, again, you wouldn't have to actuate ADS. You could wait a little bit longer. The temperature will keep drifting up. You know you are okay to at least 490. But, eventually, you are going to run into a problem if you don't recover AC power and defense-in-depth systems.

MEMBER BANERJEE: They just keep going up?

MR. SCHULZ: They would keep going up, ramping up. And the procedures would be to actuate ADS to --

MEMBER BANERJEE: And the main reason is you have uncovered the tubes?

MR. SCHULZ: Too much of the passive RHR tubes, yes.

MEMBER SKILLMAN: Let me just take off my engineer hat and my new cap for a minute and put on my public hat and say, golly, I was willing to not intervene because the plant that they were going to build in my neighborhood was going to be able to protect itself indefinitely. But you guys are doing bait and switch and changing indefinitely at 14 days.

MR. SCHULZ: It still has a definite capability. It just means you have to switch to the feed-and-bleed cooling mode, which, if you have a small LOCA, you're into right away. If you don't take operator action in 22 hours, like Bob said, there is an automatic timer that will turn on ADS.

Now the procedures are observe the plant. If it is stable, the pressurizer level is not going down, the core makeup tanks aren't draining, then you can block that signal and actually turn off the power to the PMS actuation cabinets, which blocks ADS. Thereafter, the operators would continue to monitor the plant conditions. And if it did start approaching pressurizer emptying or makeup tanks draining, then they would power back up to PMS. And again, things happen slowly, days out there. They would turn it back on.

You can also have conditions where, say you have abnormal RCS leakage at the beginning of the non-LOCA event. Well, at one day you are still going to be okay. The pressurizer level would be slowly dropping, but it would still be stable. For makeup tanks, it wouldn't be draining. But maybe three, four, five days out, you could run into a problem due to RCS inventory, not due to passive RHR cooling capability.

So, there are several reasons why you could go into ADS. Principally, it is small LOCAs, but even big RCS leaks could drive you there. The plant is still safe indefinitely.

MEMBER BANERJEE: So, the main thing that is happening compared to what was happening before -- I'm just trying to get this clear -- is that the water, instead of going into the IRWST, is going around the reactor vessel?

MR. SCHULZ: It is missing the gutter somehow.

MEMBER BANERJEE: And it is falling somewhere else, but that is --

MR. SCHULZ: And so, the IRWST level is dropping more than we thought it would based on the previous --

MEMBER BANERJEE: But the water has to go somewhere.

MR. SCHULZ: It is still in containment.

MEMBER BANERJEE: Yes, it is going just to a different part of the containment.

MR. SCHULZ: Which is why you ultimately

can put the plant safe in a feed-and-bleed mode which uses the water in the containment in a direct cooling mode, injection mode, recirc mode, back into the reactor, which is what happens in a LOCA situation. You eventually --

MEMBER BANERJEE: You just submerge your break, right? There's no problem?

MR. SCHULZ: Well, we have screens.

MEMBER BANERJEE: No, but I mean, eventually, you submerge the break.

CHAIRMAN RAY: Let's not go into GSI-191.

(Laughter.)

MEMBER BANERJEE: No, no, this is not GSI-191.

MR. SCHULZ: Well, in a non --

CHAIRMAN RAY: I'm just being a little humorous, Sanjoy.

MR. SCHULZ: Yes, thank you.

MEMBER BANERJEE: He doesn't ever want to hear that word again.

(Laughter.)

CHAIRMAN RAY: I know.

MEMBER BANERJEE: He is roasted on that.

(Laughter.)

CHAIRMAN RAY: I would suggest we move on.

We have got quite a lot in the closed section to do that will take us back through this again. So, go ahead, Terry.

MR. SCHULZ: So, this next section is talking about the changes we have made. Bob outlined them very briefly, and I will give you a little bit more information.

Probably the most important changes had to do with using, adding downspouts to the stiffener and polar crane girder. And I will show you a sketch of what that looks like.

So, that is basically taking the condensate that gets basically stripped off the containment. So, when the condensate is coming down and gets to the polar crane girder, that goes all the way around the containment and it is welded to the containment. So, it goes on to the top surface of the polar crane girder. And what we are doing now is we are connecting downspouts to that; actually, four of them around the containment. So, we take that condensate directly down and put it into the IRWST. So, there is no additional chance of losing some of that condensate. Do the same thing at the stiffener, which is, again, very similar orientation.

The gutter, we actually didn't put the

gutter above the equipment hatch and personnel hatches, and we have added the gutter to there, to more positively capture condensate that might come down to the equipment hatch.

And then, there were some changes to cables that were going up to hydrogen sensors that are in the upper dome. Unfortunately, the way the cables were routed, they went up in one place and they ran around the containment, two-thirds of the way around, and they put support plates like every foot. To minimize the need for cable trays, they basically supported the cables directly off of the support plates.

So, we ended up with a string of support plates that basically stripped, tend to strip off the condensate that gets to them. And this was a ways down the upper head.

So, we have changed that now, so that we come up in three places right under where the sensors are, the three sensors. So, we don't have this horizontal band of support plates. So, those are the three areas.

This shows you a system kind of sketch of the downspouts that we are adding. And the top part here is showing the polar crane girder. And I think Bob mentioned a second change that we made. The polar crane girder is, I think, about 8-feet high. So, there is a top plate and a bottom plate, and there is about 8 foot of containment shell that is in between them.

And there is condensation going on inside the polar crane. Now the polar crane has big holes in it for inspection, so steam from the containment gets in there and there will be condensation. And it is not a great deal, but it was enough to worry about.

And we didn't think about that when we added the drains to the top surface. But, then, we have gone back and we added these drains on the bottom surface. These are small pipes compared to the pipes here. So, we are capturing that condensation that occurs inside the polar crane girder. The stiffener doesn't have that. It is a single plate. So, there is no need to add additional.

And this is routed together in two separate downspouts that go into what we call collection boxes. This is what the gutter that is at the operating deck feeds into, and the collection boxes, then, divert to the IRWST. Normally, they drain down into the waste sump. There are valves here that close off that block that flow path anytime you actuate the passive RHR, so that the condensate gets collected in any of these areas that get to the collection box, go back into the IRWST.

And that is the end of our open.

CHAIRMAN RAY: All right. What we are going to do now is, as I promised, we will open the phone line as well as inquire here in the room, if there is any comments that any member of the public wishes to make.

I trust that Mike Corradini has been communicating with you, Joy.

MEMBER REMPE: Some.

(Laughter.)

I forget to check sometimes.

CHAIRMAN RAY: In any case, the point is that I want to not ask the members of the public to wait until suppertime, or whenever it is going to be that we get done here today, to have an opportunity for comments, because that wouldn't be fair.

On the other hand, we need another comment period after the staff has been able to make their presentation. So, this will be the first of two.

And I will turn to the phone line first and ask, if there is any member of the public, to please identify themselves and give us any comment they would like to make at this time.

(No response.)

(Sound of dialing on phone line.)

Well, I am not sure. What does that mean? Is that how we open it?

All right. Well, while that is going, anyway, is there anybody here in the room who would like to make a comment?

(No response.)

Okay, seeing none, we will have to endure this (referring to computerized comments on phone line).

I think we disconnected him somewhere along the way, at least as far as my operation of conference calls goes. So, we will wait a second and see if there is anybody who wants to comment. And then, we will have to proceed.

Also, I will say, given that it is 2:15, we will take a break now because we have got to forge on after that. I don't want to wait until four o'clock.

Okay, we have, I think, restored at least the open line for this AP1000 Subcommittee meeting. Is there anybody on the line who wishes to make a comment at this time? This is the first of two periods when we will have an open line following an open portion of the meeting.

(No response.)

No one wishes to make a comment?

We are going to proceed as follows then: we will close this line.

MEMBER REMPE: Mike has cut off, by the way.

CHAIRMAN RAY: Yes, I figured that is what happened, is the line got dropped, and we are not going to repeat the last bit of the conference according. But we will, nevertheless, invite and hear any comments that people want to make now or at the end, following the second open session.

Once again, anybody wish to make a comment now?

(No response.)

Okay. We will be taking a break, closing the line, having the closed session then, immediately following that, starting at 2:30. I expect that closed meeting to go until either a quarter to 4:00 or four o'clock. Maybe I will revise and say somewhere between 3:30 and 4:00 I expect we will end the closed portion of the meeting.

We will resume the open section of the meeting by having the staff come up and make their presentation. And we will have another opportunity for public comment at the end of that period, perhaps on the order of 4:30 or five o'clock.

But I expect we will back in the open session somewhere between 3:30 and four o'clock. That is an hour to an hour and a half after we resume following this break.

All right. With that, let's close the line, please. We will take our break, and I would ask Westinghouse to help us assure that we only have those authorized in the room when we resume at 2:30.

(Whereupon, at 2:18 p.m., the meeting went off the record from open session to take a break and, then, to resume in closed session at 2:30 p.m.)

(Whereupon, at 3:57 p.m., the meeting resumed in open session.)

CHAIRMAN RAY: Sorry to make you guys wait so long. I hope you've been entertained by all of this, but we are going to now engage with you for a while. So, please proceed.

MEMBER BLEY: There wasn't anybody outside or anything waiting for us to open the meeting, was there?

CHAIRMAN RAY: Well, I don't know. I'll ask Peter to go check on that.

Is there anyone who is standing by next door who was thrown out of the meeting room here?

It's all yours, Don.

MR. HABIB: Thank you.

Good afternoon.

My name is Don Habib, and this presentation summarizes the staff review of the changes to the AP1000 passive core cooling system condensate return. And this is described in the staff's Revised Advanced Safety Evaluation for Section 6.3. I'm the Project Manager for the staff review of the Levy Nuclear Plant Units 1 and 2 Combined License or COL application.

The staff review of the passive core cooling system condensate return was performed under the Levy COL application. It was in response to submittals from Duke Energy, Florida, which is the Applicant for the Levy COL. And these changes, associated with the design change, have also been submitted by the Vogtle Units 3 and 4 licensee.

CHAIRMAN RAY: Hear that, guys, on Levy? So, we've got a Vogtle change in-house.

MR. HABIB: The primary reviewers and presenters today are Boyce Travis from the Containment and Ventilation Branch and Tim Drzewiecki from the Reactor Systems Branch. And they were supported by Yiu Law from the Mechanical Engineering Branch and Derek Scully from the Balance of Plant and Technical Specifications Branch.

For the Levy COL application, the ACRS conducted Subcommittee and full Committee meetings back in 2011 and issued their letter of conclusions and recommendations to the Commission at that time. Since then, the staff has conducted additional reviews of additional applicant submittals under the Levy COL docket, and the staff has issued or reissued several chapters of the Levy Advanced SE.

Most recently, and the subject of today's meeting, the staff reissued the Section 6.3. Before that, the staff issued Chapter 20 to address recommendations for the Fukushima Near-Term Task Force, and we specifically gave a presentation on the Recommendation 2.1, which was the seismic reevaluation.

Also, earlier in 2014, we reissued Chapters 8 and 13. And this was to address the staff review of the electrical loss-of-phase condition described both in 2012.01 and the Emergency Preparedness Enhancement Rule. And the ACRS has not asked for presentations of these topics.

I will now discuss the licensing impact of the design change to the passive core cooling system condensate return. The design change is represented in the Applicant submittals as an exemption request and two departures from the AP1000 DCD Rev 19.

The exemption request calls for changes to Tier 1 information of the AP1000 DCD. And notably, there are changes to two Tier 1 tables, and these tables were modified. These tables list the components and piping of the passive core cooling system, and they were modified to include the screens and downspouts of the design change. And these tables are cited in several of the ITAAC for the passive core cooling system.

For the two departures included in the submittals, one was in Chapter 3, and this was modifications to the polar crane girder, internal stiffener, and passive core cooling system gutters.

And then, the second departure dealt more with the performance of the system and changes to the capability of the system to maintain safe shutdown for the non-LOCA events, basically, changing indefinitely to 14 days or 72 hours for the safety-related mission time.

CHAIRMAN RAY: Okay. Now we make these changes. We review them. We ask many, many questions. We find them to be satisfactory, let's say. But there just seems something very odd about what we're doing now as a way of correcting or resolving inconsistency between analyses and the -- I don't want to call it "licensing basis" -- what the DCD says here.

I mean, supposing we had a dozen of these things. Is there ever any intent to revise the design, the Certified Design Document? Does it matter that it is not correct, if I can use that sort of simplistic term?

MR. BURKHART: That's a great question, Mr. Chair. If we have asked ourselves that question.

And there is 5263, which is the finality provisions of design cert, which, arguably, basically, we can only impose changes when there are issues with compliance and safety. And actually, this is a candidate -- and there are some other things in here -- this is a candidate of something that we should go back and look at for revisions to the certified design.

And one of the questions is pragmatism and how do we do that in a way that does not make the regulatory regime unpredictable. So, you're right, we are collecting some of these things like that, that at some -- and we have already started engaging Westinghouse on this, when might be the right time to have an amendment or revision to the certified design.

CHAIRMAN RAY: Well, you recall that I happen to go back far enough -- maybe you do, too -- to before Part 52 was adopted. This, to me, seems inherent in the concept of Part 52.

And you recall earlier this afternoon I mentioned the potential at least exists for us to come to some generic observation in the wake of all of this.

This is an example -- I don't know that there would be any traction for it -- but it is an example of a generic issue or concern that emerges from all of this.

How the heck could we go around fixing -- I can't find the right word. I don't want to call it "deficiencies" or "errors," or whatever. How can we go around doing that with this kind of licensing action? Just right now I don't have an answer to it.

Well, thank you for your comments. Let's go ahead.

MEMBER SKILLMAN: Harold, may I?

CHAIRMAN RAY: Well, if you keep it short, because we are --

MEMBER SKILLMAN: The Chairman has restrained me on this, and I have knowledge of Harold's discipline to hold me throw. I want to make two comments.

In my view, Part 52 requires Appendix B. Appendix B Criterion 3 is designed control and XVI, 16, is corrective action. I don't understand why this was not entered into Criterion 16 on the design cert and, then, handled as a Part 21 that would have assured extended condition and root cause.

CHAIRMAN RAY: Well, we're going to come back to that, if you can --

MEMBER SKILLMAN: I believe the tools are in place to do this, and I know it has been done on another design certification.

MR. BURKHART: And it should be done.

MEMBER SKILLMAN: So, I think you had asked, from a pragmatic point of view, how do we handle this. I believe that if all of the tools are in place to ensure that this gets ventilated on the cert and in every subsequent SCOL --

MR. BURKHART: Yes, we would expect --

MEMBER SKILLMAN: And with that, I'll stop.

CHAIRMAN RAY: Okay. Well, I was going to come to the issue you raise, but later. I just wanted to insert here the question the way I asked the other question, which is, what is the applicability of Appendix B? We heard Westinghouse say they're doing testing now, for example. Does that testing, if there happens to be a criterion in the 18 criterion of

Appendix B having to do with test control, and so on, is that applicable? If so, fine. Is the Vendor Inspection Branch looking at it from that standpoint?

There are many, many questions we can ask here, but it is 10 minutes after 4:00, and these poor people haven't had a chance to make their presentation. So, I am going to have us proceed.

MEMBER BANERJEE: And Mike is going to ask my questions.

CHAIRMAN RAY: Huh? Mike wants to ask a question? You've got it --

MEMBER BANERJEE: No, he will ask the questions I've got.

CHAIRMAN RAY: Oh, he will? He is going to assume your responsibility in presenting? Okay. Well, he is on a line now in a public meeting that we will have to open for him later in order for him to do that, unless he can send us an email.

Westinghouse wants to answer a question.

MR. CORLETTI: The Westinghouse people are saying the open line is not open.

CHAIRMAN RAY: That repeats the experience of a little while ago. I'm not going to get up and do anything about it. This gentleman right here will.

Let's go ahead.

Thank you.

MR. HABIB: All right. I will now turn it over to Boyce Travis to present the next portion of our presentation.

MR. TRAVIS: Thanks, Don.

I'm Boyce Travis. I'm a reviewer with the Containment and Ventilation Branch.

First, I am going to speak briefly to the regulations and guidance the staff used to inform us in their review. As you know, this is something of a novel issue and doesn't directly conform to any of the existing guidance we have.

We applied GDC 34, Residual Heat Removal, because the PRHR is the primary credited safety-related decay heat removal system following a non-LOCA transient. GDC 44, Cooling Water, because the condensation on the containment wall is the mechanism the AP1000 uses to transfer heat to the ultimate heat sink.

CHAIRMAN RAY: Boyce, I need to interrupt you --

MR. TRAVIS: Uh-hum.

CHAIRMAN RAY: -- because, although Westinghouse says the line isn't open, and I'm sure they're right about that, I hear noise here that sounds like there is some telephone line open.

Mike, are you there?

(No response.)

Okay. There is a telephone line open. Whether it is the right one or not is perhaps the question.

Go ahead.

MR. TRAVIS: Okay. Also, we took advantage or looked at the EPRI Utility Requirements Document, the URD, and the associated Staff Safety Evaluation on that. It stipulates that passive plants have a 72-hour Design Basis and provides the impetus that safety-related systems be capable of reaching of 420 degrees in 36 hours.

In the Safety Evaluation for that document, the staff recognized that 420 was not -- and/or cold shutdown -- was not the only safe, stable shutdown condition for a plant.

We also looked at SECY-94-084, the title of which you can see on the slide. And that acknowledged the 420-degree Fahrenheit in 36 hours criteria for safe shutdown, and that is what is being used by the AP1000 DCD Chapter 6, or was being used by the DCD in Chapter 6 and Appendix 19(e).

CHAIRMAN RAY: Now that is an important point that Boyce just went over. Any questions anybody has?

(No response.)

Okay, go ahead.

MR. TRAVIS: We're on the next slide.

And so, I am going to briefly talk about the review history.

MEMBER STETKAR: Don, keep your paper off the microphone. You're the one who is --

CHAIRMAN RAY: Oh, you're the guy "on the telephone"? I see. All right.

(Laughter.)

MEMBER STETKAR: Other than the beeps, which are obviously telephone.

MR. TRAVIS: And so, I will briefly talk about the review history here as well.

For the AP600 design, it was capable of removing decay heat via the IRWST for 72 hours with no condensate return. That is specified in 5.4.14 --

(Interruption by computerized phone line.)

MR. TRAVIS: All right.

CHAIRMAN RAY: Wait.

Okay, for those on the line, we are just beginning the open session with the staff presentation, and we are delinquent in getting the line reestablished.

Go ahead.

MR. TRAVIS: Okay. And so, speaking to the review history on the matter, the AP600 was capable of removing decay heat via the IRWST for 72 hours with no condensate return, although it did include a safety-related gutter system that was made safety-related as a response to staff concerns that the changeover valves going from the sump to the IRWST might not open.

In addition, for AP600, there was no explicit modeling of a scale or integrated event that involved the non-LOCA transient; that is, something where there was a tank in containment that was heated, steamed, and then, condensate was returned to the tank. Bits of this system was tested separately, but there was no integrated test on this specific issue.

For the AP1000, the language changes for non-LOCA transient, as Westinghouse spoke to, that the IRWST and PRHR heat exchanger can remove the core decay heat for an unlimited period of time. The volume of the tank was increased. In addition, the area and flow rate through the heat exchanger were increased to compensate commensurate with the power change for going from 600 to 1,000.

And the staff found that the scaling regime that was applied going from the testing to AP600 was also for the most part applicable to AP1000.

CHAIRMAN RAY: Okay. Now this is a recital of the facts. The obvious question is, well, why? But this is not the time to go into it. But I just want to note that we're not answering the question of, well, why did we do it this way, and that is a question that we are going to have to come to grips with.

MR. TRAVIS: And we will try to speak to that a little later in the presentation.

CHAIRMAN RAY: Okay. All right, good. Thank you.

MR. TRAVIS: We can move on to then next slide.

And so, in performing the review, this kind of summarizes the containment response, what we looked at in the containment response. We took a look at whether the analysis change had any impact on the deep pressure analyses that were already performed.

We evaluated whether this analysis had any change on the containment flood uplevel. That is, what the level in containment is following a LOCA or an ADS actuation.

We looked at the test data that Westinghouse used to justify some of what you saw in the previous presentation. And we also focused on the inputs to the RCS analyses, which primarily are the condensate return to the IRWST and the containment pressure, which has a direct impact on the boiling from the PRHR heat exchanger.

We can go to the next slide.

And so, the review approach for the passive core cooling system, or PXS, focused on evaluating the impact of the PXS safety functions for which the PRHR heat exchanger is primarily emergency decay heat removal. The PXS also has the other three functions listed on this slide, and Tim will speak to all four of them later in the presentation.

The review also looked at the impact on the safe shutdown analyses, which have been separated from the Chapter 15 analyses, and looked at the impact on the Chapter 15 analyses themselves. When we say "safe shutdown" in this slide, we are speaking to the analyses that appear in Appendix 19(e) of the DCD and the FSAR.

This slide I will just go over briefly. You have already had the Applicant walk through the calculational approach. Staff audited the four calculations directly as well as approximately 20 calculations supporting these four calcs. This is just kind of a summary of the staff's understanding of what we used from the calculations in order to inform our review.

And so, the containment analysis focused on two primary areas, one of which was holdup. And when I say "holdup," I'm referring to the various means by which condensate is lost from the IRWST. There are some one-time holdup losses, like the pressurizing of the containment atmosphere, film losses, condensation on passive heat sinks that doesn't drip down into the sump under the reactor cavity. And then, transient losses, which included tech spec containment leakage, which is fairly minimal; losses over wall attachments and obstructions, that the Applicant went over in detail, and then, raining from the shell and dome.

Approximately 17 percent of the condensate that gets to the shell does not return to the IRWST, is instead directed to the sump and/or reactor cavity. They kind of communicate, as Westinghouse showed in the nodalization.

One of the areas that staff had some questions about related to film thickness. We questioned the applicability of the approximation that

Westinghouse used in their analyses to calculate the thickness of films in containment, holding up on heat sinks, the operating deck, et cetera.

In an RAI response, the Applicant reevaluated the film thickness. They determined that there was a more conservative method that could be used, and they performed a sensitivity study that incorporated that more conservative method for film holdup.

The effect is negligible in the first 72 hours. We are talking about on the order of minutes in reduction of level in the IRWST and in the long-term a fairly small effect. And when I say "long-term," I'm referring to longer than 72 hours.

The other primary area of staff focus was the termination of the condensate return rate. And in this, the big unanalyzed portion was the losses over wall attachments that did not previously exist in the staff review.

Staff asked the applicant to justify whether the correlation they were using for wall losses in testing was applicable. As Westinghouse summarized earlier, testing was done at temperatures lower than what would be encountered during the containment event. Along the wall, temperatures would exceed 200 degrees.

Again, the Applicant performed a sensitivity study for increased wall losses. This one has a slightly larger effect than the increased film thickness, but, again, in the first 72 hours the effect is negligible. And beyond 72 hours, you start to see some effect, but it is fairly small.

CHAIRMAN RAY: What do you think about this weld business that we were talking about that is similar to an attachment?

MR. TRAVIS: Yes. And so, the determination for the one at 5.8 degrees and 12 degrees, we felt that 100 percent loss was conservative. Based on the test data that we saw over the angled plate, we felt that, considering the shallowness of the weld, was a fair treatment of what goes on in that 33-degree weld.

CHAIRMAN RAY: Okay. So, just exercising judgment, you think it is reasonable?

MR. TRAVIS: That's correct.

And so, the findings we made for the containment impact: the peak pressure analyses that is currently in effect in DCD remains unchanged. The new calculation increases the heat sink area to maximize condensation, and that would be a non-conservative assumption for the peak pressure analyses.

The initial conditions for this are slightly different than that for a LOCA. Internal containment temperatures are lower for this calculation than they would be in the peak pressure case. Again, the lower containment temperature would reduce the peak pressure and, therefore, would be an inappropriate assumption for a peak pressure calculation.

And the effect of additional condensate return and holdup that takes place in this analysis doesn't have a significant impact on the peak pressure analyses until well after the point of peak pressure is reached. So, there is no impact from these analyses on the peak pressure.

Staff also looked at the containment flood uplevel following an ADS actuation or a LOCA. The only major impact that was not analyzed in the flood calculation before was the new film thickness method that we asked in the RAI about.

We performed some confirmatory analyses to determine whether that would have any effect on the flood uplevel, and the effect is very small. Containment is rather large. And so, a small increase in film does not reduce the flood uplevel adversely.

We also looked at the potential or the

effect of a lowered IRWST level following an ADS 1, 2, 3 actuation. ADS 1, 2, 3 involves spargers in the IRWST, and staff was concerned that the spargers might not be rated for uncovered depressurization in the IRWST or that damage would occur to the surrounding structures. We asked in an RAI about this. Westinghouse got back to us. The spargers are rated for -- they do not need to be submerged in order to admit water.

And somewhat related to the change, the PXS downspout screens, consistent with the elements of the gutter system that already exist, are Safety Class C, Seismic Category 1 components. They are qualified under the QA process, and the existing ITAAC amendments will apply. The same goes for the PXS downspout piping.

And with that, I will turn to Tim to talk about the PXS and RCS impacts.

CHAIRMAN RAY: Okay. We will come back to this business of Appendix B later.

MR. DRZEWIECKI: Okay. So now, we are going to go through how the review was done for the passive core cooling system.

As Boyce stated before, this was done by looking at the safety functions performed by the passive core cooling system and looking at the impact on each function. And that starts off with the emergency decay heat removal.

So, this departure had revealed we can rely on the PRHR heat exchanger for a finite period of time before we would have to get support from either a RETINA system or the transition to open loop cooling.

So, staff inquired what's the safety-related mission time for the PRHR heat exchanger. That was issued out in an RAI, and the response came with an FSAR update that changed the language from a definite to a 72-hour operational requirement for the PRHR heat exchanger. This is consistent with the Commission's position for satisfying GDC 34 and 44.

So, the next step was the performance of the PRHR heat exchanger, which is demonstrated in Chapter 15, Safety Analyses, and Chapter 19, Shutdown Analyses. So, those analyses are run out less than nine hours.

So, staff had questions about if the heat exchanger would uncover on the timeframe of a 72-hour mission time and how it would perform during that time. So, an RAI was issued in order to bound all the Chapter 15 events to, one, identify what is the most limiting event in terms of PRHR heat exchanger performance, and to run that event out 72 hours.

So, the limiting event was identified as a 15.2.6 loss of AC power station auxiliaries. This conclusion was supported by the Applicant's sensitivity studies as well as staff calculations that came to this conclusion.

The next calculation was ran out for 72 hours using the approved LOFTRAN code. It used inputs for the containment response; namely, the pressure for that containment as well as the condensate return rate.

These calculations did demonstrate partial uncovery of the PRHR heat exchanger. In fact, the top horizontal bundle does uncover. However, the Chapter 15 acceptance criteria for this event remains satisfied over the duration of the calculation, the acceptance criteria being no liquid relief through the pressurizer safety valves. Staff did their own calculations that came to the same conclusion, which is what we will be walking through now.

So, this next slide, it shows the limiting event in terms of PRHR heat exchanger performance. This is the hot and cold leg temperatures and the loop that contains the PRHR heat exchanger. The dots that you see, that's data that was taken from the DCD event in 15.2.6, and the solid lines all are the staff confirmatory calculations.

The agreement between these two sets of calculations gave the staff confidence that the modeling that they had for the system was consistent with what is in the certified design, and there was no trips or any physics that were largely different between these two models.

So, now walking through this event, the transient starts. Only 10 seconds into the event there is a loss of feedwater. One minute after you have a loss of feedwater, that is when your low-range steam generator level trip is encountered. That causes a reactor trip. That is going to stop your turbine stop valves. And this is also where you are going to trip the reactor coolant pumps because of a loss of AC power.

With the closure of the turbine stop valves, you are going to get an increase in pressure in the steam generator that is going to cause the RCS to heat up. That is what you see here.

One minute after you get your reactor trip, that is going to actuate the PRHR heat exchanger. That trip is going to come in on the low, narrow-range steam generator level coincident with the loss of startup feedwater.

So, as that injects, there is going to be this initial cold water which is the PRHR heat exchanger. So, that is going to cause this dead -- and then, the system is going to cool down at a steady pace until the cold leg gets 500 degrees Fahrenheit. When that happens, that is going to open up your discharge valve on the core makeup tanks, and that is going to inject a large volume of relatively-cool water into the system.

So, that cools down the system to the point where the heat removal from the PRHR heat exchanger is less than your core decay heat. So, the system is going to heat up again until the heat removal from the PRHR heat exchanger equals and, then, ultimately, exceeds the core decay heat. And that turns this event around.

So, this is the base event for Chapter 15.2.6. The next step was to impose the containment response, which is the pressure within the containment as well as the condensate return rate, and extend this calculation out to 72 hours. And that is what you see on this next slide.

So, the graph looks the same, but now there are these two new dotted lines. And what this shows is that the system -- and these two vertical lines, this is at 36 hours and 72 hours, respectively.

So, you do see this little dip here. Now, of course, it looks like a peak, but this is on a semi-log plot, so it is actually over the course of many hours. There is a slight heatup when you see the top horizontal bundle uncovered, but it is slight and there's not much expansion of the RSC and it continues to perform its safety function of removing the core decay heat.

As stated before, the acceptance criteria for these event is preventing water relief through the pressurizer safeties. And that is demonstrated by looking at the pressurizer, the volume of water inside of the pressurizer.

So, this dashed line that is at the top of the plot, that is the total value that is available in the pressurizer and the surge line. And this line, that is the staff's calculation using the base condensate return rate that was obtained from the Westinghouse calculations.

Next -- is there a question?

MEMBER RICCARDELLA: In all these calculations you were using that 98 percent return rate?

MR. DRZEWIECKI: No. This was using the current updated return rate that is provided by --

MEMBER RICCARDELLA: So, that is 80-something percent?

MR. DRZEWIECKI: I don't want to get into the actual value.

MEMBER RICCARDELLA: Oh, okay.

MR. DRZEWIECKI: We do know what it is, but that is a proprietary value that I can kind of pass on later.

MEMBER RICCARDELLA: Oh, I'm sorry.

MEMBER REMPE: Could you clarify, did you use LOFTRAN also or what did you use?

MR. DRZEWIECKI: Okay. So, early in the process we engaged Research and they did calculations using TRACE. However, the event that they ran was a slightly different event, and so, it didn't match up on exactly what you are seeing here. These results you are seeing are a RELAP calculation. These are based in RELAP5.

Okay. So next, staff wanted to look at how sensitive these results were based on the condensate return rate. So, we took the base curve, and we began to chop back what the condensate return rate would approach. So, here it is cut back to 70 percent, and you see a small impact on the change of expansion of the RCS. At 60 percent, it looks like you are starting heat up the RCS slightly, but very small. And then, at 50 percent, it looks like you would be trending towards failure at this.

This informed the staff of two things. One, that with respect to the condensate return ratio, there appears to be significant margin for the PRHR heat exchanger to do its function; and, two, if there was less return rate, the heatup is very slow. It occurs over tens of hours.

Okay. So, that was the emergency decay heat removal. The other functions performed by the passive core cooling system are emergency makeup and boration. That is the function of the core makeup tanks. There is no impact of that function based on this design change.

The safety injection, staff wanted to ensure that at anytime you could transition to open loop cooling. And the one thing that was different was that, if the operators do take action to block ADS actuation at about 22 hours, that when they do bring it back, they could be a much lower level within the IRWST. So, it is a series of RAIs to clarify that. It was clear that there is no minimum level required for ADS actuation.

CHAIRMAN RAY: Well, were you going to say something more? I'm sorry.

MR. DRZEWIECKI: No.

CHAIRMAN RAY: Well, I mean, not as far as the sparger is concerned, but there are some other questions that might be asked about what the operation of the spargers when they are not uncovered, what effect that might have on other things, isn't there?

MR. DRZEWIECKI: Yes. We did ask about what is the impact or could there be damage to any of the surrounding structures as well as the IRWST itself.

CHAIRMAN RAY: Or equipment in the area or not?

MR. DRZEWIECKI: Yes. And that was resolved based on how far away these spargers are from the sides of the tank and the fact that, if they were to actuate in this scenario, you would be at a reduced RCS pressure.

CHAIRMAN RAY: You don't have anything pending resolution in that regard then?

MR. DRZEWIECKI: We were satisfied with those RAI responses. They did quantify about how the pressure was going to dissipate based on the jet and how far and what they would hit.

CHAIRMAN RAY: You are talking about the center in which we defer operation of the ADS and, then, we decide we want to actuate it, right?

MR. DRZEWIECKI: Yes.

CHAIRMAN RAY: Well if you have any other information that comes to your attention, please pass it along to us.

MR. DRZEWIECKI: Will do.

Okay. So, the last aspect of this review had to do with the safe shutdown. And this is the ability to get down to 420 degrees Fahrenheit within 36 hours.

Now the approach that was used for this analysis is the same approach that was used in the certified design. And that is this non-bounding conservative analysis, some conservative assumptions; namely, the condensate return rate, and some initial conditions, as well as a modeling of the PRHR heat exchanger itself.

So, this approach, it remains consistent with the prior position that was approved by the Commission in their response to SECY-94-084. Staff has done their own confirmatory calculations and they have come to the same result, that they do achieve RCS temperature below 420 degrees in 36 hours using these assumptions.

Now this last bullet, this is talking about the Safety Design Basis of achieving 420 in 36 hours. Previously, within a DCD it is stated that this is part of the Safety Design Basis. Looking at the calculation, staff would expect that an analysis that is going to support a Safety Design Basis would be consistent with SRP 1502.

This analysis does not rise to that criteria. And so, staff was concerned that the DCD may be inconsistent.

So, after going back and forth, the language that had identified reaching 420 in 36 as a Safety Design Basis has been removed from the FSAR. However, it is still part of the Design Basis and is analyzed in Chapter 19.

MEMBER SKILLMAN: Say that again?

MR. DRZEWIECKI: Okay.

MEMBER SKILLMAN: You really lost me in the last three or four sentences.

MR. DRZEWIECKI: Okay. So, reaching 420 has been determined by doing several analyses, especially the one that was written in response to the RAI, that reaching 420 is not required to maintain the safe shutdown of the plant; that you can have a safe, stable RCS condition and a temperature above 420 degrees. Therefore, reaching 420 does not rise to the criterion of being safety-related in and of itself.

Therefore, the language that had identified reaching 420 in 36 is no longer part of the Safety Design Basis. It is part of the Design Basis, but it is not considered a safety-related design requirement.

MEMBER STETKAR: Tim, is it part of the Safety Design Basis for any other certified design now?

MR. DRZEWIECKI: Not that I am aware of.

MEMBER STETKAR: Because I don't have the ability to follow through all of these particulars and back through the many years.

What exactly is the Commission position? I mean, you know, what was the magic of 420 degrees Fahrenheit in 36 hours, such that it was defined as a Safety Design Basis and now isn't?

MR. DRZEWIECKI: Okay. Well, to be clear --

MEMBER STETKAR: It isn't AP1000, but may still be, we're not sure, for any of the other designs.

MR. DRZEWIECKI: Yes. To be clear, it was never, okay, it was never identified in this SECY that this is part of the Safety Design Basis.

MEMBER STETKAR: Okay.

MR. DRZEWIECKI: When we pulled the thread to find out what the history was of 420, it looked like it appeared as part of the URD. And then, the staff had approved that in their SER. And then, there is a SECY paper. And then, the Commission voted on it and said, yes, that's a fine position.

That was really in response to this Reg Guide 1.139, I believe it is, in which that had stated they should get down to a cold shutdown within 36 hours of 200 degrees. Now, with a passive system, you can't get there. All right? So, 420 seems to be something that they thought they could make. And now that it is designed and it is real, it is more challenging.

MEMBER STETKAR: Okay. Now we have got this thing that is called a passive design. It will just be called AP1000. We have got other things that happen to be called U.S. APWR and U.S. EPR, which happen to be called not passive. Is getting down to 420 degrees in 36 hours part of the safety requirements for those designs? Because those are now active designs. They still look like reactors to me, but I get lost on the passive and active stuff.

MR. DRZEWIECKI: In the active designs, it is important to get down to 350 degrees in order to transition over to your RHR system.

MEMBER STETKAR: Yes. Okay. That's

what you just said, and that is important to me because you just said, if I have an active design, it is important to get to what you're calling cold shutdown. But I heard Tim say, if I have a passive design, I can't get what you're calling cold shutdown. So, that isn't part of the safety basis. I don't get it.

MR. DRZEWIECKI: Well, okay.

MR. DONOGHUE: This is Joe Donoghue.

To clear up what I think Tim was getting at, the 420 in 36 was related to the passive plant design that the staff knew it was going to be reviewing. Active designs still have a difficult shutdown.

CHAIRMAN RAY: Okay. Wait a minute. This is now into the domain that I was wanting to address after we had gotten through the technical review.

MEMBER STETKAR: Okay, I'll be quiet.

CHAIRMAN RAY: No, I'm not asking that. I think we are basically through the technical review.

But it is, at least as I see it and as implied by what you are saying, John, which I think is correct, and it goes back to things that Dick has said as well, the explanation you just gave, as far as I can tell, is accurate but dumbfounding at the same time.

(Laughter.)

But it's not the first time. The one thing that I guess I want to observe here is we got ourselves into a position of not fully appreciating what we were doing on the subject of containment overpressure. I don't want to do that again here, based on what you just recited to us about it not being part of the Safety Design Basis.

I mean, we've been faced repeatedly with the fact that this being a passive and, therefore, much safer design, some of the requirements -- I will use that term -- for it we can look at as being, as you I think said, subject to revision when we find out, well, we can't really make it, what we said we would do. Okay.

I don't think anybody in the room disagrees with the proposition that we are supposed to do what we say. And so, we are going to revise things, so that we say now something different.

But, in making that change, the ones that you list up there in your presentation, it does raise the question that we are grappling with now. And again, I will go back to my comment about perhaps we will end up in a generic situation.

And I think goes to the full Committee presentation by the staff, by the way, coming up in October. We have to understand this better than we do because, when you start referencing the intent of a SECY and the Commission's response to it, and so on, as justifying a change like this, it gets over our head pretty quickly. You guys deal with it perhaps a lot more than we do, but we want to understand better what exactly it is that we mean when we do what you just described. It is no longer part of the Safety Design Basis. It's part of the licensing basis, or whatever.

And we are not going to be able to do that sitting here now. Now, I mean, you can respond to what John and I have said and others as much as you would like now, but I don't want to ask you to try and explain something. I am trying to explain to you what we need to understand better.

And if there is a lack of clarity somewhere in this, much as we were talking about earlier in a somewhat different aspect having to do with revision of the DCD, we need to understand it. Maybe we need to get the General Counsel in here or something. I don't know.

But I don't think we can just go along saying, well, somebody says that we don't have to make it part of the Safety Design Basis anymore, so we will just change it. Maybe I am exaggerating my concern here, but I am trying to communicate to you that that is just not going to work.

We need to have a better understanding, a better explanation of what, in fact, is happening when you certify a design to do a certain thing, and then, later on, you say, well, we don't need to do that after all; we can do something different, or we can describe it in a different way. It doesn't really make any difference at the end of the day. We are not there yet.

I would like to separate what I just said from the ongoing need to get a licensing action taken on the Applicants. But, on the other hand, I don't know yet that we can separate these two things.

And so, I have sort of lectured you here about something off the cuff, but we've got to have a better, more clear understanding of what the heck it is we are doing here.

MR. McKIRGAN: Mr. Chairman, thank you. This is John McKirgan from the staff.

I appreciate that request. I think we might benefit from some further reactions of the Committee, so we bring back a more meaningful presentation on that topic for the full Committee meeting. I don't know that we will be able to do it justice here.

CHAIRMAN RAY: I'm sure we can't.

MR. McKIRGAN: But we would like to interact further, so that we better understand your comment.

CHAIRMAN RAY: Yes. Now, again, I am looking to the need for us to tell you what it is we are going to do that is related to this licensing action. We can't do that except as a full Committee, and that means we have got to go over some of this material with the full Committee in October or whenever we can get it done.

But I am trying to describe now a separate problem. I think you understand it well enough, which is we need to also understand better what, in fact, it is we are doing from a process standpoint. Okay?

This hasn't got to do with what the assumption about a condensate return percentage or loss percentage is or which computer codes we are using for a particular analysis, or how many calculations we did in this case. It has to do with the basic rules that we have to live by here. Okay?

All right. Now, with that sermon behind us, we should move on and close out. I have one more thing, and then, my colleagues have other things they would like to add.

But one other thing that I still find very disconcerting is the idea that we are doing work on, I'll use the word safety. At least I think compliance with the licensing basis is a safety issue. And I am not clear whether or not we are applying Appendix B to that work. The COLA holder I don't think can intervene with the Certified Design --

MR. BURKHART: This is Larry Burkhart.

I think that all of these activities apply under Appendix B. Westinghouse and the COLA and the Applicants, you know, they incorporate by reference the DCD, which becomes part of their FSAR. So, they are required to deal with any issues. So, all these activities are covered under Appendix B and should be in the corrective action program. And there are reporting requirements in 52.6, Part 21, and some of the reporting requirements for operating reactors don't apply until the 103(g) finding and they wrote fuel. But all of these activities are covered under Appendix B.

CHAIRMAN RAY: Well, I would think so, and I don't find your saying that at all surprising. But, if you read Appendix B, it is not clear how it works under Part 52.

Now maybe the Vendor Inspection Branch is the one that provides oversight of its implementation.

Okay? But the Vendor Inspection Branch normally inspects somebody that is also being inspected by a licensee.

MR. BURKHART: Then, that should be the same case.

CHAIRMAN RAY: Well, that is not what I hear happening. It is not clear to me how it even could happen in this case.

But, in any event, these are generic kinds of issues that we need to understand better that I don't think we want to get tangled up with any concerns or issues we have with this particular licensing action we are taking here now.

But, on the other hand, like I said in the example of containment overpressure, we wound up thinking we were doing one thing and wound up doing something else, apparently. And we don't want to wind up in that position here.

MR. BURKHART: Again, you have to say one more thing about this particular change. It is that, from my understanding, what we are intending to approve is very consistent with what we have already approved in previous design certifications, well, in the AP1000 design certification. So, we are not deviating much from how the calculations were done to support getting to 420 in 36 hours, which meets the intent of -- which meets the SECY requirement.

CHAIRMAN RAY: Well, when you say, "which meets the SECY," that is when you begin to get into a murky area.

MR. BURKHART: Well, certainly the staff should consider whether they should make that regulation. Why is it just staying a SECY?

CHAIRMAN RAY: Yes.

MR. BURKHART: We should probably somehow bring that into the regulations.

CHAIRMAN RAY: Well, again, we are now deep into the weeds of process and important issues, but I think we want to just voice them here. To the extent we can separate them from what needs to be done to responsibly handle the proceeding in front of us, we should do that.

But this idea that it was a safety -- what is the word, safety --

MR. DRZEWIECKI: Safety-related Design Basis.

CHAIRMAN RAY: Well, it's safety --

MEMBER BLEY: It is right up here.

CHAIRMAN RAY: Yes, excuse me. Safety Design Basis. It is still something we say we are going to do in 19(e), but it is not something that is part of the Safety Design Basis anymore. I mean, that is something that is not easy for us to process, anyway. It may be easier for you guys.

MR. BURKHART: You're right, it is the licensing basis that is something that they need to comply with.

MR. CORLETTI: This is Mike Corletti from Westinghouse.

Maybe just to add in, I think the language that is giving people pause is that this analysis that shows safe shutdown after 420 was not a Chapter 15 accident analysis. And these words "Safety Design Basis" often refer to Chapter 15 accident analysis.

And in our certification, it wasn't a Chapter 15 accident analysis. It was an analysis. It was a conservative analysis that was presented in Chapter 19(e) as part of our licensing basis.

People, I think plus the analysis of the staff, got a little bit hung up on those particular words, which in other places means Chapter 15. And this analysis was never part of our Chapter 15 accident analysis.

So, I think a bit of this, they are really not trying to change the intent. They are trying to clean up, maybe clean up the language because these words often refer to Chapter 15, and this analysis was in Chapter 19. And the SECY did not require it to be a Chapter 15 accident analysis, but it did require it to be part of our licensing basis, which I believe it was and still is.

CHAIRMAN RAY: Okay, but, again, we have a responsibility to understand that independently of you representing to us, and I'm afraid we are not there yet.

MR. CORLETTI: Okay.

MR. BURKHART: And it took the staff a while to get there, too.

CHAIRMAN RAY: Yes. So, I wish I could cleanly cleave off the process issues and say, "Come and give us a tutorial someday on how this is supposed to be looked at." But all I can do now is say, when we have the full Committee meeting -- and that's not very long off -- I hope we can somehow make it possible for the Committee to decide that whatever action is deemed appropriate in the context of this licensing action before us can be separated from -- in other words, that we are not violating unintentionally some requirement that we don't really quite appreciate. Okay? Easier said than done, I know.

Okay, go ahead.

MEMBER BLEY: Well, excuse me.

CHAIRMAN RAY: Yes. I did this so I would remember. I rambled. Now I have to remember what -- I rambled on too much. I apologize.

(Laughter.)

MEMBER BLEY: When we have this meeting separate from the AP1000, some of us would like to see a focus on the idea of consistency and why we can't be consistent, how we could be consistent.

Some of the problems, like the one Mr. Stetkar brought up, are kind of tied up in our old notions of safety-related and not safety-related.

This plant is non-safety-related equipment, can get all the way to cold shutdown this way. I think you can run with that.

I mean, why shouldn't there be kind of functional requirements for all plants, rather than something that seems a bit arbitrary as we go from plant to plant, and gets us tied in knots occasionally like this? So, for the next time.

CHAIRMAN RAY: Okay. This was unscripted and too long-winded, but it is something that is troubling us, or at least some of us, most of us, I suppose. And we don't really feel comfortable just saying, "Oh, well, yes, it's part of the Design Basis in 1980, but it is no longer part of the Safety Design Basis." We just don't understand that yet.

What more would you like to tell us?

MR. DRZEWIECKI: Well, I've just go a few slides.

This is just our calculation compared with the Westinghouse calculation that shows a good agreement. This is RELAP versus the LOFTRAN calculation.

MEMBER REMPE: Before you leave that slide --

MR. DRZEWIECKI: Yes?

MEMBER REMPE: -- Professor Corradini is really wondering what caused the bump of four hours in your analysis.

MR. DRZEWIECKI: Four?

MEMBER REMPE: Four hours. You will see all three of your curves kind of increase around four hours.

MR. DRZEWIECKI: Oh, yes, okay.

CHAIRMAN RAY: Yes, he mentioned that.

MR. DRZEWIECKI: Yes. Okay. So, there is some uncovery of the PRHR heat exchanger in this analysis. So, when you begin to uncover some tubes, when you see there is a peak, there is an inflection certainly --

MEMBER REMPE: It is an increase, yes.

MR. DRZEWIECKI: Yes.

MEMBER REMPE: Okay. Thank you.

MR. DRZEWIECKI: No problem.

Okay. So, then, our conclusions. So, our conclusions on this review were that the design changes and the FSAR changes are acceptable. The Chapter 15 analyses are not affected. However, there is a new section that was added to Section 6.3 that describes a 72-hour analysis that bounds all Chapter 15 analyses that take credit for the PRHR heat exchanger.

That analysis was supported by staff confirmatory calculations. We achieved 420 degrees in 36 hours. It is met using the analysis approach, those previously approved for Chapter 19(e). This is part of the Design Basis, but it is not safety-related. This is also supported by staff confirmatory calculations.

CHAIRMAN RAY: Part of the Design Basis, but it is not safety-related. I understand the English words, but I'm trying to understand what the heck it means.

(Laughter.)

MEMBER STETKAR: Written as part of the Design Basis; it is not safety-related.

CHAIRMAN RAY: Oh, you're meaning safety-related in the old sense?

MEMBER STETKAR: Well, that is part of -- yes. I think that is what this means.

CHAIRMAN RAY: Well, yes, but --

MR. BURKHART: The key message to take is that we are doing nothing inconsistent from what we did before, how the calculation was done. We may be fooling around with some words, but how the calculations were done is the same; it is consistent with --

MEMBER STETKAR: On the other hand, my point is "fooling around with some words" has real implications on people who design, build, and license and operate plants. And "fooling around with words" is not what the regulator ought to do. We ought to understand what those words mean and apply them, as Dennis said, apply them consistently across all of the designs.

MR. DONOGHUE: Joe Donoghue again.

The staff recognizes this question to be part of this review. We didn't come to an easy conclusion, Mr. Chairman. And you thought it was easy, but it wasn't easy for us to do that.

I think what you heard was in Chapter 15 the safety concern or the safety focus for the system is don't go solid. The 420/36 would certainly guarantee that.

And in the course of this review, staff and Westinghouse came to the conclusion that we weren't getting close to challenging the system, the safety function of the system. And in Chapter 19, that analysis which was always there, which is affected by the design change, was reviewed thoroughly. And we think that in that case they still meet the 420 in 36. Okay?

CHAIRMAN RAY: Okay, but no.

(Laughter.)

MR. DONOGHUE: No?

CHAIRMAN RAY: Look, I spent my life knowing the difference between safety-related and not safety-related.

MR. DONOGHUE: Okay.

CHAIRMAN RAY: Trust me, I do know. But I apply it to hardware, to structures, systems, and components. I don't apply it to a performance requirement.

So, let me ask this question: is what you need to do in order to ensure 420 degrees in 36 hours is met going to be part of the tech specs? Or I shouldn't say that that way because that is already, I guess, in the COLA.

But I would need to know whether meeting that requirement was something that was subject to tech spec non-compliance if I failed to it, tech-spec-level enforcement action, for example. Is it or isn't it?

MR. BURKHART: Actually, it helps define the modes on when some aspects will be critical.

CHAIRMAN RAY: You know, I mean, if I treat a safety-related piece of equipment as non-safety-related, I can be cited for failure to comply with my license.

I am just sort of dumbfounded by the idea that there are performance objectives now that are safety-related or not safety-related, as opposed to hardware, structures, systems, and components. That I'm used to.

Now, when we decide we are going to change something that we have called safety-related and say, no, it's not safety-related anymore because the SECY doesn't require it, or something of that kind, I am just really lost. And I have been in this business a long time. But I will confess Part 52 is a learning experience. So, I'm ready to learn. Okay?

MR. BURKHART: Okay.

CHAIRMAN RAY: All right. Now, with that, does that conclude the staff presentation?

MR. DRZEWIECKI: Yes.

CHAIRMAN RAY: All right. Because what we are going to do is, with you still here, we are going to invite public comment again, just in case -- because it comes at the end of your presentation, basically. I mean, you're not going to run off, I'm sure.

So, let's open the telephone lines. And while that is being done, I'll ask, is there anyone here in the room who wishes to make a comment at this time?

(No response.)

Okay. Seeing none, we'll ask a similar question to the phone line.

Mike, are you there?

MEMBER CORRADINI: I am here, unless you can't hear me.

CHAIRMAN RAY: I can hear you, and I'll start with you, and then, ask if there is anyone else. Do you have anything you would like to offer after this terribly confusing discussion we just had?

MEMBER STETKAR: Actually, he can ask

questions because --

CHAIRMAN RAY: Yes, he can. He can ask questions as well as make comments.

MEMBER CORRADINI: No, I passed on my questions to Sanjoy and to Joy. So, I'm fine.

CHAIRMAN RAY: All right. Do you want to weigh-in on this religious discussion we were just having?

MEMBER CORRADINI: No, I'm agnostic. I'll let you Catholics and Protestants there --

(Laughter.)

CHAIRMAN RAY: Okay. Fair enough.

Any other person on the telephone line who would like to make a comment?

(No response.)

Hearing none, we will, then -- I will poll the members here at the table. We will close the line and consider that. Are you going to leave it open? All right. I don't care.

Oh, all right. Let's go around the table here, as we normally do at this juncture, and see if there are things that any of the members still with us wish to add to the record, starting with you, Pete.

MEMBER RICCARDELLA: I don't have any comments.

CHAIRMAN RAY: Dick?

MEMBER SKILLMAN: I do. Harold, you have communicated to my satisfaction the anxiety that we feel about the process part of this. So, I thank you for that, and it's on the record. And I believe it bears real scrutiny.

I want to make one, maybe two other comments. First of all, the authors of the design cert were not and are not clairvoyant. And so, there is room for the design cert to be amended to be correct. So, there's no harm, no foul, as long as the design cert author steps forward and says, "We understand the deficiency and here's how we're going to fix it."

I would make just one final comment. When one reads the regulatory evaluation -- my prep for this meeting was pouring over the RAIs and doing analysis on my own. But here's a wrinkle that I think the staff ought to look at very carefully.

In the regulatory evaluation, the same comments from 50.59 are asked regarding significant hazard consideration. "Does the proposed change involve a significant increase in the probability?", and the other questions. And in each case, it is convenient to answer no on a 50.52 item.

If the question was changed in this case to, if the change had not been made to the downspouts, to the gutters -- there were modifications to WGOTHIC, which is why Sanjoy asked the question -- if those changes had not been made, how would those significant hazard consideration questions have been answered? And I would suggest to you that they may have been answered quite differently than they show up in the record. The text would be, "If this change had not been made, would there have been a different outcome?"

So, I am going to go back to my Chairman, but those are my comments.

MR. BURKHART: I understand the question. It's just license amendments are done in accordance with 50.91, and the hazard consideration doesn't ask that question in that way. I understand what you are saying. And actually, the staff has gone there when we were going through the significance of this issue and totally agree.

Remember, certification is a rulemaking, a good-faith effort on everybody's side to do that. So, I can tell you that Westinghouse -- and they can speak for themselves, too -- but I know that they are gathering things beyond that amendment. It may be not until the renewal.

But what I want to say is that, for those things that are adequate protection compliance issues, our focus is on the facilities that are licensed or getting licensed. Our first priority is not necessarily amending the design cert. It is making sure that those who are licensed or soon to be licensed adequately address the issue.

But I totally understand and agree with what you're saying.

MEMBER SKILLMAN: Okay. Thank you.

CHAIRMAN RAY: Steve?

MEMBER SCHULTZ: I appreciate the presentations today.

And I share your concern, Harold. I think we have a good understanding based on the presentations, all parties today, of the technical evaluations that have been done and of the design changes and how those design changes and the evaluation has resulted in improved performance. But the licensing portion of this is still to me not fully clear, and I do believe it needs to be. So, I am looking forward to more understanding between now and the time we meet with the full Committee.

CHAIRMAN RAY: Thank you.

Dennis?

MEMBER BLEY: Nothing more, but the words.

I didn't say anything about the words. But I'm not sure anybody can point me to a place that says here's the Safety Design Basis for a plant. I know I can look at the design cert and see the Design Basis. But the three phrases, Design Basis, licensing basis, and Safety Design Basis as an ensemble, I am not sure are really defined. I wouldn't mind being shown I'm wrong.

CHAIRMAN RAY: Yes. As I have said repeatedly, I have a similar feeling.

John?

MEMBER STETKAR: I don't have anything more.

CHAIRMAN RAY: Ron?

MEMBER BALLINGER: Nothing more.

CHAIRMAN RAY: Charlie?

MEMBER BROWN: Nothing.

CHAIRMAN RAY: Joy?

MEMBER REMPE: Nothing.

CHAIRMAN RAY: Okay. Well, we didn't explore something that was mentioned, but, again, I think it wouldn't be terribly productive right now, since I think we heard that a Part 21 report analysis was done, and it was deemed not to be required. That is what I was reading 10 CFR about yesterday, John.

I have my own reading of what Part 21 says.

I have had some experience with it, too. Dick has had his experience.

It is very murky to me how we are supposed to function in this world with regard to, like I say, Part 21 or oversight of the implementation of Appendix B by a design certification holder, et cetera. And I think we have got to find some way to learn about this, but we all don't want to get off into that sort of an exercise and cause it to hold up the action that is pending here with regard to the Levy and Vogtle, and so on.

So, my best guess is that we will try and preserve the need to better understand the process, but try to focus ourselves just on what is being proposed here. Maybe we will say we reserve judgment on this business about, as you summarize up there, about it is part of the Design Basis, but not safety-related. Still, it puzzles me.

And we need to learn more. But, nevertheless, we have looked at what specifically is being done in this instance and have whatever conclusions the full Committee has when they happen about it.

At least as the Chairman of this Subcommittee, I'll strive to do that. I don't know if

I can do it successfully or not, but I'll give it a try.

So, when you come back at the full Committee -- and I am going to say this to Westinghouse and Duke as well -- bear in mind that we're not going to be easily accepting of what I'll call simplistic process answers. But, on the other hand, we are going to try to focus on the technical issues at hand and separate out the process questions for discussion elsewhere.

So, what I'm saying is don't tell us, "Oh, don't worry about that because we've got this interpretation of the rules that say you don't need to worry about it." Let's just stick with the work that you have done, which all of us have looked at, and as best I can tell, meet the needs of moving ahead.

And then, we will try to carve out the issues that we have been talking about for the last 15 minutes and deal with them separately.

Anything else that anyone wishes to say?

(No response.)

If not, we'll call the meeting adjourned.

(Whereupon, at 5:08 p.m., the meeting was adjourned.)

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Issue History

December 2011 – UK GDA questions original condensate return assumption (constant 90%)

December 2012 – Applicant verbally advised NRC of issue and changes under ISG-011.

April 2013 – Formal submittal (Levy - departure and exemption request): design change adds downspouts to polar crane and stiffener, improves gutter design to increase condensate return rate + revised analysis incorporating changes.

May 2013 – NRC staff audits condensate flow over gutter and attachment plates test plan. Staff terminated the audit for lack of calculation reports.

Issue History

July/October 2013 – Applicant advised NRC of delay in submittal, citing third-party review and need to incorporate further modifications made to design into calculations.

January 2014 – Levy submits revision of formal departure and exemption request, makes supporting calculations available for NRC audit. The staff began a second audit, which is open.

February 2014 – Staff issues first round of RAIs concerning supporting analysis under audit.

April 2014 – Vogtle submits LAR similar to Levy departure request.

LEVY
ACRS UPDATE
09-17-14

"Changes to Passive Core Cooling System Condensate Return"

AGENDA

Open Session

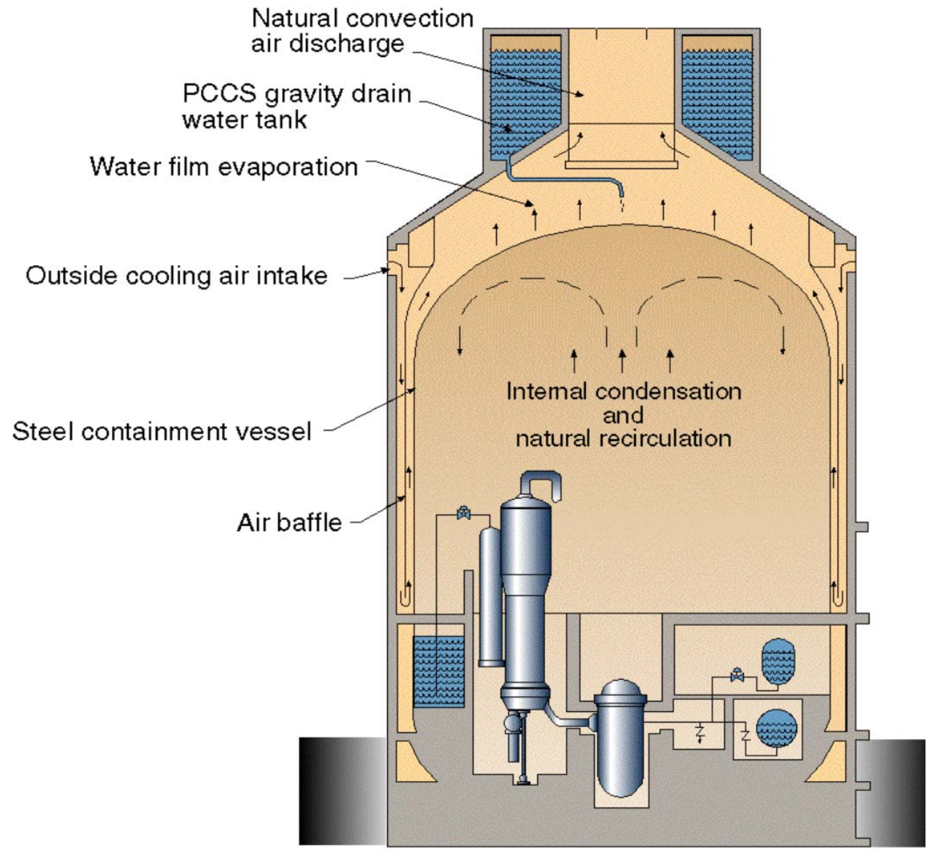
- Overview of long-term PRHR HX operation
- AP1000 safe shutdown systems / operation
- PRHR Reevaluation and Licensing Impacts
- Design changes to improve containment condensate return to IRWST

Closed Session

- Analyses performed to support long-term PXS operation:
  - What each calculation does and methodologies used
  - Discussion of results
- WEC condensate return testing

PXS Safety Design Description: non-LOCA Operation

- During non-LOCA events IRWST water absorbs heat from PRHR HX
  - Takes 2-4 hours to heat up to saturation, begins to boil
  - Steam is discharged to Containment through vents in IRWST roof
- Steam condenses on Containment surfaces
- Condensate flows down Containment walls to the condensate return gutter and returns to IRWST



AP1000 Safe Shutdown

- In non-loss of coolant accident events, the PRHR HX will bring the plant to safe shutdown and maintain this condition
  - AP1000 safe shutdown defined as reactor coolant system (RCS) temperature ≤ 420°F in 36 hr
  - This temperature does not represent a plant safety limit, if the RCS temperature is somewhat higher it would have no consequences
- In loss of coolant accidents, passive safety injection and ADS will achieve and maintain safe shutdown for an unlimited time
  - These features also provide diverse safety-related backup to PRHR HX operation

Technical Issue: Identification

- During detailed design implementation Westinghouse identified the need to revisit the technical basis for the condensate return rate
  - Condensate return rate varies with time
  - Additional mechanisms for condensate loss were identified or better quantified
- Westinghouse initiated a study to fully characterize and quantify condensate return rate
  - Apparatus testing, design improvements identified
  - Analysis of thermodynamic behavior during steaming and condensation undertaken

Technical Issue: Quantification

- Westinghouse test / analysis results:
  - Condensate losses due to physical features were quantified by test
  - Condensate return rate was lower than assumed in the DCD Chapter 19E shutdown temperature evaluation using the PRHR HX
  - Plant would still be safe, however the Chapter 19E shutdown temperature evaluation would not being bounding
- Decision made to improve gutter system condensate return
  - Use polar crane girder (PCG) and stiffener as intermediate level gutters and add downspouts to transfer directly to IRWST
  - Modify operating deck gutter to reduce losses
- Allows plant to meet safe shutdown temperature / time (Chapter 19E)

Results of PRHR Reevaluation

- FSAR Chapter 15 Design Basis Accident (DBA) Analysis
  - Demonstrates PRHR Closed Loop cooling achieves safe, stable condition for 72 hours

- Safe Shutdown (SSD) Analysis
  - Achieve SSD conditions (<420F) in less than 36 hours
  - Maintain SSD for more than 14 days
  - No change in evaluation methods from certified design

COLA Impacts

- Part 2 - FSAR
  - Chapter 1, Table 1.8-201; Section 3.2; Section 3.8; Section 5.4; Section 6.3; Section 7.4; Section 9.5, Table 9.5-201; Section 14.3, Table 14.3-202; Chapter 15; Chapter 19
- Part 4 – Technical Specification
  - Change to Bases Only
- Part 7 – Departures and Exemption Requests
  - Departures 3.2-1 and 6.3-1 and Exemption
- Part 10 – ITAAC
  - Appendix B – Tier 1 Departures

AP1000 Plant Condensate Return to IRWST

Terry Schulz
Consulting Engineer, Westinghouse Electric Co.

Westinghouse

IRWST Steam Condensate Return Conclusions

- **AP1000** plant changes will be made to increase condensate return to IRWST
  - Downspouts from Polar Crane Girder and Stiffener to IRWST
  - Gutter location and design
  - Elimination of many H2 sensor cable support plates in dome
- Testing and analysis confirm that revised design meets safe shutdown cooldown and duration criteria / objectives
- Testing, analysis and design changes have undergone staff audit / review

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Agenda

- Overview of long-term PRHR HX operation
  - Includes summary of issue, plant changes, licensing actions
- **AP1000** plant safe shutdown systems / operation
- Design changes to improve containment condensate return to IRWST
- Analyses performed to support long-term PXS operation:
  - Each calculations purpose, methodology, and results
- WEC condensate return testing

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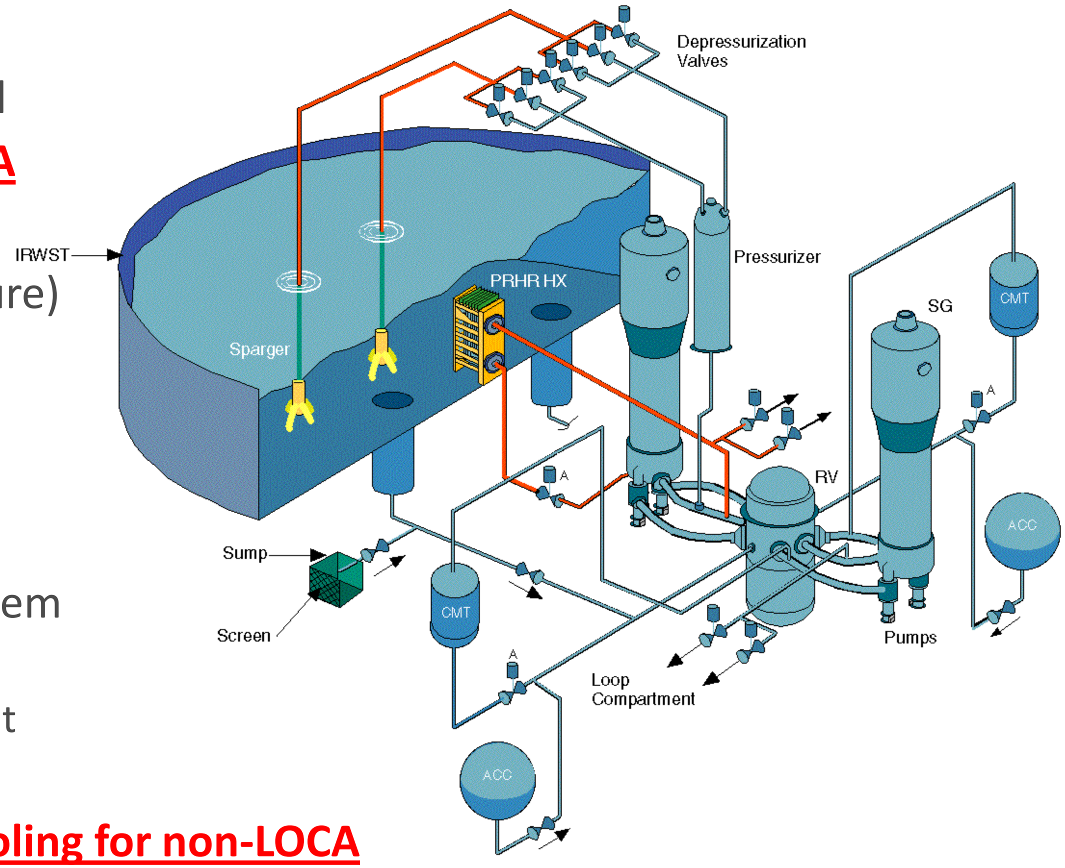
PXS Decay Heat Removal

- PRHR HX
  - Natural circ. decay heat removal
  - **Long-term cooling for non-LOCA**
- Passive safety injection
  - Core makeup tanks (High Pressure)
  - Accumulators (Intermediate Pressure)
  - IRWST Injection (Low Pressure)
  - Containment Recirculation
  - Automatic depressurization system
    - Stages 1-3 release to IRWST
    - Stage 4 releases to containment
  - Long-term cooling for LOCA
    - **Also backups long-term cooling for non-LOCA**



If PRHR cooling decreased below decay heat, backup core cooling would be provided by passive feed/bleed (safety related)

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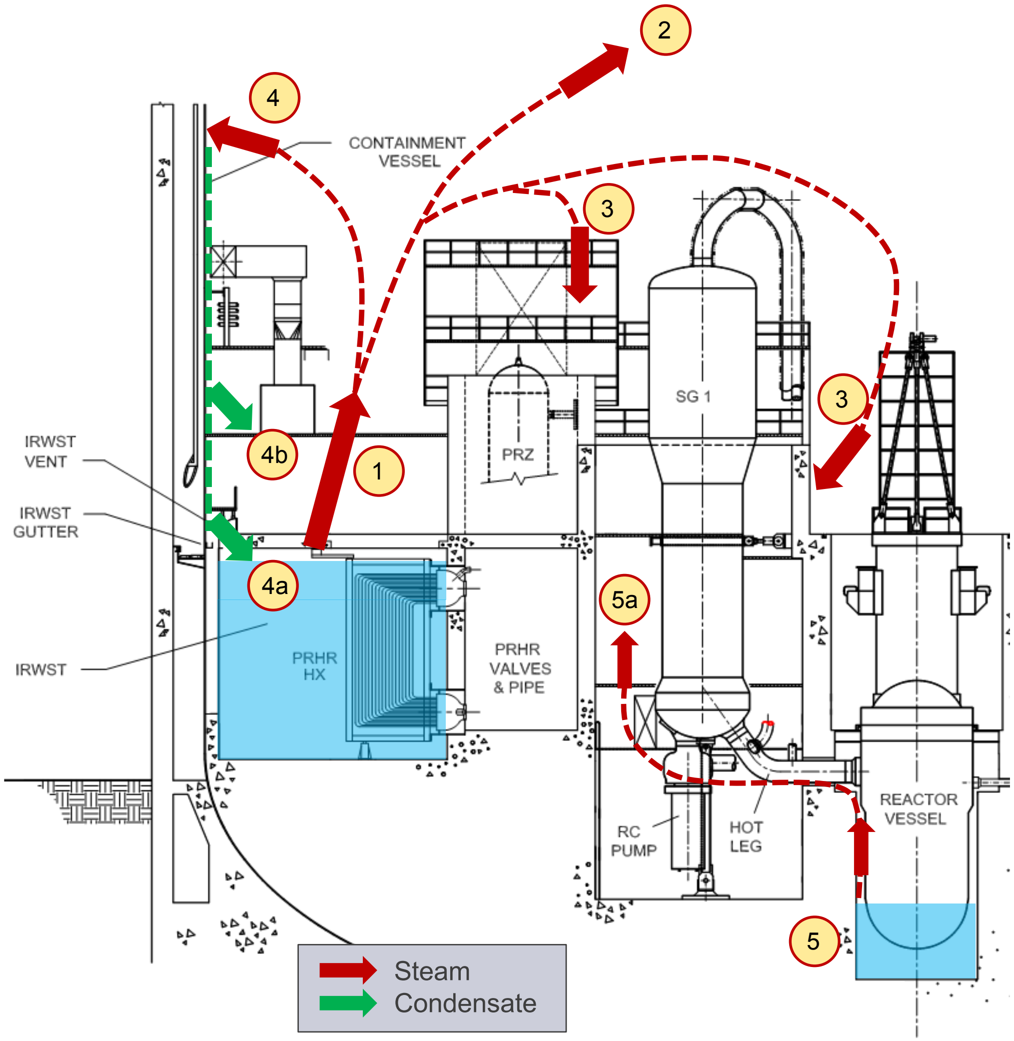
Where Does IRWST Steam Go?

1. Steam leaving IRWST
2. Pressurizes containment
   a. Lost from IRWST
3. Condenses on walls, floors, structures
   a. Lost from IRWST
4. Condenses on CV
   a. Most collected and returned to IRWST
   b. Some splashes / spills off
5. Losses from IRWST collect under RV, contact hot RV
   a. Steam rises up into cont.



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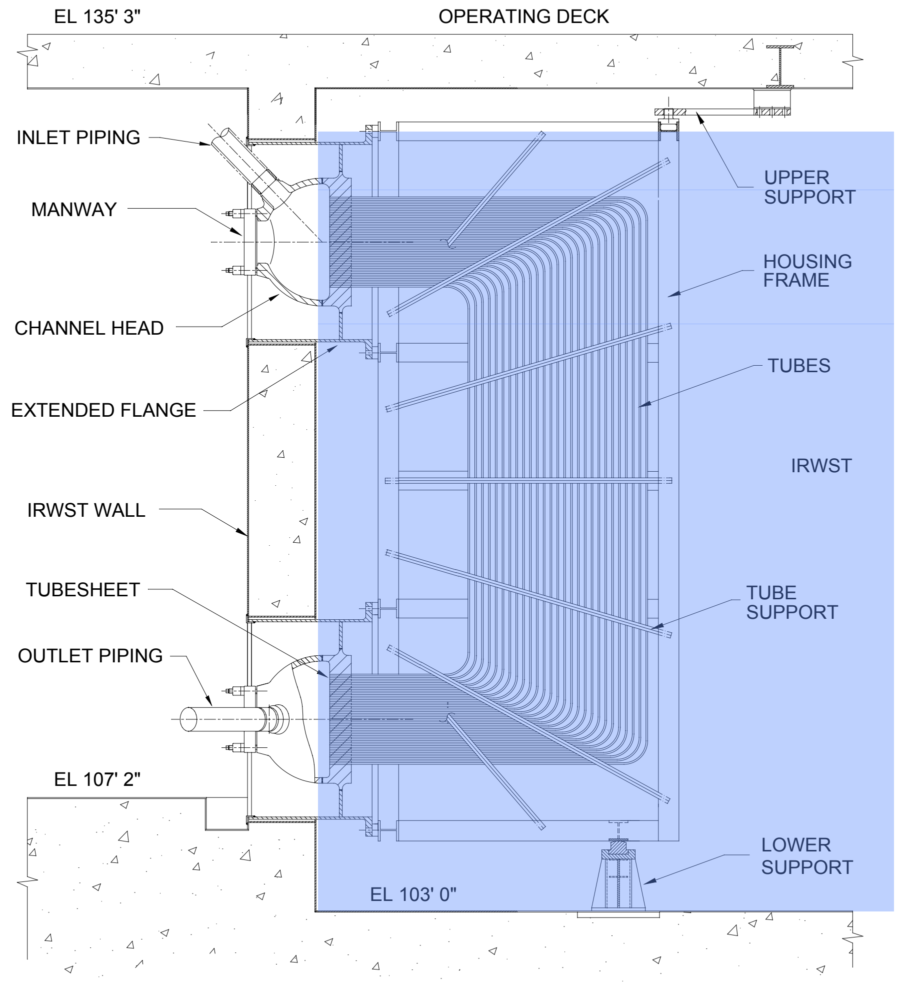
Passive Decay Heat Removal

- DCD/FSAR Safety Analysis assumed constant fraction of steam to atmosphere returned to IRWST
  - Actual losses from the IRWST are larger and vary with time
- Multiple mechanisms exist for condensate losses
- Condensate losses will cause IRWST level to decrease
- In long term, PRHR HX tubes uncover, performance is reduced
  - Safe shutdown temperature can be maintained even with substantial tube uncovery



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AP1000 Plant Safe Shutdown Criteria

- Safe Shutdown temperature (420°F) is a licensing commitment
- This temperature was selected to achieve a safe stable, low-energy condition in the RCS within the PRHR HX capability
  - RCS pressure will decrease to small fraction of design pressure (2500 psig)
  - 420°F Tavg >> 440F Th >> RCS pres >> ~337 psid (13.6% of RCS design)
    - Assumes RCS drops to saturated pressure, reasonable since no Pzr heaters

Tavg (F)	Th (F)	Sat. Pres. (psia)	Delta Pres. (psid)*	Percent RCS
420	440	382	337	13.6%
430	450	423	378	15.2%
460	480	566	521	21.0%
490	510	744	700	28.2%

* Reduced by 30 psig containment pressure

If RCS temperature exceeds 420°F somewhat, Safe Shutdown would not be challenged

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AP1000 Plant Safe Shutdown Criteria

- DCD / FSARs state PRHR HX can maintain safe shutdown conditions for non-LOCA accidents "indefinitely"
- Have adopted quantitative duration as internal design objective
  - 14 days was selected based on that time being long enough to essentially eliminate the need to switch to passive feed/bleed cooling except for very unlikely / extreme hazard events
    - For most events AC power / DiD systems will be recovered in < 3 days
    - Only challenge would be extreme hazard events (seismic, tornado) that might damage plant features and prevent DiD recovery in 14 days
  - 14 days is good objective; not a safety requirement because …
    - Larger than expected RCS leakage can limit duration
    - Open-loop core cooling using ADS and passive injection is always available as a safety backup to closed-loop PRHR HX cooling

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Agenda

- Overview of long-term PRHR HX operation
  - Includes summary of issue, plant changes, licensing actions
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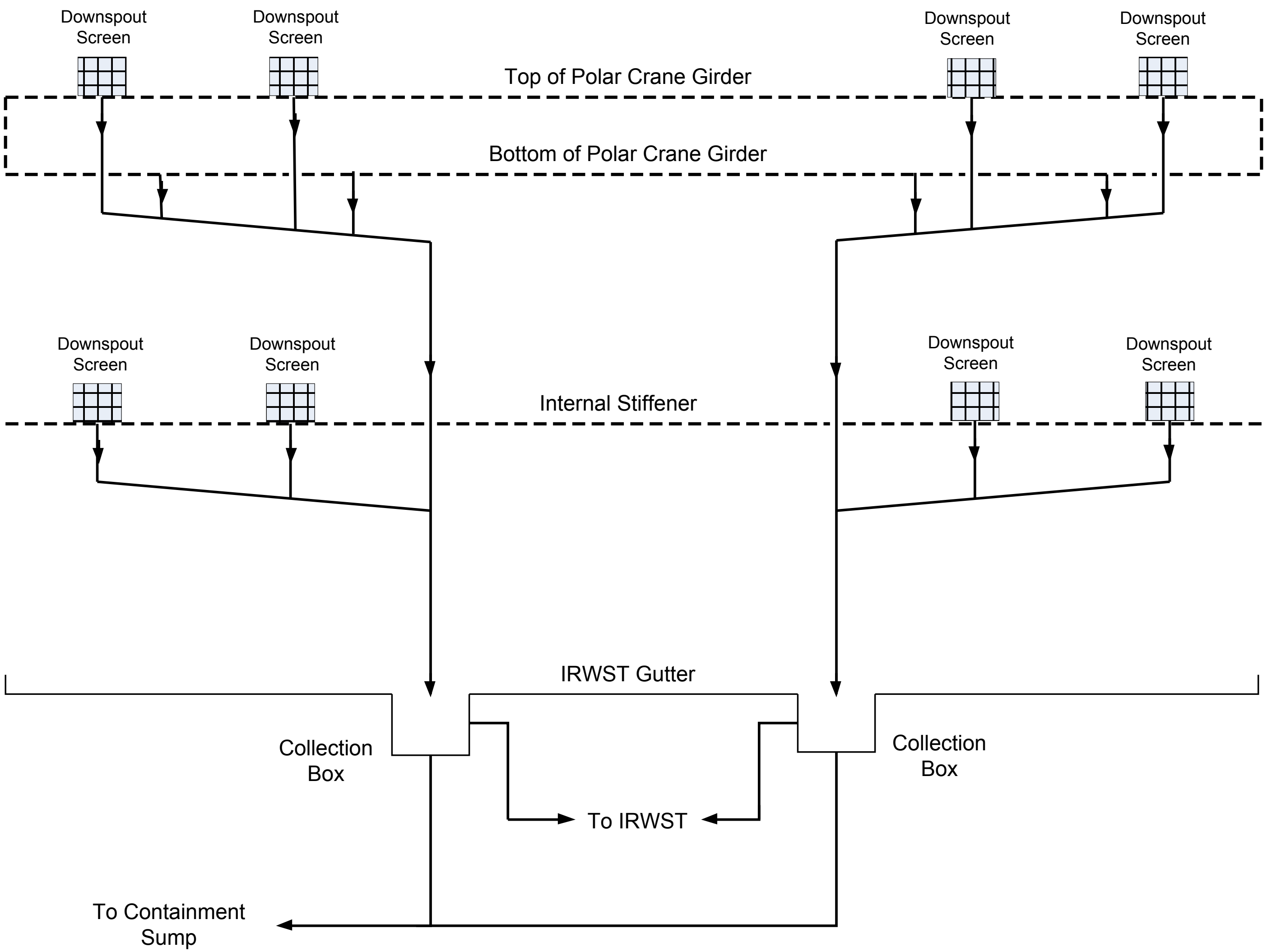
  - Each calculations purpose, methodology, and results
- WEC condensate return testing

Design Changes To Improve Condensate Return to IRWST After Station Blackout

- Changes developed to increase condensate return to the IRWST
  - Use polar crane girder and internal stiffener as intermediate gutters and add down spouts to drain condensate to IRWST
    - Minimizes losses associated with flow over obstacles
  - Optimize IRWST gutter
    - Extended to collect above upper equipment hatch and personnel airlock
  - Change routing of cables to hydrogen sensors
    - Reduces quantity of support plates (obstacles) attached to the containment dome

Design Changes To Improve Condensate Return to IRWST After Station Blackout

- Down spouts added to internal stiffener and polar crane girder to direct condensate to IRWST
- Drain holes plugged
- Rough screens over downspout entrances prevent potential plugging of downspouts



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Presentation to the ACRS Subcommittee

Staff Review of Changes to AP1000 Passive Core Cooling System Condensate Return Section 6.3

September 17, 2014

Outline

- Staff Review Team
- Background (Levy COL)
- Licensing Impact
- Regulations/Guidance
- Review Approach
- Review History
- Technical Issues Encountered – Areas of Staff Focus
- Staff Findings
- Conclusion

Staff Review Team

- Boyce Travis
  - Containment and Ventilation (presenter)
- Tim Drzewiecki
  - Reactor Systems (presenter)
- Yiu Law
  - Mechanical Engineering
- Derek Scully
  - Balance of Plant and Technical Specifications
- Don Habib
  - Project Management

Background – Levy COL

- Levy COL staff interaction with ACRS 2011
  - Letter of conclusion and recommendations

- 2012-2014 staff review of additional applicant submittals
  - Key chapters of advanced safety evaluation issued or re-issued

Topic	Advanced SE	Interaction
Condensate return design change	Section 6.3	September 2014
Fukushima recommendations	Chapter 20	January 2013 (seismic)
Bulletin 2012-01	Chapter 8	Not planned
Emergency preparedness enhancements	Chapter 13	Not planned

Licensing Impact

- Design change includes exemption request and two departures from AP1000 DCD Revision 19
- Exemption Request – Change to certified Tier 1 information
  - Table 2.2.3-1
    - Modified list of components in passive core cooling system design description (added downspout screens)
  - Table 2.2.3-2
    - Modified list of piping in passive core cooling system design description (added downspout drain lines)
  - Modified Tier 1 tables are cited in ITAAC for passive core cooling system

Licensing Impact (continued)

- Departure 3.2-1
  - Modifications to the Polar Crane Girder (PCG), Internal Stiffener, and Passive Core Cooling System (PXS) gutters

- Departure 6.3-1
  - Changes DCD PRHR-HX capability to maintain safe shutdown for non-LOCA events from “indefinitely” to 14 days (72-hour safety-related mission time)

- Levy FSAR/DCD Chapter and Section Changes
  - 3.2, 3.8, 5.4, 6.3, 7.4, 9.5, 14.3, 15, 15.2.6, 19, 19E and technical specification bases (Chapter 16)

Regulations/Guidance Informing the Review

- GDC 34 - Residual heat removal
- GDC 44 - Cooling water
- EPRI Utility Requirements Document for passive LWRs and associated SE
- SECY-94-084 (“Policy and Technical Issues Associated with the Regulatory Treatment of Non-safety Systems in Passive Plant Designs”)

Review History

- AP600
  - Capable of 72 hours of decay heat removal for non-LOCA transient even with no condensate return (IRWST Volume = 70,000 ft^3)
  - No explicit modeling of SBO/non-LOCA tests using only PRHR-HX and condensate return, only WGOTHIC analysis and ADS tests

- AP1000
  - For non-LOCA transients, PRHR HX "removes core decay heat for an unlimited amount of time…in closed-loop mode" (IRWST Volume = 73,100 ft^3)
  - PRHR-HX area, flow rate increased to compensate for increase in power
  - Staff found AP600 testing applicable to AP1000 as part of the DCD review

Review Approach
Containment Response

- Evaluate impact on peak pressure analyses
- Evaluate impact on containment floodup level
- Evaluate applicability of test data
- Evaluate inputs to reactor coolant system analyses
  - Condensate return rate to IRWST
  - Containment pressure

Review Approach
Passive Core Cooling System

- Evaluate impact to PXS safety functions
  - **Emergency decay heat removal**
  - Emergency reactor makeup/boration
  - Safety injection
  - Containment pH control
- Evaluate impact on safe shutdown
- Evaluate impact on Chapter 15 analyses

Summary of Applicant's Calculation Approach

- ~20 calculations related to the design change supporting four calculations referenced in the submittal:
- **Calc. (1)**: WGOTHIC containment response
  - Models containment + PCS; No RCS
  - Forcing function incorporates wall losses from (2)
- **Calc. (2)**: Condensate return from shell
  - Uses test data + conditions from (1) to calc. losses over shell attachments
- **Calc. (3)**: PRHR HX sizing / performance calculation
  - Combines results from (1) and (2) to provide transient condensate return rate to IRWST for (4)
  - Basis for applicant justification of long-term behavior (>72 hours) of the PRHR HX
- **Calc. (4)**: LOFTRAN
  - Calculates 36 hour system response using inputs from (1) and (3)
  - Demonstrate T_{ave} < 420 °F in 36 hours (using BE assumptions)
  - Provides bounding values (DB + assumptions) to Calc. 1 for decay heat to IRWST, temperature of reactor vessel

Review Focus – Containment Analysis

- Holdup
  - Determination of total holdup
  - Film thickness
    - Staff questioned applicability of approximation used in submittal (RAI 7439, 06.03-3)
    - Applicant re-evaluated film thickness, performed sensitivity study for more film holdup; negligible effect on the performance of the PRHR-HX during the first 72 hours
- Determination of condensate return rate
  - Losses over wall attachments
    - Staff asked applicant to justify correlation for wall losses from testing (RAI 7439, 06.03-5) - Applicant tested losses over wall attachments at non-prototypic temperatures, extrapolated
    - Applicant performed sensitivity studies for increased wall losses, indicated almost no impact on first 72 hours and small reduction in long-term (beyond 72-hour) mission time

Staff Findings – Containment Impact

- Containment peak pressure unchanged
- Containment floodup level following ADS actuation or LOCA for containment recirculation not adversely affected
- Potential lowered IRWST level following PRHR-HX actuation does not challenge ADS 1/2/3 actuation
- The PXS downspout screens are AP1000 safety class C, seismic Category I components and will meet the QA requirement of 10 CFR Part 50, Appendix B. Existing ITAAC design commitments also apply.
- The PXS downspout piping are AP1000 safety class C, seismic Category I piping, designed to ASME Code Section III and will meet the QA requirement of 10 CFR Part 50, Appendix B. Existing ITAAC design commitments also apply.

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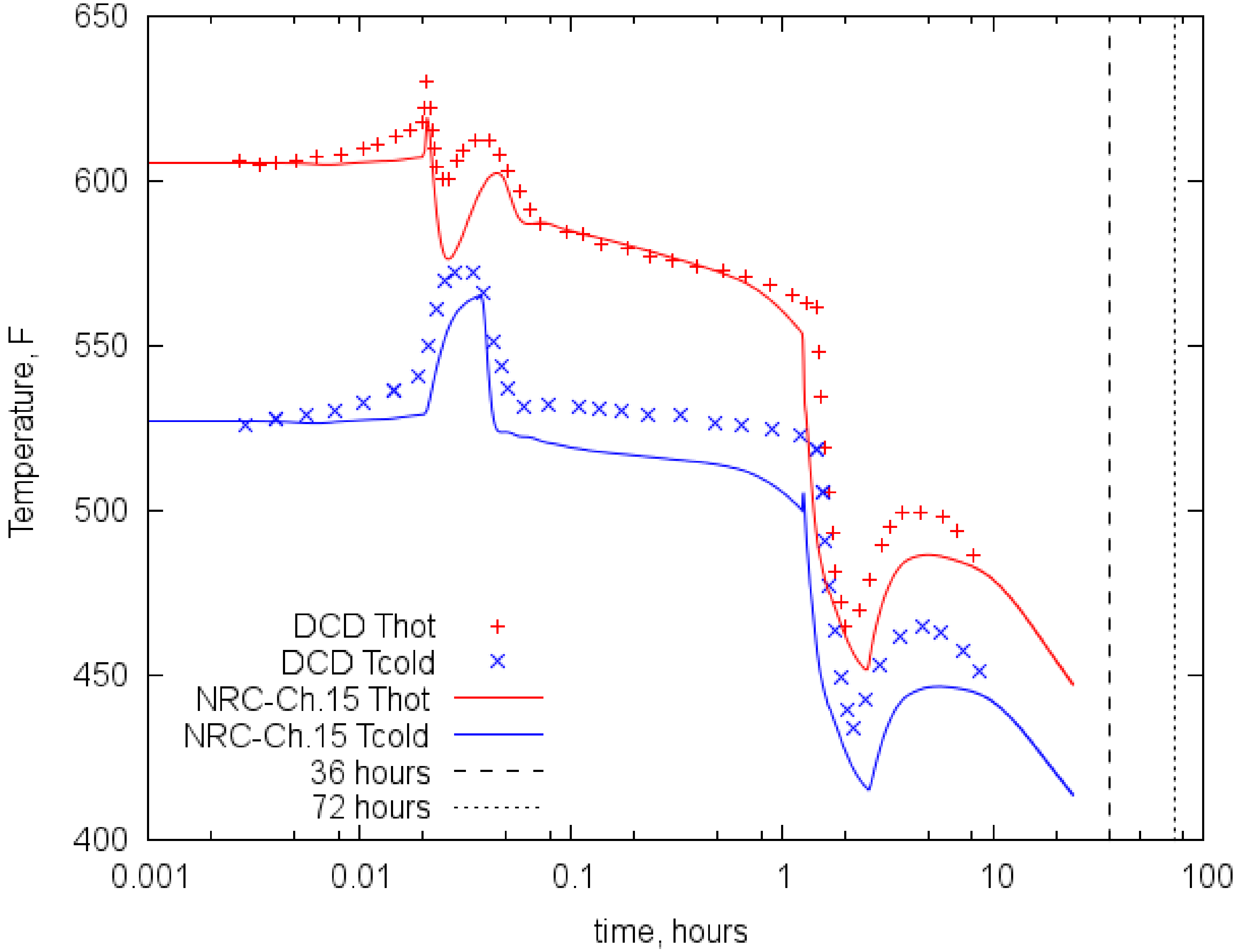
Review Focus – PXS Safety Design Basis

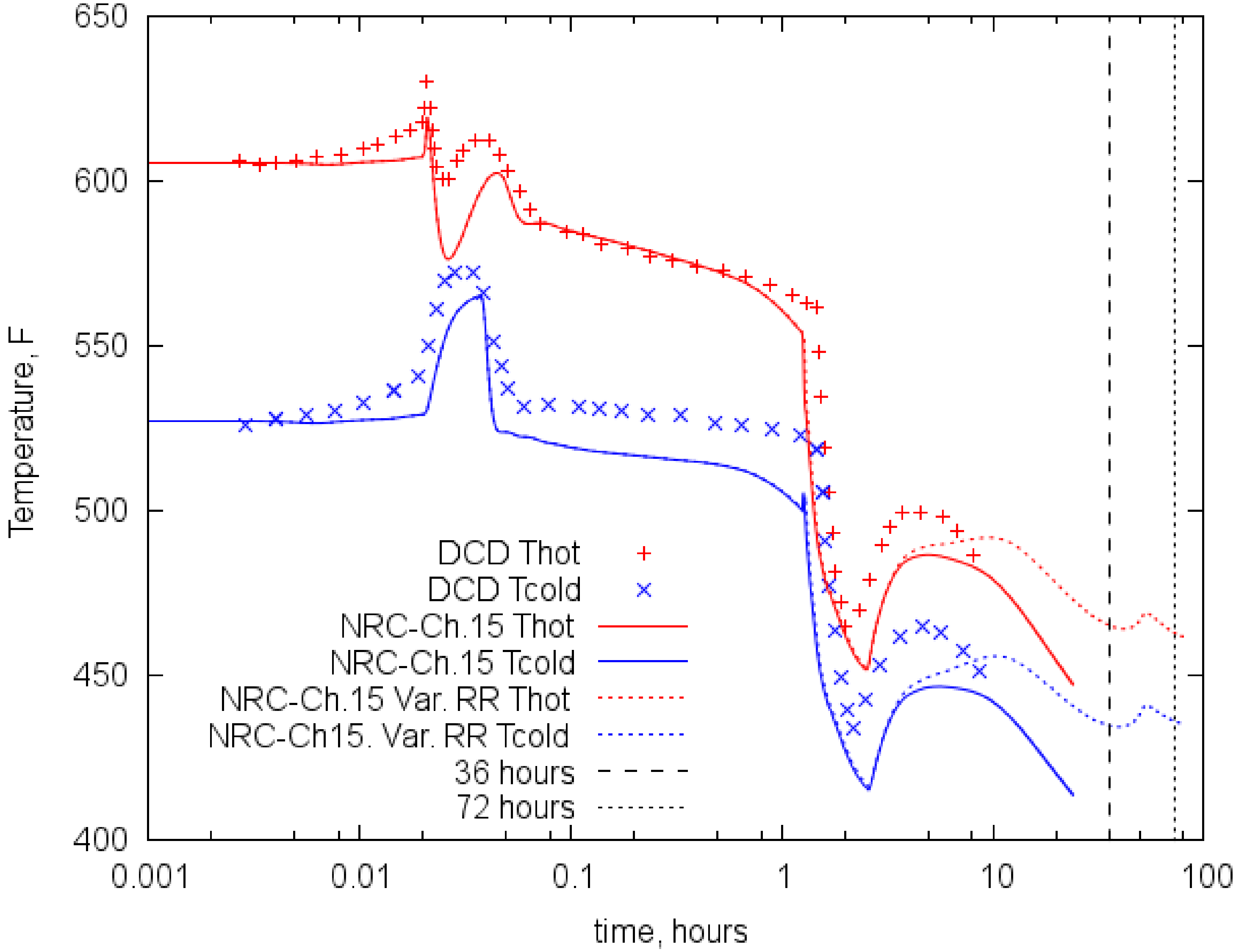
- Emergency Decay Heat Removal
  - From “indefinite” to “72-hour operational requirement” for PRHR-HX
  - Limiting Chapter 15 event determined to be Loss of AC Power to Plant Auxiliaries (LOAC)
    - Supported by sensitivity studies performed by applicant (RAI 7440, 15.02.06-2)
    - Confirmed by sensitivity studies performed by NRC staff
  - 72-hour calculation (LOFTRAN)
    - PRHR-HX uncovery is experienced during 72-hour event
    - Chapter 15 acceptance criteria remain satisfied
    - Confirmed by NRC staff calculations

Confirmatory Analysis Results
DBA RCS Temperature



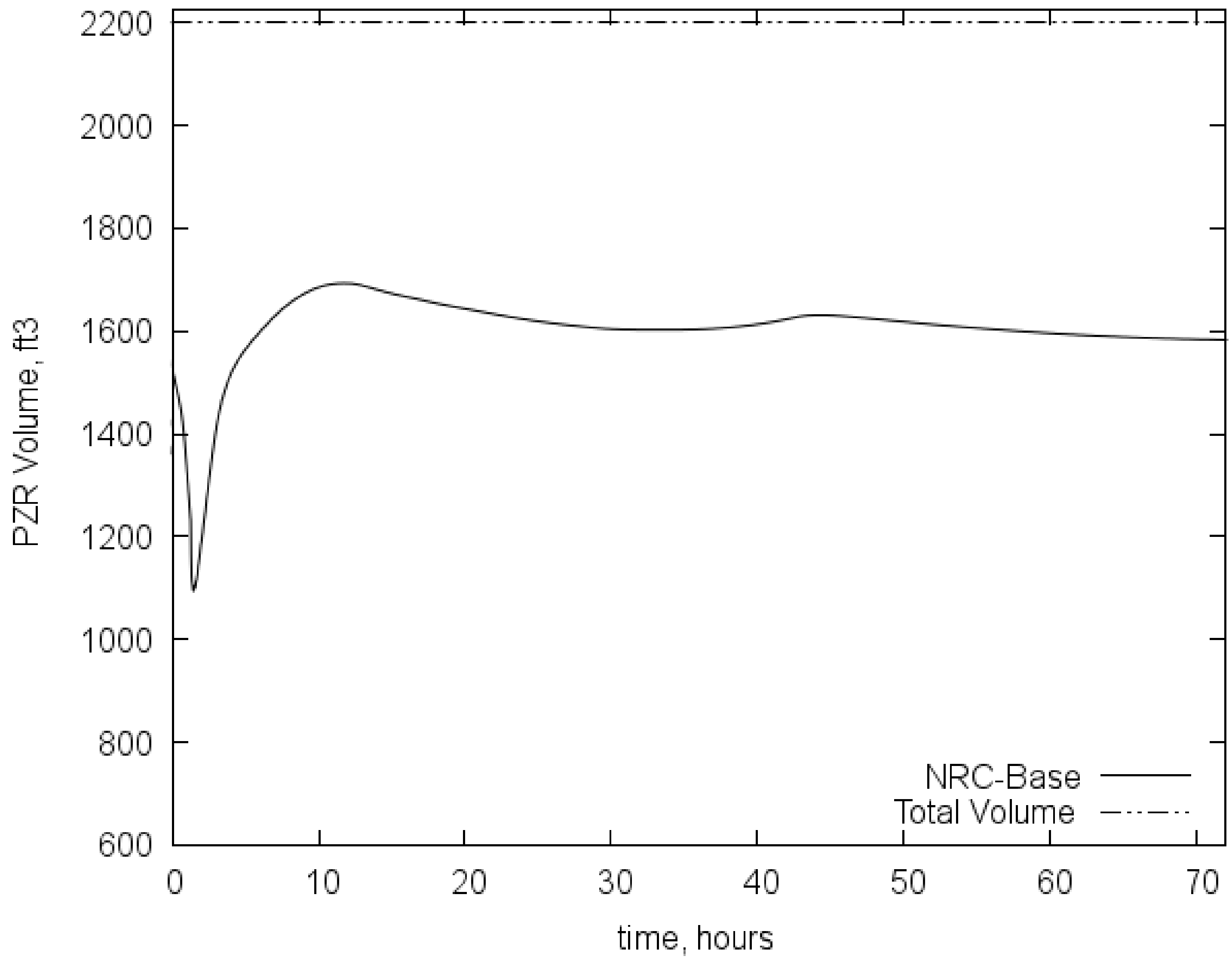
Review Focus – 72 hour analysis

RCS Temperatures



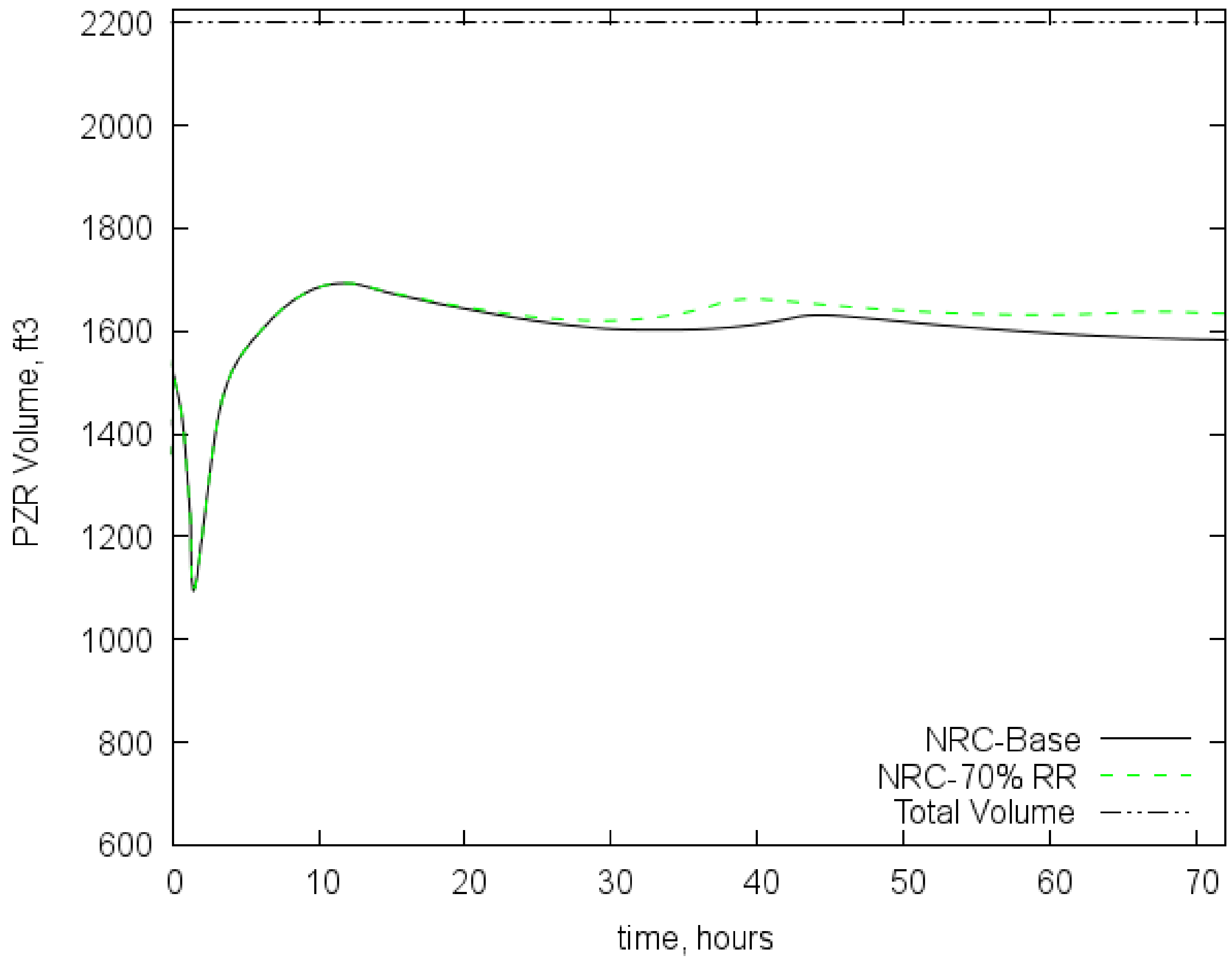
Review Focus – 72 hour analysis

Volume in Pressurizer



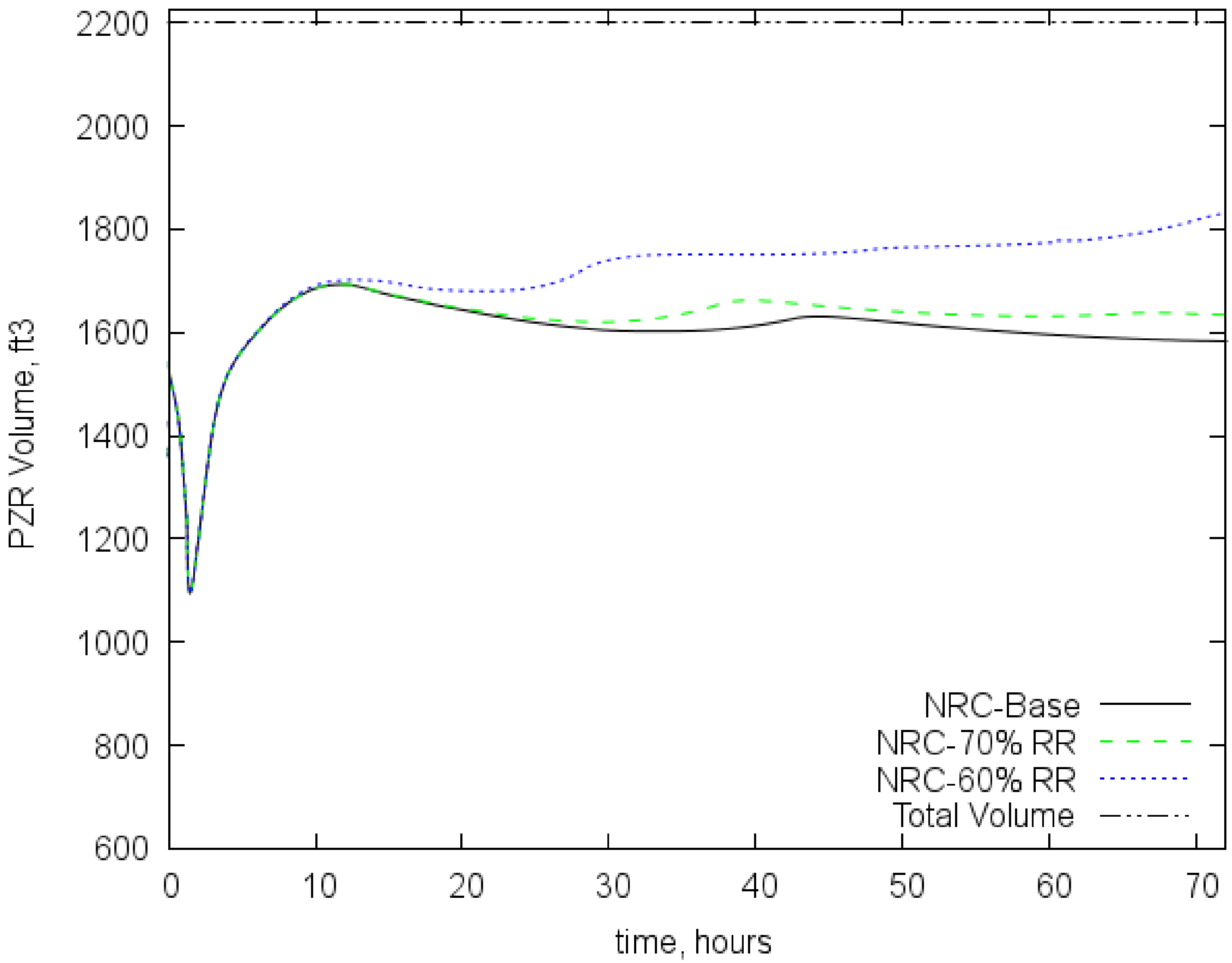
Review Focus – 72 hour analysis

Volume in Pressurizer



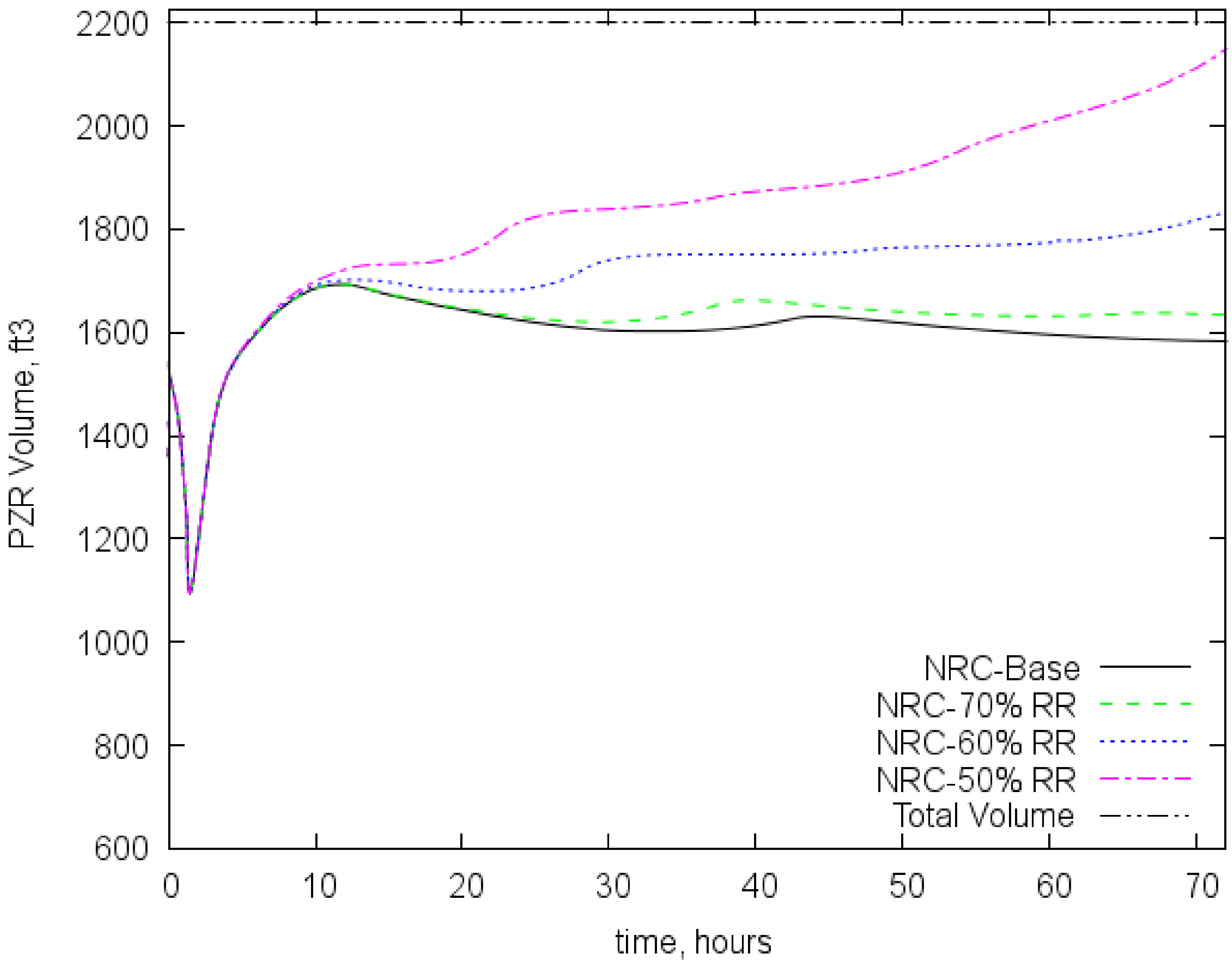
Review Focus – 72 hour analysis

Volume in Pressurizer



Review Focus – 72 hour analysis

Volume in Pressurizer



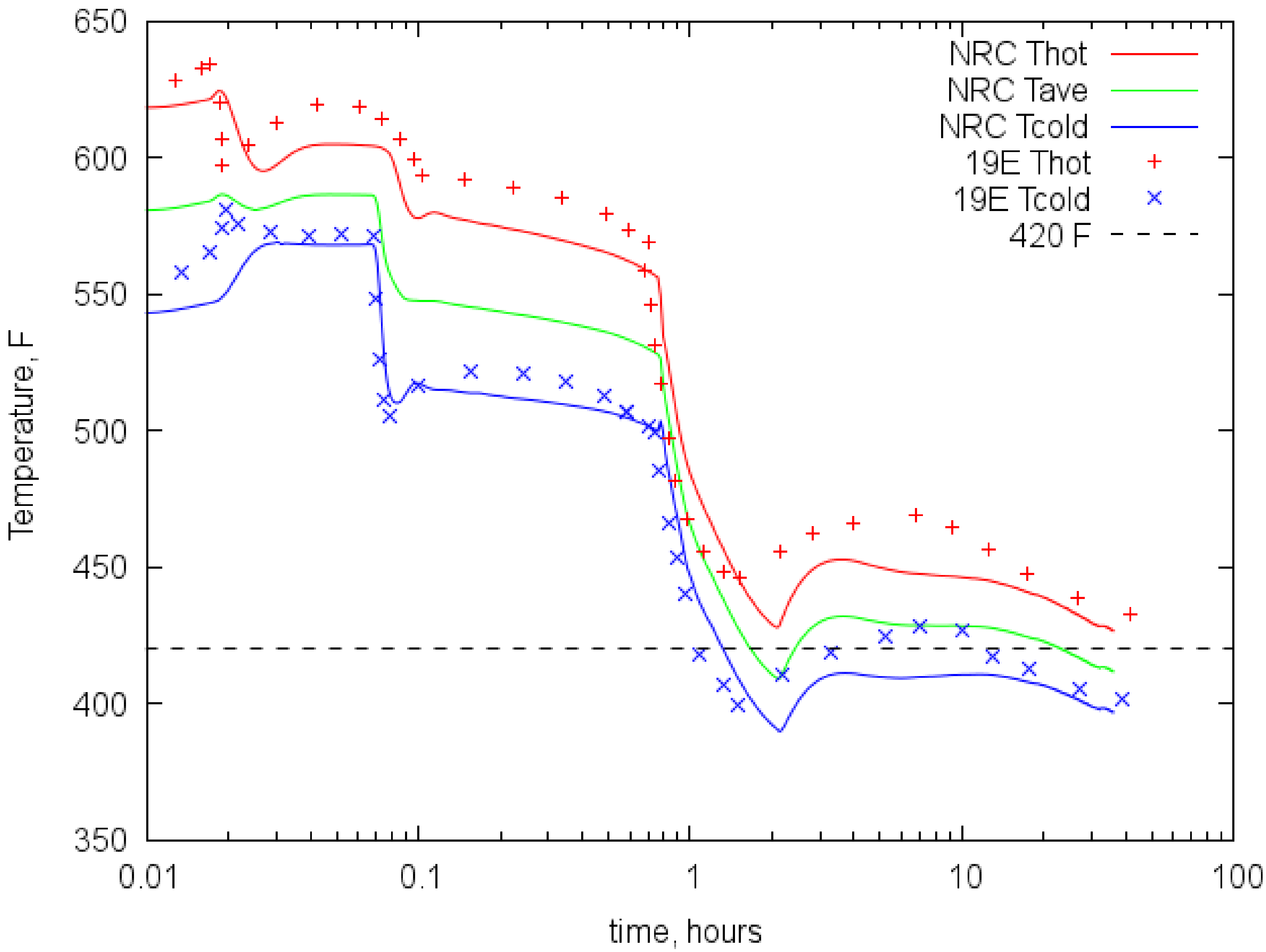
Review Focus – PXS Safety Design Basis

- Emergency makeup/boration
  - No impact
- Safety injection
  - Transition to open loop cooling is retained as defense-in-depth
  - No minimum level in IRWST is required for transition to open loop cooling
- Containment pH control
  - No impact

Review Focus – Safe Shutdown Analysis

- Applicant asserts 420 °F in 36 h achieved using conditions consistent with previously approved analysis in 19E following design changes
  - “non-bounding, conservative analysis”
    - Some nominal values used—most significantly, for decay heat
    - Also incorporates conservatisms in containment initial conditions, environment temperatures
- Remains consistent with the prior position approved by the commission in SECY 94-084
- Supported by staff confirmatory analysis
- 420 °F in 36 h removed from safety design basis in 6.3.1.1
  - Still part of the design basis in 19E

Confirmatory Analysis – Safe Shutdown Temperature



Conclusions

Design changes and FSAR changes are acceptable

Chapter 15 analyses are not affected

- Bounding analysis described in updated FSAR Section 6.3.3.2.1.1
- Supported by staff confirmatory analyses

420 °F in 36 h is met, by using analysis in Chapter 19E

- This is part of the design basis, but not safety-related
- Supported by staff confirmatory analysis

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Acronyms

- ADS – Automatic Depressurization System
- IRWST – In Containment Refueling Water Storage Tank
- PCCS – Passive Containment Cooling System
- PCCWST – Passive Containment Cooling Water Storage Tank
- PCG – Polar Crane Girder
- PRHR HX – Passive Residual Heat Removal Heat Exchanger
- PXS – Passive Core Cooling System

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Backup Slides

Issue History

December 2011 – UK GDA questions original condensate return assumption (constant 90%)

December 2012 – Applicant verbally advised NRC of issue and changes under ISG-011.

April 2013 – Formal submittal (Levy - departure and exemption request): design change adds downspouts to polar crane and stiffener, improves gutter design to increase condensate return rate + revised analysis incorporating changes.

May 2013 – NRC staff audits condensate flow over gutter and attachment plates test plan. Staff terminated the audit for lack of calculation reports.

Issue History

July/October 2013 – Applicant advised NRC of delay in submittal, citing third-party review and need to incorporate further modifications made to design into calculations.

January 2014 – Levy submits revision of formal departure and exemption request, makes supporting calculations available for NRC audit. The staff began a second audit, which is open.

February 2014 – Staff issues first round of RAIs concerning supporting analysis under audit.

April 2014 – Vogtle submits LAR similar to Levy departure request.

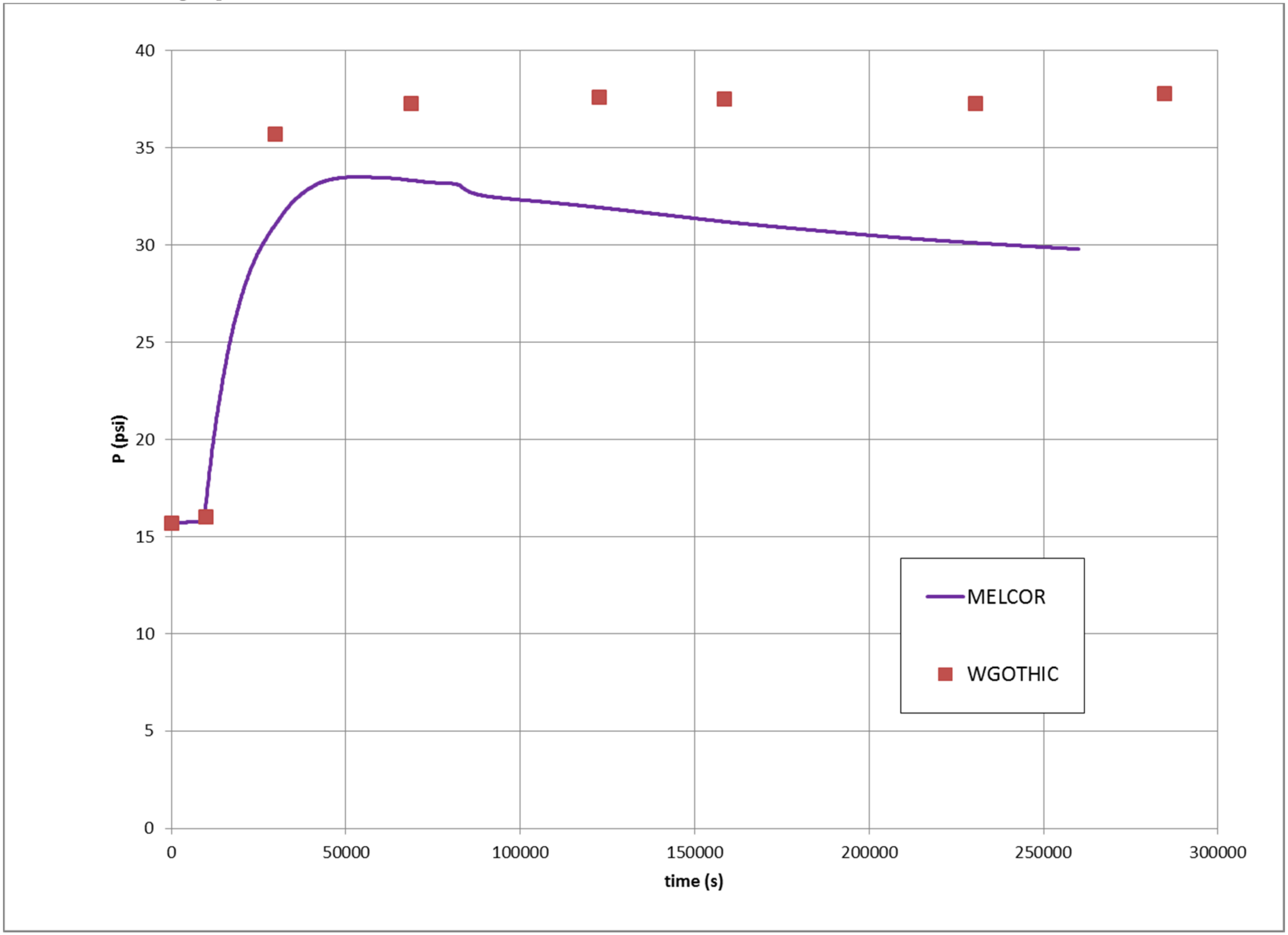
Technical Rationale for Changes

- Applicant states:

  Changes are necessary to reflect a 'significant technical correction associated with the design described in the licensing document that, if not changed, would **preclude operation within the bounds of the licensing basis**'

  - DCD Chapter 19E "Shutdown Temperature Evaluation"
  - Without changes, Chapter 15 non-LOCA analyses would require revision
- Change requires approval because Tier 1 material is modified: new gutters and downspouts are safety-related and therefore seismic Category 1

Confirmatory Analysis Results: Containment Pressure



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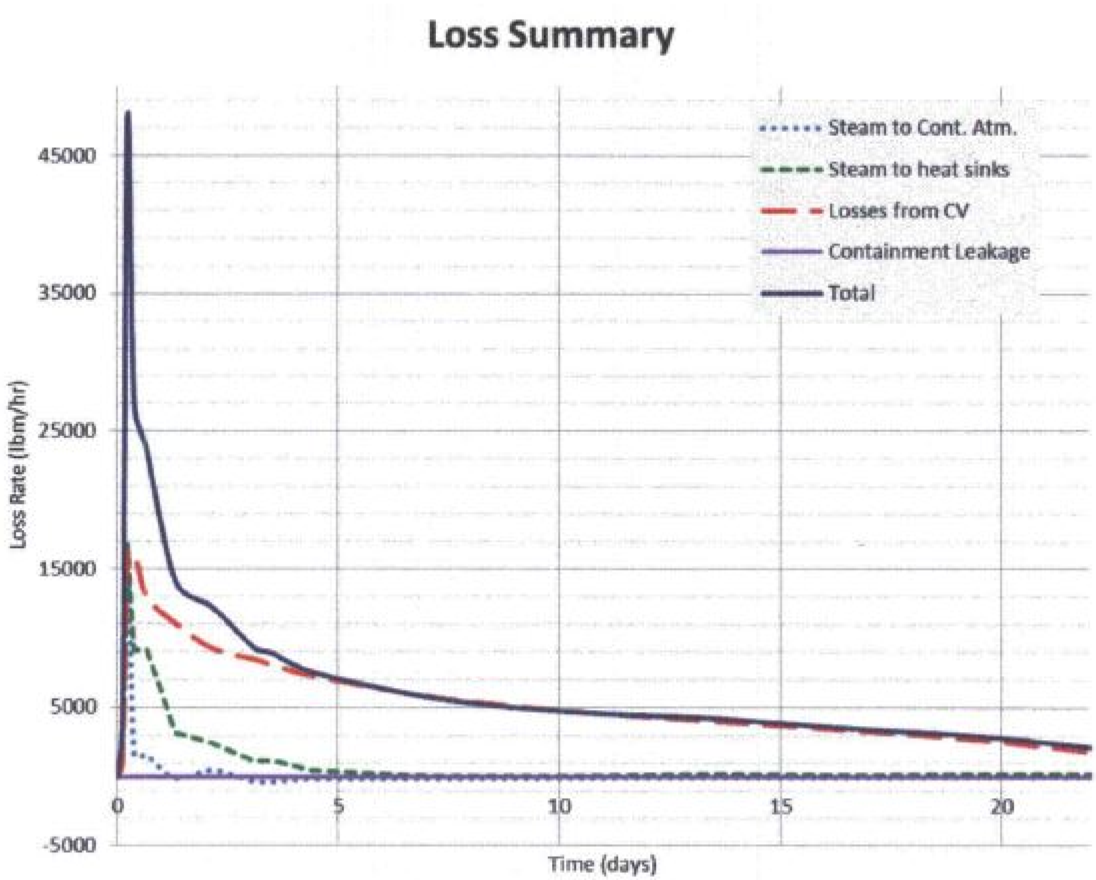
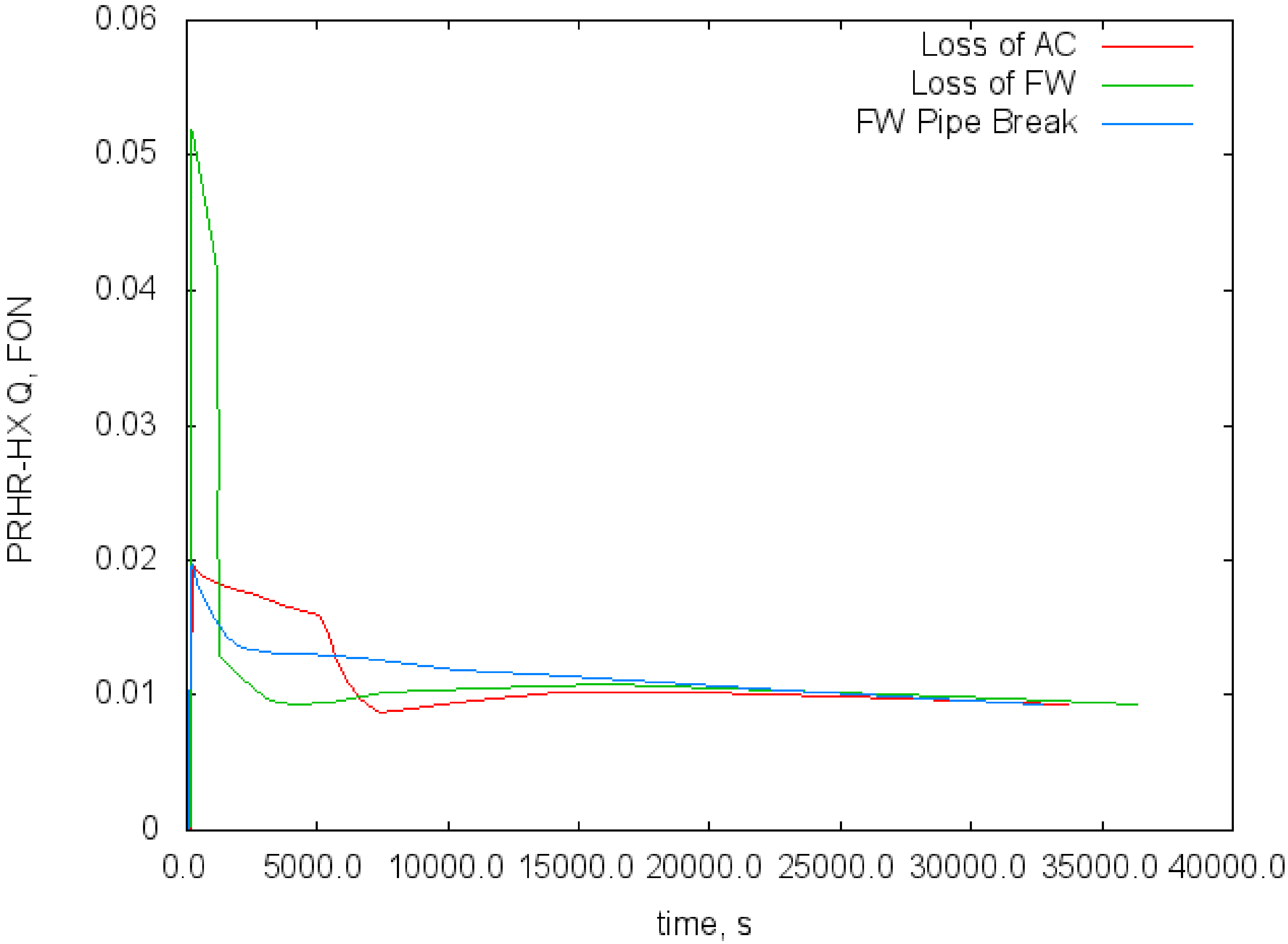


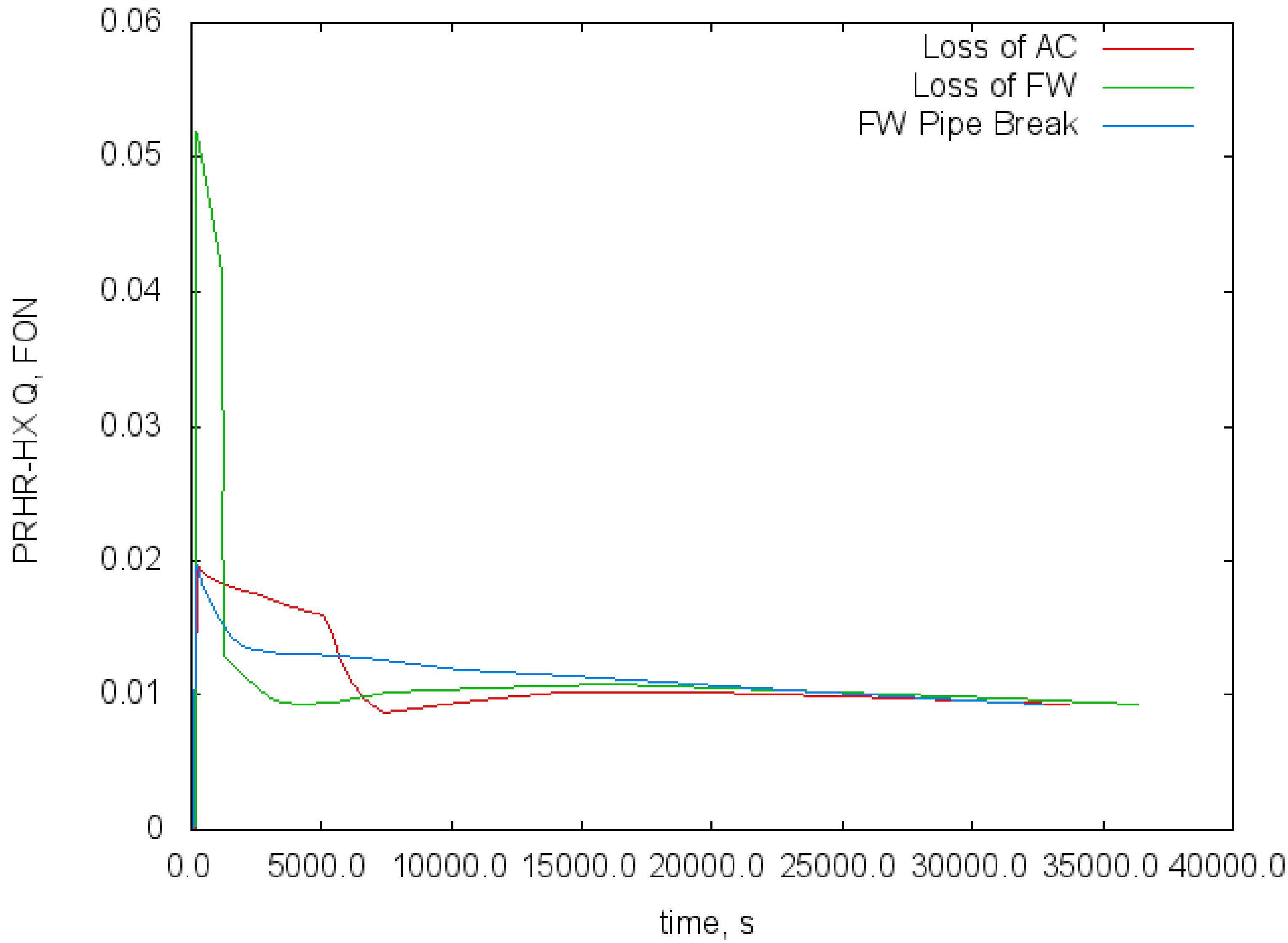
Limiting Event

DCD Section	Scenario	Calculation Duration
15.2.6	Loss of AC Power to Plant Aux.	6.2 hours
15.2.7	Loss of Feedwater	5.4 hours
15.2.8	Feedwater System Pipe Break	3.1 hours
15.5.1	Inadvertent Operation of CMTs During Power Operation	8.6 hours
15.5.2	CVCS Malfunction that Increases RCS Inventory	5.6 hours
15.6.3	Steam Generator Tube Rupture	6.7 hours

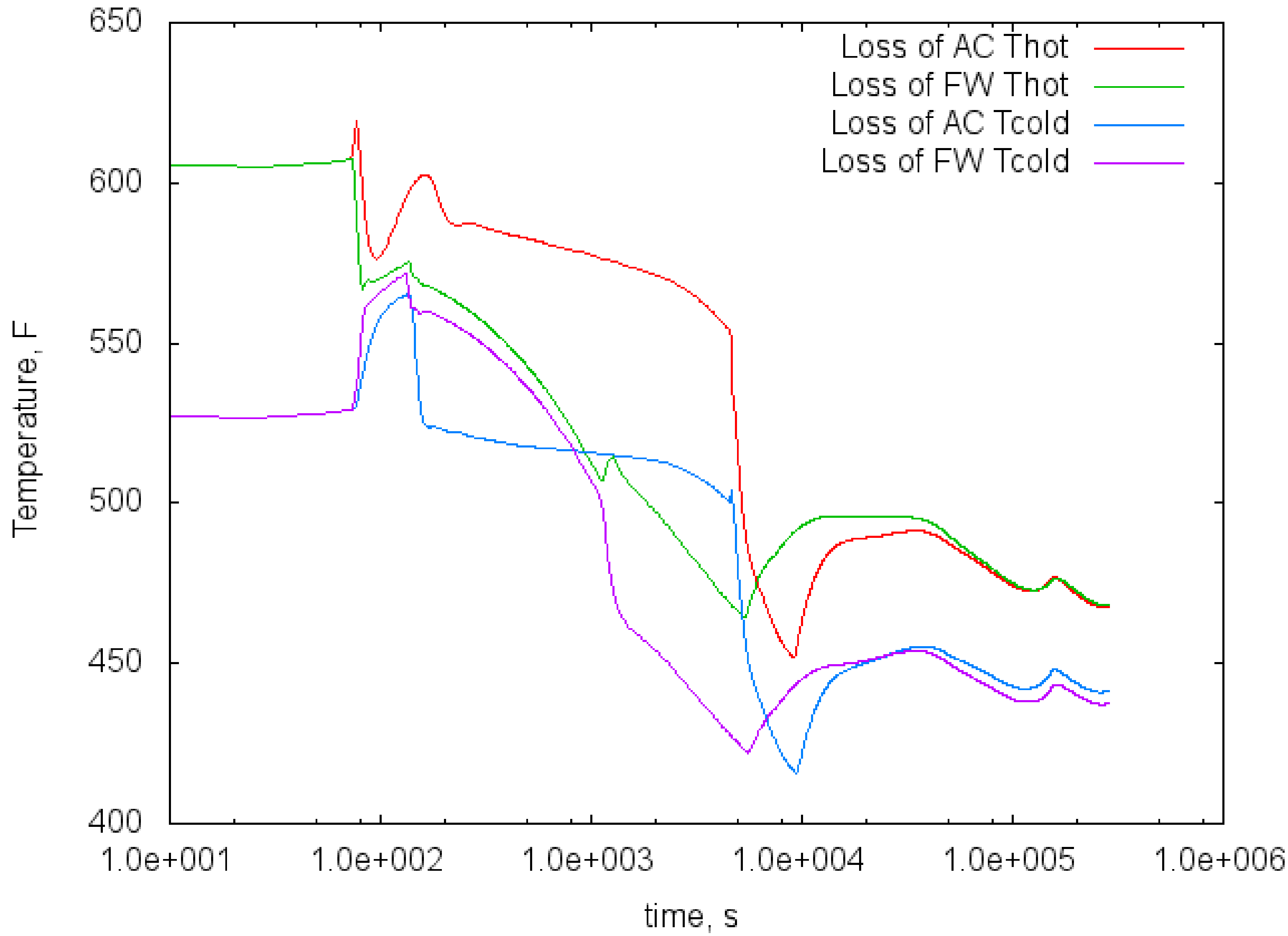
Confirmatory Analysis – Limiting Event



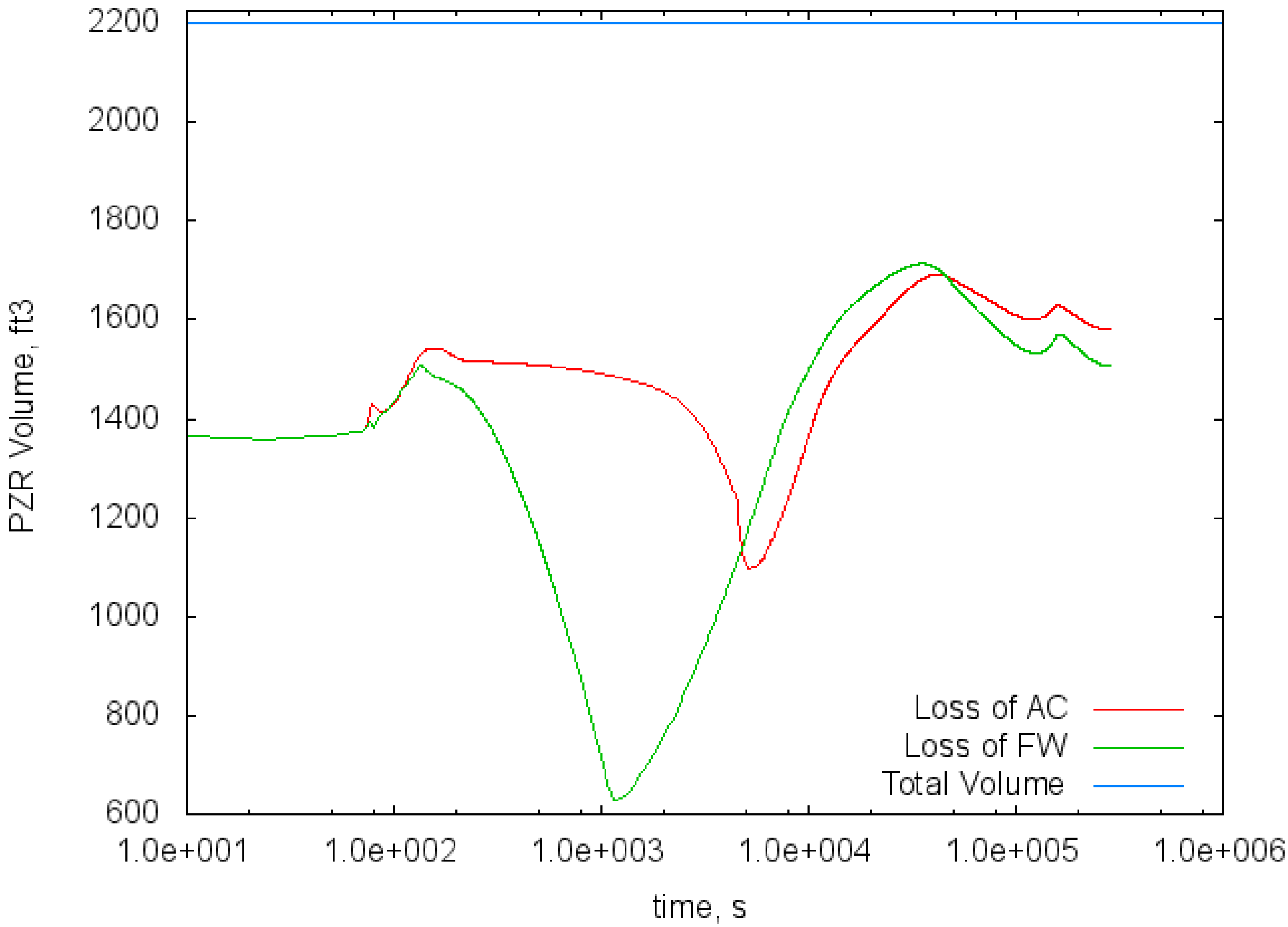
Limiting Event



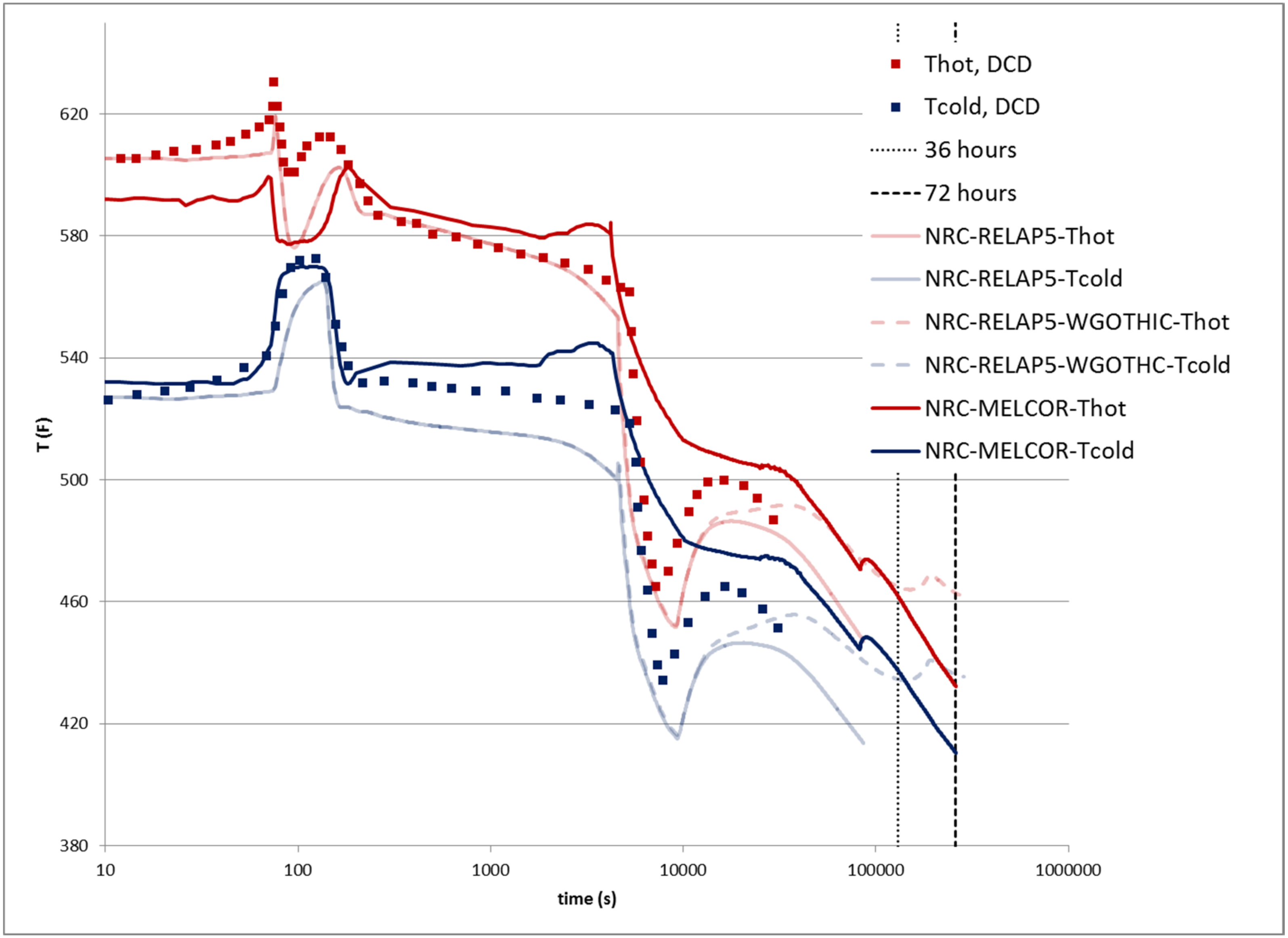
Limiting Event



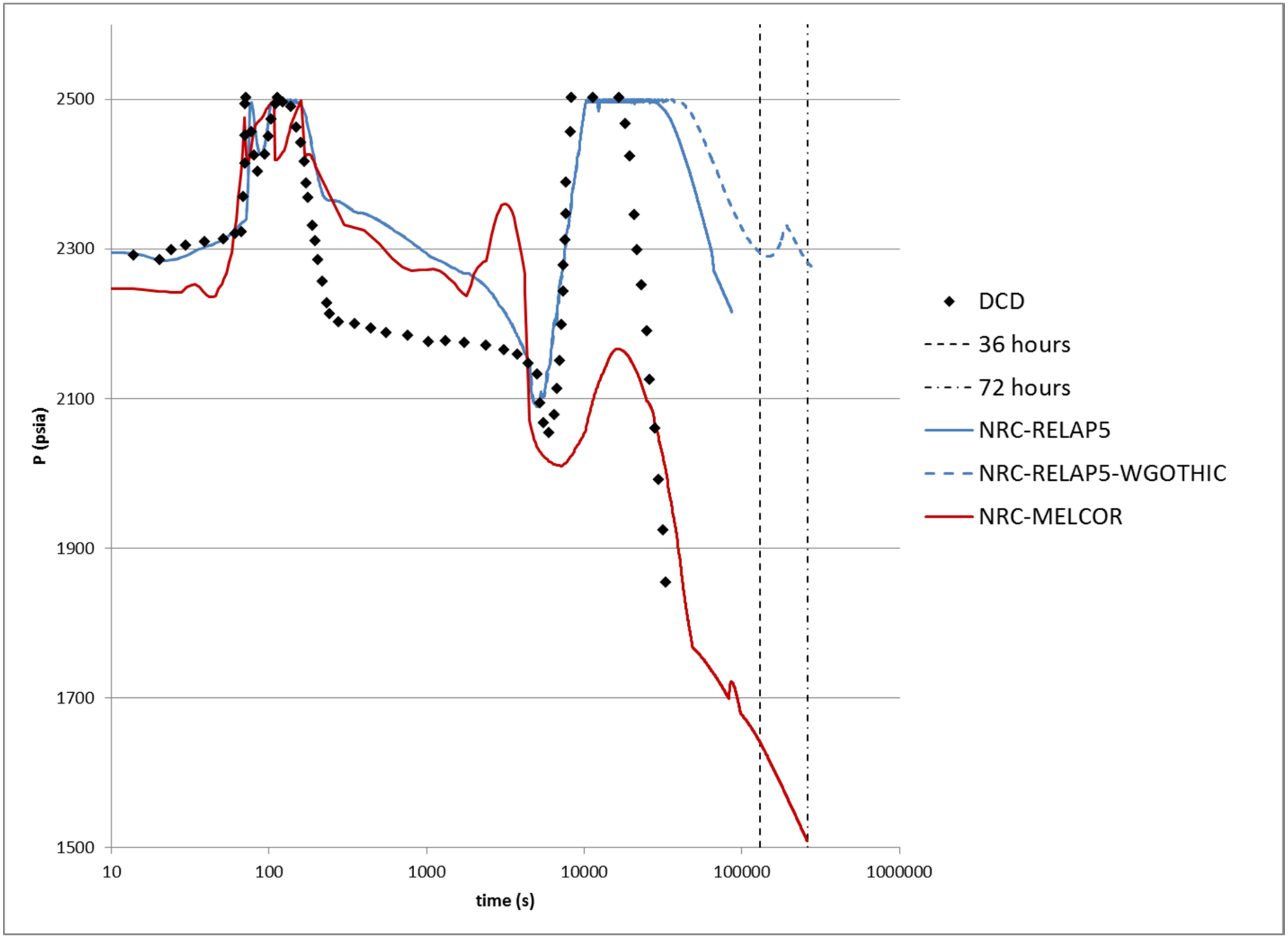
Limiting Event



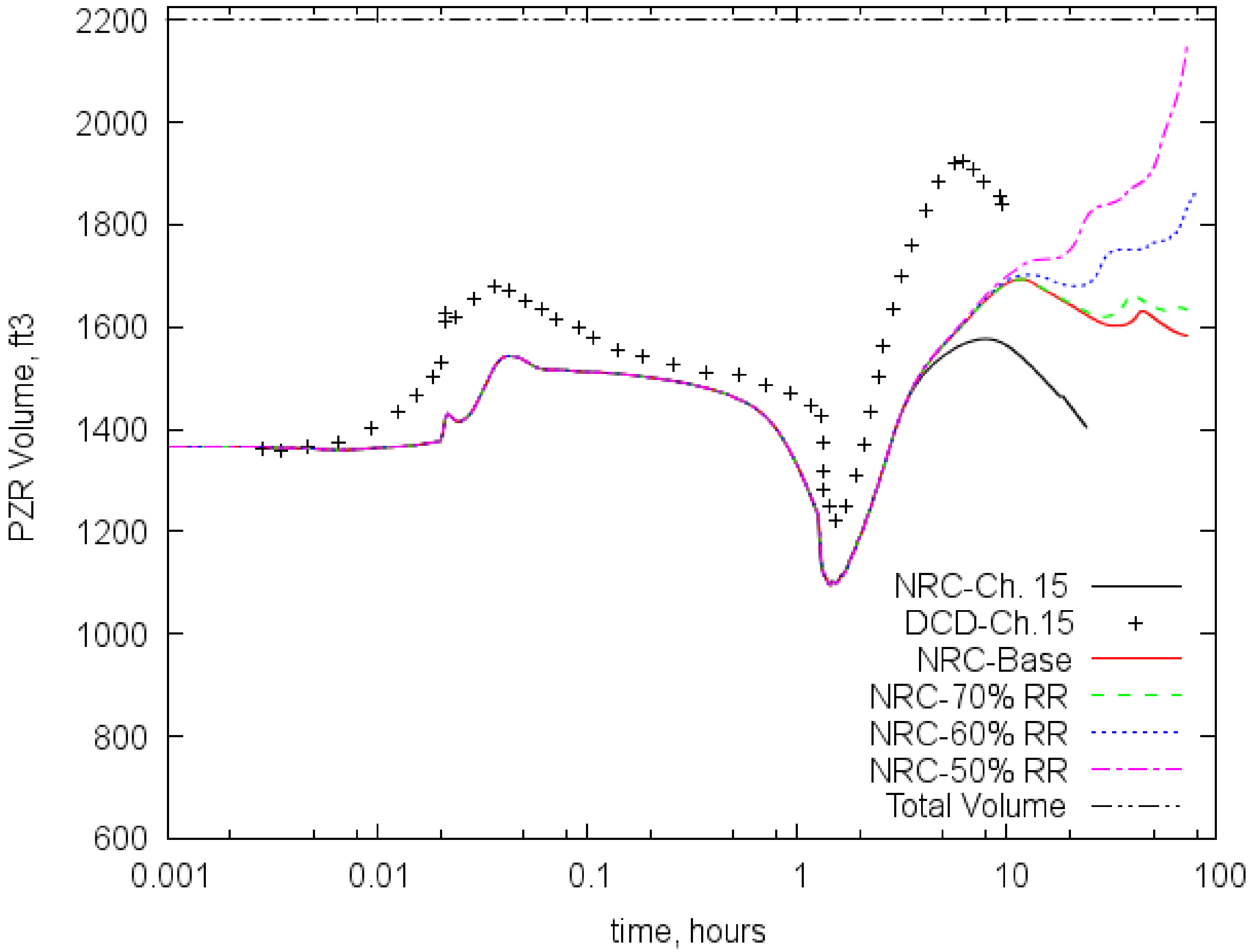
Confirmatory Analysis Results
DBA RCS Temperature



Confirmatory Analysis Results: DBA RCS Pressure



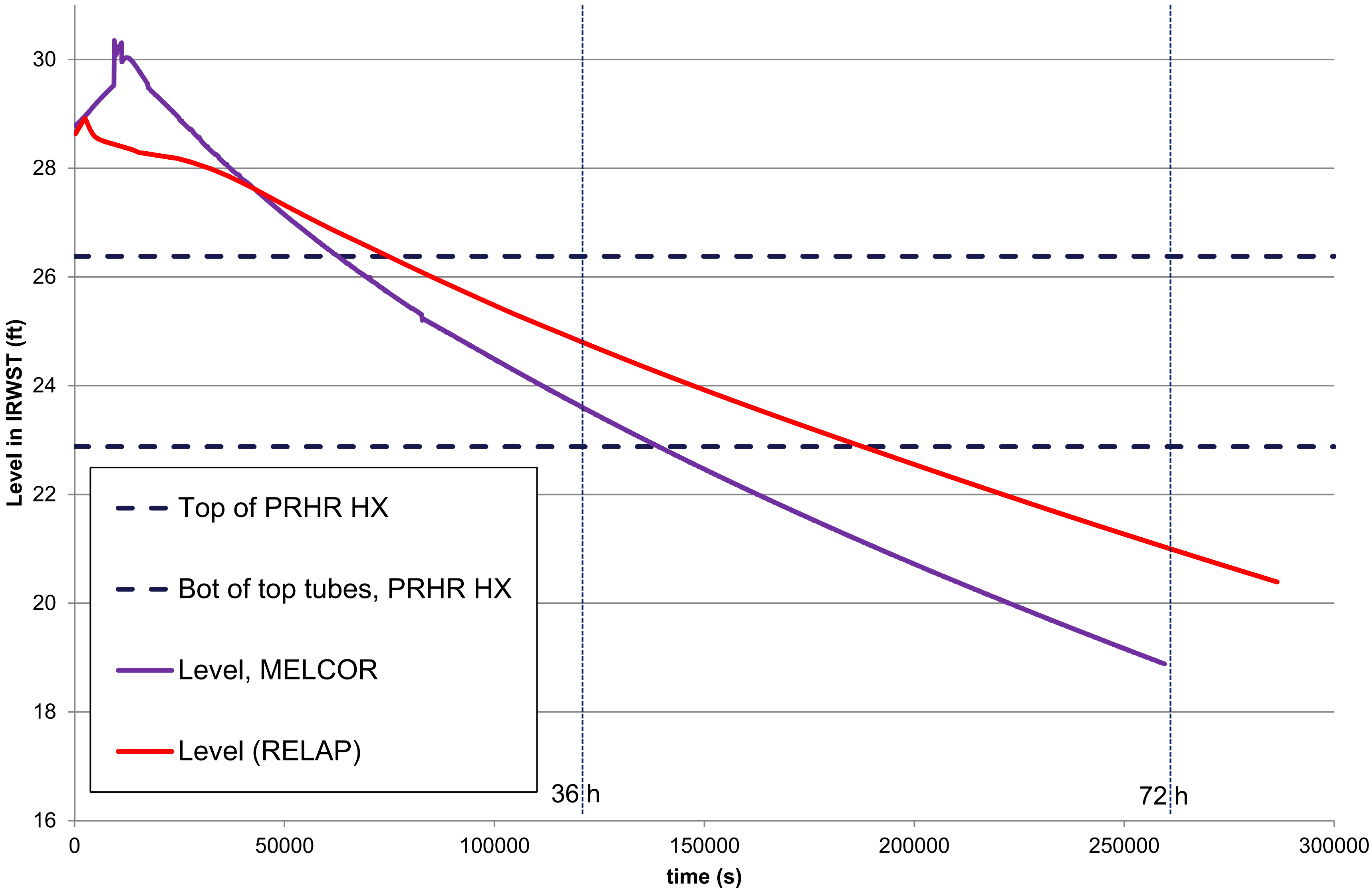
Confirmatory Analysis – PZR Volume



Review Focus – Design Basis Impact

- PRHR remains primary safety related system for mitigating non-LOCA transients
- Safe shutdown achieved with design modifications under traditional design basis, Chapter 15 conditions
- Criteria required:
  - Stable or decreasing RCS temperatures
  - Heat removal from PRHR exceeds core decay heat
  - No liquid relief through the pressurizer safeties
  - Fuel safety limits and pressure boundary design limits not challenged

Confirmatory Analysis – IRWST Level



Review Focus – Design Basis Mission Time

- Post 72-hour actions
  - Staff requested clarification of actions post-72 hours following a non-LOCA transient (RAI 7440, 15.02.06-3)
  - Applicant stated containment makeup could be necessary dependent on containment leakage

- PRHR HX mission time
  - Staff requested the applicant clarify the PRHR mission time, safety-related design basis, use of “indefinite” in FSAR (RAIs 7475, 06.03-10 and 11 and 7484, 06.03-12)
  - Applicant revised PRHR HX performance into two periods: 72-hour safety-related and 14-day non-safety design basis
  - Subsequent FSAR revision removed 420 °F in 36 h from safety-related design basis

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