Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committe on Reactor Safeguards
US EPR Subcommittee: Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Monday, November 14, 2011

Work Order No.: NRC-1280 Pages 1-333

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

US EPR SUBCOMMITTEE

+ + + + +

OPEN SESSION

+ + + + +

MONDAY

NOVEMBER 14, 2011

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dana A. Powers, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

DANA A. POWERS, Chairman

SANJOY BANERJEE

CHARLES H. BROWN, JR.

GORDON R. SKILLMAN

JOHN W. STETKAR

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

SURINDER ARORA

TANYA FORD

PAUL PIERINGER

GETACHEW TESFAYE

JOE COLACCINO

ED McCANN

PHYLLIS CLARK

LARRY WHEELER

RYAN EUL

JAMES O'DRISCOLL

EDUARDO SASTRE

ALSO PRESENT:

MARK FINLEY
CYRIL RODEN
TOM ROBERTS
SANDRA SLOAN
KEVIN CONNELL
FRED MAASS
EUGENE MOORE
DARRELL GARDNER
STEVE HUDDLESTON
JEAN LINDSTROM
TIM STACK
RAM SARMA
SUSAN McCONATY
TONY LITTLE
JOHN CROWTHER
RICHARD BASHALL
ROBERT DAY
ROBERT LITMAN

I-N-D-E-X

P R O C E E D I N G S

8:30 a.m.

CHAIR POWERS: This meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, US EPR Subcommittee. I am Dana Powers, Chairman of the Subcommittee.

ACRS members in attendance are Dick Skillman and John Stetkar. Charles Brown will join us tomorrow I think, or maybe this afternoon. Derek Widmayer of the ACRS staff is the designated federal official for this meeting.

The purpose of the meeting is to continue our review of the SER with Open Items for the design certification document submitted by AREVA NP for the US EPR design and the SER with Open Items for the combined operations licence application submitted by UniStar for the Calvert Cliffs nuclear power plant Unit 3.

We will hear presentations on the discussed Chapter 7, instrumentation and controls, group 1, Chapter 9 Auxiliary Systems, the DCD SER, and Chapter 7, instrumentation and controls, and Chapter 18, human factors engineering of R-COLA SER.

The Subcommittee will also hear an introductory presentation to evaluations conducted by

AREVA to address GSI-191, and I address during that part of the presentation we may close the meeting to protect proprietary interests.

The Subcommittee will hear presentations by and hold discussions with representatives of AREVA NP, UniStar and the NRC staff and other interested persons regarding these matters.

The Subcommittee will gather relevant information today and plans to take the results of the reviews of these chapters, along with other chapters reviewed by the Subcommittee, to the full Committee at future full Committee meetings to be determined.

The rules for participation in todya's meeting have been announced as part of the notice of this meeting previously published in the Federal Register.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice.

Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressed the Subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so they may be readily heard.

Copies of the meeting agenda and handouts are available in the back of the meeting room. A telephone bridge line has been established with the meeting room today and I understand we will have participants from AREVA NP and UniStar on the line periodically during the meeting.

We request that participants on the bridge line identify themselves when they speak, and keep their telephone on mute during times when they are just listening.

Do members of the Subcommittee have any opening statement?

I noted that Professor Banerjee has joined us. Thank you very much sir.

MEMBER BANERJEE: I am at your disposal.

CHAIR POWERS: We are just in your debt. That's all. No opening statements? Then I will proceed. I will call upon Surinder Arora, the NRR Project Manager, for the Calvert Cliffs Unit 3 review, to open the meeting.

MR. ARORA: Good morning everybody. My name is Surinder Arora and I am the lead PM for the Calvert Cliffs Unit 3 COL application reviews.

The way we are going to present today the order of presentation is on Slide number two, which is currently being displayed.

I will give a brief overview of the project, where we are today, and then I will turn over the presentation part to UniStar and after UniStar finishes their presentation, we will have the technical presentation.

The slide which is being displayed now, number three, provides a chronological order of major milestones of the Calvert Cliffs Unit 3 COL reviews.

As of today we have presented to ACRS Committee 11 complete chapters and one partial chapter. Two more chapters are scheduled for presentation during this November meeting. One of them is being presented now. That's Chapter 18. And tomorrow we will be presenting Chapter 7.

Next slide please. This slide provides details of the completed chapters with Subcommittee review dates, and as previously stated, two more chapters, 18 and 7, are scheduled for presentation during this meeting, but those are the two highlighted chapters.

That's basically where we are today in the COL review process and I will take this opportunity to introduce Tanya Ford. She is the chapter PM. She will be coming back later and presenting the technical portion of our presentation today.

And with that, I will now turn over the meeting to Mr. Mark Finley. He is the Vice-President of UniStar and he will introduce his team and start with the UniStar presentation for Chapter 18.

CHAIR POWERS: Let me just interrupt and check and see if any of the members of the Subcommittee have questions for Surinder.

Not at this time. Mark.

MR. FINLEY: Good morning. Thank you, Surinder. Like Surinder said my name is Mark Finley.for those of you who don't know I have been with UniStar for five years. Previously I had been in charge of the engineering area and just recently we have combined engineering and regulatory affairs and I am the Senior Vice-President, Regulatory Affairs and Engineering for UniStar.

Greg Gibson, who was formally in charge of regulatory affairs, you know him well, he sends his regards. He has been promoted. He is actually President of UniSgtar.

CHAIR POWERS: It doesn't matter. We still can assign him tasks, and will do so.

MR. FINLEY: Through me, we can still assign him tasks. So good morning, we appreciate the time slot this morning, and tomorrow afternoon, as Surinder said, to cross two more chapters off the list for Calvert Cliffs 3.

So, good, John, thank you. So we are on Slide 2 and there should be a brief discussion this morning. Chapter 18, mainly we incorporate by reference the Chapter 18 from AREVA as you have seen.

We will focus on supplementary information, site-specific information and we have one departure that we will talk about. We are building off-of the meeting, Chapter 18, for the US EPR FSAR back in August 18th of 2011.

Slide 3. As you will see we have one departure, really as much an enhancement as a departure -- we will talk about that in some detail -- regarding the human performance monitoring program.

We have no ASLB contentions. There are five COL information items we will discuss, no SER Open Items and two confirmatory SER items.

My team here today, and on the phone, Cyril Roden will lead the presentation. He is our manager of I&C and electrical engineering at UniStar, and supported by Tom Roberts, who is our manager of operations and maintenance, and John Rucke will support with the slides.

And we have some other support on the phone here. As you see the names, I won't discuss each of those names.

Slide 5, again a fairly brief presentation. Cyril will discuss the COL items and the one departure with Tom's support, and then we will have some conclusions and that should be it.

Please don't hesitate to ask questions when they pop into your head.

CHAIR POWERS: Do you really need to provoke this Subcommittee?

(Laughter)

I have never seen them reluctant to ask questions.

MR. FINLEY: This I know. And Cyril, Slide 6.

MR. RODEN: Okay, thank you Mark. My name is Cyril Roden. As you may guess, I am from France, from my accent. I joined UniStar in August 2010 to work in engineering on I&C and electrical.

Prior to that I worked for 11 years within EDF in nuclear engineering, working on I&C and electrical topics, both for operating plants and new build, and I have got a French engineering degree on electrical design, signal processing and automation.

So, the presentation will focus on the description of the COL items and the departure. So on Slide 6 we have our first COL item on our chapter, which in fact states that UniStar operating service will execute the NRC-approved HFE program as described in the DC.

Next slide. The second COL item deals with the emergency operations facilities concerning the EOF. The plan is to modify the existing Calvert Cliffs Unit 1 and 2 EOF to accommodate and interface with Calvert Cliffs Unit 3.

And this modification will be consistent with the US EPR HFE program described within the DC and consistent with the NUREG-0696, which is about the EOF.

We commit in our COLA to of course check the operability of the EOF for Calvert Cliffs Unit 3, but also be sure that there is no degradation for Calvert Cliff Unit 1 and 2.

And I state in the second bullet the correct implementation of this HFE program will be verified through site-specific ITAAC, which is part of our COL.

Concerning the operational support center, the OSC will be designed for Calvert Cliffs Unit 3 and will not be shared with Calvert Cliffs unit 1 and 2, and this OSC will be designed also consistently with the US EPR HFE program as referenced in the DC.

MEMBER STETKAR: Cyril.

MR. RODEN: Yes.

MEMBER STETKAR: I've forgotten, if I ever knew. Where is the emergency operating facility located at Calvert Cliffs, physically?

MR. RODEN: It's -- I'll just look at --

MR. ROBERTS: My name is Tom Roberts. I have been in the industry for 38 years and I have held different positions in operations, engineering, maintenance and construction.

I have had multiple leadership roles at several plants across the US including St Lucie plant, Turkey Point, Byron nuclear station and Calvet Cliffs.

Recently I have just finished a two-=year assignment out of Flamanville Unit 2 in the construction organization. I have a B.S., Bachelor of Science degree and civil structural engineering with a minor in environmental engineering.

I am a Registered Professional Engineer and I also have the INPO Plant Manager Certification.

To answer your question, at Calvert Cliffs, the OSC is located right in the security complex.

MEMBER STETKAR: Not the OSC, the EOF.

MR. ROBERTS: The EOF?

MEMBER STETKAR: Yes.

MR. ROBERTS: The EOF is located up in Prince Frederick so it's approximately 12 miles away.

MEMBER STETKAR: Okay, thanks.

MR. ROBERTS: I didn't remember. OSC must be somewhere, you know, within the fence

MEMBER STETKAR: Right, it's just outside the main -- the security fence going into the protected area --

MR. ROBERTS: Okay.

MEMBER STETKAR: at Calvert Cliffs.

MR. ROBERTS: Okay, thanks.

MR. RODEN: Any other question on that slide?

(No response)

MR. RODEN: So let's move to the next one. Slide number 8. This core item deals with staffing levels and qualification. The staffing levels of qualifications of plant personnel specified in the CC Unit 3 FSAR will conform to the regulatory requirements.

And the results of the staffing and qualification analysis shall be verified by the implementation of an ITAAC, which is in the DC, and as it states in these slides, the staffing and qualification will be based on the HSI, the human system interface design features as described in the task analysis implementation plan.

MEMBER STETKAR: Just be careful with the microphone. I don't want to move the --

MR. RODEN: No, it's me. Sorry.

MEMBER STETKAR: They are really, really sensitive.

MR. RODEN: Okay. Sorry about that.

MEMBER STETKAR: It just bothers the transcript.

MR. RODEN: Yes, understood. Next slide please. The two next COL items, the first one deals with principles and site procedures. The HFE principles and criteria are incorporated into the program for site procedures and which is consistent with the guidance of the operational guidelines described in section 13.5 of our COL.

And concerning the principles and the training program, these -- the HFE principles and criteria are incorporated into the development of the training program scope, structure and methodology, and this is described in section 13.2of the CC Unit 3 FSAR.

And these two COL items are the last ones we have in our Chapter 18.

MEMBER SKILLMAN: I am Dick Skillman. I would like to ask a question.

MR. RODEN: Yes.

` MEMBER SKILLMAN: It goes back to your EOF and combining the Calvert 3 EOF activities with the present Calvert 1 and 2 EOF activities, and this is as much a human factors question as it is a practical, nuclear power plant question.

You have got two Ps that are a vintage, and then you have the super whamodyne P that is, in all candor, a very different machine -- similar technology but a different machine.

What actions will you be taking in UniStar to ensure that the personnel in the EOF and the recognition of the EALs for Calvert 1 and 2 that are probably different than Calvert 3, are separated, that these people understand these are not three very similar machines, they are two very, very similar machines, and one very different machine. The EALs will likely be different. So I understand

So I understand the notion of combining the EOF. The question is around the human factors of assuring that the people in EOF understand they are dealing with two different machines. Their responses may be very different because of the design differences.

What is the vision for how that will be addressed? I think maybe Tom would be the best to answer that question.

MR. ROBERTS: What we've done is we have walked down the EOF with Calvert Cliffs Units 1 and 2, their operating staff, and we realize there's still a lot of work to do in that modification.

So we are still negotiating that with Units 1 and 2, but what we had envisioned is that you would almost have two separate areas with a combined area, but it's very preliminary.

So we understand that there's going to be some differences, specifically on EOP, some slight differences in the emergency response and the EALs, but we don't think there's going to be any problems overcoming that.

But it's not going to be like it's all in one area.

MR. FINLEY: I would also add, I think

your question got to training as well, and at this point we expect to use separate teams, essentially a team trained for the Calvert Cliffs Unit 3 through a separate training process from the teams that would staff the EOF for Calvert Cliffs 1 and 2.

Right now we don't see a significant overlap in the personnel that would be staff. So the idea is more to share the physical facility as opposed to sharing the staff so that the training programs would be separate and obviously focused on the EPR processes and parameters.

MEMBER SKILLMAN: Thank you. MR. RODEN: Any other questions? So let's move to Slide 10.

CHAIR POWERS: Does that mean that if I am trained to run 3, I cannot be cross-trained to run 1 and 2?

MR. FINLEY: No, I wouldn't say that. It's our staffing plan, Dr. Powers, just envisions a separate staffing and not a sharing of the licensed operators at this point in time, or the emergency response staff.

CHAIR POWERS: How about fire brigades?

MR. FINLEY: Fire brigades? Tom, do you want to --

MR. ROBERTS: The specific question about sharing of fire brigades?

CHAIR POWERS: Yes.

MR. ROBERTS: The Unit 1 and 2 is about a half mile from Unit 3, so we will have separate fire brigades as part of our emergency planning between those two different units.

If there's a case that potentially that later on down the road we can look at combining some fire brigades to make a more robust response, we will do that. But we haven't considered that at this point.

MR. RODEN: Slide 10. Here is the human performance-monitoring program. On that area we decided to take a departure from the DC, the US EPR HPM is replaced, that the UniStar HPM program, both program rae very similar. We adapted the program on our needs.

The ,key differences we have between the two programs are summarized in that slide. We use an Operational Focus Aggregate Index to trend the performance of key variables that can impact the operations' human performance.

And this aligns with INPO guidance and we use our UniStar Corrective Action Program as one unique overarching program to track HFE issues and to get operational feedback.

And we do not use a separate program for human performance monitoring, but this is part of our corrective action program.

MEMBER SKILLMAN: What is the classification of this departure? It's a two-star or Tier 1 or Tier 2?

MR. RODEN: It is Tier 2.

MEMBER SKILLMAN: Okay, thank you.

MEMBER STETKAR: I am assuming this process is in place already at Units 1 and 2? Is that true?

MR. ROBERTS: You are referring to the operational index?

MEMBER STETKAR: Yes.

MR. ROBERTS: Yes. That is correct and it's the way the industry is headed, down this road.

MEMBER STETKAR: Thank you.

MR. RODEN: On next slide there is a little more details on the human performance-monitoring program. The bottom line, we meet the requirements of the NUREG-0711, and we have five sub-bullets which describe the set of tools that build this program.

As already talked, we have the corrective action program that will be used to track, to document, to trend and to resolve issue that may occur.

We will have a design change control process that will be used any time a significant modification will affect the human-system interface and we will use a similar tool and monitor the performance, the human performance with this change, to be sure that there is no degradation.

We will use the Probabilistic Risk Assessment any time we will have an issue where the plant or the personnel cannot be monitored or simulated easily, and we will have our plant maintenance and inspection program to have our SSC working properly and to have the operator will have proper notification when a system or equipment is unavailable.

And the last bullet is about the Operational Focus Aggregate Index that we use to trend the performance of the personnel of the plant.

MEMBER STETKAR: Cyril, I am going to put you on the spot for the PRA bullet. We had a little bit of discussion about that topic during the DCD Chapter 18 discussions.

At that time, AREVA said that they were determining the significance of particular operator actions for special attention or incorporation within the human factors engineering program, based on some type of numerical importance ranking, that it's my understanding works as follows, that suppose you have two actions, one action during full-power operation and a different action during shutdown, and you do the risk assessment, and each of those actions has the same Risk Achievement Worth. Let's just call it an index of 100.

However if the risk, the total risk average -- excuse me, it's early in the morning, I'll say it again -- average annual risk during shutdown was only 10 percent of the average annual risk during power operation because you are only shut down a small fraction of the time, that particular action during shutdown would be discounted by a factor of 10. In other words, it's not as important so it would receive less attention.

That doesn't seem to be reasonable for the purposes of placing an emphasis on human factors engineering for that second action. If it's very, very, very important to risk during shutdown, I should care an awful lot, for example, that the operators have adequate alarms, indications, procedures for that action, regardless of the fact that I am only in shutdown, you know, a month out of every couple of years or so.

So I was curious whether you had thought much about that as you transition from sort of, that guidance in the DCD human factors engineering process to your own plant-specific human factors engineering, whether you were just basically going to adopt that scaling process verbatim, and if so, why that's reasonable.

It's a long question. You are not a PRA guide but your slide does have a bullet that says PRA.

CHAIR POWERS: But this is a critical aspect of human engineering. I don't care --

MEMBER STETKAR: Well, it isn't --

CHAIR POWERS: if you use PRA or roll dice to do it, we still need to understand If there is a critical action during shutdown that's risk-important, I don't think you should be de-weighting.

MR. RODEN: No, you should -- you should -- that's my opinion anyway, you should make sure that you have adequate you know, indications, alarms in the control room, that you have adequate procedures, you have adequate training for the operator, because if the operator's ever placed in that situation during shutdown and he doesn't have that supporting information, it's not going to be a good day at 3.

MR. RODEN: I do not have a clear answer to that. As you said, it's a long question. From the human performance-monitoring program itself, as I stated, the use of the PRA is really used when you can't modulate or use a simulator to that particular area.

MEMBER STETKAR: Yes, it's a slightly, you know the way you described it, and the way it's described in your FSAR, it's a slightly different context from the context that I brought up.

The context I am concerned about is how is the PRA used or how are those risk-significance measures used to identify risk-critical actions that you want to pay particular attention to, either in the hardware design, the layout of the boards and things like that, or you know, if not that, certainly in your procedures and your training for specific actions, and in particular during shutdown because shutdown is typically you know, discounted numerically in that average annualized risk, just because of the short term time of shutdown.

MR. ROBERTS: I might offer a little bit

more information. It's -- you know if you look at our PRAs, you have your shutdown risk PRA, it's a specific document and within that document when we do our task analysis for all our procedures that we use during shutdown or Modes 4 through 6, we would specifically look at those tasks to determine how reliable the human performance is within those tasks and come up with a human performance reliability type number that would feed into that specific PRA, so it's not necessarily a scaling between your full power PRA.

CHAIR POWERS: But the PRA is doing the scaling for you automatically.

MEMBER STETKAR: But Tom, what you just said is if you do that separately, you know if you have a full-power PRA model and a shutdown PRA model, and if you look at those human actions within the context of each of those models, without worrying about stitching them together, to get some sort of average, overall plant risk, that sounds like it's more responsive to my concern then, than the statement in the DCD which says -- I won't read it verbatim -- but it essentially says that you discount the human actions for example during shutdown, if the shutdown produces lower average annualized risk when you put the two models together.

I mean, that's -- that's -- and we had some discussion about that and they, you know, essentially confirmed that's the way it was envisioned to work.

From what you just said, if you do it separately, then those two actions that I mentioned that would have a numerical weighting of 100 during shutdown and 100 during power, in principle should receive equal attention, if I understood what you were telling me about the process that you used.

So that's somewhat encouraging, but it's a little bit different than the process that's described, or at least the way I understand it in the DCD, as far as identifying which of those actions you really do want to pay attention to.

So you may want to think about that a little bit. It's -- in -- I don't know what -- in Rev 2 of the DCD the discussion is in section 18.6.3 -- I'm sorry, that's of the SER. I don't have the section number of the DCD.

But it has to do with -- it quotes Fussell-Vesely importance and risk achievement worth and how you weight things, so you may want to look at that and think about it in the context of how you are actually going to implement the program at Unit 3.

MR. ROBERTS: We'll do that. Thank you.

MEMBER STETKAR: I recognize that this is a bit of a discussion for the DCD, but if indeed you had a little bit different philosophy about how you wanted to do that, that's the reason I was sort of asking you to explore whether you had thought about that at all.

MR. FINLEY: Right, to this point, we haven't developed the details of the program that would use the PRA insights, so we plan to follow essentially what's in the US EPR FSAR at this point, and have not actually written the process.

MEMBER STETKAR: Okay.

MR. RODEN: And that is all for me. Thank you very much.

MR. FINLEY: Thank you, Cyril. So in conclusion, Slide 13, Cyril has discussed the five COL items. Again, we have no ASLB contentions. There is one departure, enhancement I would say, to the human performance monitoring program. We have no SER open items. We have responded to all the REIs and there are two SER confirmatory items and if there's no other questions, that's all we have.

CHAIR POWERS: Any other questions you would like to pose? Let me emphasize that we are very interested in this prioritization of importance of tasks, especially in the shutdown versus the normal operations so we will be interested in how that comes along once it starts coming along.

MR. ARORA: Okay, understand, thank you.

MS. FORD: All right, good morning. As I mentioned before, my name is Tanya Ford and I am the project manager responsible for coordinating the staff's review of Chapter 18, for the Calvert Cliffs Unit 3 Combined License Application.

Today's presentation will cover the staff's Phase II Safety Evaluation Report for Chapter 18. The technical staff that supported this review include members of the Operator Licensing and Human Performance Branch, Paul Pieringer and Jim Bongarra.

There were two questions issued to the applicant requesting additional information for Chapter 18. As stated previously, there are no open items identified, however there are two confirmatory items that will be discussed later in the presentation.

If there are no general questions, at this time I would turn the presentation over to Mr. Paul Pieringer, who will continue the human factors engineering presentation for the staff. Paul?

MR. PIERINGER:. I'm Paul Pieringer. I am the technical reviewer for Chapter 18. I guess one point of clarification. We do have one open item that tracks completion of the EPR FSAR, just to make sure that when that's done we go back and check this particular safety evaluation and make sure it's accurate.

There are two confirmatory items. Both of these, the applicants provided updated documents to reflect an update to the latest revision of the FSAR plus the answer to the two questions from the RAIs. I'll discuss those in more detail in the next slide.

The COL information item that dealt with the design of the emergency operating facility does conform to NUREG-0696. The staff's concern here has been that many applicants just say use an IBR, and they go directly to the Design Certification Document, which typically, to my experience, only covers the data that is going to be presented in the EOF, not necessarily the layout of the complex, trending of data, accessibility of data, those other elements that HFE design looks at.

So by virtue of the applicant's reference to the NUREG-0696 and the design certification, he had a complete set of commitments relative to that particular design.

The staffing and qualifications information item, the applicants provided the standard industry list of engineering expertise and operating expertise that's based from operating experience from the operating reactors.

What we are particularly interested in in this area, is that the staffing they are committed to is actually bounded by the existing regulations. The reason we are interested in that is because as we get more towards advanced reactors and passive cooling designs etcetera, there's different qualifications and perhaps different staffing levels could potentially be needed.

And so what we do is we back up to the EPR FSAR in this case, particularly the task analysis element and we look at that task analysis result and verify that the qualifications and staffing requirements identified in that task analysis are actually consistent with what the applicant is submitting in their FSAR and in this case we are still waiting for that task analysis to be completed.

So this is one of those interfaces between the EPR FSAR and the Calvert FSAR, and so ITAAC 5 is there and we credited that with completing this verification.

Procedures and training are both operating programs, they are addressed in Chapter 13. What we are doing here is we are eliminating redundancy in the safety evaluation reviews.

We have gone back and we have verified that everything that we would look at in human factors space is included in the inspections that are conducted under the operating programs.

I did want to take a little bit of a digression here and just go through the -- an outline of how procedures are handled because it was discussed at a previous meeting here.

But the Chapter 13 review specifically looks at the scope of procedures, both administrative and operating, and then at the program for developing those procedures.

And then most importantly, it looks at the procedure generation package. I can discuss procedure generation package in more detail if there's interest, but the bottom line on that is that three months before training on EOP starts, the staff receives step procedure generation package, reviews it and writes a safety evaluation on it.

MEMBER STETKAR: And Paul, that is three

months before training, so that would be in principle perhaps a couple of years before fuel load?

MR. PIERINGER:. Exactly.

MEMBER STETKAR: Okay.

MR. PIERINGER:. And it is formal training, so they may be doing some informal training even before that.

MEMBER STETKAR: Right, but as soon as you start actually giving people exams -- okay, thanks.

MR. PIERINGER:. And then as we talked about before, we also look at how these procedures integrate with the operating panels and the training programs during the integrated system validation that is done as part of the HFE program.

The human performance monitoring program is submitted as a deviation but I can tell you that the EPR FSAR is virtually the same as the Calvert FSAR in terms of fundamental program scope.

The reason it was submitted as a deviation is because both the -- DCD -- I used the term interchangeably, okay, DCD or the Calvert FSAR are much more detailed than what we are used to seeing in an HPM submittal.

And so Calvert was faced with having to either take a lot of deviations to very small detail or one deviation which allowed the staff to basically review their program directly against the 0711, and for us that was -- we appreciated that decision because it actually made -- it simplified our review.

They have included the fundamentals as we see it and that's an integration with the corrective action process, integration with operating experience and integration with the operator training program.

And those are the three pieces that 0711 fundamentally directs us towards and they had a good program for doing that, and a lot of other detail on how they were going to trend and track the results from that program.

MEMBER STETKAR: Paul, before you leave this slide, when -- your brief discussion of the first bullet reminded me of something from our -- in our meeting in August, and I also tend to call things the DCD, but the design certification FSAR.

Some submittals include what's called a minimum inventory of annunciators, alarms, displays in the main control room as part of either the certified design or the COL application.

This one does not, and my recollection was the staff apparently issued a revision to Branch Technical Position 18-1 -- I am reading from my notes here so excuse me if they are wrong, I wanted to see if I could get some clarification -- saying that that is not necessary because since the entire human factors engineering program or the vast majority of it is a post-COL activity, there's no need to submit those minimum inventories until some time before fuel load. Is that -- am I interpreting that correctly?

MR. PIERINGER:. I'd like to add a little bit more --

MEMBER STETKAR: Okay.

MR. PIERINGER:. of the fundamentals of why we made that decision. It's not that minimum inventory is not important. In fact, it's probably the most important set of controls, displays and alarms that we are interested in.

MEMBER STETKAR: Right.

MR. PIERINGER:. What we didn't want to happen is to have that most important set developed outside of the staff-approved processes and so what we saw happening was is that to meet the -- let me see, the EPR FSAR deadlines, the EPR staff was using generic technical guidelines and coming up with their set of what they believed to be the best controls, displays and alarms.

And it was pretty good but in my opinion, I was reluctant to say it was good enough because when you go to the NUREG-0711 process, what it drives you towards is first a specification on what functions are being performed and then how those functions are allocated, either automated actions or manual actions.

And then you do a task analysis using that== taking those functions to a lower level of detail, and then off the task analysis, you develop your list of controls, displays and alarms.

And so I was probably the driver for saying we really need to make sure that we keep the controls, displays and alarms connected with the functional analysis that's happening, the functional allocation and then the task analysis, so that we maintain the process and we don't encourage secondary processes to develop that could undermine our primary process. So that was more the fundamental argument being used.

MEMBER STETKAR: Yes, and that's -- you know, that's essential, that sort of feedback, if you can call it -- I don't know whether it's a feed forward or a feedback loop.

But I guess my concern is looking back at the whole design certification and licensing process is that identification of some person's or group's concept of a minimum inventory of important indications and alarms early in the process, could help the designers if the designers hadn't -- the hardware designers, the people who are actually, you know, building the hardware to the extent that it's built, identifies things that they might not have thought of otherwise.

And if you delay that process until too late in the evaluations, there may be a lot of reluctance on the part of hardware designers for example to install new indications and alarms.

So there's always that risk. There's always the risk that when you complete the entire human factors engineering process, you identify something that you hadn't thought about.

The question is where in the whole timeline of the process is the applicant or the combined applicants willing to accept that risk? Because you are right, you really never know exactly what you might need until you finish that final task analysis.

MR. PIERINGER:. And I would say that perhaps you may not even know what you really need until you finish the final V&V.

MEMBER STETKAR: That's probably true.

MR. PIERINGER:. And the same argument you are making could be applied to like operating experience. There are like -- well, you are familiar with the six first elements of the 0711 process are all design inputs, and so what we have been stressing to the applicants is you really can't do your HSI design, which is section 8 of the 0711, until you have got these design inputs done.

So it doesn't make a lot of sense to us if you come in with an application that's got all your design input work deferred out.

And so more and more are coming in with a lot of that work submitted as final design versus DAC, now not all, and so we still -- we still are challenged by that point you are making here of how quickly can you get that design input information.

MEMBER STETKAR: In particular because we are talking about EPR, you know, US EPR today, they are one of the design centers that have a lot more information about the design available at the design certification stage rather than pushing it off to DAC.

And that's you know, another reason why I was a little bit -- I don't want to use the term concerned -- curious at least for this particular design center, why, you know why they couldn't at least specify some of that minimum inventory, recognizing it will, of necessity it still is not complete until you do all of the HFE work.

MR. PIERINGER:. There's a -- I don't remember -- I only worked on the V&V section for the EPR FSAR, but I believe they still have used DAC quite extensively through their submittal, even on some of the areas where they may have the design they have submitted as a DAC.

MEMBER STETKAR: There is some, I mean I am just looking at it in comparison to some of the other design centers. There's much less here.

MR. PIERINGER:. Okay.

MEMBER STETKAR: Well let's just say less. But I didn't -- if I hear you, the basic idea is that from the staff's perspective, you would rather see a submittal -- well, it's not a submittal though because all of this will be examined during an inspection process.

MR. PIERINGER:. It becomes an ITAAC.

MEMBER STETKAR: It's an ITAAC, right.

MR. PIERINGER:. Right.

MEMBER STETKAR: But you'd rather have that project process essentially one inspection of a fully-integrated set of human factors, engineering and design rather than effectively a two-step process where you look at you know the, whatever minimum inventory is submitted at either the design certification or the COL stage and then go back and close the loop later.

MR. PIERINGER:. Yes. And it gives you that connectivity too, with functions in particular, so that you have --

MEMBER STETKAR: Well, but I mean that connectivity would -- in principle would be available at the ITAAC inspection stage anyway. Okay.

MR. PIERINGER:. It would be, yes.

MEMBER STETKAR: Thank you.

MR. PIERINGER:. That concludes my presentation, pending any further questions.

CHAIR POWERS: I have a question. I don't know whether -- I am not even sure how to ask it. But what I am struggling with here is trying to understand here's a plant that we have no -- no similar plant has been built and operated, but there are plans afoot to do so.

Do we get information from those plants that come online earlier that is of any use to us?

MR. PIERINGER:. This borders between an opinion here. From the EPR FSAR perspective, to my knowledge no, you don't get any additional operating experience fed back in once you are into rulemaking, unless the applicant decides they want to revise it like Westinghouse did, and then we do look for an update on the operating experience.

In thinking through that, I think the same would be true of the COL applicant's SER. Once we have approved that, that completes the operating experience input.

Now, where you will see it interface is in the V&V effort. On a full-scope simulator they run scenarios, they come up with deviations. Those deviations have to be resolved.

When they resolve them, they look, as you would in any corrective action process, they look for whether it's procedure-related deviation, a training-related deviation, a human factors-related deviation and they use operating experience to feed their selection of corrective actions for whatever created the problem.

And by virtue of Appendix B now, and particularly the corrective action process, you will see operating experience fed back in that way. But that's the only way I know of where it's factored in.

MEMBER STETKAR: I mean, in principle, you know, you characterized it as this is a brand new plant that has never been built or operated. That's certainly true for the United States, but this design in particular is not wildly different from designs that had been operated in Europe for several years, the basic, fundamental plant design, you know, the operation of the systems and --

CHAIR POWERS: Well, it's the problem that I'm wrestling with. I can find plants that are sisters in this country and each has different operating characteristics, remarkable differences.

And so here I am thinking what a real challenge Tanya faced here in reviewing this because the plant's never -- it hasn't been built. Nobody has operated this plant.

And what you think about and the chances that you, the applicants, the licensees had left something out, seems to me to be extraordinarily high.

MEMBER STETKAR: Now, that's why I like that minimum inventory early on because it gives you some insights about what, you know, people have thought about and in principle, where they have learned from that relevant operating experience, what are -- you know, whatever degree of relevance it might have from sister plants in particular in Europe.

At least you know it's not complete, you know that it needs to be, to be checked and verified, when they complete the human factors engineering, but it in principle, if somebody had discovered because of operating experience it would be really, really good for an operator to have a certain alarm that very obviously alerted the operators to a particular condition, you know, that in principle would show in that minimum inventory early on, or should or could.

CHAIR POWERS: But it may not.

MEMBER STETKAR: It may not. It may not. That's right. It may not. It may not.

CHAIR POWERS: Let me ask another question that I again don't know how to ask, but we heard at the beginning of this presentation, COLA applicant outlined that he was setting up systems to be independent and not shared with Units 1 and 2.

And he didn't go through clearly the trade study that he did to come to that decision. He just said here is how we are going to do it. When the staff reviews those kinds of decisions, what kinds of pros and cons does it look for?

I mean we are going to have here a system in which two-thirds of the operators are trained on one system, and one-third are trained on a different system. How do you look at that?

MR. PIERINGER:. From a -- I'm going to narrow this to the how do we look at it from an HFE perspective.

CHAIR POWERS: Yes, it's the HFE that I am --

MR. PIERINGER:. It's obviously the training and emergency planning --

CHAIR POWERS: Yes, there are lots of other things. I'm interested in the HFE, yes, that's right.

MR. PIERINGER:. But fundamentally we assume that they are going to be trained and that training is effective. If it's not, then it's found during emergency drill exercises.

So we understand there's several barriers in emergency planning area that are downstream that aid us in identifying human performance issues, and that is the primary reason I think that the HFE prescription for the Tech Support Center in the EOF aren't as fully-developed as they are for the Control Room.

So, when we get to the EOF, we are faced with what I would call more generic guidance and the way we apply that is fundamentally we look for data accessibility, can the person who needs the data find it and get to it accurately, which takes you back to plant layout and Control Room console -- EOF console design, and anthropometric data, how big the screen sizes are etcetera.

So we look at that element, and then we look at data presentation, trending -- is trending available -- to some extent, data recovery. In this case one of the concerns was that the EOF is certainly getting all the data from the -- the plant computer, from the integrated digital platform, wherever it's coming from.

But the EOF is also getting typically radiological protective information from a lot of teams. It doesn't necessarily go through any -- through the Control Room.

So we are looking to make sure that that particular element of the EOF is addressed within the scope of the plan. Now that is primarily done however under ITAACs.

We look at their commitment to 0696 and it says yes, they are going to meet these general standards and then we wait until the ITAAC and we do inspections to verify that they have actually succeeded in meeting those standards, and we do the judgement by analyzing their performance during the emergency drills.

And it's that transition where you are going from human factors really to emergency planning space and it's the emergency planning inspectors who are doing that assessment.

CHAIR POWERS: I think what -- correct me if I am wrong. I am coming away with the impression, in this particular area we review things as best we can, based on the inventory of experience that we have derived from a variety of sources and whatnot.

And what we are relying on in all these pre-activities -- the training, the simulators, and things like that -- will catch anything that we may have omitted or been pollyanna-ish in our views about and things like that, that the system -- I mean, essentially the system is set up, you review as best you can and then you have a checking function that presumably catches the more egregious omissions.

MR. PIERINGER:. Where I would add to what you stated was that we have a fairly -- we have a detailed process for how to do human factors engineering, and I would say that it has a high potential for identifying 99 percent of the necessary --

CHAIR POWERS: I fully agree with that.

MR. PIERINGER:. Right. And when we get to the V&V section, it's not so much the egregious misses that we are looking for, it's the subtle things, it's the interfaces between operators, communications that takes place or doesn't take place, it's things that are in the wrong location, things that can't be read, hesitation, things that just cause the operators to stop and think or stop and get confused --

CHAIR POWERS: What's going on here.

MR. PIERINGER:. or whatever, right?

CHAIR POWERS: Yes.

MR. PIERINGER:. And so the test is, is the process really robust? We believe it is, and as we have done reviews, we have found areas that we needed to develop further and we are doing that in Rev 3 now.

But generally, those have been more of enhancements, not fundamental changes to what we are looking at.

CHAIR POWERS: Where I think you have hit the nail on the head is, is the process robust, is really the question that should be asked and apparently is asked, and you are coming away with an affirmative conclusion on that.

MR. PIERINGER:. I am convinced that it is by virtue of the level of detail we go to in understanding the process. Typically a general applicant comes in with a pretty general statement of how the HFE program is going to run, and the first set of RAIs drives us down to working-level procedures and we pull up a lot of information from working-level procedures to tell the staff how the process is working, you know, what criteria are being used, when things are reviewed, how they are reviewed, etcetera, and it's that level of detail we are really using to validate the process.

Now, there's a part of me that wants to reserve, kind of, aside, five percent safety margin here that says we will really know how well it works when we see that V&V.

And so we have got a fairly developed inspection plan going forward to look at that V&V effort, make sure its being run in accordance with all the direction for V&V, but make sure that it actually results in a V&V that exercises the processes that we have approved.

So it's the classic comparison of here's our licencing basis, we are going to validate that, and here are the results, we are going to validate that, and I think that -- by looking at the results from that V&V inspection, we'll be in a very comfortable position at that point. I'll be able to take my five percent safety factor and report back to you that it's either good or we have some additional improvement.

MEMBER STETKAR: I think a lot of that -- and remind me if I'm wrong, because I've a terrible problem remembering details of things these days -- I think an important part of that V&V process though is the selection of the scenarios that you actually use for your V&V activities and you know, by implication, serve as a basis for your inspection activity.

If those scenarios are not cleverly -- let me use that term -- selected to challenge a fairly broad spectrum of human performance, both individual and team interactions, procedures and potential confusion and whatnot, then all you are doing is verifying, you know, essentially rubber-stamping something that you knew already, that yes indeed, they can start up the plant, yes indeed, they can shut down the plant, but --

So I'm hoping that the guidance for your inspectors and the guidance in the guidance documents spends a little bit of time on how one crafts those sceenarios.

Because if you know, the -- the appropriate selection of those scenarios will do awn awful lot to give you that extra confidence, that extra five percent that you are talking about.

MR. PIERINGER:. I am in 100 percent agreement. In fact, EPR was the design center where we really exercised or developed, fully developed that. We did it with the ESBWR, too, but we specifically asked for all scenarios to be submitted as part of the DCD for that reason.

What we found is that that was not a reasonable request because part of the scenario is specific acceptance criteria and many of those acceptance criteria aren't available yet because they mostly relate back to thermodynamic performance of the plant in terms of pass/fail and then the rest of the criteria are more human performance.

But so what we said is okay, well if you can't provide all the scenarios, we want a minimum of three scenarios that represent diverse types of plant transients.

And then we reviewed those three as models against all the criteria from 0711, and we accepted those three plus the commitment in an implementation plan for V&V.

And then there's an ITAAC to complete development of the remaining scenarios and so during this discussion we have, it's clear that those ITAAC -- those ITAAC scenarios have to reviewed and approved prior to running the I&V, and there's a timeline here, just like there's a timeline with the rest of the sections of 0711.

MEMBER STETKAR: My recollection is that the inventory of those scenarios, I think someone told me, is typically on the order of 10 to 15 to 20 type scenarios. I mean it's not 100 scenarios and it's not 5.

MR. PIERINGER:. Typically the numbers we have seen are 20 or more.

MEMBER STETKAR: Okay.

MR. PIERINGER:. And they aren't just a LOCA, large-break LOCA.

MEMBER STETKAR: Right, no that's --

MR. PIERINGER:. They are --

MEMBER STETKAR: That's what you don't want to run.

MR. PIERINGER:. They are a LOCA with a lot of distractions to the operator, equipment failing, equipment doesn't work, you know, just trying to put the operator in a worst-case configuration.

And what we have stressed is that we are not testing the operator. We are testing the human-system interface. And so applicants were initially coming in with training scenarios and those really weren't in my opinion challenging enough.

And so when we worked through the guidance in 0711 plus these draft scenarios these sample scenarios, we came up with what I thought was a good combination.

And so the draft scenarios, the sample scenarios -- I'm sorry -- the sample scenarios will actually establish kind of a precedent that inspectors will use to say that the other 17 or whatever are comparable to the three that the staff has already reviewed.

MEMBER STETKAR: I'd be interested to see how that works out. That's not part of a COL activity obviously, but somehow.

CHAIR POWERS: I find this discussion just very, very useful by the way, I mean, it's a nice discussion to understand how you do things, because I am sitting here blanching at, oh my God, how do you do this thing, and you guys have obviously done it and it's nice to hear how you are thinking.

Other questions you'd like to pose to the speakers?

MS. FORD: Well, this concludes our Chapter 18 presentation from the staff, and thank you for your time.

MR. ARORA: I want to thank you, Dr. Powers and members of the Subcommittee for giving us the opportunity to bring this Chapter to you today.

CHAIR POWERS: Again, this kind of discussion on how you think about doing things and how you go about doing it was just extraordinarily helpful to me anyway, and I appreciate you taking the time to do that.

MR. ARORA: Sure.

CHAIR POWERS: The number of outstanding items is all very interesting but how you think about things is really quite interesting.

No further comments, we will break until 10 o'clock.

(Whereupon the above-entitled matter went off the record at 9:39 a.m. and resumed at 10:00 a.m.)

CHAIR POWERS: Let's come back into session. We are going to discuss the US EPR's design certification overview of the GSI-191 approach.

Getachew Tesfaye will begin the discussion for us.

MR. TESFAYE: Thank you Mr. Chairman. Thank everyone. Good morning. My name is Getachew Tesfaye. I am the NRC project manager for AREVA's US EPR design certification project.

Today and tomorrow we continue our first three ACRS presentation of the staff's Safety Evaluation Report with open items. For the record, I will briefly summarize our first three activities.

To date, we have completed the first three presentation of 14 of 19 chapters. We have presented Chapter 8, electric power, and Chapter 2, site characteristics on November 3rd, 2009, and Chapter 10, steam power conversion system and Chapter 12, radiation protection, on November 19th, 2009.

On February 18 and 19, 2010, we presented Chapter 17, Quality Assurance, and portions of Chapter 19 for realistic risk assessment in civil accident evaluation.

On March 3, 2010, we presented Chapter 4, reactor, Chapter 5, reactor coolant systems and connector systems.

On April 6, 2010, we presented Chapter 11, radioactive waste management, and Chapter 16, technical specifications.

On April 8th, 2010, we briefed the ACRS full Committee on the seven chapters that were completed through March 2010.

On April 21, 2010, we completed the Chapter 19 presentation. Also on April 21, 2010 we received a letter from the ACRS full Committee Chairman on the seven chapters that were completed through March 2010.

The letter stated ACRS has not identified any issues that merit further discussion. On May 27, 2010, the staff submitted its reply to ACRS.

On November 30, 2010 we presented Chapter 13, conduct of operation. On February 7 and 8, 2011, we presented group 1 sections of Chapter 15, transient and accident analysis. On March 23, 2011, we began the Chapter 15 group 2 presentations with realistic large-break LOCA topical report presentation.

On April 5, 2011, we presented Chapter 6, engine and safety features. On August 18, 2011, we presented Chapter 18, human factors engineering and completed Chapter 15, transient and accident analysis by presenting group 2 sections.

Today and tomorrow, November 14 and 15, we will present Chapter 9, auxiliary systems, all sections except 9.1, and Chapter 7, instrumentation and controls.

In addition, AREVA will make an informational presentation on Generic Safety Issue 191, GSL-191, assessment of debris accumulation on PWR sump performance.

We plan to present chapter 9, section 9.1 and Chapter 3, design of structures, components, equipment and systems, on January 17/18, 2012. Our current schedule calls for completing first representation by February 2012.

That completes my prepared remark, Mr. Chairman, and thank you.

CHAIR POWERS: Derek, have we volunteered to bring some chapters forward?

MR. WIDMAYER: We did but we are not going to be doing it in December. We volunteered, but it's not going to work out.

CHAIR POWERS: They are not cooperating with us, huh?

MR. WIDMAYER: I didn't say anything.

CHAIR POWERS: Have we moved it to January?

MR. WIDMAYER: We can take it up with the full Committee.

CHAIR POWERS: Yes, it looked to me like

that was kind of low-intensity when I last looked at it, because I mean we are developing kind of an inventory of chapters that we have largely completed and we just need to move them into the next section.

MR. WIDMAYER: Yes, we will look at January.

CHAIR POWERS: Okay.

MR. COLACCINO: Dr. Powers, this is Joe Colaccino at GPPR projects branch. We appreciate that move to January. Quite frankly the staff is working very, very hard to finish Phase II by the December time frame so that we could definitely support something in January.

CHAIR POWERS: Okay. We will look at it. I know we volunteered to do it in December and I think we got bounced for other things, and they have just voted to have a January meeting but it looked to me like the agenda was fairly light.

So we will try to make a press to move some more chapters there and Derek will keep you informed on that.

MR. COLACCINO: Right, you wouldn't be able to do everything, obviously, that's -- and we are -- we have just got --

CHAIR POWERS: We have got half a dozen

that there were not any great controversies associated with, so we can identify and just move them -- move them forward in the process so we don't hang things up.

MR. COLACCINO: Agreed. Thank you.

CHAIR POWERS: I mean I think that's useful, just to get the letter to say we have done this and to mark progress and things like that. I mean clearly those issues that are deeply controversial, and any one of the presentations which Sloan failed to attend gets additional scrutiny, but those where she was here and added incredible value, we can move forward on. I couldn't resist.

MS. SLOAN: It's been a few months --

(Laughter)

CHAIR POWERS: Okay. We are going to proceed on to the GSI-191. I understand that at some point here you are going to want us to close this for proprietary material.

MS. SLOAN: And we have a breakpoint slide that will indicate when we have come to the portion of the presentation that has proprietary information. I would just say in advance of that, our colleagues from UniStar and if there's anyone here from PPL, are welcome to stay for the closed portion of the session, but we would ask the members of the public to be dismissed.

CHAIR POWERS: We can think about doing that.

(Laughter)

CHAIR POWERS: Okay. Are you ready? Go ahead.

MS. SLOAN: We are ready.

CHAIR POWERS: Okay.

MS. SLOAN: It will be Dr. Powers and the other members of the Subcommittee. We appreciate the opportunity to come before you today.

CHAIR POWERS: More lies, right?

(Laughter)

MS. SLOAN: I'm paid to say that.

CHAIR POWERS: I see.

MS. SLOAN: Appreciate the opportunity to come in advance of when you actually see the SER with open items associated with GSI-191. We asked for this opportunity at this point in time to give you an overview of the US EPR approach for addressing GSI-101 related issues.

And within the time allotted, and we recognize that this is a topic that has historically generated quite a bit of interest. But within the time allotted today, which is approximately two hours, we would like to give you an overview of the US EPR approach to address GSI-191 issues, such as those associated with sump strainer clogging, chemical effects and fuel downstream effects.

I will say, knowing that there is historically a lot of interest in this subject matter, we will try our best to answer your questions today. But if there are areas that you feel like we need additional follow-up on, or you have other questions, we will make note of those and we will come prepared in our meeting in 2012 to address those particular topics.

We have brought some of our subject matter experts from AREVA today. Because it is, again, a two-hour discussion, we brought these particular folks. There is quite a larger team that is working on GSI-191 for AREVA, who we can take the followup questions back to, but we will try to do our best today to answer your questions.

What I would like for you to get out of the presentation today is that for EPR, our approach reflects the commitment to resolving these issues at the design phase, which is really I think unique compared to, say, operating plants, where we are faced with the issue of trying to in retrospect, if you will, backfit the plants to address these issues.

So by design, from the beginning, EPR considered these effects, which gives us quite a few advantages to resolve those issues at the design phase.

You will also hear about the extensive analytical evaluations that we have performed, as well as a complementary test program to confirm performance characteristics, and to demonstrate design margins.

Let's see. And I mentioned that portions of the presentation will be closed. There will be a pause prior to that, and then we will begin the proprietary part of the discussion.

I will turn it over at this point in time to my colleague Kevin Connell, who will introduce himself, and then what we'd like to do is at the very beginning, take the opportunity to have each of our staff here talk about their background and qualifications at the beginning, so that when it comes time for the Q&A, they can just jump in and answer any questions.

MEMBER BANERJEE: Let me just ask you a question before you start. You have an extensive effort in Erlangen AREVA, I don't know --

MS. SLOAN: GmbH.

MEMBER BANERJEE: Yes, are you in touch and are there people in Erlangen involved in your program?

MS. SLOAN: Yes. And it's part of AREVA. There are centers of expertise if you will, but then there is collaboration across the various regions. On this particular topic, there were experts engaged from Germany, France and the US to address this issue.

MEMBER BANERJEE: They have also extensive test facilities. Are you using any of those?

MR. CONNELL: We have used mainly the ones in the United States that were already certified for the --

MEMBER BANERJEE: Well, the first time I actually saw downstream effects was in your Erlangen facility.

MR. CONNELL: Yes, we had thought about doing more of an integrated type of approach too, but for the types of testing and the type of debris that we had, we didn't feel as though we needed --

MEMBER BANERJEE: Was your debris different from theirs?

MR. CONNELL: We have a low-fiber plant. We are using lower fiber here in the United States.

MS. SLOAN: What you will find, not surprisingly, you probably appreciate, in each of the different licencing environments, there are different expectations.

MR. CONNELL: We presented this also to MDEP in Helsinki a few weeks ago, and we went through the differences and the similarities. The design is the same.

The differences in the debris stream and the regulations, we discussed that, too.

MEMBER BANERJEE: Is it regulatory-driven or is it actual plant -- there are differences in the plants?

MR. CONNELL: Oh, there's different testing protocols that have already been established here in the United States, and it's simpler to go through the established protocols for the operating plants and then for the previous design centers, than it would be to renew the protocols, demonstrate why these protocols are the most conservative.

There's so much history involved, we decided to keep going down the same path that our operating plants have been doing.

MEMBER BANERJEE: Okay --

MS. SLOAN: Just to address your question, it's both things.

MEMBER BANERJEE: Yes.

MS. SLOAN: There are slight differences in the debris that Kevin talked about, in the design in the different countries., the choices of insulating materials, and assumptions, but there are also differences in protocols.

MEMBER BANERJEE: Okay, let's hear it.

MR. CONNELL: Okay.

MEMBER BANERJEE: Because this was a very impressive facility and I haven't seen the equivalent here. Perhaps you have one, I haven't seen your facility.

MR. CONNELL: Oh yes. Well, we have similar testing facilities that we used here. But -- thank you Sandra -- as Sandra said, my name is Kevin Connell, and I presented before a year -- I guess two years ago, for Chapter 10.

But just a brief background. For the past four years I have been manager of the systems and plant design group for AREVA for new plants. Prior to that, I had performed, it was project engineering manager and procurement engineer for steam generator replacements, performed 12 of those with Duke Power and also with Duke Engineering Services and then AREVA

SGT.

I started my career almost 30 years ago with Duke Power as a system engineer, design engineer for the original construction and start-up and operation of Catawba Nuclear Station, so I have kind of come complete circle in getting back to the plant design also again.

I have with me Fred Maass, who is our manager of the systems group and also Eugene Moore, who is our thermal hydraulic expert. And do you want to give a little bit of background?

MR. MAASS:. My name is Fred Maass. I am manager at EPR systems, I have a BS in Mechanical Engineering. I have been in the industry approximately 25 years, in the commercial industry, spent a few years with the the naval nuclear reactor program.

Currently we are working on finalizing this particular topic as part of our efforts in systems engineering. So --

MR. MOORE: Good morning. My name is Eugene Moore and I have a BS in mechanical engineering from Ohio State and a Masters in nuclear from Texas A&M. I have been with AREVA for almost six years and for most of that time I have been in safety analysis, but for the last year and a half I have been on GSI-191.

MR. CONNELL: And I failed to mention that I have a Bachelors from Purdue University and a Masters from the University of South Carolina, and since both Fred and I went to Purdue and Gene went to Ohio State and Ohio State lost to Purdue this weekend, he has the honor of directing the slides.

(Laughter)

MR. CONNELL: All right. Thank you very much. The next -- what we want to try to do, as Sandra had said, is really give more of a presentation, give you information about what we have. We will go through a little bit of the details of our design.

I'm not really sure how familiar you are with the design. We will go through some of the test facility information. We always have the opportunity to come back later too, to give you some more information as requested.

But this -- really the idea behind this is mainly to get input, what kind of concerns, what kind of questions you have. You have seen this of course with other design centers, so what we want to do is present what we have done with our design center, and see if there's any other information you would require for that.

So for this presentation, what we will do is go through a brief overview of the plant design with respect to the debris-retention system, and then get more into the strainer head loss testing program and then into the final fuel assembly, downstream effects testing.

So our basic design approach, what we did was build from operating plant experience. One of the key difference between the operating plants and what we have here with the EPR is our in-containment refueling water storage tank.

Now this is similar to a function with the refueling water storage tanks, the RWSTs that are in operating plants. This IRWST is located immediately below the RCS systems, below the heavy floor. We will have a cutaway section so you see that. It's a very large pool for over 400,000 gallons, and that's the primary difference between it.

We also have what we feel is a very robust three-tiered retention system. We have first a weir with a trash rack associate with it that's right below the RCS, then it goes into retaining baskets and those retaining baskets are partially submerged in the

IRWST, and then it would then get carried to the strainer itself.

CHAIR POWERS: What are the surfaces in the IRWST?

MR. CONNELL: These are mesh surfaces, not perforated plate, but mesh surfaces.

CHAIR POWERS: That's on the filter, the IRWST itself?

MR. CONNELL: Oh, it's stainless steel.

CHAIR POWERS: Stainless steel, unpainted?

MR. CONNELL: Unpainted. And again I will get into some more details and we will have some pictures too we can take a look at, of our sister plant, OL3. But the other part that we have really focused on too, especially in the last year, was trying to reduce the overall risk by creating -- by specifying low fiber, in fact we don't have any fiber in the zone of influence for this design.

MEMBER BANERJEE: Do you have it outside the zone of influence?

MR. CONNELL: Outside, there may be some. We reserved the right to be able to do some of that too, but -- and our testing has had of course some fiber testing in its --

MEMBER BANERJEE: What is the fiber?

MR. CONNELL: Nukon blanket.

MEMBER BANERJEE: And within the zone of influence you have what, jacketed Nukon?

MR. CONNELL: Reflective metal. And so the other part of our program too, to reduce the risk, is to have a cleanliness program that restricts the amount of latent debris and as a result the latent fiber that is in the latent debris.

This has been reviewed and discussed and agreed upon with our COL applicants too. It is an aggressive but very achievable cleanliness program, but again, focused to reduce the overall debris and then as a result, the latent debris.

CHAIR POWERS: In the zone of influence, all your coatings are qualified?

MR. CONNELL: Yes.

CHAIR POWERS: So you don't have any unqualified coatings going in?

MR. CONNELL: No. I don't believe so. Fred?

MR. MAASS:. No.

MR. CONNELL: Okay. Now, this is a cross-section of our debris-retention system.

MEMBER BANERJEE: Your buffer is?

MR. CONNELL: Is TSP, trisodium phosphate.

That's actually located right here. In this cross-section, picture just above here would be where the RCS is. This is the heavy floor right below the reactor coolant system. A break location up here would then flow through the -- across the heavy floor to our two-inch weir, and then we have a trash rack that would then cover the opening to the IRWST.

The trash rack is a four by four inch grid. The water would spill through, our TSP baskets are located here, and our buffer would then take effect with the flow that comes into the IRWST.

This here is the IRWST. Partially submerged in this, is our retaining basket. That's our -- this, if you think of it, would be our first line of defense, the weird and the trash rack. The second line of defense --

CHAIR POWERS: And the surfaces in that weir and trash rack and things like that, they are all stainless steel as well?

MR. CONNELL: This would be coated concrete, correct?

CHAIR POWERS: Coated with what?

MR. CONNELL: Qualified coatings, epoxy --

MR. MAASS:. That's what we've assumed is epoxy, top-coated epoxy.

MEMBER SKILLMAN: Trash rack area, approximately how much please?

MR. CONNELL: Trash rack area is approximately, I thought it was around six foot by around four foot approximate area. I have seen this a few weeks ago at OL3 in there, and it was approximately six foot by four feet.

MEMBER SKILLMAN: The cross-section there shows that it is vertical. Is that a cage, or is that a floor -- MR. CONNELL: Yes, there's a few more slides on -- this is what it actually looks like.

MEMBER SKILLMAN: Oh, okay. I'm sorry. You can go back to where you were. Thank you.

MR. CONNELL: No problem.

MEMBER SKILLMAN: Oh, one more question.

MR. CONNELL: Yes.

MEMBER SKILLMAN: The vertical drop from the trash rack area down into the retaining basket?

MR. CONNELL: Yes.

MEMBER SKILLMAN: Is this a funneled or conduited entry, or is this just Katie bar the door, down comes the water and it ends up where it ends up?

MR. CONNELL: Well, the gap between the top of the retaining basket and the bottom of the heavy floor is a foot and a half. It's not very far. And there is an overlap region. There's -- the baskets are wider than the opening itself.

MEMBER SKILLMAN: Thank you.

MR. CONNELL: So the break flow again would come down into -- first it would flow down into the retaining basket. Now, heavy debris, reflective metal, insulation, large components, gloves, you know, any kind of large debris, would first get stopped by this trash rack.

Whatever would come through a four by four opening, then would go down into our retaining basket. The retaining basket has a 0.08 by 0.08 inch mesh. So the flow would then come down into here.

Initially, of course, it would be at the same level as the IRWST but as debris would accumulate, it is allowed to then rise and the basket filtration system keeps filtering the debris before it communicates directly into the IRWST.

And in the case where you would have complete debris blockage in here, which we didn't necessarily have, but you would then flow over into the IRWST.

Now, so the fluid would communicate through the retaining basket, through the 0.08 mesh, and also could communicate over the top of the retaining basket.

And then -- so this would be more or less the second line of defense. The last line of defense would be the strainer itself, and again, the material is the same strainer material we have on the basket of 0.08 inch by 0.08 inch grid.

And then the flow would then be taken into the suction of the ECCS pumps.

MEMBER SKILLMAN: How was the 0.08 by 0.08 mesh chosen?

MR. CONNELL: Good question. It was the original design we had for OL3. That was designed for the types of debris that they have had through operating plants.

Last year we went through another sensitivity testing program to see if we could tune that material to something possibly smaller. Some of the plants have been using some smaller perforated plate, smaller grids.

We found that that did not significantly affect the bypass for the type of debris that we have, so we found that that was optimum from the standpoint of retaining the debris, you know, getting a sufficiently low bypass, and still allowing though, still preventing a large delta-P that we would have across the strainer.

We don't want to have a large delta-P that would starve our pumps for NPSH purposes.

MEMBER SKILLMAN: How is the open area that is the particle size that can find its way through that mesh, how is that particle size addressed on the downstream pumps and the downstream equipment beyond the strainer, the SIS strainer?

MR. CONNELL: Yes, we have done testing and qualification for that. Do you want to talk a little bit about the downstream?

MEMBER SKILLMAN: Will it be later in your slides?

MR. CONNELL: Well, we talk about the downstream effects for the fuel assembly. We will talk about that in a --

MEMBER SKILLMAN: Fuel assembly is only one piece.

MR. CONNELL: Right.

MEMBER SKILLMAN: Here are your pumps. Here are the internal ports and passages, there could be cooling passages in there, sealing areas.

MR. CONNELL: Right.

MEMBER SKILLMAN: And my real question

gets to how are those capillaries protected by this strainer? That's my real question.

MEMBER BANERJEE: Are you able to access all the information that has been developed in response to Dr. Skillman's question, which has some proprietary aspects to it, by the PWR Owners Group. Do you have access to that or will you be getting access to that information?

MR. CONNELL: Yes, we have access to the PWR Owners Group.

MEMBER BANERJEE: Right. That's proprietary information, to some extent. It's in the Reg Guide 1.82 revision. It's revision 4. It's been referred to. The revision is still not out, it's draft, but nonetheless it's there, and you will have that information.

MR. CONNELL: Yes, we do. Yes. Do you want to talk about it --

MR. MAASS:. Yes, the access we have is to the testing that was done by AREVA for our fuel owners, so --

MEMBER BANERJEE: For the downstream effects?

MR. MAASS:. Yes, for the fuel assembly downstream effects.

MEMBER BANERJEE: Nono, I'm not talking about those. I'm talking about specifically leaving aside the downstream effects, the other information.

MEMBER SKILLMAN: My question is a plumbing question. Are we going to goo up the pumps with this fine debris?

MEMBER BANERJEE: But there is a lot of information out there, obviously, and there's been a huge amount of testing done on that.

MR. CONNELL: Fred, did you want to address that?

MR. MAASS:. Well, one of the ways we are controlling that is by specifying the concentration of debris material that goes into the downstream fluids. We will require our vendors, our component vendors to address that as part of their testing program, to qualify our permit.

MR. CONNELL: Is that for valves and pumps and --

MR. MAASS:. Yes. And the amount of testing that was done for I guess the proprietary document that you are referring to, that was done a lot more along the lines for existing components, and essentially what we have planned to do is try and build that in up front, that experience from our vendors, to capitalize on that, the work they have done for the operating plants, so by specifying our --

MEMBER BANERJEE: Really my question is, will you be able to access it under whatever arrangement is needed, that proprietary information?

There is proprietary information on exactly the question that he asked, and that's for existing plants. But you learn a lot from that, and I don't know if AREVA has access to that information or not. That's really the question.

MR. CONNELL: For any of the information that we don't have access to, we would have to replicate.

MS. SLOAN: The answer is yes and no, when it comes to the Owners Group. I think if I captured this correctly. For tests that we performed on behalf of the Owners Group, we have the rights of access to that data. We do not have right of access to all of the PWR Owners Group data.

MEMBER BANERJEE: And you are not -- I am not talking about downstream fuel effects.

MS. SLOAN: Right.

MEMBER BANERJEE: I'm talking of downstream effects other than the fuel effects.

MR. CONNELL: That's right.

MEMBER BANERJEE: So you don't have access to any of that data that was developed by other vendors or whatever, for the Owners Group?

MR. CONNELL: No, none of the proprietary information that was developed for --

MEMBER BANERJEE: Right, and you haven't bought into getting that information?

MR. CONNELL: No, not at this time.

MEMBER BANERJEE: Okay, so that -- we can have an offline conversation but there's a lot of information on the topic. But they don't have access to it.

MEMBER SKILLMAN: And there have been utilities that have been forced to do an overwhelming amount of testing in order to get restarted, that did this exact same thing.

I appreciate your opening comment, Sandra, that it is your intention to resolve these issues at the design stage, and for me, part of the design stage includes recognizing that with the combination of sieves and strainers and that type of equipment, particularly the emergency core cooling equipment has been protected internally, and that's really what I'm asking about and that's what Dr. Banerjee is also communicating.

We can talk off-line but there's the fuel I understand, the fuel and plugging the fuel assemblies, but there are also some mighty important components that do have some vulnerabilities, and if you are really in the mind set of designing in the front to prevent having to go through some painful OE later, now's the time to address those issues. Thank you. Thank you.

MR. CONNELL: Okay. Thank you, I appreciate the comment. Are there any other questions on the retaining system itself? I can go to the next slide.

MEMBER STETKAR: Kevin, just one and it's sort of a geometry question. Off to the right there, there's an arrow coming in from the annulus. So in principle, if the retaining baskets fill really full, they could spill over out into the annulus?

MR. CONNELL: Yes. Thank you. That is a key feature to this too, because --

MEMBER STETKAR: I was curious, you know, why.

MR. CONNELL: The idea is that it is nice that these retaining baskets -- now there' four of these located and four openings of course -- that they can communicate to the other retaining baskets.

So as soon as it -- as soon as we rise to this level, it communicates to the other four baskets, other three baskets, through the retaining -- through the annular region, and so that could then -- in essence you would have to fill up all four of those to finally get an overflow over.

MEMBER STETKAR: Thank you. Is there nothing down in the bottom of the annulus that you care about in terms of equipment? I've seen some designs that, because of protecting valves and things like that, they tend to find their ways into the annulus.

MR. CONNELL: For the considerations we have, we know that this area could during accident conditions be flooded, so we have --

MEMBER STETKAR: Anything that --

MR. CONNELL: Right, designed around those --

MEMBER STETKAR: is up at a much higher level --

MR. CONNELL: either consideration that it doesn't matter if it's submerged or if it is, that we have it designed.

MEMBER STETKAR: Thank you.

MEMBER BANERJEE: You mentioned that you

can back-flush. Can you show me on this?

MR. CONNELL: It doesn't show it here but there is a -- it would have a -- there's a flow that you can align so that it would then have a larger pressure in this area and it would create the flush from inside the strainer on out.

We do have --

MEMBER BANERJEE: That's an operator action?

MR. CONNELL: Yes. Again, we don't take credit for it --

MEMBER BANERJEE: No, I know.

MR. CONNELL: in safety space or safety analysis.

CHAIR POWERS: In your upper portion where you have your trash racks.

MR. CONNELL: Up here.

CHAIR POWERS: Do you proscribe galvanized and aluminum?

MR. CONNELL: We restricted the amount of aluminum in that area. We did allow -- in our testing we did allow for some aluminum in our autoclave testing. We allowed for some that would be maybe tags or such, but the design is such that we do not allow the aluminum in that area that would uncoated --

CHAIR POWERS: How about galvanized materials?

MR. CONNELL: Galvanized, I don't believe so either, did we?

MR. MAASS:. I don't believe so.

MEMBER BANERJEE: There is no galvanized material up there?

MR. CONNELL: Not in the flood area, not in the area that we are looking for the break location. We'll need to verify that also but --

MEMBER BANERJEE: Because you know that your German counterparts found that unless you buffer the solution, if you have boric acid, you get significant attack of the zinc and that causes -- I have a beautiful curve which shows how the pressure losses go up within about a little while, which was done by your colleagues in AREVE actually. Okay.

MR. CONNELL: And again, we don't plan to have that, we'll do a verification of that. I don't want to just leave it off the top of my head.

Okay, the next view is from our three-dimensional model. This shows the area of the IRWST. As you can see here, it surrounds most of the bottom part of containment.

So this is the entire pool, approximately

433,000 gallons. These are the retaining baskets, and then we have four of those. We have one located here and here, these are similar designs, and then we have designs for the open areas here and here.

Just above these locations are where the openings from the heavy floor and the trash rack are located. So again, the flow would come into these baskets, these retaining baskets, enter the area of the IRWST. These are the four strainer locations that are poised above the suction of the ECCS system.

Okay, next slide. This goes into a little bit of the detail that we had talked about earlier, defense in depth, first line of defense we are looking at is the two-inch weir and the four by four inch grid surface, the trash rack area that is above the opening that goes down into the IRWST.

MEMBER BANERJEE: What's the material again?

MR. CONNELL: This is stainless steel, four by four inch grid, with the two-inch weir that would be surrounding the outside of this.

Now we have the retaining baskets. We have two single compartment baskets that are designed like this and then two double-compartment baskets.

The minimum flow filtering area that we

have is approximately 721 square feet. The minimum volume for these is 1,500 cubic feet, and then as we mentioned before, 0.08 by 0.08 mesh.

MEMBER BANERJEE: What do you mean by two double-compartment and two single -- I --

MR. CONNELL: This double-compartment design ew have adopted from the OL3 design. It's identical to that. There was more concern with some debris coming in from the annular area for this design.

So the idea was that we would have a compartment that would possibly take most of the debris that would come from the annular area and then be able to rise up separate from the other debris that would come down from the RCS floor.

This is all one large compartment through here. So the design was such that we could take more debris from the annual area. This could then overflow, communicate through the annulus to these other retaining baskets, and wouldn't necessarily overload a basket --

MEMBER BANERJEE: So you have a basket that is not shown behind --

MR. CONNELL: No, oh, I'm sorry, this is just a wall that is in here. So it's double-compartment, it has another wall right here that has an eight by eight -- 0.08 by 0.08 inch mesh separating this portion of the basket.

What's not shown here of course is the wall of the IRWST, so the flow would come in from the annular area area into this smaller compartment here. There's a wall there that has a 0.08 inch mesh.

MEMBER BANERJEE: Okay, so that's what's missing.

That's what I --

MR. CONNELL: It's a little bit confusing from that standpoint.

MEMBER SKILLMAN: So, as we look at this, Kevin, there are four, approximately 721 square foot --

MR. CONNELL: Retaining baskets.

MEMBER SKILLMAN: retaining baskets. You have 28, 2,900 square feet of protection on the four different sets. Is that --

MR. CONNELL: More than that, yes yes. In our second line of defense, just the retaining basket. And then we will get into the strainer itself.

MEMBER SKILLMAN: And when one looks at the -- if you will, the highest specific velocity through the most compromised strainer, what are you seeing in terms of acceptable velocities?

MR. CONNELL: Do you recall what the actual velocities were fo rthis?

MR. MAASS:. No, I do not.

MR. CONNELL: What we did of course was set Pu our tests so that we would replicate in full scale what the velocity would be, the approach velocity would be for that.

So I know we have done the tests and studied what the approach velocity was.

MS. SLOAN: We'll just have to take a follow up item.

MEMBER SKILLMAN: That is fine. What I am really thinking about is even with, say you do have aluminum and you do have zinc and you do get some type of precipitate and it's very small, but it does begin to compromise this 0.08 by 0.08 screen, now do you have a delta-P and a vector that's going to collapse the membrane?

MR. CONNELL: Yes, and we have done testing with precipitants and well, we will go into more of the testing that we have done for that.

MEMBER SKILLMAN: Okay, thank you.

MR. CONNELL: But we will address that.

MEMBER SKILLMAN: Thank you.

MR. CONNELL: Okay.

MEMBER BANERJEE: So you basically have two screens in series --

MR. CONNELL: Yes, let's go back to one more.

MEMBER BANERJEE: of the same --

MR. CONNELL: So essentially, we almost have three screens in series. We have the trash rack, we have the retaining basket screen but the trash rack is four by four inch, and then a 0.08 inch mesh and then another 0.08 inch mesh.

MEMBER BANERJEE: Yes, two similar screens.

MR. CONNELL: Right. We looked at sensitivity --

MEMBER SKILLMAN: Times four.

MR. CONNELL: Times four, correct. Yes, looking at these four locations for the baskets of course and then four for the suction strainers.

Okay. Now these are pictures of the actual IRWST at OL3 and as I mentioned, I was in there a few weeks ago. I actually had to dress-out to get down into it. You had to put -- because it's a clean area now, you had to make sure that you had booties and overalls that were clean material. They didn't want construction material coming into this, and they have actually done down here, you can see a leak test of this.

It's, you know I have seen drawings of it and I have seen the design, but until you go down into that area, it's hard to picture.

The inventory itself as I have mentioned before, 433,000 gallons and even though in our testing we have done some circulation across the bottom so that we prevent any kind of settling in our testing, as you can see, there's plenty of surface area here for debris to settle out also on this floor, as well as above that on the heavy floor too, under the RCS.

MEMBER BANERJEE: So these holes are about two millimeters roughly right?

MR. CONNELL: About a 12th of an inch square.

MEMBER BANERJEE: About two millimeters?

CHAIR POWERS: They are almost exactly two millimeters.

MEMBER BANERJEE: So they are not that small.

MR. CONNELL: But they are good, from the standpoint that they do retain the debris. We had --

MEMBER BANERJEE: They let a lot of fiber and particulate matter through, right?

MR. CONNELL: Yes, about a 70 percent bypass for the -- when you do fiber only through this, you get about 70 percent bypass.

MEMBER BANERJEE: Okay, that's interesting. The -- when you say promotes settling of fine debris, that's a nice statement, but do you actually take credit for it?

MR. CONNELL: No. As I mentioned, we -- in our testing we tried to sweep the bottom of the --

MEMBER BANERJEE: Because it's very hard to take credit for that.

MR. CONNELL: And we had contemplated doing intricate models to show what that is, and we said --

MEMBER BANERJEE: Forget it.

MR. CONNELL: no, it's simpler, let's just keep it stirred up and not even worry about it.

MEMBER BANERJEE: Okay.

MR. CONNELL: Okay.

CHAIR POWERS: It's great that we can ask more questions but --

(Laughter)

MEMBER BANERJEE: I don't think you should waste your time.

MR. CONNELL: Somebody had mentioned too you put a picture in it and a picture is worth a thousand questions too. So, but I think it also gives you the idea though of what we are looking at.

Here is the strainer. Now this does not have the mesh on it. This is just before the mesh is put on there. It's approximately, just under eight feet tall and the minimum filtering area is 690 square feet.

And again we have the mesh and as we have mentioned before there are four of these --

CHAIR POWERS: I am not sure what you mean by minimum filtering area when you quote that number.

MEMBER BANERJEE: Why the minimum?

MR. CONNELL: This is -- for the size that we have right -- the minimum is taking into account the amount material that would not be filtering or we don't take credit for filtering, because of the area behind it has a structure, support structure.

CHAIR POWERS: So you assume that all unobstructed screen --

MR. CONNELL: That's correct.

CHAIR POWERS: to the full height, so you have water clear up to there.

MR. CONNELL: Yes, water about two and a

half feet to a little over two feet above at the minimum level, so it's --

CHAIR POWERS: So that really isn't a minimum. It's what you expect.

MR. CONNELL: Yes. Yes. Okay, so additional features that we have. As we mentioned to you the --

MEMBER BANERJEE: Are these also installed in your Finnish plant?

MR. CONNELL: Yes.

MEMBER BANERJEE: So, it's identical in fact?

MR. CONNELL: Identical to the OL3 design.

MS. SLOAN: That's where the pictures are coming from.

MR. CONNELL: Yes. In fact that's the Finnish strainer right now.

MEMBER BANERJEE: The whole layout and everything is the same?

MR. CONNELL: Yes.

MEMBER BANERJEE: That you showed?

MR. CONNELL: Yes.

MEMBER BANERJEE: So if we wanted to, we could go and take a look at that?

MR. CONNELL: Yes.

MEMBER BANERJEE: Okay.

CHAIR POWERS: I think it's particularly appropriate for you to go and visit that and look, especially since it's February.

(Laughter)

MEMBER BANERJEE: I am in there almost every two months so it's not such a big deal to go down.

CHAIR POWERS: February would be an admirabl etime --

MR. CONNELL: Yes, maybe in the springtime would be a little bit better.

CHAIR POWERS: No. No. Nono.

MR. TESFAYE: Well, we are planning a site visit in January, so you are welcome to join us.

CHAIR POWERS: There you go, Sanjoy. No one can claim that as a boondoggle, can they?

(Laughter)

MEMBER SKILLMAN: As we talk about the GSI implication of this, I am interested at some point in seeing a cross-section of how this robust straining and filtering design enables the refueling equipment to function. This is your RWST in the building and I am curious what the relationship is between that name, RWST, and where your fuel is, because I'm thinking your fuel's up 30, 40 meters above you.

So I'm curious, the use of the term and how you move that inventory where you refuel it.

MR. CONNELL: We can get more into the description of that.

MEMBER SKILLMAN: Thank you.

MR. CONNELL: Okay, so other features that we had talked about the retaining basket is oversized, overlapped the trash rack portal, there's a gap between the top of the retaining basket and the bottom of the heavy floor, about a foot and a half associated with that.

Retaining basket size, mesh size is equivalent to -- is the exact same mesh size as what's used on the strainer. We have inverted side screens on the sump strainer and that really just refers to this slant here.

In order to promote any sloughing of material as you would build a bed, gravity would help have this either slough down or slough off and of course once we use some of the back-flush, it would give the ability to slough off a little bit easier.

And we had also mentioned fibrous insulation was eliminated from zone of influence and we have the non-safety related back-flush capability.

Now I was going to go into our testing program. What we have done is we of course did confirmatory chemical debris testing, and what that did was validate our chemical debris analysis so that we know what chemicals are produced as a function of time through the accident in the IRWST.

CHAIR POWERS: I have no idea what that means.

MR. CONNELL: Okay. It's autoclave testing that we have done for the materials that would be found in containment. We did autoclave testing for using 2,800 ppm boron solution, and then we injected over a period of two hours our buffering solution and then what we did was be able to analyze --

CHAIR POWERS: Did you test epoxy-coated concrete in contact with these various solutions?

MR. CONNELL: Yes, concrete was part of the testing also, yes

CHAIR POWERS: But epoxy-coated concrete.

MR. MAASS:. It wasn't painted.

MR. CONNELL: Did we have any epoxy in it?

MR. MAASS:. No.

MR. CONNELL: Okay.

CHAIR POWERS: So you don't think epoxy does anything in this stuff?

MR. MAASS:. We didn't test it, so --

CHAIR POWERS: Why not?

MR. CONNELL: We'll take a look at -- we didn't believe that it would interact in a way that would create any harmful chemical precipitants.

CHAIR POWERS: What is the dose rate?

MR. CONNELL: The dose rate in lower containment?

CHAIR POWERS: The dose rate in that solution that you are creating.

MR. CONNELL: The radiation dose rate?

CHAIR POWERS: No, we did not radiate during the autoclave testing, correct?

MR. MAASS:. No.

CHAIR POWERS: What -- the epoxy that you use has a solvent. What is that solvent?

MR. CONNELL: The solvent for the epoxy?

CHAIR POWERS: Yes.

MR. CONNELL: I don't know what that would be. Do you have any idea?

MR. MAASS:. No, we'd be using similar specifications that are used for operating platns but I don't know what the solvent is.

CHAIR POWERS: You would typically -- the paints -- epoxy paints give off solvent throughout their lifetime. You don't heat-treat them or anything like that. You put them up and just let them dry. And I presume that is what you do on these concrete surfaces as well.

And the solvents tend to be pretty mobile. They tend to react negatively to being irradiated, make something that looks a lot like glue.

MS. SLOAN: I think we are going to have to --

MR. CONNELL: Yes, we'll take an action item on that.

MEMBER BANERJEE: The chemical autoclave tests and things, were they similar to the ICET tests that were done in the early stages of the chemical effects program under NRC sponsorship?

MR. CONNELL: Are you familiar with the --

MR. MAASS:. Not exactly familiar with all of the ICET tests, the way they were done. What we did was we utilized the information that was gained from that testing and augmented it with the testing that we did. So that was the goal of our program, was to --

MEMBER BANERJEE: But was the design of the experiment similar, or was it different and --

MR. MAASS: That I do not know.

MR. CONNELL: Like we said, we can bring our chemistry department in and we can --

MEMBER BANERJEE: Yes, it would be good to know a few more details --

MS. SLOAN: I don't think we bother chemists today, but there are a team of them --

CHAIR POWERS: Well, when you do that, you might ask them about, well you did testing with concrete and coated concrete so I presume you got some Wollastonite precipitation and things like that.

MS. SLOAN: What sort of precipitation, Dr. Powers?

CHAIR POWERS: Calcium phosphate.

MR. CONNELL: Yes, we had calcium phosphate, aluminum oxyhydroxide and sodium aluminum silicate, were the typical precipitates --

CHAIR POWERS: Everywhere, that's dirt. You have got bromide coming out because you had some aluminum in there. It's interesting. It's hot. How how was your autoclave test?

MR. CONNELL: We've had the range of -- we tried to follow the range of the temperatures of the IRWST so we started it around 120 degrees and went up to saturation at around 210 and then came off of that.

Again, we tried to follow the same profile that we'd expect.

CHAIR POWERS: There's an ASTM standard for qualified coatings that involve substantially hotter temperatures than those for more protracted times. I wonder why you didn't follow that protocol. Maybe you did, because it's -- I mean, it's a strange ASTM test. You calculate what your environment is and that dictates the temperature and pressure protocols, so maybe you did. I don't know.

MR. CONNELL: I don't know. We have to check with our chemistry department.

CHAIR POWERS: That would be interesting to see.

MR. CONNELL: Okay.

MEMBER SKILLMAN: I would like to add to Dr. Powers' question about the coatings and the radiation level on the coatings. It sounds like you know, why would that matter.

And I would offer that the most important time when this equipment is responding is when there has been a core damage accident and you are pouring highly radioactive water down into the sumps, and in a sampling of one, TMI's water, it was 150-200 microcuries per cc, and the primary emitter is cesium strontium, and we pooled the water, 55 ccs for an eight R per hour meter. The water itself was the source term and its residue remains there today.

And so at the time when the success of the coatings and the strainers and the filtration are most important, can be when the radiation level is beyond what most people might have considered.

And so if that source term is able to release from the coatings, from the epoxy, some form of a solvent, or if it's able to lift the epoxy off the concrete, then I would suggest that for the design to be complete, that needs to be a design consideration, what's the radiation level that this material is successful with.

And that data is easily available but I would just offer that those radiation levels were beyond what most people ever imagined.

MR. CONNELL: Okay.

MEMBER SKILLMAN: Thank you.

MR. CONNELL: Yes, we'll follow up on that.

CHAIR POWERS: The equivalent qualification dose rates are pretty formidable. It surprises me how high.

MR. CONNELL: For our other testing of course we went through strainer retainer basket testing. We tested those both in tandem, and then we also conducted our fuel assembly downstream effects testing.

MEMBER BANERJEE: So did you do what we would call a prototypical geometry test, or are you going to go into these tests --

MR. CONNELL: Yes.

MEMBER BANERJEE: in more detail?

MR. CONNELL: I'll go into the geometry that we used, the scaling that we used.

MEMBER BANERJEE: And did you use chemical surrogates?

MR. CONNELL: Yes.

MEMBER BANERJEE: And these were the approved surrogates?

MR. CONNELL: That's correct.

MS. SLOAN: Can we go back to your question about situations with core damage. At that point, I think you are beyond the design basis conditions from which we would be able to analyze this.

CHAIR POWERS: It doesn't matter. The source term you have to consider in the DBA is close enough to a severe accident source term so it doesn't really matter. His point is still valid.

MS. SLOAN: Okay.

CHAIR POWERS: Because you have presumably ballooned and ruptured cladding.

MS. SLOAN: I guess I would argue that perhaps we might end up addressing it in a different way because I think the story you will hear from Kevin is we have taken every possible conservatism we believe is reasonable in how to address a design-basis accident, and I think once we got into beyond design-basis type conditions, there might be different assumptions and ways that we would evaluate that.

I think we've had to think a little bit about conditions where the core is degraded.

MR. CONNELL: Yes, and again we did it consistent with the protocols of testing that the industry has used up to this point. So the only hesitancy I wanted to express though is I wanted to go back and talk to my chemistry folks before I said exactly what kind of radiation levels or why we did not consider radiation levels.

MEMBER BANERJEE: But I guess Dana's point is that even in the design basis scenario, you have to consider pretty high radiation levels.

MR. CONNELL: That's what I want to go back and investigate, yes.

MEMBER BANERJEE: Yes.

MR. CONNELL: What is postulated -- what are the radiation levels postulated for a loss of coolant accident? That's what we will need to go back and take a look at.

Okay. This gives you a little bit of an overview of the timeline of our testing. Owners' group downstream effects testing took place in the end of 2009.

We did our autoclave testing also in that same period. We did a number of strainer basket head loss testing through 2010 and then we conducted our own downstream effects testing at the end of 2010, and then again earlier in mid-part of this year.

We'll go into a little bit more detail but it will just give you a little bit of a timeline of the progression of the testing we had.

MEMBER BANERJEE: I'm just trying to read this fiber bypass and maximizing thin-bed effects had no what?

MR. CONNELL: We'll go into that in a little bit more detail.

MEMBER BANERJEE: Had no effect?

MR. CONNELL: Right.

MEMBER BANERJEE: Ah, effect was missing.

MR. CONNELL: Which one are you talking abouT?

MR. MAASS:. Second one over.

MR. CONNELL: Second one over.

MR. MAASS:. Yes, missing the final punchline.

CHAIR POWERS: It has no S. It must get cut off in the --

MEMBER BANERJEE: Attempts to reduce -- increase strainer head loss I assume. Well, that's to be expected right? It reduces bypass.

MR. CONNELL: What we had to consider was how much fiber we had. We had two considerations. You have fiber in containment, you want to be able to strain it, but then again you don't want to have too much of a head loss so that you'd start your ECCS pumps.

So we -- what we do, we did sensitivity testing on the strainer material itself to see if we can optimize that somehow, maybe even have a variation between the basket and the strainer.

And what we determined was those variations really did not make that much of a difference, so that -- part of the key was that the system was already designed fairly well. The key was let's reduce the source, let's look at of course eliminating all the fibrous insulation in zone of influence, and then also have a cleanliness program that maintains that, so that the latent debris and the fiber in that latent debris are also minimized too.

MEMBER BANERJEE: In the Finnish plants do they also use two-millimeter holes?

MR. CONNELL: Yes.

MEMBER BANERJEE: So it's the same hole?

MR. CONNELL: Same, same design. Okay. So the testing that we have done for the strainer basket head loss testing, we did five types of tests. What we were really trying to concentrate on though was two objectives, of being -- making sure that the dp, differential pressure across the strainer and the basket, mostly the strainer, is maintained at an adequate level that does not starve the NPSH for the pumps.

And then also what we wanted to do was to try to optimize or minimize the amount of bypass that gets downstream to the downstream effects testing.

MEMBER BANERJEE: You said that 70 percent bypasses of the fiber.

MR. CONNELL: We -- it was less than 70 but we conservatively bounded at 70, yes.

MEMBER BANERJEE: So a lot of fiber that gets through.

MR. CONNELL: Unless you don't have much to begin with.

MEMBER BANERJEE: There is always fiber. That's the problem. Anyway, let's go on.

MR. CONNELL: Okay. So the five tests that we did was debris transport, the clean strainer head loss test, the design basis debris load test, and then we did the thin bed and fiber-only tests, and I'll go into a little bit more detail with what we looked at for those.

But first I wanted to talk about the scaling. For the vertical scaling we essentially have a full height scale test. It was essentially a slice of the basket and strainer combination.

For the flow area we had slightly less than 1 to 10. For the --

MEMBER BANERJEE: It was a smaller basket or a full-sized basket?

MR. CONNELL: Fill-sized basket. We'll go through to an actual picture of this. So this kis si the test facility. It's a test flume, that we have the basket that is designed here, and on this side we would have the 0.08 inch mesh and allow it to actually overflow if necessary and come down into the IRWST, the rest of the IRWST.

This is the strainer and again it was essentially a slice of the -- it's a full height of the basket and a full height of the strainer itself but not full width.

We just took a portion of that to represent a little bit less than one tenth.

Okay. You want to go back? Yes. Thanks. The flow area, again, we had 1 to 10 and then the flow rate, the overall flow rate was 1 to 10.

Now that the actual velocity though that it would encounter would be similar to the velocities that we would expect in the actual IRWST.

MEMBER BANERJEE: When you've got stuff falling ointo this, does it -- this is coming fomr what? A few feet up?

MR. CONNELL: Yeyes.

MEMBER BANERJEE: And does it cause the fluid to be turbulent in this basket?

MR. CONNELL: There are some dynamics inside the basket area, and that's what we had looked at to see if we could possibly optimize that with some of our sensitivities, but you do have some of the turbulence of course, of the churn of that but then of course you would have the flow that goes straight out through the basket itself.

We have been able to actually look at even some smaller sections of this, some even smaller scale testing and see what kind of flow patterns we would have to see if we could optimize it from that standpoint.

But in the end the best material was sufficient for what we really needed to do, the straining capability and, the robustness of capturing any paint chips, any debris that come through the trash racks, that basket was ideal from that standpoint.

MEMBER BANERJEE: The flow coming into the basket, does it sort of come down like a waterfall, or what's the --

MR. CONNELL: Yes, it would be free fall from the floor, and it would create a turbulence.

MEMBER BANERJEE: And would it be like a sheet of water or a jet of water or --

MR. CONNELL: More of like a jet of water you know, you would be coming from all sides. What we simulated that was a jet of water from three different nozzles coming down into it to simulate the contact.

MEMBER BANERJEE: But when you scaled this experiment, you had a setup to add water in the same way, like a small section of what you'd expect.

MR. CONNELL: Correct. For the same amount of flow that that section would see.

MEMBER BANERJEE: Right, and how much -- what was the velocity of the falling water?

MR. CONNELL: I'm not sure.

MEMBER BANERJEE: It's only two feet up. What's your --

MR. CONNELL: Yes, we --

MR. MAASS:. The velocity -- well, our flow rate for the pumps were about between 300 and 325 gallons per minute. The initial drop from the heavy floor to the surface of the IRWST is approximately seven to eight feet.

MEMBER BANERJEE: Oh okay. So it was coming down quite a clip.

MR. MAASS:. Yes.

MEMBER BANERJEE: So roughly how many feet per second?

MR. MAASS:. That I couldn't tell you right off the top of my head.

MEMBER BANERJEE: I just want to get a feel for how turbulent this is. Was it splashing around or was it just --

MR. CONNELL: Yes ,there was some you could see, also you would have the -- the flow would go in below the surface and come back up again. It would only be about half a flick below the surface that the water that the jet would penetrate roughly.

But that is all contained within the basket area too, so you would have that type of frothing, that type of turbulent water. There's a lot on the surface. It would create some sort of a flow stream also through the basket. It would be randomly turbulent through that area too, but again, then it would flow out, of course, we have the suction point in the strainer area so that would then eventually create flow streams that would go through the retaining basket and then through the strainer.

MEMBER BANERJEE: And the velocity, typical velocities through these two-millimeter holes, or screens, how much was this?

MR. CONNELL: It varies of course. At the surface it was a lot higher. We had some -- I don't recall exactly what those velocities were though. They had -- we had plotted out as part of our tests what types of velocities we would see at the varying heights.

MEMBER BANERJEE: So you would expect that the velocities would be a bit higher at the bottom because of the head of water but you are saying that it was higher at the surface?

MR. CONNELL: You would have some surface flow right through and again, it depended on you know what stage your basket was filtering at, you know, at the first, yes, you would get a lot of flow because it would be --

MEMBER BANERJEE: At the bottom.

MR. CONNELL: At the bottom, right.

MEMBER BANERJEE: And that would clog up --

MR. CONNELL: And then you would start to rise up and then you would get a little bit more flow through there. You'd still have flow of course through the whole entire basket, and at different high flow areas you would have a little bit less debris until they would essentially film, you know, form a film --

MEMBER BANERJEE: So if you ran this for a long time, did you find that the debris became fairly uniform after a while, or did you still have a gradation?

MR. CONNELL: No, it became -- we were able to reach a steady state.

MEMBER BANERJEE: So it would come to -- more or less cover the --

MR. CONNELL: Once we added all our debris, yes.

MEMBER BANERJEE: Yes.

MR. CONNELL: As we added stages it would come to a steady state for that, and then -- and you are right, it was pretty much evenly distributed because as you can imagine, you would have flow through the less dense areas, you would have more flow and then of course they would bring more and more debris until you hit a point where it would equalize.

MEMBER BANERJEE: But the thing is, if let's say you have got 70 percent fiber bypass, ultimately you know, assuming it doesn't get stuck in the fuel, or if it -- let's hope not -- it comes back in some form, doesn't it?

MR. CONNELL: Yes. We recirculate --

MEMBER BANERJEE: You recirculate it. So does that mean that you eventually take out all the fiber, or does it still continue to give you a bypass? As you slowly form a mat on this, did you find that it would eventually take out all the fiber?

MR. CONNELL: Well, the way we had tested it, we had filter bags so that -- for the bypass testing --

MEMBER BANERJEE: Okay.

MR. CONNELL: We simulated, assumed the very worst case, just fiber, and then we would only go through one pass of it.

MEMBER BANERJEE: Just one pass.

MR. CONNELL: Right. And then we would capture the fiber and we'd say that's the bypass. In reality you're right, it would continue to filter itself, and so it wouldn't continually see -- the 70 percent bypass would degrade over time, but we did not assume any of that.

MEMBER BANERJEE: Yes, the concern, well, the problem is on two sides. One is of course the fiber going through what effect it might have on downstream effects. And now the other concern is that as you push the 70 percent through, assuming that now it doesn't get stuck in the fuel and all that stuff, that it comes back eventually, then does it build up, you know, and progressively you filter that out, so ultimately all of it ends up on your screens?

MR. CONNELL: Yes.

MEMBER BANERJEE: So that two different scenarios, I mean building up on the screens is probably not as getting caught in the fuel, but nonetheless one hsa to look at those two extremes, and I'm wondering how you did that.

MR. CONNELL: Well, and essentially our design debris loading test did that. We threw all the debris in. We would measure the dp across the strainer, and again it's in the basket strainer combination.

The other conservatism is we threw all the debris, the 100 percent of the design debris, into the one basket. We assumed all of it came into one because we could not necessarily prove that -- what the exact split would be between the different baskets.

MEMBER BANERJEE: Right right, I understand.

MR. CONNELL: So we threw all that in. The result is the basket did fill up with paint chips and such, it filled up and it actually overflowed, but the downstream effect of that was there was no dp, no significant dp across the strainer itself.

The basket took most of that filtration off, so we looked at that as our design debris, you throw everything in, what happens?

And that was then compared to of course the thin bed and also the fiber-only test too. The fiber-only test was the worst-case study to say how much would get downstream, because what we found is if you throw other debris in, that debris helps filter it too, you know, the paint chips and the RMI and all the other debris, that helps retain it too.

What would happen in the worst case, if you didn't have any other debris, you just had the fiber and that's where you get the downstream effects basis.

MEMBER BANERJEE: Right, no, all I'm trying to understand is I mean there are two sort of broad scenarios. One is that you know you just have essentially one path and it goes through your -- some material goes through your baskets, some goes through your strainers, and that eventually they get to the in-vessel or whatever, and some of that gets caught there.

And let's say that all the fiber is taken out in this process so none of it recycles back. That's one limiting scenario. The other limiting scenario is that all of it recycles back so that 100 percent of your fiber ultimately ends up on your strainer so that in order to get let's say a bounding estimate, because fibers we have found settles very slowly in turbulent flows, so it's very hard to make a case for fibre or fine particulate settling. This is an ongoing debate with existing plants as you know.

MR. CONNELL: Yes.

MEMBER BANERJEE: But it's been very hard to prove that there will be significant settling given the highly turbulent conditions and inlet settling and all that sort of stuff.

So let's assume that everything is particulate and fiber, let's just, I'm postulating this as a thought problem, is brought to your baskets and strainers. Some of it gets through.

And then whatever happens downstream, happens downstream and none come back, which is the sort of thing that I'm sure your strainers and your baskets work well for that.

Now imagine that on the other hand the other bad scenario is none of it gets stuck and all of it eventually comes back because it's always entrained, and so you will eventually end up with 100 percent of your fibers and particulates on your strainer and your baskets.

Now, when that happens, that means you have been recirculating that flow for a long time. Have you done tests of that nature really?

MR. CONNELL: Let me describe the test

that we did. I believe it addresses the issues you are talking about. When we do a fiber-only test, for the strainer basket combination, from there it is only a one-pass, again this is the worst case, we throw in all the fiber, we actually batch it in small amounts, so that we are not just throwing it in in clumps onto the --

MEMBER BANERJEE: Nono, I realize, that is the worst-case -- the worst-case downstream effect.

MR. CONNELL: So it collects all that fiber.

MEMBER BANERJEE: Right.

MR. CONNELL: Now, we take that to downstream effects testing --

MEMBER BANERJEE: Right.

MR. CONNELL: And we say we are not taking account for the fact that it could get refiltered again --

MEMBER BANERJEE: That's the worst case for your downstream.

MR. CONNELL: So we are throwing all that into our fuel assembly and at that point, that's when we measure the delta-P and then we throw in the chemical precipitants too, because that's really the bad actor that starts to make the goo --

MEMBER BANERJEE: And I hope you throw in particulates.

MR. CONNELL: We throw in particulates, yes.

MS. SLOAN: But I think your question Dr. Banerjee is if all the fiber collected on the screens, what would the dp be, what would the net effect be.

MEMBER BANERJEE: Yes, all the fiber and particles.

MS. SLOAN: It just recirculates to infinity where it all finally ends up on the screen surface.

MEMBER BANERJEE: That's exactly my question.

MR. CONNELL: But that case should have been covered though in the original design debris case --

MEMBER BANERJEE: Perhaps it was --

MR. CONNELL: we threw all of it in there. Yes. And we kept recirculating and until it --

MEMBER BANERJEE: Okay, so you have answered my question then. That's really what I was asking.

MR. CONNELL: Yes.

MEMBER BANERJEE: Did you throw it all and just keep recirculating

MR. CONNELL: Yes.

MEMBER BANERJEE: so it all ended up on the screens. So you did that.

MR. CONNELL: Yes.

MEMBER BANERJEE: And you did -- because it's not just fiber, it's fiber plus particulate plus chemicals that matter. I mean all of the above, right?

MR. CONNELL: Yes. Did you want to add anything, any other details to that?

MR. MAASS:. No. Yes, we did use the standard. We put particulates in first and then fiber and then the chemicals and we ran the test for approximately 24 to 36 hours.

MEMBER BANERJEE: And you used silicon carbide for your particulates?

MR. MAASS:. Yes.

MEMBER BANERJEE: So you used all the usual surrogates?

MR. MAASS:. Yes.

MEMBER BANERJEE: Did you use hair?

MR. MAASS:. No we did not.

MEMBER BANERJEE: Not for your fuel right, fuel downstream effects?

MR. MAASS:. No.

MEMBER BANERJEE: We've had problems with hair. They don't behave the same as other fiber. I can't tell you how we know. Some other people have --

MEMBER SKILLMAN: My I ask if I could go back to 15 please. I believe the second bullet is communicating that the velocity that you used is the velocity that you would expect to see in an actual event. That's what one to one means?

MR. CONNELL: That's correct.

MEMBER SKILLMAN: The horizontal direction seems to me to deserve an explanation. If I read the little Excel top chart there it's 1 in 10. Should I interpret that to mean instead of using what could have been 20 feet a second horizontal, you used two?

MR. CONNELL: Oh no, that wouldn't be velocity. That would be --

MEMBER SKILLMAN: It says flow rate --

(Simultaneous speaking)

MEMBER SKILLMAN: Q always equals AV and so what I am really getting at is the aerial flow rate in a horizontal direction that is kilograms per second per 100 square centimeters or gallons per second per square foot or whatever metric you might use, the danger in these systems is the velocity.

And if the velocity is stemmed because of plugging, that is your delta-P and that is what will starve ECCS. So please explain that third bullet, the scaling, please.

MR. CONNELL: Gene will go ahead and talk through this one then.

MEMBER SKILLMAN: Okay.

MR. MOORE: I will -- Kevin is bringing the slides, picture.

MR. CONNELL: Okay, what we have is actual recirculation flow at the bottom of the test facility. This recirculation flow is meant to disrupt any material that would form at the very bottom of that. We would still have, for the horizontal flow coming into the strainer itself, it still would be a one to one type of communication.

MEMBER SKILLMAN: And one to one in that context means the velocity horizontally through the slanted strainer, 0.08 0.08, is the velocity that would be experienced by the actual ECCS pumping equipment when iut was in service after a LOCA.

MR. CONNELL: That is correct.

MEMBER SKILLMAN: Thank you.

MEMBER BANERJEE: There is a subtle aspect to this and I think it's fairly important to understand, that if you did this test in this segment, you have to really ensure that there is no settling between the basket and the strainer, because in real life, if you look at this, this is very turbulent, there are flows parallel to the -- you know because of the geometry of the system.

MR. CONNELL: Yes.

MEMBER BANERJEE: So did you ensure that nothing settled between them?

MR. CONNELL: Yes.

MEMBER BANERJEE: Stir it up or whatever?

MR. CONNELL: Yes that's what this pipe arrangement is. This is the region between the strainer and the basket. The recirculation flow that we had, you can see the pipe go across the bottom of this too.

It had jets of water that would flow out across the flow --

MEMBER BANERJEE: Keep it entrained.

MR. CONNELL: Yes, to keep --

MEMBER BANERJEE: Okay.

MR. CONNELL: so that there would not be any settling --

MEMBER BANERJEE: All right.

MR. CONNELL: on that floor.

MEMBER BANERJEE: So you guys did everything on that one,

MR. CONNELL: We think so, yes.

MEMBER BANERJEE: We'll have to go and take a close look at it at some point, but it's still operational?

MR. CONNELL: We have had the staff of course --

MEMBER BANERJEE: Yes yes.

MR. CONNELL: witness many of these tests.

MEMBER BANERJEE: Okay.

MR. CONNELL: Okay. We talked about many of these tests before so I will go through a little bit faster to see if there's any questions associated with it.

So the thin bed test. This was really designed to make sure that we did not have a thin bed issue where, as you know, you could build up a very thin bed that would have a larger delta-P than possibly having a large amount of fiber from the testing --

MEMBER BANERJEE: There's many experiments which have shown this of course.

MR. CONNELL: Yes. That's right. So what we have done for the US EPR, we were able to cut down on the batch sizing so that we added smaller and smaller batch sizes to see if we would create a thin bed effect on that, and for the -- again we threw 100 percent of the debris in for this strainer test.

Results was that the basket did not overflow. We did see some rise in the basket but it did not overflow. So it -- so that is telling us that everything is getting strained by that first retention basket strainer and then we didn't have to take into effect any other kind of flow over that that would then carry fiber directly from the heavy floor on into the strainer itself.

MEMBER BANERJEE: Don't go so fast. And this was ==was this test also done with this recirculation that you are talking about, so ultimately all the fiber ended up on these beds or --

MR. CONNELL: Yes.

MEMBER BANERJEE: As you formed the mat, it will eventually --

MR. CONNELL: It kept rising in the basket, rising in the basket, but for the design-basis amount that we threw in, the 100 percent, it never reached the top of the basket.

MEMBER BANERJEE: Okay, but you effectively took out all the fiber? At the end of the day you got almost clear water going through?

MR. CONNELL: What we did was we ran the test until we had a stable level of water. Now I don't think we ran the test until we filtered 100 percent out.

MEMBER BANERJEE: Okay, so whatever. Some fiber may still have been going through.

MR. CONNELL: That's right. But as a function of time it would diminish, your actual bypass would diminish.

MEMBER BANERJEE: You did this with fiber only, with fiber and particulates and fiber, particulates and chemicals? I just want to make sure I get this clear in my mind.

MR. CONNELL: The thin bed and -- it was just the fiber and particulate, correct, I mean and the precipitants, right?

MR. MAASS:. No, for the thin bed test and the design-basis test, it was all three. We added the particulate first, then the fiber, and then the chemicals for everything except for the fiber-bypass only tests. And that was just fiber.

MEMBER BANERJEE: And you ran them to steady state?

MR. MAASS:. Yes.

MEMBER BANERJEE: How many hours did that take?

MR. MAASS:. Roughly between 24 and 36.

MEMBER BANERJEE: That's long enough.

MR. CONNELL: And we talked about the fiber-only test. Again, we used 100 percent of the -- let me add too, with the fiber-only test, another conservatism was that we used the filter bags with one micron?

MR. MAASS:. One micron.

MEMBER BANERJEE: But that was to find the bypass.

MR. CONNELL: To find the bypass, but if you think about it, it's -- all we do is weigh it before and then weigh it after, and we are assuming every bit of weight difference is fiber.

MEMBER BANERJEE: Yes, there's some particulates in it as well.

MR. CONNELL: Right. Right. So, but it was very accurate as far as --

MEMBER BANERJEE: You have the same problems as everybody else.

MR. CONNELL: Yes. You have seen it before.

MEMBER BANERJEE: But nonetheless,

everybody also assumes fiber because there is no -- well, you could analyze what's in there --

MR. CONNELL: Yes, we could.

MEMBER BANERJEE: of course. And you could get a better picture of what --

MR. CONNELL: The SEM. And in fact, we originally did ont use the filter bags. We usually did SEM analysis. We found that that was very much less than 70 -- we had a smaller bypass.

MEMBER BANERJEE: You had the option to do detailed analysis --

MR. CONNELL: I know but we were able to get all the way through it with this, so we said that's accepted protocol, there's very little questions that we would anticipate with that approach.

We talked a little bit about the zone of influence. This is the standard zone of influence that we used in our design for metal reflective and for qualified coatings, inorganic zinc and then jacketed Nukon.

As I mentioned before too, the design -- we have eliminated the use of the fibrous insulation in the zone of influence so the only fiber that we have to contend with at this point is the fiber that is in the latent debris.

MEMBER BANERJEE: So now, with this jacketed Nukon, 17D, you are assuming that the jacket will protect the Nukon, or do you not have any Nukon?

MR. CONNELL: It is defined in our zone of influence that if we used Nukon bands, we would use that, but we eliminated it. So we didn't have to take it into --

MEMBER BANERJEE: Okay. But that's sort of a little misleading.

MR. CONNELL: Yes.

MEMBER BANERJEE: Okay. Because you don't have Nukon within your 17D. Is that how I understand it?

MR. CONNELL: No, we do not have Nukon within our 17D.

MEMBER BANERJEE: Okay. So that you can take it out.

MR. CONNELL: You can take it out.

MEMBER BANERJEE: So that we don't get confused.

MR. CONNELL: But for completeness that's what we would have assumed.

MEMBER BANERJEE: That you would have assumed, but you don't have Nukon there.

MR. CONNELL: That's correct.

MEMBER BANERJEE: Okay.

MR. CONNELL: And the chemical debris that we had talked about before, we used a StreamAnalyzer to predict what the aqueous solution specification should be, the pH, precipitants, form versus time, performed autoclave testing and then yielded the precipitants that we had talked about, the aluminum oxyhydroxide, calcium phosphate and then sodium aluminum silicate.

Of course we didn't use -- we used a surrogate for the aluminum -- the sodium aluminum silicate because of the hazardous material for that

MEMBER BANERJEE: But you used the surrogate in your experiment?

MR. CONNELL: Yes.

MEMBER BANERJEE: The approved surrogate.

MR. CONNELL: Right, that's correct.

CHAIR POWERS: Derek is now -- has the material.

MR. CONNELL: Okay, so as a summary of the strainer and retaining basket tests, we ran 50 small-scale sensitivity tests --

MEMBER BANERJEE: Excuse me I need to get back. Where do you have fibrous insulation at the moment?

MR. CONNELL: We have some fibrous insulation that we would allow in lower containment. Our RCS system is all reflective metal, even down to small bore. We have it all designed for reflective metal.

Presently the bottom of the pressurizer, all the RCS components, they are all reflective metal. We would anticipate, Fred, what other locations --

MR. MAASS:. Areas where we would expect would be outside the zone of influence like steam piping and things like that we have the option of putting fibrous material outside that, and that's generally outside the equipment space since we have a two-room containment.

MEMBER BANERJEE: And are there any accidents which would require recirculation cooling which would occur in these areas, forming jets?

MR. MAASS:. No.

MEMBER BANERJEE: None whatsoever. None of them require any form of --

MR. MAASS:. That is correct.

MEMBER STETKAR: If the baskets fill up there will be water flowing out there though.

MR. MAASS:. Yes.

MEMBER STETKAR: That's a --

MR. MAASS:. Annular space.

MEMBER STETKAR: question I asked about that --

MR. MAASS:. Yes.

MEMBER STETKAR: That annular space --

(Simultaneous speaking)

MEMBER STETKAR: penetration areas that --

MR. MAASS: Yes.

MEMBER STETKAR: But those aren't jets. That's just circulation of fluid. Is the fibrous insulation out in those areas up high or is it down in those areas?

I've been looking at geometrical layouts because I don't know anything about fibers and things like that, but those are characterized as pipe penetration areas. Are there piping penetration areas or -- what are they? The spaces are characterized on the plan views as penetration areas.

MR. MAASS:. The -- we will try and make a distinction in what we are saying. The annular space is in the service area inside the containment that we are talking about, as opposed to the annulus building itself. Okay.

MEMBER STETKAR: Yes, and I understand, if you go back to Slide 4, that that -- what I will call the spill-over space goes into the annular spaces inside the = what I'll call the, I don't know, the shield wall or something like that.

MR. MAASS:. Right.

MEMBER STETKAR: So and those are characterized, at least on the plan drawings, as penetration areas.

MR. MAASS:. Yes, the piping won't go through there. We have no intention of allowing any fibrous insulation below the flood level.

MEMBER STETKAR: Below the flood level. Okay.

MR. MAASS:. Which is approximately seven to eight inches.

MEMBER STETKAR: Yes, I mean, you know, I have been trying to look at elevations and plans and you don't get the full picture, but okay.

MEMBER BANERJEE: It'd be interesting though to just know where, you know, it's some sort of a layout where the -- maybe it's already there in your --

MEMBER STETKAR: In principle, there's no water out there unless the baskets fill up on this drawing to minus seven feet, you know, and the water spills out into that area.

But that area goes down -- I think that areas goes down below that to some level, right?

MEMBER BANERJEE: You may already have the information somewhere where you can just point us to it, but we would like to see where you are going to allow fibrous insulation.

MR. CONNELL: We can follow up on that.

MEMBER BANERJEE: It may be prudent for people not to put it in anyways, but that's a separate issue.

MR. CONNELL: Okay. So that brings us to the summary. As I mentioned before, we had 50 small-scale sensitivity tests that took place late last year and then continued on to the very beginning of this year.

That's where we looked at varying the material that we had for the filtering medium, looked at smaller and smaller hole sizes, perforated plate as well as mesh, determined that for our design, it really was the optimum for 0.08 inch mesh material.

Then we conducted 15 large-scale tests to determine what the actual bypass --

MEMBER BANERJEE: How small were the small-scale tests?

MR. CONNELL: They were more table-top

tests that were conducted at Alliance Research.

MR. MAASS:. Halden.

MR. CONNELL: Halden, I'm sorry. And I guess the --

MEMBER BANERJEE: This is Halden, where is it, New Jersey?

MR. MAASS:. Worcester, Massachusetts, near there.

MEMBER BANERJEE: Worcester, Massachusetts. There are two or three places doing testing and so I keep getting mixed up where they are.

MR. MAASS:. The downstream testing was done in Ewing, New Jersey.

MEMBER BANERJEE: Okay. So these small-scale tests and then the large-scale tests were done at the same place?

MR. MAASS:. Yes.

MEMBER BANERJEE: Are these tests still operational or have you have closed them down?

MR. CONNELL: They can be restarted again --

MEMBER BANERJEE: If needed.

MR. CONNELL: if we needed to.

MEMBER BANERJEE: Okay.

MR. CONNELL: The flumes still exist.

They are with the strainer and basket.

MEMBER BANERJEE: But you'd have so little -- essentially you are saying you have latent debris. There's nothing else.

MR. CONNELL: That's right. We have gotten down to the point where that's all we have, is latent fiber. And they were summarized in our tech report

MEMBER BANERJEE: You reported these tests, they are available? The staff have them?

MR. CONNELL: They will have the latest report on the 18th.

MEMBER BANERJEE: Okay.

MR. CONNELL: Okay. That concludes our open session.

MEMBER BANERJEE: Let me just -- one second.

MR. CONNELL: Sure.

MEMBER BANERJEE: So no significant head because everything was taken out by your baskets, right?

MR. CONNELL: Correct.

MEMBER BANERJEE: Okay, thanks.

MEMBER STETKAR: I think it's a good question that Dr. Banerjee raised about where you will have fibrous insulation. I am thinking about things like feedwater and steamline breaks that would then communicate -- yo udo get high-pressure jets out there in the penetration areas, let's call it.

That water will then -- it's not a LOCA but that water will then flow down through that space and communicate in through those annular openings into the IRWST from which your you know, injection pumps -- we are not talking about recirculation now. We are just talking about normal plant injection, which you will need in some form for steamliner --

MEMBER BANERJEE: It happened in the past.

MEMBER STETKAR: Yes.

MEMBER BANERJEE: Yes.

MEMBER STETKAR: So despite the fact that it's not a design-basis LOCA type zone of influence, because of those communication pathways there might be stuff that comes in the other way, for not necessarily LOCA recirculation, either, I'm just thinking about normal -- because it's your IRWST after all.

MR. CONNELL: But again it had to go through the tortuous path, settle out --

MEMBER STETKAR: It does indeed. It has to be able to get there. But --

MR. CONNELL: Yes. Yes. And you still

have the trash rack and then the basket itself.

MEMBER STETKAR: Exactly. Sure.

MR. CONNELL: So those are fairly large surfaces too. And we also find the clump material, I mean we are taking the most restrictive fines you know, and when you clump the material, that doesn't have as much of a dp, that doesn't have as much of a concern. It gets caught in the basket, it doesn't even really get to the strainer is what we have been finding.

MEMBER BANERJEE: So ultimately if it is exposed for a long period of time --

MR. CONNELL: And baked.

MEMBER BANERJEE: Yes. Yes. So I think you are doing okay. All right.

MS. SLOAN: So we should pause.

CHAIR POWERS: We now have a pause to close this session and I turn to our --

MR. WIDMAYER: We are good right now.

CHAIR POWERS: You are good? We think we are good. Do you think we are good?

MS. SLOAN: If he says we are good, we are good.

CHAIR POWERS: Well, it's your material.

MEMBER BANERJEE: It's your material, it's your audience.

MS. SLOAN: If there are members of the public who are not AREVA, UniStar, PPL or Bechtel, I would say we need to ask them to leave.

MR. CONNELL: But Bechtel is okay. You can stay.

CHAIR POWERS: Please charge ahead then.

MR. CONNELL: Okay.

(Whereupon, the matter went off the record to go into closed session at 11:37 a.m.)

AFTERNOON SESSION

1:01 p.m.

CHAIR POWERS: Okay, we are going to move to Auxiliary Systems I guess. Getachew, you're going to lead us out?

MR. TESFAYE: Yes. Today we hope to finish Chapter 9, Group 1 which is all the sections except 9.1 Fuel Handling and Storage Systems. Our plan is to complete that today so that we can devote the whole full day for Chapter 7 and Charlie tomorrow.

CHAIR POWERS: Okay, so we should be done by no later than 1:30 tomorrow, right?

(Laughter)

MEMBER STETKAR: You mean 1:30 tomorrow with Chapter 9?

CHAIR POWERS: No.

MEMBER STETKAR: Okay.

CHAIR POWERS: I'm counting on us being done with it early tomorrow.

MR. TESFAYE: Hopefully we'll bring the second part of Chapter 9 in January.

CHAIR POWERS: In January, okay. Okay.

MR. TESFAYE: With that I guess I leave it to AREVA to make their presentation.

CHAIR POWERS: Oh Darrell, are you leading the charge here?

MR. GARDNER: Yes, sir.

CHAIR POWERS: You can do this without Sloan supervision?

MR. GARDNER: She's close enough to reach over and whack me if I deserve it.

CHAIR POWERS: All right, okay. We don't have her up there front and center. You guys did it great. That information briefing was terrific. I liked it. I know you were quiet, you didn't say anything.

(Laughter)

CHAIR POWERS: When you come for the full thing she does the chemistry section, okay? Go ahead, Darrell, I'm sorry.

MR. GARDNER: That's all right. So as Getachew said we're going to do Chapter 9 today. It's an overview of what's in the US EPR FSAR with the exception of Section 9.1 which we'll discuss hopefully in January. Today's overview will focus on the most significant systems within this portion of the chapter. While we have not prepared specific presentation materials on all the systems such as the non-safety systems, turbine island, secondary side heat removal, those kinds of things, we are prepared to answer any member's questions on those systems should you have any. The EPR design approach for those systems are fairly typical and consistent with the existing operating fleet. And given the scope and size of the material in this chapter we're focusing on the most important systems.

So with that, we have a pretty good team here assembled this morning, this afternoon now. Steve Huddleston will be doing the water systems and Jean Lindstrom will be doing the drains and sampling systems, and Fred Maass will be covering a CBC PASS and extra boarding system. And then we're going to do a little bit of a shuffle to get through the rest of the chapters with more presenters. So with that I'll turn it over to Steve to get started.

I guess I just want to make one quick introductory remark I guess to follow on on the water systems. Again, many, many water systems in Chapter 9. We're focusing on the most important. Okay?

MR. HUDDLESTON: Okay, thanks Darrell. My name is Steve Huddleston. I've been with the EPR project since 2005. I'm currently, I manage BOP systems engineering group. At the time that I was with the EPR project I supervised the fluids systems on Section 9.2 and I'll be talking about four of the safety-related fluids systems in Section 9.2. I've been in the industry on the military side and on the civilian side since the 1970s and I have a degree in mechanical engineering from Purdue University and I'm a registered PE in Illinois.

CHAIR POWERS: So Purdue is up a hand over Ohio State today.

MR. HUDDLESTON: I'll be talking about the essential service water system, the ultimate heat sink, component cooling water system and the safety-chilled water system. I'm showing right now, this is a compound figure. It illustrates how these fluid systems tie together. If you'll direct your attention to the essential service water system you'll see that it provides cooling water to the CCW heat exchanger and to the emergency diesel generators. During operation of course it would only supply cooling water to the CCW heat exchanger. It returns that water to the ultimate heat sink which is a mechanical draft cooling tower.

And on the other side you'll see the CCW system picks up loads throughout the nuclear island both non-safety and safety loads including the safety chilled water system. And I'll just note that two divisions of the safety chilled water system are water-cooled by CCW, two divisions are air-cooled.

Essential service water system operates during normal operation, safe shutdown and cooldown and following a design basis accident in which case, and this will be true for all the trains that we discuss, two trains are required for safe shutdown. We also have one dedicated non-safety train which allows the removal and is designed for the removal of severe accident heat removal.

The safety-related essential service water system provides cooling to the component cooling water heat exchangers, the emergency diesel generator heat exchangers and the essential water system pump room coolers. And as I said before this heat is removed to the ultimate heat sink cooling towers. This is a schematic that demonstrates the flow path of the system as it's laid out. Essentially we take water from the cooling tower basin using the essential service water pump that's pumped through a debris filter and then it goes to supply the room coolers and the CCW heat exchanger and the EDG coolers. This is the flow path through the component cooling water system heat exchanger and the emergency diesel generator coolers. And this is the return flow path to the ultimate heat sink cooling towers. You'll note that there's a bypass valve. The bypass valve is in operation during cold weather to keep cooling tower basin warm.

There's also a keep-fill line. A keep-fill line provides fill to vertical portions of the piping when that system is out for maintenance so that we don't have void formation in the piping.

The dedicated train, the non-safety dedicated train, that takes a suction and is located in the Train 4 ultimate heat sink cooling tower basin. And it's powered from Division 4 Class 1E power source EDGs. Yes?

MEMBER STETKAR: Steve?

MR. HUDDLESTON: Yes.

MEMBER STETKAR: Back on slide 9 the -- you have to excuse me. Let me preface all of my comments by saying the only document I had was FSAR Revision 2. I haven't seen the interim Revision 3.

MR. HUDDLESTON: Okay.

MEMBER STETKAR: So any of the stupid comments that I make that are answered easily in that interim Revision 3 please tell me. I just didn't have it. The keep-fill line, is it there or is it to the left of the return isolation valve?

MR. HUDDLESTON: No, it's there. It's on

the right-hand side.

MEMBER STETKAR: It is.

MR. HUDDLESTON: Yes. That valve would be shut.

MEMBER STETKAR: Okay.

MR. HUDDLESTON: And that way it retains the volume in that line when it's -- when the line is shut down.

MEMBER STETKAR: It strikes me that if it was there it's just spraying in the spray nozzles.

MR. HUDDLESTON: Well, that's -- it looks that way because in the figure the line shows horizontal, but in the actual geometry there's a vertical portion of the line that fills up.

MEMBER STETKAR: Okay, so it's just a low-pressure. Okay, I got it.

MR. HUDDLESTON: There's a level indicator there.

MEMBER STETKAR: I got it.

MR. HUDDLESTON: That the operators have to --

MEMBER STETKAR: I got it. Thank you.

MR. HUDDLESTON: Okay.

MR. GARDNER: Mr. Stetkar, I'll also point it's actually Revision 3 was issued in August. So it's no longer an interim, it's a full Revision 3, August of this year.

MEMBER STETKAR: Our thanks to the staff for getting it to us in a timely fashion. We haven't seen it yet.

CHAIR POWERS: I thought I had it.

MEMBER STETKAR: I only have -- Derek?

MR. WIDMAYER: I have to check. I thought we had Revision 3.

MEMBER STETKAR: I only think I have Revision 2. But anyway.

MR. TESFAYE: The SE is based on Revision 2 but the staff has used interim Revision 3.

MEMBER STETKAR: Well actually I think it's based on Revision 3 because a lot of the questions are compiled. Check, Derek, because maybe I misplaced Revision 3, but anyway. Continue. I'm sorry.

MR. HUDDLESTON: Just to --

MEMBER STETKAR: I was trying to guess where it was because I didn't have it in Revision 2, so thanks.

MR. HUDDLESTON: Just to recap, I was talking about the dedicated train. The important thing here is that it's powered both from a Class 1E

Division 4 source and from the station blackout diesel generator for diversity.

MEMBER STETKAR: Before you get to the ultimate heat sink because we're going to switch gears as I understand it there are level, sump-level switches in the Safeguards Building that isolate essential service water and trip the pump on level to preclude apparently some flooding scenario where you could actually flood up above zero elevation and affect two divisions anyway if not more. Again, I don't have any information about those signals or the switches. The -- what I could find was in the safety evaluation report it says each sump is equipped with two level instruments, actuation of one of two will provide an alarm in the control room and isolate the affected division. That means that I can shut down an ESWS division if I have a signal from one level switch. Is that the logic, it's a one out of two for the division?

MR. HUDDLESTON: I couldn't speak to the logic.

MEMBER STETKAR: Well, perhaps I can get the questions on the table then and you can say you can't speak to the logic. If that's the case does that flood isolation signal override safeguard signals for essential service water? In other words, if I get a safeguards actuation and essential service water gets an on signal, if I have a high-level signal from a level switch will that shut down the division despite the fact that I have a safeguards actuation signal? Do you know that?

MR. GARDNER: I think we don't have our I&C folders here but we understand the question.

MEMBER STETKAR: I was hoping that they would be here since Chapter 7 is tomorrow. So maybe you can caucus with them.

MS. LINDSTROM: This is Jean Lindstrom. I'll answer that for the vents and drains portion. The sumps are in the vents and drains system.

MEMBER STETKAR: Yes.

MS. LINDSTROM: The instruments are and actually there's one.

MEMBER STETKAR: There's only one?

MS. LINDSTROM: There's one safety-related per division.

MEMBER STETKAR: Okay, so this statement of one of two is not even --

MS. LINDSTROM: You'll see the new revision has been corrected.

MEMBER STETKAR: Okay.

MS. LINDSTROM: And the scenario is just one. The scenario is you won't have two divisions that fail, one will -- well anyway it will go there, in the vents/drains system but --

MEMBER STETKAR: Okay, if you're going to address it in vents and drains we'll wait till we get there.

MS. LINDSTROM: It does shut down the essential service water pump and the valve.

MEMBER STETKAR: Yes, I understood that. It closes the valve, it trips the pump.

MS. LINDSTROM: Yes.

MEMBER STETKAR: But even with a safeguards signal in place.

MS. LINDSTROM: We'll have to recheck the I&C part but it does shut it down.

MEMBER STETKAR: My question, where I'm headed with this line of questioning is I wanted to first understand how the system worked and if it does shut it off, you know, if it overrides a safeguards signal for example then the next question was going to be can the operators in turn manually override that signal. Because the concern is about flooding in the Safeguards Building, I understand that concern. However, shutting down ESWS also kills one of the diesels which is not a load that you particularly care about this particular flooding scenario. So I'm curious whether there's some way that the operators can restore cooling to the diesel if indeed this occurs during a safeguards situation. That's why I'm asking questions about, you know, numbers since -- because a spurious high-level signal for whatever reason because there might be other water from other sources in that area during a seismic event let's say or a fire protection system might go off for whatever reason let's say could also isolate perhaps one or maybe even two of your ESWS divisions.

MR. GARDNER: So are you asking this from an equipment protection standpoint?

MEMBER STETKAR: I'm asking it from an integrated system response perspective. My concern is can we shut down ESWS, one train, maybe two trains because I don't know about the physical geometry of the Safeguards Building or where various piping systems are routed within that building. My concern is if there is a signal from a single level transmitter that can shut down a train of ESWS and prevent either its automatic response during safeguards condition, and I understand the problem about flooding, but prevent cooling for a diesel is a bigger concern, I -- that may satisfy all of the design and licensing criteria but I would like to understand how that system works. My problem is I don't know enough right now to know what follow-on questions to ask because I don't really know enough about how those isolation signals work, whether they can -- whether they override a safeguards signal, whether they in turn if they do override the safeguards signal can be reset by the operators such that the operators could restore cooling let's say to a diesel if you needed it by isolating the supply to the Safeguards Building.

MS. LINDSTROM: Yes, currently there is an open item for that particular item on the vents and drain system RAI 476. So that's an open item being tracked --

MEMBER STETKAR: Okay.

MS. LINDSTROM: -- about the use of those functions.

MR. WIDMAYER: Dr. Powers, you guys are working with Revision 2. That's the current version. I was unaware that any SERs chapter was being prepared on Revision 3, so.

MEMBER STETKAR: Well, it's -- the way it's characterized in the SER is there apparently was an RAI response and AREVA can correct me if I'm wrong. My interpretation is there was an RAI response that compiled essentially the responses to several, a large number of RAIs, you know, 50-plus type RAIs and as a result of resolutions of those RAIs developed what's characterized in the SER as an interim Revision 3 of at least Section 9.2 of the FSAR. And it's characterized in the SER as an interim Revision 3 in response to RAI 465, Question 9.2.1-51.

MR. TESFAYE: That is correct. That applies only to that particular section, Section 9.2, the water systems. By basing it on the interim Revision 3 to eliminate the number of discussion of those multitude of questions.

MEMBER STETKAR: I'll only say it's really, really difficult for folks like me who like to understand how systems work to shoot at a moving target because we don't get all of the RAIs and responses, nor do we particularly want all of the RAIs and responses. You know, perhaps some of the questions that I'm going to be asking could have been, I could have answered them for myself rather than bringing them up in the context of this meeting had we had that information. It's even a bit more troubling if indeed Revision 3 of the FSAR was issued in August and we didn't have it. I mean, it is --

MR. WIDMAYER: But see, I'm not going to give it to you until I find out it's the official version.

MEMBER STETKAR: Yes.

MR. WIDMAYER: So you're not inundated with material.

MEMBER STETKAR: No.

MR. WIDMAYER: I've not been told that Revision 3 is the official.

MEMBER STETKAR: Okay.

MR. TESFAYE: I repeat again Revision 3 is not the best for this SE. Revision 3 for that particular section, that's in response to that RAI, that particular RAI just mentioned. Interim Revision 3 is the FSAR markup in response to that particular RAI. So, interim Revision 3 is what you have in response to that RAI.

MR. WIDMAYER: Yes, but he doesn't have that. That's --

MEMBER STETKAR: Yes.

MR. TESFAYE: You don't have that.

MEMBER STETKAR: But I don't have that, for example.

MR. TESFAYE: Okay. Understood.

MEMBER STETKAR: I'm sorry, Steve. Did you at least get the questions about the level switches and that stuff? Because the concern was trying to understand, you know, how they interact and under what conditions could it shut the system down. There are also concerns, for example, if they're just level switches you could have leaks from other systems, in particular fire protection systems out in the Safeguards Building that would isolate ESWS. It has nothing to do with ESWS. ESWS would be perfectly happy cooling water and the diesel generator. And perhaps the operators might want to make it do that under certain circumstances but if the isolation signals won't let them that could be a problem. That's why I'm trying to understand what those interactions are. Okay, thank you.

MR. HUDDLESTON: I'll move on to the ultimate heat sink. The ultimate heat sink is four redundant safety-related trains eject heat from the ESW during normal operation, cool-down, shutdown, DBA accident. And as before we need two ultimate heat sink trains to shut down a design basis accident.

Each ultimate heat sink consists of a mechanical draft cooling tower with two fans. There's two 50 percent fans, spray nozzles, tower fill, drift eliminator. It's a fairly conventional design for a cooling tower. The tower contains the two 50 percent fans are powered from the EDGs during DBA. For the train 4 cooling tower fans can be powered both from EDG and from SBODG diesels.

MEMBER SKILLMAN: I'd like to ask a question, please.

MR. HUDDLESTON: Yes.

MEMBER SKILLMAN: The switchgear to account for that capability, has that been evaluated in Chapter 8? That is -- could conceivably be a common mode failure. Should the switchgear fail then neither can respond. Can you please speak to how the switchgear for the selection between EDG or a station blackout diesel has been evaluated?

MR. HUDDLESTON: I don't think I could address --

MEMBER SKILLMAN: I would like to put that on the record, please.

MEMBER STETKAR: I can help you out there a little bit. We did go through that quite a bit in Chapter 8. It's a manual. The station blackout diesels, I think they start automatically but they're aligned manually.

MR. STACK: Yes, that's correct. The SBO

diesels are automatically --

MR. WIDMAYER: Name, please.

MR. STACK: I'm sorry. Tim Stack from AREVA. I can go through the introduction if you want or just answer the question. The SBO diesels are going to automatically start on the loop and it'll be manually loaded so that you wouldn't parallel the bus. You would only go and start reloading some common loads if the EDGs did not start.

MEMBER SKILLMAN: Okay, thank you.

MEMBER STETKAR: And EDGs, I checked last night. The EDGs have enough capacity to pick up these fans. They're pretty healthy fans but they're pretty healthy SBO diesels also.

MEMBER SKILLMAN: I was more concerned about a common mode failure defeating both simultaneously. Thanks.

MR. HUDDLESTON: The ultimate heat sink basin has a 72-hour capacity. An SBO would not require or would be able to survive no makeup for 72 hours. And that would provide the capacity for evaporation and drainage or water loss from the cooling tower.

MEMBER STETKAR: Steve, that capacity -- I've now lost myself completely so bear with me. Let me just see if you're going to address it. Again, this is rev 2 of the FSAR. There is a discussion and a table, it's Table 9.2.5-4 regarding what are characterized as, I don't know if they're called worst case, but yes, worst case heat removal conditions in terms of local environmental conditions, wet-bulb temperature and so forth. The only thing I wanted to confirm is the discussion in the FSAR shows those conditions over a 24-hour period. It doesn't show the actual temperature in the cooling tower basin, it only shows the input wet-bulb and I think dry-bulb temperatures that you use for that worst case analysis. The conclusion was that the maximum ESWS supply temperature does not exceed 95 degrees. Is that true for the full 72 hours or is that only true for the 24 hours that you applied those particular conditions to? In other words, at the end of 24 hours did you stop the analysis and say okay, I have less than 95 degrees C -- degrees Fahrenheit so I'm okay, or did you actually run the worst case conditions out over the 72-hour design basis LOCA?

MR. HUDDLESTON: Well, there were two different types of analysis performed. One was to determine the worst case evaporative conditions.

MEMBER STETKAR: Yes, that's the one that

I'm talking about.

MR. HUDDLESTON: Yes. Then the 24-hour also determines the greatest heat load on the basin so that's where we see the greatest challenge to the 95 degrees.

MEMBER STETKAR: That's the greatest qdot, it's not the integrated heat which would determine the final temperature.

MR. HUDDLESTON: Not over the 72 hours --

MEMBER STETKAR: Right.

MR. HUDDLESTON: -- but the response on the basin is to peak and then begin to drop off. And that --

MEMBER STETKAR: Do you have an analysis that shows what the basin temperature looks like for 72 hours under those worst case evaporative conditions for design basis?

MR. HUDDLESTON: We do have an analysis.

MEMBER STETKAR: Does the temperature exceed 95 degrees?

MR. HUDDLESTON: No.

MEMBER STETKAR: It does not. I see a lot of people looking back and forth at each other which leads me to pause.

MR. SARMA: This is Ram Sarma from

Bechtel. The way the analysis was the first 24 hours when we did the analysis and applied worst case heat load after about 12 hours the basin temperature kept on -- it peaked at 94.6 and then it went down from there so the analysis was terminated at 24 hours. Because the heat load was also continuously --

MEMBER STETKAR: Yes, I understand the heat load is certainly going to decrease but the actual, the temperature profile showed a peak and then actually started to decrease. Okay, that's -- thanks. Thanks. You said 94.6? Which I guess is less than 95. Thanks.

MR. HUDDLESTON: This figure just simply demonstrates the functions that are provided to the cooling tower basin in the sense that we have a normal makeup path and an emergency makeup path and a normal chemical addition path. Also, you'll notice the normal makeup path provides water to the keep-fill line.

Moving on to the component cooling water system, it's also a four train system. A closed loop provides heat removal to safety and non-safety related components.

MEMBER STETKAR: I'm sorry. I have to write notes here otherwise I never remember anything.

Can you go back to the ultimate heat sink? This is I hope a simple question. For potential ice removal conditions I notice that you can run the cooling tower fans in reverse.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: There's some statements in the FSAR about if it's operating in reverse the division is still considered operable. When you get a safety ejection signal any fan operating in a reverse direction will automatically trip and restart following a coast-down. Is that restart interlocked with an actual zero rotation signal or is it only based on a time delay? I don't really want to start a fan, try to start a fan if it's running in reverse because I'm going to trip the circuit breaker for that fan.

MR. HUDDLESTON: Yes, it's a good question. I don't think I have the details on that, on the circuit arrangement. I'm not sure if it would.

MEMBER STETKAR: Okay. The first thing I think about, you know, if it's only a time delay then I really want to be sure that that fan is stationary when I try to start it. Otherwise the in-rush current on that circuit breaker, it's going to be really large. I mean you'd almost guarantee the fan supply breaker is going to trip.

MR. SARMA: The current logic is there is -- the cooling tower fans has to coast down, reverse rotating fan has to coast down and there's a certain time that the cooling tower manufacturer recommends for it to coast down to a complete stop. And after that the fan will --

MEMBER STETKAR: So it's based on a time delay. I guess then my question is what type of tests are you going to be performing because the manufacturer may have made some, I don't know, conservative assumptions that they thought were conservative for their particular use that may not be conservative for this particular application regarding the coast-down time. You know, so I guess the question is if it is based on a time delay what tests are you going to perform on the as-built, as-installed system to make sure that they do, those fans do indeed become either stationary or that the load is at least low enough so that when you give it a signal to start in the forward direction you don't actually trip those circuit breakers. Having burned up motors in my time because of mis-wired windings I'm aware of this. Okay, so maybe you want to think about that. That's -- if it is on a time delay then it's a question more in terms of your startup testing program and whether you have an ITAAC in place to confirm that. Thank you. I'm sorry for being so slow but notes take long to write.

MR. HUDDLESTON: Back to the component cooling water system. It -- we have a shallow tube heat exchanger that's cooled by ESW as we talked about before. And as we mentioned I think a couple of times now so far we have two trains, CCW required and design basis accident heat removal. The important point here is the safety-related loads, RHR, safety injection, reactor coolant pump, thermal barrier cooling, the safety chiller cooling of which we cool two trains, train 2 and 3 with CCW and spent fuel pool cooling heat exchangers.

This is a listing of non-safety loads. I won't go through it, it's quite extensive, but I'll just point out some of the major loads to the CCW system from these non-safety loads would be for example operational chiller. That's a fairly good-sized load and the chemical and volume control high-pressure heat exchangers are also a fairly good-sized load.

MEMBER SKILLMAN: May I ask you, please, to explain why that particular load is not categorized as safety grade?

MR. HUDDLESTON: It's all of -- it's not relied on for accident mitigation.

MEMBER SKILLMAN: Do you have to run your reactor coolant pumps?

MR. HUDDLESTON: Not necessarily.

MEMBER SKILLMAN: Just from a lot of experience in this particular system why wouldn't you just opt on the side of safety, put that over on the safety side so that you always retain the option of running your reactor coolant pumps and letting down at least your seal injection flow rate. It seems to me that that's one that's almost worth arm-wrestling over. You understand what I'm saying?

MR. HUDDLESTON: I do. It's a choice.

MEMBER SKILLMAN: I think in the years gone by there was a time early on when we would isolate component cooling water and in time we realized, golly, you've got to keep component cooling water going because you've got a thermal barrier heat exchanger and you've got your letdown pumps.

MR. HUDDLESTON: We do have thermal barrier backup coolants.

MEMBER SKILLMAN: But it just seems that this is one that might have been put over in the --

it's easier to take it out of the keep it in category when keeping it in may give some rather significant operator flexibility.

MR. HUDDLESTON: That's a question we'll take.

MEMBER SKILLMAN: Thank you. Thanks. I would offer that the other items you've identified I think kind of pass the common sense test as probably not being needed but this is one that can give the operators a chance to run reactor coolant pumps in an awkward position. So maybe it means you've got to take a couple more thousand BTUs an hour, whatever the number is, in order to grant that flexibility that could be significant in terms of some form of accident response.

MR. HUDDLESTON: Okay. Going on to the dedicated CCW train which is provided for severe accident heat removal, also of course Class 1E power from Division 4 and from station blackout diesel generators as well as the EDGs.

As we go on and look at the safety-related trains we'll find that the design or the architecture of the system is such that we have two trains on two sides, so we have four trains together. Each of the two trains on each side supply a common header and we refer to those as common headers 1 and 2. And if I move on to the figure layout it might be a little easier to explain. In this case we're looking at train 1 and train 2. Here are the CCW pumps supplying flow through each of their heat exchangers. Only one train at a time can supply the common header. In this case common header 1.B, this is the common header, supplies loads that are both safety-related side and some non-safety related loads which can be isolated in an accident. Up here we have the common 1.A which is the fuel pool cooling heat exchanger.

So there are different modes of operation. For example, typically we might have one train supplies all of the common loads on one side and then on the other side we'd have another train supplying both the common loads and fuel pool cooling. During normal operation we would expect to supply one fuel pool cooling heat exchanger. In an accident, when we have an accident condition we would supply both common headers and eventually all of the LHSI heat exchangers for RHR heat removal.

And if we're -- I'll move on to the other side. So we see that here we have train 3 and 4. Train architecture are essentially duplicated. Once again, on the side 2 we're supplying the fuel pool heat exchanger, one fuel pool heat exchanger, and we also note that we supply the reactor coolant pump thermal barriers.

MEMBER STETKAR: Steve, before you get into the thermal barrier stuff because that's sort of a little bit different animal to think about let me -- I really like this drawing. It takes awhile for at least rev 2 of the FSAR to figure out how everything is tied together. This is a good drawing.

As I was reading the SER and this again may be a problem with timing, there apparently in reply to some questions from the staff they asked about essentially failure modes of the transfer valves.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: And my reading of the SER anyway is that it was stated that the, let me call it the train transfer valves between train 3 and 4 on this drawing fail as is where the valves for the non-safety consumers fail closed. So for example on this particular drawing there's a couple of hydraulic-operated valves in the upper right center of your middle oval there that supply the non-safety loads kind of within the right-hand side of that oval, that those would fail closed but the train 3 to train 4 transfer valves up on the main header fail as is. Is that correct?

MR. HUDDLESTON: Well, we went through several iterations on the logic for those valves and basically I think where we ended up was we could go through a train transfer. Basically you can't have -- it's set up so you can't have the transfer valves on both sides open at the same time. So.

MEMBER STETKAR: You need -- and let me make sure I understand that. As I understand it both -- let's say train 3 is normally aligned and operating so that the supply valve is open and a return valve is open.

MR. HUDDLESTON: Right.

MEMBER STETKAR: Both of those valves must be closed before either of the train 4 valves open, is that right?

MR. HUDDLESTON: Yes, that's right.

MEMBER STETKAR: So for example if I have, I think of failure modes because I'm a PRA kind of guy, if either of the train 3 valves fails to close the transfer will not occur, is that correct?

MR. HUDDLESTON: Right.

MEMBER STETKAR: Or if either of the, obviously if either of the train 4 valves fails to open the transfer doesn't occur.

MR. HUDDLESTON: Right.

MEMBER STETKAR: So any four of those single-valve failures will disable the transfer.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: Okay. So I understand that part. Now, in terms of -- since they're hydraulically operated valves they can -- you can wire them up to pretty much do anything you want to do with them. Which direction do those valves go when you lose power to the hydraulic operator? And I have no idea what the hydraulic operator, I don't know whether it's a solenoid or --

MR. HUDDLESTON: Well, bear in mind that those valves aren't specified yet.

MEMBER STETKAR: I understand, but the design, this is a design philosophy. It's not a particular valve that I'm talking about.

MR. HUDDLESTON: And the design answer that we had so far is it will require that they fail shut.

MEMBER STETKAR: Fail closed.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: Okay. And that's -- because that was different from what I read in the

SER. So that answer --

MR. HUDDLESTON: I could be wrong. I could be wrong. So if --

MEMBER STETKAR: Well, if you're wrong I've got a bunch of questions. I'm not sure -- if they fail closed I may have some questions. If they don't, if they fail as is, in other words remain open I have a line of questioning that I'd like to pursue. But I don't want to ask a number of questions that are pointless if I don't know how those valves work.

MR. GARDNER: Sounds like we need to get the answer for you if we know it.

MEMBER STETKAR: Yes. Because I don't want to waste our collective time here asking questions that are not applicable if the valves actually do fail closed. I'll ask the staff how come they understand that the valves fail as is, but that's a different issue. I'll have to think about it, Dana. We'll keep moving. Let me think about this at the break. I may want to come back to component cooling water, but I don't want to waste time with my --

MEMBER SKILLMAN: I would like to ask a question on component cooling water, please, and it's to you, Steve.

MR. HUDDLESTON: Yes.

MEMBER SKILLMAN: I spent three years on the design team in Germany with my family building Muelheim Kaerlich. And Kaerlich was the BMW 205 plant, very much like Bellefonte but with this design, almost this identical design. And those of us who were part of the team came to learn that of all of the systems, of all of the auxiliary systems in the plant this is basically the largest. It's complicated, it's got a lot of E loads, it's got four strings, actually it's got eight 50 percenters so that you have four 100 percenters. You can take a signal act and a single pass of a maintenance failure and still survive. So the overarching engineering is remarkable. But the question that we kept testing with each other is what happens when everything works the way it's supposed to. If you do have a LOCA and everything gets commanded to start are we going to be in an over-cooling situation that we had not anticipated? My question is have you given that question consideration? In other words, can you be in a situation with so much hardware and so much defense-in-depth and redundancy that you now have a different problem that you hadn't anticipated: too much cooling.

MR. HUDDLESTON: Right. Your question is have we analyzed for the case where we have all four ultimate heat sinks --

MEMBER SKILLMAN: Everything goes flat all at one time and gee whiz, how did we get here. That's my question. And I'd be curious. To me it's -- it sounds like a tricky question and I'm not trying to be coy or tricky. I'm just thinking this plant's never been built, this one, and is there a situation where everything functions exactly like it's supposed to in an upset condition and now the operator is being taken to a new place that the operator didn't anticipate. And I may be wrong. Maybe this plant's been built and they've had that incident and you've got data that shows it's a non-event.

MR. HUDDLESTON: I don't have any numbers for it.

MEMBER SKILLMAN: Okay.

MR. HUDDLESTON: We'll get you some numbers on that.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: Just out of curiosity, Steve, I'm pretty familiar with kind of a German plant precursor to this basic plant design but not familiar with the EPR. Is this cross-tied system configuration common or is this a particular U.S. EPR design? I haven't seen this sort of cross-tied, you know, dual division cross-tie in CCWS and ESWS.

MR. HUDDLESTON: No, not on the U.S. side I wouldn't say it's common from my experience.

MEMBER STETKAR: But is it common over in Europe? Is this a --

MR. HUDDLESTON: I have seen some German designs.

MEMBER STETKAR: You have? Okay. Okay. Thanks. I was just curious. I hadn't run into it. Okay.

MR. HUDDLESTON: Okay, thermal barriers. Thermal barriers to the main coolant pumps are supplied from either one of the two common header sides. And this is the simplified arrangement. On one side we have one common header, over on the other side we have the other common header. During normal operation only one side at a time is lined up to supply the four reactor coolant pump thermal barriers. And you can switch sides but just as we discussed before the logic is set up so that the valves are not all open at the same time.

MEMBER STETKAR: A couple of questions here, and it's not so much CCWS but it's related. This again I'm paraphrasing from the SER because I don't have rev 3 of the FSAR. But the SER says that

RCP seal degradation is expected to occur in as little as two minutes if all cooling is lost, both for thermal barrier cooling now and seal injection. What's the basis for that two minutes? Have you actually run tests on these seal packages to see that the seals start to fail and what does degradation mean? I mean, degradation can be anything from not being perfect to failure.

MR. HUDDLESTON: No, I'm familiar with the number but I don't know how it was obtained, whether it was by test or by design.

MEMBER STETKAR: Because that two-minute time period is a fairly short period, especially if it means the onset of external leakage.

MR. HUDDLESTON: Right, and you're referring to the two minutes required to keep the reactor coolant pump --

MEMBER STETKAR: It came up in the notion of the transfer, for example, if you had a problem --

MR. HUDDLESTON: Right.

MEMBER STETKAR: -- getting the, you know, the black valves open and the white valves closed basically. There was some discussion about, you know, transit times on the valves and things like that.

MR. HUDDLESTON: So your question is how -

-

MEMBER STETKAR: What's the basis for that two minutes?

MR. HUDDLESTON: What is the basis for the seal failure in two minutes.

MEMBER STETKAR: Well first of all it's characterized as seal degradation and I don't know what that means. That could be anything from, you know, not absolutely perfect conditions to absolute disappearance of the seal package. And I don't know what that means. And so I'm curious about, you know, what level of degradation will be achieved and whether or not you've done anything that looks at the rate of leakage from the seals as a function of time after loss of all cooling because that's another part of the supporting analyses for component cooling water and also something that feeds into the tech specs as I suspect. I just don't know whether you've done any of those analyses on the seal packages that you expect to install on these pumps.

MR. STACK: Steve, this is Tim Stack. Let me speak a little more to that, John. I mean, and I haven't read that specific language in the SAR in that section but you're going to have seal injection which is redundant to the thermal barrier cooling. And if you lose all your seal cooling you still have the stand-still seals with pumps tripped.

MEMBER STETKAR: Well, that's -- what I wanted to ask you and I looked in Chapter 5. I mean, I understand the discretion of the stand-still seals in Chapter 5 but they are always characterized as when the pump becomes stationary, you know, it settles down, you get the face-rubbing seal and even above that you get the nitrogen pressure that sort of closes it. They're never characterized as stopping leakage after failure of the original, you know, the basic seal package occurs. And there's no drawings in there that shows me how all of those seals are arranged. So I don't know how that all works. As I said, it's part of -- there is a discussion in terms of a time progression that says you will develop -- in fact, it says -- there's a discussion, again I'm paraphrasing from the SER so you have to excuse me, that under a station blackout condition for example, loss of all CCW, loss of all seal injection, that the normal seals will fail in 10 minutes but within 15 minutes the stand-still seal will stop everything. You know, and there's something like a hundred gallons a minute leakage rate, starts at 10 minutes and then it drops off to about 2 gallons a minute after the stand-still seals ostensibly stop it. But I don't know how all those seals work together and I couldn't find any drawings of the seal package, at least in the FSAR that I have. So that's sort of this line of questioning about what's the basis for 2 minutes, what's the basis for 10 minutes, how does the stand-still seal stop everything within 15 minutes.

MR. STACK: We'll take that as a question.

MEMBER STETKAR: Again, it's not particularly CCWS but it's related to the CCWS seal-cooling function. You know, if you have a detailed picture of the seal package itself it might explain an awful lot about how the hydraulics work in there. I just couldn't find one.

MR. HUDDLESTON: Okay. Safety chilled water system. Safety chilled water system consists of four trains as we've talked about before. Two of those trains are water-cooled, two of the trains are air-cooled. Provide safety-related HVAC systems, supply chilled water to the low-head safety injection pumps, trains 1 and 4, to the fuel building ventilation system. Each train consists of a refrigeration chiller unit, two pumps and an expansion tank. One chiller train is sized to meet the cooling load of two trains. Each train is located within its own safeguard building. Division 1 and 4 are backed by the SBO diesels. Cross-tie valves on these between the trains will be open normally with one train in operation. So what you see here is this is an arrangement for two of the four trains where we have cross-tie valves between the two trains. During normal operation we would have two pumps in operation, one chiller online. That chiller would be supplying chilled water to both division 1 and 2 loads for example, and back to the pumps. In the event of a line failure where we detected a loss of pressure in the surge tanks indicating a failure on one side we would shut these cross-tie valves, the cross-tie valves would be shut.

MEMBER STETKAR: Let me ask you more about cross-ties now.

MR. HUDDLESTON: Sure.

MEMBER STETKAR: I love cross-tied systems so you have to bear with me. I got really confused reading the SER about this particular system so let me just ask questions. The train cross-tie valves, the two motor-operated valves that cross-tie the trains there, are they -- there's two signals that I read about. One signal is called a LOW-2 system pressure signal and there's another signal called a MIN-2 pressure signal that I understand the MIN-2 pressure signal is always discussed with regard to the expansion tank, surge tank, whatever you want to call it there.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: The LOW-2 pressure signal is discussed separately but I don't know whether those two signals are the same signal just given different names or whether they're separate signals.

MR. HUDDLESTON: I'm not sure of the exact wording and why it's discussed that way but part of the confusion may be that we have a LOW DP signal and that's a low pressure signal across the chiller which is an indication of low flow in the system.

MEMBER STETKAR: This wouldn't, I was thinking about pipe breaks, take a consumer out somewhere, break the pipe and --

MR. HUDDLESTON: Right. The pipe break is supposed to be the MIN --

MEMBER STETKAR: MIN-2.

MR. HUDDLESTON: MIN-2 in the surge tank.

MEMBER STETKAR: Okay, well I don't -- maybe -- I thought that the FSAR -- yes, the FSAR also, rev 2, Section 9.2.8.6 says, "The cross-tie isolation MOVs close on LOW-2 system pressure," L-O-W-

2. And there's, in Section 9.2.8.2.2 of the FSAR it says, "Complete loss of nitrogen or water volume in an expansion tank will close the cross-tie valves on MIN-2," M-I-N all caps pressure because there's also a MIN-3 pressure signal that comes in at a lower value.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: So it sounds in the FSAR as if there are two separate signals. The staff in the SER discusses them as if they're two separate signals. And the problem is there's a confusion in the SER about whether they're automatic or manual signals. So I was going to ask you if there are two separate signals are they both automatic, are they both manual? In other words, is this simply an alarm that the operators receive and they must close the valves manually to isolate the break or is it an actual automatic signal that closes the valve?

MR. HUDDLESTON: I think the intention was that it was a manual signal.

MEMBER STETKAR: Okay. If it's a manual signal then I have real questions because why am I then not going to fail two divisions of SCWS with a pipe break that drains both expansion tanks because both expansion tanks are connected to the system continuously? If that pipe break occurs and the operators don't respond within X minutes where X varies depending on the size of the break I can drain those expansion tanks and it looks like I might lose suction for those pumps in two divisions. MR. HUDDLESTON: If the operators are not fast enough.

MEMBER STETKAR: If they're not fast enough. Now, you know, there's some 4-inch lines out there and the, at least if I read in the SER again there is in response to one of the questions is I have 100 gallons, 100 gallons of water in each of those expansion tanks. So I've got a 200 gallon margin on a system that normally has a 565 gallons per minute flow. Now, it depends on how big the break size is but if I break a 4-inch pipe I'm pretty much going to drain those tanks pretty much faster than most operators can respond I think. Not so much if I break a half-inch line.

MR. HUDDLESTON: True.

MEMBER STETKAR: So if they're manual signals what I'd like to know is what time is available for the operators to actually close those valves before I lose expansion tank inventory. For example, if I break -- the consumers, the line sizes are all over the place but you've got three-quarter inch lines, you've got an inch line out there, a few 2 and a half-inch lines and the headers, and then there's a big 4-inch header that supplies something or other out there. So I'm really curious if they're all manual.

MR. HUDDLESTON: So, are you -- would the question be --

MEMBER STETKAR: The real question is if they're manual I'd like to know how much time is available for the operators to manually isolate the break for a break -- for a broken three-quarter inch line, a broken 1-inch line, a broken 2 and a half-inch line, and a broken 4-inch line before you actually lose suction for the SCW pumps and disable both of those trains.

MR. HUDDLESTON: Right. I would presume the operator time would be -- the time for the operator to react would essentially be the same for all of those things. Once he's reacted then it's the closure.

MEMBER STETKAR: I'm talking about the time available for him to react before I lose suction, not how long it takes him to push a button.

MR. HUDDLESTON: Which should be enveloped by the 4-inch line.

MEMBER STETKAR: The minimum would be

influenced by the 4-inch line so if you want to just look at the minimum it would be the 4-inch line. The reason I ask is because also the thing I read is the de-min water makeup to the expansion tank is manually, locally manually --

MR. HUDDLESTON: Yes.

MEMBER STETKAR: -- aligned. So it's, you don't get automatic makeup --

MR. HUDDLESTON: Right.

MEMBER STETKAR: -- that's going to, you know, feed the system and keep feeding the break to extend the available time interval. So yes, I mean if you want to do it for the 4-inch that's fine. I was trying to get a range of times and a range of, you know, available times. But if you want to do it for the 4-inch that would certainly bound the minimum time for the operator response.

Is that also true, when you say the isolation is manual is that also true for the MIN-2 pressure signal from the expansion tank? Again, I'm operating under the notion that there are two separate signals here which might be misguided. But the notion is that on MIN-2 pressure in the expansion tank the operators would receive that alarm and then manually close the cross-tie valves.

MR. HUDDLESTON: Right.

MEMBER STETKAR: Because I'm also trying to -- I got mixed messages trying to read the FSAR and read what was in the SER about whether either of those isolations if indeed there are two were manual or automatic.

MR. HUDDLESTON: Okay.

MEMBER STETKAR: But it's your understanding that they're all manual. Okay, thanks. And a final question on the SCWS and this is regarding tech specs -- ESWS tech specs and CCWS tech specs are consistent. They allow a single train to be inoperable for 120 days and two trains to be inoperable for 72 hours and I sort of understand that logic. SCWS is different. SCWS allows a single train to be inoperable for 30 days and if -- because there's no other limitation. If more than one train is inoperable you go into whatever the 3.0, you know, you basically shut down. What's the basis for the 30-day SCWS tech spec as compared to 120 days, and why is it different? I mean conceptually why is this system treated differently in terms of tech spec space than CCWS or ESWS? Especially CCWS because CCWS also operates in kind of a cross-tied mode.

MR. HUDDLESTON: You think it should be

120 days?

MEMBER STETKAR: I'm not going to tell you what I think it should be because I don't have any basis for any of these numbers. I'm just curious why is it different? I mean, it's so obviously different that it seems like there must have been some forethought put into this and some rationale of why it's different. And I'm not necessarily advocating that it should be the same, I'm just raising the notion that it's different and it's so much different that I'm curious why.

MR. HUDDLESTON: I just remember that the discussion at the time, because we went through a change on this design when we put the cross-tie valves in so that we could operate both divisions cross-ties open and that we could operate -- it gave us the flexibility to do maintenance so that 30 days was chosen as the time that would be required to do maintenance.

MEMBER STETKAR: What I'm trying to understand though, typically a lot of those differences in times and LCOs are -- I'm trying to stay out of the PRA world here as much as possible but they're based on, for example, perceived safety importance of a system where systems that have higher safety significance typically have shorter LCOs because, you know, you don't want to have them out of service, you know, for extended periods of time. Even though you meet all of the design basis licensing, you know, criteria with one train out of service, for example, or even with two. And that's what I'm trying to understand is for some reason this system more important to safety than ESWS or CCWS which would drive the fact that a single train has a shorter allowed outage time and you do not allow two trains to be out of service compared to the other systems that have longer single train durations and the allowance for having two trains out simultaneously.

MR. HUDDLESTON: I think your question is does the PRA analysis drive --

MEMBER STETKAR: I don't want to, you know, what I'm trying to probe is was this derived from the PRA or what's the basis for this?

MR. GARDNER: Let me try. I think, one, we'll go back and get an answer for you because our tech spec guy is not with us but it's not PRA-based. I would observe though that --

MEMBER STETKAR: You need to say that.

MR. GARDNER: -- trains that are tied together and that the loads are different on the trains.

MEMBER STETKAR: There may be a very good reason --

MR. GARDNER: -- influencing those times but we'll get you a more specific answer.

MEMBER STETKAR: Yes, there may be a very reasonable rationale and since this is not a risk-informed application it's probably not based on PRA results.

MR. GARDNER: Correct.

MEMBER STETKAR: Okay, thanks.

MS. LINDSTROM: I'm Jean Lindstrom, engineering supervisor. I have a chemical engineering degree from the University of South Carolina and a master's from North Carolina State. I've worked in power plants about 15 years, half of that being with Duke and the other half being with AREVA. On the EPR I probably worked about the last four years excluding last year working on auxiliary systems. So I'm going to go over the process auxiliaries in the --

MEMBER STETKAR: Jean, I'm sorry, I hate to keep doing this. I'm starting to sound like Columbo.

(Laughter)

MEMBER STETKAR: I'm probably starting to look like Columbo too. Now I'm starting to feel like Columbo. I realize you're going into Section 9.3. Back on Section 9.2 a system that you decided not to discuss but as evidence that I may be dense but I do keep good notes, back when we were discussing I think Chapter 10 of the FSAR I started asking some questions about the turbine building close cooling water system and the auxiliary cooling water system. I was told at that time not to worry my pretty little head because we discussed those systems during our review of Chapter 9. Here we are. So, now I'll ask the questions within the context of Chapter 9 so I can get them on the record here. The turbine building closed cooling water system is a non-safety system and it's characterized as being not important to safety. And that term is used quite a bit to justify at least in RAI responses why it doesn't need to meet certain qualifications. My question is first of all does the PRA contain the auxiliary cooling water system and the turbine building closed cooling water system. And when I say "contain" I don't mean by a single block with a number in it, I mean does it have pumps and pipes and valves in there for those systems with power supplies. I would hope that it does. I don't know that it does or does not. If it does I'm curious about what the Fussell-Vesely importance values are and the Risk Achievement Worth values are for each of those systems. The reason I ask that question is the term "important to safety" is not safety-related but it does have connotations in terms of maintenance rule type issues. So I'm trying to discern whether or not these systems meet the numerical criteria for example being important enough to safety that they would be treated under the maintenance rule. Because they are relatively important systems, after all. They cool everything out in the secondary side of the plant which in design basis licensing I recognize is not particularly important but it may be in terms of risk significance. So that's one question that I have regarding those systems and I recognize we don't have the right people here today to answer that.

Why does the, at least rev 2 of the -- well, rev 2 of the FSAR includes no information whatsoever about either of these systems other than there's a flow drying of the circulating water system that shows conceptually where the supply and return lines come back in from auxiliary cooling water. But there's no other information about these systems. Now, I'm led to believe that perhaps in rev 3 of the FSAR at least turbine building closed cooling water is described because there's quite a bit of discussion in terms of RAIs about that system. Is the auxiliary cooling water loop described at all in rev 3 of the FSAR?

MR. HUDDLESTON: Yes, it is.

MEMBER STETKAR: It is, okay, okay. Then I'll hold off on that until we see rev 3. Does rev 3 of the FSAR contain a complete list of cooling loads for turbine building closed cooling water do you recall?

MR. HUDDLESTON: I don't recall.

MEMBER STETKAR: I was going to say I'm curious about that because in the RAI responses, again I'm paraphrasing, it says cooling loads are primarily in the turbine building. As required cooling loads in non-safety related outdoor areas and in the electrical switchgear building may be served.

MR. HUDDLESTON: Yes.

MEMBER STETKAR: So, you know, because of the nature of kind of interconnected things, if turbine building closed cooling water provides a cooling function for either switchgear rooms or transformers that may have a relationship to offsite power availability or supplies to important loads. That's why I'm asking about those loads. If they're in rev 3 that's fine. If they're not I'd like to know what the actual cooling loads are. So you may want to make a note of that. If it's in rev 3 I can read tables pretty easily.

The only reason I bring this up, by the way, is that some PRAs of other plants, pressurized water reactors, have shown that things like turbine building closed cooling water and secondary service water, whatever you want to call it, can be relatively important contributors to risk. Now, I don't know for this particular plant because this plant has a lot more redundancies of safety-related equipment than some of the other plants but just because it's non-safety related and out in the turbine building doesn't mean it's not necessarily important. It's certainly important to the operators. They don't want to burn up stuff out there but given the design basis accident they probably have other things to worry about. Thanks. I'm sorry, Jean.

MR. GARDNER: So I just want to make sure I recap this. I think what you're wanting to find out is are these systems described in rev 3 --

MEMBER STETKAR: Yes.

MR. GARDNER: -- and what's their relative importance in the PRA.

MEMBER STETKAR: What's their relative importance, yes. Are they, well first of all, are they --

MR. GARDNER: -- modeled and then what's their importance.

MEMBER STETKAR: Yes. And if they are modeled, I'm assuming they are, but if they are modeled what's their numerical importance measures. I'll be quiet now, thanks.

MS. LINDSTROM: All right, we'll move on to the sections I'll be presenting, 9.3.2 and 9.3.3 Process Auxiliaries. First, Section 9.3.2 is the process sampling systems, nuclear sampling system secondary and the severe accident sampling which is in some of the U.S. plants known as the PASS system. 9.3.3 is the equipment and floor drain system, recyclable and non-recyclable fluids. We refer to it as the nuclear island vent and drain system. This is just a nuclear island vent and drain system. Turbine building drains will be -- discharges will be in Chapter 11. So next slide, please.

So moving to the process sampling. And the purpose, this is very typical of plants that you see in the U.S. The sampling system is basically a sampling system. It does not have any control functions. It's purely monitoring of the fluids, physical and chemical properties. The nuclear sampling system, active, slightly active, gaseous and corrosion products. The secondary system of course is the turbine island, steam generator blow-down and steam condensate feedwater cycle. Severe accident sampling is -- and these are all non-safety systems -- is containment atmosphere and the IRWST. Sometimes in 9.3 you'll see the hydrogen monitoring system which in our FSAR is in Chapter 6 so we won't be discussing that in 9.3.2. And also a subsystem to sampling is the PERMSS in 11.5 which talks about the radiological monitoring. So that's in 11.5.

The systems are non-safety but do have containment isolation systems inside of them that are safety functions. All three contain those. They will shut and remain shut except for the lines on the RCS which after a period of time can be reopened for NUREG-0737 as needed to sample reactor coolant. So they will shut automatically and then there is a provision on the RCS to reopen.

MEMBER STETKAR: Jean, let me stop you there. Something I didn't quite realize when we were going through Chapter 5 I think it is, there's some discussion that you don't have a separate steam space or gas space sample line from the pressurizer in this plant.

MS. LINDSTROM: Yes.

MEMBER STETKAR: The pressurizer, it's characterized as continuously vented to the reactor coolant drain tank.

MS. LINDSTROM: Yes.

MEMBER STETKAR: How does that all work and does -- are those -- is that vent line isolated automatically on a safety injection? How does this all work?

MS. LINDSTROM: That's a good question. As far as the actual operations of the line I'm not exactly sure of the I&C functions on it but I will say it does vent to the nuclear island vent and drain reactor coolant drain tank and there is two different vents on it. One is for normal so it's a continuous purge and the other one is for startup so it's a larger purge line. The exact -- the valves on that is not in the vent and drain system or the sampling system. We'd have to go to the reactor coolant.

MEMBER STETKAR: Right and I indeed --

MS. LINDSTROM: I do not know the operation of those.

MEMBER STETKAR: Okay. I made myself a

blowup of the drawing so I could actually see the valves. There's one line that's normally connected and it's a 1-inch line, it's got two motor-operated valves in it. There's another line that has two manual valves in it that bypasses those motor-operated. The size of that line is not shown. And then there's, there's kind of a third branch that goes through two motor-operated valves that's a 3-inch line that goes out if you want to feed nitrogen in or if you go to the vacuum, if you want to pull a vacuum when you're de-gassing. Is that --

MS. LINDSTROM: We'll have to get clarification on the actual pressurize because I don't know the exact operation of it but one is an in-operation purge line, the other one is a startup purge. But we'd have to take that as an action item.

MEMBER STETKAR: I'm assuming the one to the vacuum pump because the 3-inch line is the startup, what you're characterizing as the startup purge and the 1-inch is the normal operation line. But how does -- I mean that line is pressurized to, I don't remember the pressure on this plant, 2,500 some odd pounds or so. What happens out in the reactor coolant drain tank? I mean, does this go through a sparger that --

MS. LINDSTROM: It does go through a sparger underneath the water and it is, and then that tank I continuously purged for --

MEMBER STETKAR: That's continuously open.

MS. LINDSTROM: Yes.

MEMBER STETKAR: So you just --

MS. LINDSTROM: Yes, and that will be in the vent and drain system.

MEMBER STETKAR: You just keep venting that.

MS. LINDSTROM: It's -- we push air in, pull air out.

MEMBER STETKAR: Okay, because I was looking for it in the vent and drain and maybe I missed it. I didn't see much on the reactor coolant drain tank.

MS. LINDSTROM: It may not have been there but that is a continuously purged tank.

MEMBER STETKAR: Okay. Well, what -- yes, then even the question though about isolation of the normal vent line is more important because I'm assuming that the discharge from the reactor coolant drain tank is isolated by containment isolation signal, isn't it?

MS. LINDSTROM: Yes.

MEMBER STETKAR: So I certainly don't want to pressurize the reactor coolant drain tank and blow it up and create a LOCA path --

MS. LINDSTROM: Correct.

MEMBER STETKAR: -- for example for a plain vanilla safety injection.

MS. LINDSTROM: And we'll take that as an action. We can get you a further --

MR. GARDNER: I'm not sure I totally understand the question.

MEMBER STETKAR: The question is if you have a normal vent line open to the reactor coolant drain tank, let's call it a 1-inch vent and that vent is connected to the steam space and the pressurizer which is a high-pressure volume if you're normally venting the gases I understand how pressure will not increase in the reactor coolant drain tank during normal operations, especially if you're going through a sparger. If you isolate the discharge line from the reactor coolant drain tank and keep the inlet line open from the pressurizer I would suspect the pressure in the reactor coolant drain tank would in some reasonably short period of time approach pressure in the pressurizer. I suspect the reactor coolant drain tank is probably not rated for full system pressure which means I now open up a LOCA pathway from the top of my pressurizer which is not a particularly good place to have a LOCA for operator response for example, especially if you use pressurizer level signals for anything in the plant. So my question is if the pressurizer vent line, the one that's normally open, if that's isolated automatically by a safety injection signal then I'm okay. Now the second question is, you know, can the operators as you were mentioning after some period of time override that signal so you can indeed somehow get a steam space sample from the pressurizer is sort of a follow-on.

MS. LINDSTROM: We'll come up with an answer to that. I'm going to have to -- we'll have to discuss it with the RCS people.

MEMBER STETKAR: I mean, you understand the question that I'm asking.

MS. LINDSTROM: I do understand your question but I don't know the answer.

MEMBER SKILLMAN: I'd like to pile on because I had the same question. It's common for the pressurizer to be vented directly to the waste gas decay tanks or for the makeup tank to be vented to the waste gas decay tanks as a way of peeling off whatever isotopes you have either in the makeup tank or the pressurizer. Here you're going through the RC drain tank on a continuous basis --

MS. LINDSTROM: Yes.

MEMBER SKILLMAN: -- and that raises in my mind how do you cool that flow stream.

MS. LINDSTROM: In the drain tank.

MEMBER SKILLMAN: So it's just --

MS. LINDSTROM: The drain tank has a cooler on it.

MEMBER SKILLMAN: So the drain tank cooler takes care of that --

MS. LINDSTROM: And it will recirc itself back to the drain tank. And it is set up for pressurizer relief tank cooling, a 5-hour period. Maybe I can go over that more.

MEMBER STETKAR: It's also isolated. It's part of the non-safety loads that are isolated off the component cooling water system. But that's --

MEMBER SKILLMAN: Okay.

MEMBER STETKAR: -- that's a different question.

MEMBER SKILLMAN: Your pressurizer sample is actually the sample of your RC drain tank.

MS. LINDSTROM: Well, we do take a liquid pressure sample and we do take a sample off the reactor coolant drain tank. And I think we just answered an RAI on that --

MEMBER SKILLMAN: That's correct.

MS. LINDSTROM: -- on how that method is calculated to -- it's a calculated number. And we're assuming, we have three different samples off the reactor coolant and a fairly fast flow through them so we're assuming that the hydrogen is very uniformed and we can -- by taking the liquid and we can also do the reactor coolant drain tank. We're assuming with the calculation, there's some inputs from the reactor coolant drain tank that it is calculated to the numbers that are called into the calculation, that we have the correct concentration.

MEMBER SKILLMAN: Okay, now you're running hydrogen-rich in your RC drain tank. How do you assure that that doesn't become a point of explosion?

MS. LINDSTROM: We can take that as an action item.

MEMBER SKILLMAN: I'd like to offer that question.

MS. LINDSTROM: As far as the sampling system, it's just a monitoring system, it has no control. So we'll have to take that as a control question and we'll have to --

MEMBER SKILLMAN: Well, you're pulling hydrogen out of the pressurizer.

MS. LINDSTROM: The reactor coolant drain tank.

MEMBER SKILLMAN: And you're building a hydrogen over-pressure or a hydrogen partial-pressure in the RC drain tank.

MS. LINDSTROM: And we're purging the RC tank to the gaseous waste system. So we're pulling it back off by continuously purging that tank. So what comes out of the water and back into the void space will be continuously purged out. So the tank is sized to about a 40 percent purge space to allow for the hydrogen gases to kind of settle or move to the top and be re-purged out.

MEMBER SKILLMAN: Got a lot of hydrogen moving around.

MS. LINDSTROM: And we do have fairly good purge on it, so.

MEMBER SKILLMAN: Thank you.

MS. LINDSTROM: Okay. Any more questions? I'll go back to in the severe accident sampling system the valves are always closed. I should say on the containment atmosphere it only will be opened in -- after a period of time in a severe accident. Non-safety functions, I think I went through this. Chemical, physical, microbiological and radiological. Again, purely a monitoring system, not a -- there is no control within this system. So it's just AD operator.

I have a diagram of the severe accident sampling system which I think -- refers to it in some as the PASS. We are able to take three different samples, the gaseous containment and the IRWST which is the sump. The gaseous samples are taken by the NaOH is put into the sample pools, the gas is bubbled up through the NaOH which scrubs them of the iodines and aerosols. So we'll get a sample of the atmosphere. Then we'll sample the scrubbing fluid for the iodine aerosols. The sump is directly a liquid sample. They are, the modules are in a closed room away from the sampling module and they're diluted to 1 to 1,000 for operator protection and radiological reasons. And when we're done they're re-injected back into the containment.

Again, these valves, it's a heat trace valve if it's not clear on the picture. That's because it's a gas sample. So when the operator will access it in a field building the rest of the modules are in the safeguard building. There should be no, the sample should be diluted before the operator pulls a syringe off of it.

This is a non-safety system so it is taken out of the tech spec and that was an option. So we move it from the tech spec to make it a non-safety system. What we left ourselves with was a monitoring system, environmental monitoring system external to the plant so this was allowed through the requirements.

MEMBER SKILLMAN: Jean, you mentioned that you're complying with NUREG-0737.

MS. LINDSTROM: Right.

MEMBER SKILLMAN: Can you speak to the source term that might have been considered in designing the SASS or the PASS?

MS. LINDSTROM: Yes. We're going to have to take an action item on that, on the exact source term of that.

MEMBER SKILLMAN: Do you understand why I'm asking the question? Do you understand what the source term could be post-accident?

MS. LINDSTROM: Yes. So we'll have to formulate an answer for that. That's I think a longer answer.

MEMBER SKILLMAN: Okay, thank you.

MS. LINDSTROM: But we'll take that.

MEMBER STETKAR: It's especially pertinent for this because it is the severe accident sampling system.

MS. LINDSTROM: Yes.

MEMBER STETKAR: So it in principle could be operating when your SAHRS --

MS. LINDSTROM: That has been done. I don't want to -- I can't quote that answer off the top of my head.

MEMBER SKILLMAN: Well, just getting to it can be a real problem.

MS. LINDSTROM: So we will come up with that, the correct wording and things. Again, this is -- any questions on this? As far as -- this is a typical post-TMI system.

Okay, I'll move to Section 3.3 if there's no questions. Okay, this is the equipment and floor drain system. We refer to this as the nuclear island vent and drain system, NIDVS, and temporary storage collects potentially radioactive fluids or radioactive fluids on the nuclear island. And we can either recycle which is the primary vent and drain, or we try to recycle if we can back to the parent system we say, or process drains, or our regular floor drains which are -- the difference are controlled and uncontrolled areas. Those all go to the rad waste system. Let's see. I think I mentioned before turbine islands in Chapter 11, if you had questions on that, and we define the nuclear island as the reactor building, safeguard buildings, fuel building, access building, auxiliary building and radioactive waste processing building. So those are our definitions of the NIDVS. Next slide, please. Okay.

This again is a non-safety system but does contain safety functions contained in isolation. And the flooding. Flooding in Safeguards Buildings, fuel buildings, the reactor buildings. The reactor building actually has -- is also the lowest level in the sump is actually used also for the reactor coolant leakage detection system. So that's maybe a dual function on that one. And the Safeguards Buildings and fuel buildings are purely flooding functions. And we talked about the -- they're all just back to the operator except the safeguard building which actually does trip the pump and the valve. The fuel building just sends in an alarm to the operator that a potential for flooding.

The non-safety functions, I won't go over them all but it's just, it's a holdup and we can, we have the ability to re-inject back into the containment building from the auxiliary building if we need to delay treatment. Rad waste maybe isn't working or is being overworked. And this is also a tool for -- to indicate maybe some leakages throughout the plant. Next slide, please.

Okay. The way that the vent and drain system is set up is that we try to classify them according to whether they can be recycled or not and that has to do with the boron. We do have, we have leakages that are known like reactor coolant drain pump leakages so those that we do know we will recycle back to the parent systems. Also by origin. And the piping, we've arranged the piping especially through the safeguard buildings not to pipe from one safeguard building to another safeguard building. It will go from the safeguard building directly over to the auxiliary building so we do not pick up any -- we do not flood the next safeguard building or we don't pick up any drains in the next building, potentially flood the adjacent safeguard building.

We don't take any credit in the drain system for a flooding event. There's no credit taken in the system. And we do have temporary and permanent connections on this. Most everything is gravity-drained. If it is in the bottom floor we still have two layers of protection. It will be double-wall pipe. It fits in the bottom floor concrete. Other than that it's all just gravity-drained single pipe to that lowest, to the tank that's closest.

MEMBER SKILLMAN: Jean, relative to gravitational flow what is the specification, or what will be the specification for the fall?

MS. LINDSTROM: The slope?

MEMBER SKILLMAN: Yes.

MS. LINDSTROM: Well, most of ours are fairly vertical runs. Currently I do not know that we have a specific number on what is enough slope or not. I can check on that though.

MEMBER SKILLMAN: I'd like that question on the record and it applies to many systems more than just this system. But we've gone through the gas collection and all the plants have gone through all kinds of nonsense trying to get gas out of this header or that header, this safety injection pump, that one.

MS. LINDSTROM: We do have guidelines. We try to slope on piping.

MEMBER SKILLMAN: It really becomes an AE function to -- for the licensee to enforce the fall but if you don't do that you're going to end up with horizontal pieces of pipe that can't be drained, can't --

MS. LINDSTROM: For low points?

MEMBER SKILLMAN: Yes. And you'll have stuff down there that'll -- will give you a source term or a field level where you say, you know what? For a few minutes of thinking about this we would not have this problem.

MS. LINDSTROM: Yes.

MEMBER SKILLMAN: There needs to be enough slope that the lines clean themselves, that they flow. And it almost always shows up in rad waste 2 feet under concrete, you can't get to it.

MS. LINDSTROM: Yes. We have very few pipes that are actually in concrete but we can't help -- there's just a couple. But we have minimized most of them. And that is a problem. We will get you the sloping requirements. They're just, I think we have them written in guidance for piping but we'll find them. This one, no tech specs on this particular system. Any questions? Okay, I'll move on to Fred.

MR. MAASS: My name is Fred Maass. I'm the manager of EPR NI systems engineering. As they said before I've got over 25 years of nuclear experience. I am a graduate of Purdue University with a BS in mechanical engineering so I thought I'd mention that since my compadres have.

CHAIR POWERS: This is a conspiracy. We'd get a different crew if the football game had come out differently.

(Laughter)

MR. MAASS: So yes, I'd like to discuss the CVCS system and the extra borating system. The CVCS system is fairly typical of existing plants. It maintains the coolant inventory, the pressurizer level control, source of water for purification, chemistry control, seal injection, makeup water. It has four safety-related functions. It provides RCS pressure boundary integrity, boron dilution mitigation, RCS overfill and provides containment isolation.

MEMBER SKILLMAN: Before you proceed I would like to know why seal injection is not safety-related.

MR. MAASS: Because we have component cooling water available for termination of the event so that's a safety-related system that provides cooling to it.

MEMBER SKILLMAN: Are you comfortable with that?

MR. MAASS: Typically I think that's

fairly similar to existing plants.

MEMBER SKILLMAN: Not the ones I'm familiar with.

MR. MAASS: Okay.

MEMBER SKILLMAN: Hey, it's your design.

MR. MAASS: Yes.

MEMBER SKILLMAN: And it's your seal LOCAs that you're messing with but it seems to me that of all of the things that you want to have, you want an abundance of safety-grade seal injection backed up by an abundance of safety-grade component cooling water so that no matter what you get cool seals that are fully sealing against whatever's going on in the reactor coolant system.

MR. MAASS: I understand.

MEMBER SKILLMAN: Thank you.

MR. MAASS: Many non-safety related functions for this system allows for boron control, RCS boron control, makeup via -- for a water inventory control, again seal injection, chemical and radiological control and provides auxiliary spray of the pressurizer to control pressure when we don't have our seat pumps operating.

Unique features built for the EPR. We have a hydrogenation station where we add hydrogen to the system. We have a volume control tank that actually works more as a surge tank as opposed to being in the primary flow path for letdown. We have a high pressure reducing station where we control letdown flow to maintain pressurizer level. And it's powered as alternate power from the SBO diesel generator.

MEMBER STETKAR: But the hydrogenation is a little bit different. Is that typical for European designs? I haven't seen that before either. This is just a new --

MR. MAASS: I'm not exactly sure. I do not know that.

MEMBER STETKAR: And about, if I read correctly about 90, you know, only about 10 percent of the letdown flow actually goes through the volume control tank.

MR. MAASS: That is correct.

MEMBER STETKAR: It's just to basically keep, you know, uniform boron concentration there.

MR. MAASS: Yes.

MEMBER STETKAR: And about 90 percent goes through that -- and that's a continuous hydrogenation --

MR. MAASS: Yes.

MEMBER STETKAR: -- because you're continuously venting the pressurizer, right?

MR. MAASS: Right.

MEMBER STETKAR: You just move a heck of a lot more hydrogen in this plant than you do --

MR. MAASS: Yes.

MEMBER STETKAR: -- in other plants.

MR. MAASS: But we keep a lower concentration so, a tighter control on our concentration.

MEMBER STETKAR: Until you get the open item resolved I guess.

MEMBER SKILLMAN: Fred, is there any OE from Europe on use of the hydrogenation station?

MR. MAASS: Right now I do not know so I would have to look that up for you.

MEMBER STETKAR: I'll let you finish writing. I understand writing notes. What's the cover gas in the VCT then?

MR. MAASS: Nitrogen.

MEMBER STETKAR: Nitrogen? Okay.

MR. MAASS: This is just sort of a busy flow diagram. It's out of the FSAR, fairly, pretty much. It identifies the flow path, various flow paths in through seal injection and makeup and letdown. The regenerative heat exchanger, the HP cooler and the various subsystems that it interfaces with such as coolant supply, storage, coolant de-gas, coolant purification and the reactor boron makeup water system. So those are kind of subsystems of the CVCS.

MEMBER STETKAR: Fred, I hate to hit you with this but this is another item that we were requested to save until Chapter 9.

MR. MAASS: Okay.

MEMBER STETKAR: This is from March of 2010 for example. The de-boration protection function of CVCS as I understand it, first of all the safety-related part of that just to make sure we're clear about safety-related versus non-safety related. What happens is you close I think two valves in the letdown lines, a valve from the volume control tank and that is the safety-related function, those three valves.

MR. MAASS: Yes, I believe so.

MEMBER STETKAR: Then in parallel to that you line up the suction of the charging pumps to the IRWST but that's just to keep seal injection going and so forth. On this drawing, I like this drawing. What are those three valves? Are they the two containment isolation valves in the letdown line in the upper left corner and the volume control tank outlet valve? Are those the three valves that close?

MR. MAASS: I would have to look to confirm. I do not remember exactly which of those valves actually close but I do know it's more in the suction lines as opposed to the discharge lines for the other one.

MEMBER STETKAR: The reason I'm going to ask is I brought this up during the Chapter 4 discussion. If I'm operating during shutdown I'm not letting down through that normal flow path. I believe I'm letting down through the line that's shown vertically to the left of the containment isolation from RHR and SI.

MR. MAASS: Right, yes.

MEMBER STETKAR: That's the low-pressure letdown line. And under those conditions does the low boron concentration signal automatically isolate that line? Because at that point if it does not I'm within only that single VCT outlet valve for isolation of a potential dilution path.

MR. MAASS: Okay.

MEMBER STETKAR: So the question is you know if I'm operating on low-pressure letdown during a refueling outage when indeed there might be more opportunity, by the way, for dilution of the primary system are the valves from the low-pressure letdown line closed automatically by the low boron concentration, whatever it is, low boron concentration signal, whatever the de-borating actuation signal. The tech specs require that system to be operable in all modes of plant operation but they, I think they just specify that the system, they don't specify specific valves or things like that so I'm not quite sure how it operates in shutdown.

MR. MAASS: Okay.

MEMBER STETKAR: You don't have an answer for that?

MR. MAASS: Right off the top of my head no, I don't.

MEMBER STETKAR: As I said, I brought it up because we were asked to delay that until Chapter 9 so I did.

MR. MAASS: Okay. Yes.

CHAIR POWERS: You also don't have an answer yet.

MEMBER STETKAR: No, but at least I asked the question now in the right place. They can't tell me to wait until Chapter, you know, like 3.

MEMBER SKILLMAN: Before you change this image, for each reactor coolant pump --

MR. MAASS: Yes.

MEMBER SKILLMAN: -- is it accurate that seal injection flow rate per pump is 8 to 10 gallons a minute and 6 to 8 or 9 enter the reactor coolant system and 2 to 3 returns through the seal return line? Is that how to think about it?

MR. MAASS: Yes, that's approximately how it works.

MEMBER SKILLMAN: So your net inflow for four reactor coolant pumps being fed seal injection is roughly 4 times 6 or 4 times 8 gallons per minute, 36 to 42, something like that. And now my question about your high-pressure cooler.

MR. MAASS: Okay.

MEMBER SKILLMAN: That is not cooled by component cooling water because that is not an essential or not a safety --

MR. MAASS: Right.

MEMBER SKILLMAN: -- service. So now I'm sitting here, I have a casualty of some sort, I'm not cooling that 32 gallons a minute. I'm continuing to feed my reactor coolant pumps. What do I do with that water?

MR. MAASS: Well --

MEMBER SKILLMAN: -- constantly increasing pressurizer level and now I'm going to have to do something?

MR. MAASS: You're correct in the fact that the letdown path would be isolated. I would imagine that yes, you would have the increase in pressurizer level. I'm not sure exactly what the mitigation strategy is right off the top of my head. So I would have to look that up for you to follow that path through to the logical conclusion.

MEMBER SKILLMAN: It's not my purpose to antagonize you.

MR. MAASS: Okay.

MEMBER SKILLMAN: I'm thinking of real life casualty, a real life situation where the operators are torn between continuing seal injection and they're watching the pressurizer level go up. And they're saying what do I do now. Clearly they're going to figure this out in procedure space. Going back to the young lady who started this, she said we're going to solve this stuff right at the design stage. It seems to me that this is an integrated set of questions that deserve attention now because it's easy to walk away and say we're just going to leave it just the way it is but from my years of experience keeping the reactor coolant pumps running, maintaining seal coolant and maintaining component cooling water to the thermal barrier heat exchangers and also to the letdown gives the operators flexibility in maintaining normal pressure and temperature and pressurizer level no matter what's going on.

MR. MAASS: Okay.

MEMBER SKILLMAN: Now it looks to me like this is a potential hole in your armor. I mean, you've got defense-in-depth redundancy, this is a marvelous machine, but it seems like this is one of those horseshoe nail situations. It's a little wrinkle, if it's addressed on the front end -- and I might say as it was with BMW in 1969, '70 and '71 we unraveled this. It led to great flexibility in spite of the TMI 2 event.

MR. MAASS: Okay.

MEMBER SKILLMAN: So the real issue is that safety classification of seal injection to the reactor coolant pump seals. The safety classification of the component cooling water for your high-pressure cooler for a letdown such that those two enable unbridled use of your reactor coolant pumps, particularly the seals.

MR. MAASS: Okay.

MEMBER SKILLMAN: Thank you.

CHAIR POWERS: Dick, could you give me a paragraph on that?

MEMBER SKILLMAN: Yes, sir.

MR. MAASS: All right. Extra Borating System. It was in Section 6.8. It was deferred to 9.3.4. It's a safety-related source of concentrated boron to support plant cooldowns. Safety functions include reactivity control for non-LOCA events and the steam generator tube rupture. Maintains RCS pressure, boundary integrity and containment isolation. It has no non-safety related functions. It's basically a system that's only designed to borate the RCS.

MEMBER SKILLMAN: Question, please.

MR. MAASS: Yes.

MEMBER SKILLMAN: You've got your normal boron which is your 1 in 5 to 20 percent B-10.

MR. MAASS: Right.

MEMBER SKILLMAN: Then you have this one that has the elevated boron.

MR. MAASS: Right.

MEMBER SKILLMAN: How do you keep the color of money separated?

MR. MAASS: Are you talking about the boron enrichment?

MEMBER SKILLMAN: Yes.

MR. MAASS: Okay.

MEMBER SKILLMAN: Here comes the boron truck. Which one? I don't know, one goes over there, the other one goes over there. Put them where they belong.

MR. MAASS: I would have to check but I'm pretty sure that we use enriched boron throughout.

MEMBER SKILLMAN: That's not what your documentation says. You've got two different enrichments onsite.

MR. MAASS: Okay.

MEMBER SKILLMAN: And that leads me to wonder what controls are there to ensure that the naturally occurring B-10 boron --

MR. MAASS: Right.

MEMBER SKILLMAN: -- is where it is supposed to be and the enriched boron which is approximately 50 percent more boron B-10 as per weight mass is where it's supposed to be. And so here's an element that physically looks identical. One has significantly more B-10 and it's only B-10 that's going to take a neut. So how do you keep that chemical separated so the right chemical's in the right place for the right use?

MR. MAASS: Okay.

MEMBER SKILLMAN: That's my question.

MR. MAASS: Okay. I will have to get back to you on that.

MEMBER SKILLMAN: Thank you.

MR. MAASS: All right. Another flow diagram of the extra borating system. Basically feeds all four loops, two train system, fairly simple. And that's the end of my presentation.

CHAIR POWERS: I look through this, Darrell, and I see we're about halfway through. It might be an appropriate time to take a break here.

MR. GARDNER: I would agree.

CHAIR POWERS: So why don't we break until, what, 10 after? Is that okay? Designated federal official?

MR. WIDMAYER: Sure.

CHAIR POWERS: I'm not going anywhere this evening so we've got lots of time.

MR. WIDMAYER: Apparently no one else is either.

(Laughter)

(Whereupon, the foregoing matter went off the record at 2:54 p.m. and went back on the record at 3:10 p.m.)

CHAIR POWERS: Let's go back into session.

Darrell?

MR. GARDNER: Okay, we're ready to start with Section 9.4. And we have Susan McConaty who's going to be describing the HVAC systems. And again I would say, not that this will preclude any questions but that we prepared the presentation material on a selected set of ventilation systems, not all of the ventilation systems.

MS. MCCONATY: Okay. I'm Susan McConaty. I got my degree in mechanical engineering at University of Lowell. I've been in the nuclear power industry since 1975. I was 15 years with Stone & Webster mainly working on operating plants and was with Yankee Atomic where I was a system design engineer and was working on the Maine Yankee project doing HVAC recovery of their design basis when the plant was shut down. And then we -- it's sad.

MEMBER STETKAR: That solved that problem.

MS. MCCONATY: Right, right. And then became -- worked with Duke Engineering and now AREVA and started working on the EPR in 2005. Okay.

These are the buildings that are going to be part of our presentation. Chapter 6 has already been presented so it's not part of the presentation. And the other systems in Chapter 9.4 are basically non-safety and typical so as Darrell had mentioned they're not part of the presentation. Next slide, please.

Okay, the control room air conditioning system maintains the controlled environment in the control room envelope for personnel and equipment operation. It maintains control room habitability per the guidelines of GDC 19 and Reg Guides 1.78 and demonstrates control room envelope integrity to provide radiation protection per the guidelines of Reg Guide 1.197 and SRP 6.4, maintains the positive pressure within the control room of greater than 0.125 inches water gauge with respect to adjacent areas during DBAs and provides HEPA and iodine filtration of the outside inlet air and the recirculated air from the control room envelope to remove potential contaminants and iodine during the DBA. And this is per the guidelines of Reg Guide 1.52. And the control room envelope is isolated from outside air upon detection of a toxic gas. Next slide, please.

The non-safety functions are to provide outside ventilation air for personnel, maintain ambient conditions for personnel and equipment, and maintain a slightly positive pressure within the control room envelope with respect to adjacent areas.

The control room envelope consists of the following areas: the main control room, technical support center, restrooms and kitchen, computer room and the HVAC equipment room. Next slide, please.

This diagram shows the cracks during normal operation with the ESF filters bypassed for the outside air. It's mixed with recirculating air distributed and either recirculated or exhausted through the kitchen or restroom exhaust.

MEMBER SKILLMAN: Question, please. Back to your slide 43, please, safety functions. I understand control room habitability, maintaining the positive pressure relative to the adjacent areas, the iodine filtration, isolation on toxic gas. Is maintenance of temperature part of this? It seems to me that for the control room to be successful we've all learned the digital equipment particularly has to be at some cool temperature. If it's allowed to be warm it's not functional.

MS. MCCONATY: Right.

MEMBER SKILLMAN: So I'm wondering is there an additional safety function for temperature.

MS. MCCONATY: It -- I would have to look and see what that safety-related temperature is. I know in one of the instances where there isn't cooling provided it may get up to 104 degrees.

MEMBER SKILLMAN: Normally --

MS. MCCONATY: But that's for --

MEMBER SKILLMAN: Normally 104 is the upper limit.

MS. MCCONATY: Right, yes.

MEMBER SKILLMAN: And there's a desire to be much, much below the -- 104 is pretty testy for the operators.

MS. MCCONATY: Right.

MEMBER SKILLMAN: But there is commonly an equipment temperature limit where the equipment begins to be questionable. And so I'm wondering if there is a temperature safety function associated with the control room.

MS. MCCONATY: Okay, I'm not sure on that.

MR. GARDNER: We can check. I would say remember this is a non-traditional control room with lots of panels and the heat loads coming from those is, it's a different control environment.

MEMBER SKILLMAN: You control the plant from the control room?

MR. GARDNER: Yes, but operator temperature would not be something that would be a safety-related consideration, it would be a personnel comfort.

MEMBER SKILLMAN: There's no safety-grade electronics in the control room?

MR. GARDNER: Well, we can talk about that tomorrow. You're here tomorrow? We're going to talk about the control room tomorrow and the I&C system.

MEMBER SKILLMAN: I hope you're --

MR. GARDNER: Yes.

MEMBER SKILLMAN: It would seem to me it ought to be. And I would think that there's a temperature limit that we've all learned over the years where digital equipment is happy at one temperature and it's unhappy at a temperature higher than that.

MR. GARDNER: I think it's a higher number maybe than you're --

MEMBER SKILLMAN: Okay.

MR. GARDNER: We'll talk about it tomorrow.

MEMBER SKILLMAN: Okay. Thank you.

CHAIR POWERS: What is the unfiltered in-leakage from the control room?

MR. GARDNER: I'm sorry, Dr. Powers?

CHAIR POWERS: What is your unfiltered in-leakage on the control room?

MS. MCCONATY: The outside air that's brought in?

CHAIR POWERS: When you isolate for an accident you get, there's some air that's going to come in unfiltered. What is it?

MS. MCCONATY: Unfiltered. Well, we maintain the positive pressure in there so I'm not sure where the in-leakage would be.

CHAIR POWERS: Just open the door. I mean as soon as somebody walks through the door you're going to get some in-leakage that's unfiltered.

MR. GARDNER: You're asking what's the assumption for the unfiltered in-leakage for the dose calculations. Do you happen to know that?

MS. MCCONATY: No, I don't.

MR. GARDNER: Okay.

MS. MCCONATY: Any other questions on this slide?

MEMBER STETKAR: Yes. Now, I'm trying to read notes from the last time we discussed this, so. The only active, if I can call it that, exhaust path in the control room envelope is through the kitchen and whatever it is, the little line on the lower, kitchen and restroom exhaust line out there. My notes from the last time we discussed this in Chapter 6 was that line is isolated, I don't remember what signals isolate that line. The question is that the control room envelope contains both the main control room and the technical support center, and the occupancy, kind of the design occupancy for those areas can be up to about 30 people I think, about 25 people in the technical support center and a nominal 5 people in the main control room itself. If that exhaust path is isolated how do I have enough volume of air flowing through the main control room envelope for normal habitability? And I'm talking about not particularly temperature now but carbon dioxide buildup for example.

MS. MCCONATY: Right, right. I'm aware of this question that is an open item from Chapter 6.

MEMBER STETKAR: It's still? Okay.

MS. MCCONATY: It's still open, yes.

MEMBER STETKAR: It's still open, okay. Okay.

MS. MCCONATY: Right.

MEMBER STETKAR: I didn't know whether you'd come to resolution on that yet. Okay.

MS. MCCONATY: Okay, any other questions? Okay. Next slide, please. This shows the accident alignment with the outside air and the recirculation air from the control room is passed through the ESF filters and the isolation valves on the exhaust are isolated. Any questions on that? Okay, next slide please.

Okay, the fuel building ventilation system. The safety functions are to maintain a pressure in the fuel building less than -0.25 inches water gauge. It provides exhaust filtration for potentially contaminated airborne particles, part of the discharge to the vent stack and maintains temperature in the boron rooms using electric heaters to maintain the minimum design temperature at above 68 degrees to prevent the crystallization of the boron solution. And it maintains temperature in the fuel pool and extra borating pump rooms using safety-related recirculation coolers to maintain the maximum design temperature below 113 for equipment operation. Any questions? Okay, next slide please.

Okay, the non-safety functions are to maintain ambient conditions in the fuel building with the normal air supply is from the nuclear auxiliary building ventilation and it's also exhausted by the same system. It maintains a slight negative pressure with respect to the outside environment via the air supply and exhaust from the NABVS and it has filtered exhaust from the nuclear auxiliary, the NABVS through HEPA and carbon filtration for the air exhausted during normal operation.

CHAIR POWERS: On the carbon filtration what, I mean what are you trying to achieve with carbon filtration? Iodine?

MS. MCCONATY: Iodine removal, yes.

CHAIR POWERS: Okay. So it's merely governed by an ASTM spec?

MS. MCCONATY: By an ASTM spec?

CHAIR POWERS: Yes. For carbon filtration of iodine.

MS. MCCONATY: Well, okay. It's to, I believe those filters are to Reg Guide 1.140 and it's to 8(g)(1) ASTM.

CHAIR POWERS: Oh.

MS. MCCONATY: Right.

CHAIR POWERS: Yes, just an ASTM spec.

MS. MCCONATY: Right. Okay. And in the event of a fuel-handling accident the fuel pool hall is isolated and the air is filtered through the ESF filters in the safeguard building ventilation system filtration trains.

CHAIR POWERS: What kind of mass can those filtration trains tolerate?

MS. MCCONATY: Excuse me?

CHAIR POWERS: What kind of mass can those filtration trains tolerate?

MS. MCCONATY: You mean flow rate? The flow rate, the mass?

CHAIR POWERS: I mean, you're going to have a fuel-handling accident, you're going to drop a fuel load -- a fuel assembly on the floor. The air oxidations can produce a lot of aerosol. What kind of aerosol mass is going to go down that filtration train?

MS. MCCONATY: Okay, I don't know. I'd have to get back to you on that. So what's the exact question, the mass?

CHAIR POWERS: Yes, I mean if you've got HEPA filters you can probably tolerate a kilogram on a HEPA filter. If they have roughing filters in front of them, probably more. I just don't know.

MS. MCCONATY: Well I know we have an open item on that from, it must have been from Chapter 6 for the 6.5.

CHAIR POWERS: Probably.

MS. MCCONATY: Right.

MEMBER STETKAR: Susan, before you flip the slide the charging pumps are located in the fuel building, is that correct?

MS. MCCONATY: Yes. I think so, yes.

MEMBER STETKAR: They -- and the only cooling for those, are they in separate rooms by themselves or are they out in an open area? I have no idea. If you answer you have to come up and tell us who you are.

MR. MAASS: I will have to check on that.

MEMBER STETKAR: The only reason I was asking is that the fuel pool pumps and the extra borating pumps have separate, you know, room coolers for them.

MS. MCCONATY: Right.

MEMBER STETKAR: But I don't see any of that for the charging pump room. So I was curious, you know, if you do have a loss of fuel building ventilation system that these charging pump rooms are going to heat up if they're in separate rooms. If they're out in an open area obviously it'll take longer. But I'm just thinking about survivability of the charging pumps after loss of the bulk fuel building ventilation system.

MR. GARDNER: For what function?

MEMBER STETKAR: Survivability of the charging pumps. You know, how long. You know, you have provisions such that the charging pumps can be powered from the station blackout diesels. You have the ability of at least manually if not, you know, automatically maintaining charging flows as long as possible to reactor coolant pump seals and for makeup. But if the pump rooms are going to heat up and the charging pumps are going to overheat all of that long-term capability for makeup and seal injection isn't worth very much.

MS. MCCONATY: Okay.

MEMBER STETKAR: Recognizing that, you know, I fully acknowledge that all of these functions you know are quote unquote non-safety related but you have made extra provisions for the charging pumps in terms of power supplies and things like that. I was just curious about whether or not thought has gone into keeping the, you know, their locale cool.

MS. MCCONATY: Okay. Next slide, please. This shows the LOCA alignment for the ventilation system with the NABVS is isolated and is being exhausted through the safeguard building ventilation system filters. Next slide, please.

This is during a fuel-handling accident with the fuel pool hall isolated and it's being exhausted again by the SBVS. Normal ventilation is maintained to the rest of the fuel building using the NABVS. Okay, any questions on the fuel building ventilation system? Okay, next slide please.

Okay, now we're at the nuclear auxiliary building ventilation system. It does not have any safety-related functions. Its non-safety related functions are to provide conditioned supply and exhaust air to the nuclear auxiliary building fuel building and annulus during -- to maintain ambient conditions for personnel and equipment during normal operation, and also to exhaust the safeguard building controlled area during normal plant operation. It maintains these areas at a slightly negative pressure and provides exhaust filtration during normal operation per the guidelines in GDC 60 and clean air filtration guidelines of Reg Guide 1.140. It provides conditioned supply and exhaust air to the containment ventilation full flow and low flow purge system during a plant outage, and provides conditioned supply air to the low flow purge system during containment access during normal operation.

Okay, this slide shows the exhaust of the NABVS. The blue line is the normal path. It exhausts four different areas and has seven different exhaust lines coming in. If iodine is detected in one of these lines that flow path is diverted up through the carbon filters for iodine removal and then exhausted through the vent stack. Any questions on the nuclear auxiliary building? Okay, next slide please.

Okay. All four of the safeguard buildings are serviced by two different ventilation systems. This one's the safeguard building controlled area which is the potentially contaminated area. The safety functions of the ventilation system are to maintain the controlled area at a negative pressure of -0.25 inches with respect to adjacent areas during accident operation. And it provides HEPA and iodine filtration for the exhaust air from the safeguard building controlled area and fuel building prior to being discharged from the vent stack per the guidelines of Reg Guide 1.52 and controls the release of radioactive materials from the containment following an accident. It maintains ambient conditions within the controlled area of the safeguard building for equipment operation using safety-related recirculation cooling units. Okay, next slide.

Okay, non-safety are to maintain ambient conditions for personnel and equipment. It gets its conditioned cooled or heated air from the safeguard building ventilation electrical division which will be next and is exhausted by the NABVS. During a fuel-handling accident in the fuel building it maintains the pressure in the fuel-handling area at 0.25 inches and provides exhaust HEPA and iodine filtration, and meets the guidelines of GDC 61, 62 and Reg Guide 1.152. During normal operation it maintains the pressure in the controlled area, a negative pressure and provides exhaust filtration via the NABVS. Any questions on that? Next slide, please.

This is the accident alignment for the safeguard building ventilation system. Over on the left the normal exhaust by the NABVS is isolated and the exhaust is drawn through the ESF filter along with the air from the fuel building. Any questions on the controlled area ventilation system?

Okay, the electrical division of the Safeguards Building ventilation system maintains ambient conditions in the safeguard building electrical and non-contaminated areas which include the component cooling water, emergency feedwater and safety chilled water pumps. It provides ventilation air for the battery rooms to maintain hydrogen levels less than 1 percent volume per the guidelines of Reg Guide 1.128 and provides cooling to maintain ambient conditions within the battery rooms. The non-safety functions are to provide ventilation and maintain ambient conditions in the safeguard building electrical area, provide ventilation and cooling for the battery rooms and to provide ventilation air for personnel.

Okay. This is a diagram of the system for trains. Trains 1 and 4 are shown; 2 and 3 are the same except for they do not have the maintenance trains shown in green. The -- it's a typical system where the air is brought in heated and cooled and filtered and distributed to the various areas. The exhaust from the clean areas can be recirculated. The exhaust from the battery rooms and rooms containing refrigerants is exhausted directly outside. And the maintenance trains, the maintenance train in division 1 can also serve as the unit, the division 2 and 4 can service division 3. Okay, any questions here?

MEMBER SKILLMAN: Yes. Is it accurate that trains 2 and 3 simply do not have the green marked equipment? Is that what you're communicating with the line at the bottom?

MS. MCCONATY: Right. We have two trains, we have two maintenance trains and over on the -- by the supply shaft plenum, a little bit more over on the left and down you see a connection that's going over to division 2. So it can be directly interconnected to division 2. So any of the four divisions of the ventilation system can be taken out for maintenance at a time.

MEMBER SKILLMAN: So if we were looking at trains 2 and 3 instead of 1 and 4, trains 2 and 3 would also have the green marked equipment?

MS. MCCONATY: They would not have the green marked equipment. They would have a connection showing, coming from division 1 and 4.

MEMBER SKILLMAN: Okay.

MEMBER STETKAR: But there's -- if I go to the plant and I count up supply fans I can count a total of five in the plant? One for each division plus a maintenance or are there six?

MS. MCCONATY: There would be six. There's two maintenance trains.

MEMBER STETKAR: There are two maintenance trains.

MS. MCCONATY: There are two maintenance trains, right.

MEMBER STETKAR: Okay.

MS. MCCONATY: One and 4 each have the maintenance train in their building.

MEMBER STETKAR: Okay.

MS. MCCONATY: Then it can be cross, you know.

MEMBER STETKAR: But there's duct work that goes over to the other building?

MS. MCCONATY: Right, yes.

MEMBER STETKAR: So essentially I can substitute either of those maintenance trains interchangeably for any one of the four divisions.

MS. MCCONATY: You could only use the one in division -- in train 1 for train 2.

MEMBER STETKAR: I've got you, okay.

MS. MCCONATY: Right. So they're only connected to one other division.

MEMBER STETKAR: I've got you. It's the maintenance 1, 2 --

MS. MCCONATY: Right.

MEMBER STETKAR: -- and the maintenance 3, 4.

MS. MCCONATY: Three, 4, right, right.

MEMBER STETKAR: Okay, gotcha, thanks. And they live in their respective buildings.

MS. MCCONATY: Right, yes.

MEMBER STETKAR: I've got you.

MS. MCCONATY: Right.

MEMBER STETKAR: Thank you.

MS. MCCONATY: Okay, any other questions? Okay. Containment building ventilation system. The safety functions connected with the containment building ventilation system are containment isolation to meet the guidelines of GDC 56 for primary containment and to provide HEPA and iodine filtration for air exhausted from the containment to meet the guidelines of Reg Guide 1.152 and GDC 41, 42 and 43. And the non-safety functions are to provide a low flow purge of containment for access during normal plant operation, provide HEPA and iodine filtration of potentially contaminated airborne radioactive materials from the containment equipment and service compartments during normal operation via the internal filtration subsystem. And during a fuel-handling accident it also provides the filtration for the fuel-handling accident in containment using the low flow purge subsystem.

The main cooling system provides cooling for the equipment in service areas within containment and the reactor pit fans supply air from the containment cooling subsystem to the reactor pit and to maintain the temperature of the concrete below 150 degrees to prevent degradation. It maintains pressure, negative pressure in containment during fuel-handling and provides conditioned air to the containment during plant outages via the full flow purge.

MEMBER STETKAR: Susan, the low flow purge can be operating during normal plant operation, is that correct?

MS. MCCONATY: Periodically when personnel need to access the containment.

MEMBER STETKAR: That's -- I was going to ask you, do you have any operating experience to sort of estimate the fraction of time that that would be running?

MS. MCCONATY: I would say I don't have the plant -- I'm not sure how often they would be accessing containment.

MEMBER STETKAR: Okay.

MS. MCCONATY: Do you --

MEMBER STETKAR: I'm curious about it because it's a large ventilation path that could be normally open.

MS. MCCONATY: Right.

MEMBER STETKAR: And I didn't want to bring it up earlier. It's the only set of air-operated containment isolation valves that I could come up with that would be normally open, could be normally open during plant power operation. I know they're designed to fail closed on loss of air pressure or loss of electricity but there have been instances where contaminants in the air lines have caused binding of the little spools in the solenoid valves such that even though you de-energized the solenoid air isn't vented and the valve stays open. So, and because it's a large path --

MS. MCCONATY: Right.

MEMBER STETKAR: -- it's sort of interesting. So yes, I'd be curious if you have any operating experience from similar plants what fraction of time they might be open. It's all, I mean it's basically how they control operations and how often people need to go in or whether or not you need to operate the system for just basic air cleanup inside the containment. I just don't know. The plant I used to work in, we had it running constantly even though nobody ever went in there. It just isn't necessarily the best thing to do but that's the way it was aligned.

MS. MCCONATY: Right. Yes, yes, the containment system is one of those that's a little bit different than a lot of the U.S. plants.

MEMBER STETKAR: Yes, that's right and

that's why, you know, I was asking if there is any operating experience from Europe where they would have a similar basic inventory of equipment in containment and probably requirements for personnel to go in there periodically and make sure that things were still where they're supposed to be, that sort of thing.

MS. MCCONATY: Right.

MEMBER STETKAR: I just don't know whether that's a daily or weekly or monthly or, you know, every now and then sort of activity.

MS. MCCONATY: Okay. All right. And this is a diagram of the ventilation systems and it's showing it with the full flow purge if you can discern the green lines from the black lines there.

MEMBER SKILLMAN: Question, please. On the right-hand side of the reactor building there is what appears to be a rectangular compartment. What is that, please?

MS. MCCONATY: Oh, that's showing the annulus. You mean with the two isolation valves on each side?

MEMBER SKILLMAN: Yes.

MS. MCCONATY: Yes, that's showing the annulus. And we've got, you know, the isolation valves on each side.

MEMBER SKILLMAN: Thank you.

MS. MCCONATY: Okay. Okay, this now would be the ventilation system for the emergency-powered generating building. The safety function is to remove the heat generated from the emergency diesel generator building and maintain ambient conditions for the operation of equipment during the design basis accident including loss of offsite power. And non-safety is to maintain ambient conditions in the building for personnel and equipment during normal operation. Okay, next slide.

This shows the system, it's typical for all four trains. It's composed of three subsystems. The diesel hall which is, you probably can't read that. On the top we have the air intake and the air exhaust compartment, and then below that is the diesel hall. And so we've got the supply air coming in and then it's exhausted. And the supply is slightly higher because it maintains that area at a slight positive pressure to keep dirt and contaminants and that out. Then right below the diesel hall we have the electrical equipment room and that room takes air from the outside and also recirculated air and filters it, cools it and heats it and returns it. That area is maintained at a slightly positive pressure to the diesel hall. And over on the left we have the main fuel tank room which the exhaust fan draws air in from either the air intake or from the diesel hall. And in both the, well the diesel hall and the main tank area we have safety-related heaters to maintain the minimum ambient temperature in those rooms.

MEMBER SKILLMAN: What is the basis for the maximum temperature in your diesel hall? What is it that would require cooling? What is it that drives cooling?

MS. MCCONATY: Well, the electrical equipment room of course is the electrical components in that area. That's the only area that's really receives cooled air. The rest of it's all on outside air.

MEMBER SKILLMAN: Are there some specific components that drive that design temperature?

MS. MCCONATY: In the electrical room?

MEMBER SKILLMAN: Yes.

MS. MCCONATY: I don't know. We'd have to check on that.

MR. LITTLE: My name is Tony Little. I was the system engineer for the dc design. I've been involved with diesel generators now 38 years, with commercial nuclear and nuclear Navy. As an EDG supplier I worked for EMD. In 1986 I started working in commercial. I've been system engineer at Rancho Seco, Palo Verde and Point Beach, and I've done other modifications at numerous other plants. I worked for E&S and AREVA. Currently I'm project manager installing a diesel at Brunswick.

What's driving the temperatures in the control room is this diesel has all digital controls so they have a maximum temperature that they're allowed top rate at. And in the diesel hall that's where the temperature goes to add 115 ambient with the heat load that these diesel's putting off and the controls that are in there are qualified to that temperature. It can get up to 140 I think.

MEMBER STETKAR: Local panels up in the hall or are they downstairs?

MR. LITTLE: They're in a control room downstairs.

MEMBER STETKAR: They're in the control room downstairs.

MR. LITTLE: And it has HVAC control in there.

MEMBER SKILLMAN: And their max is 115 Fahrenheit?

MR. LITTLE: I think -- I don't know if

that's high, is it?

MEMBER SKILLMAN: My real question is what is the limitation on temperature? I've been around a lot of diesel engines for a long time --

MR. LITTLE: Well, the diesel engines, the diesel engines, that will go up to 140 degrees in those rooms with 115 ambient. And that's in --

MEMBER SKILLMAN: And so you've got some equipment on the engines.

MR. LITTLE: Correct.

MEMBER SKILLMAN: Some instrumentation on the engines.

MR. LITTLE: That's correct.

MEMBER SKILLMAN: But you also have a control room near the engine.

MR. LITTLE: And the control room has HVAC control in it and maintains the temperature I think at --

MS. MCCONATY: Okay, at 95 degrees.

MR. LITTLE: Yes. Maximum.

MS. MCCONATY: Yes.

MEMBER SKILLMAN: Okay, thank you.

MEMBER STETKAR: These engines have electronic governors on them? Or how do you run the governor on the engine?

MR. LITTLE: These do not have electronic.

MEMBER STETKAR: They do not.

MR. LITTLE: Oh, well they have like an EBG, a Woodward type --

MEMBER STETKAR: They have a Woodward? Okay.

MR. LITTLE: -- electronics on it. But it's not a digital --

MEMBER STETKAR: Electronics in the Woodward.

MS. MCCONATY: Okay, any other questions on the diesel? Okay. All right. Then we have the ventilation systems for the essential service water pump building and that maintains ambient conditions within the ESW pump room areas for operation of equipment during the DBA and during normal operation maintains ambient conditions for personnel and equipment. Next slide, please.

And this shows the typical ventilation system for all four trains. The room air is drawn in through the cooler and a moisture separator and heater and cooled or heated as needed and then distributed to the pump area or the electrical equipment room. And -- that was it. And then recirculated. Okay. All right. Any other questions on any of the ventilation systems? Okay.

MR. GARDNER: Okay, we're going to move from ventilation over to fire protection with John Crowther.

MR. CROWTHER: My name is John Crowther. I'm a graduate fire protection engineer from the University of Maryland but I always wanted to go to Purdue if that makes any difference.

(Laughter)

MR. CROWTHER: Kevin's my hero.

CHAIR POWERS: Purdue doesn't have nearly as good fire protection program as the University of Maryland, so.

MR. CROWTHER: I have 43 years of experience in fire protection, 25 of which is in the nuclear area. And my, the section that we're talking about or sections that we're going to be talking about here is 9.51 and Appendix 9A. And just a brief thing on Appendix 9A. It's called the fire protection analysis but what it really is is based on the fire hazards analysis for individual fire areas. So -- in there. So, next slide.

Topics we're going to discuss, fire protection defense-in-depth, applicable regulatory requirements, elements of the fire protection program, the FHA, the fire hazards analysis, fire protection systems and their design features, and then finally the post fire safe shutdown analysis. Next slide.

Defense-in-depth. This is nothing new, this is industry definition so, you know, I could get into it. Basically you try to prevent a fire from occurring but if it does you detect it and control it and extinguish it quickly.

CHAIR POWERS: It's the strangest definition of defense-in-depth on the face of the planet.

MR. CROWTHER: Well, yes.

(Laughter)

CHAIR POWERS: But we all know and love it, so.

MR. CROWTHER: It's an industry standard. Nothing new or fancy here. Next slide.

Applicable regulatory requirements. Obviously we were trying to comply with the NUREG-0800 Standard Review Plan for 9.5.1. And I've listed there the various regulatory requirements. Unique to new plants is the fact that we're -- for complying with Appendix A of the Standard Review Plan for Advanced Reactors. We do address NFPA 804 requirements, there's a lot of good information in there, but the

NRC has not endorsed 804 because of some differences of opinions on certain things in there so we're basically following the 804 guidance except where there's conflicts and the NRC regulatory guidance takes precedence. And fire PRA has been developed based on Appendix C of the Standard Review Plan.

And kind of unique to new plants is the compliance with SECY-90-016. That's where you have, you can't credit reentry into any fire area for any kind of manual actions or repairs and you must have at least one shutdown path and containment that's available. And finally, slow caught gases suppression system elements cannot adversely affect the ability to shut the plant down.

CHAIR POWERS: That's a very short-term issue of smoke transport and it is removed to digital systems the corrosive nature of smoke. Raises questions about what happens in the long term. Contacts, pieces, things like that in the smoke. Have you given that any thought?

MR. CROWTHER: It's been very difficult getting any good information on survivability of digital equipment so that's been a struggle. I don't have a good answer for you.

CHAIR POWERS: Yes, but I mean that's the problem. I mean, we know the stuff's corrosive. How does it affect the digital equipment you actually have in the plant. And finding that data.

MR. CROWTHER: It's been a real challenge. And we've checked with European as well as U.S. and have not gotten a lot of information.

CHAIR POWERS: Yes, as far as I know there's just some exploratory studies that said yes, it has an effect. Or can't have an effect.

MR. CROWTHER: Yes, I don't disagree. We'll have to take a --

CHAIR POWERS: It was not a design consideration in this plant to -- aside from this fairly short -- this short-term requirement means that you don't have a whole hell of a lot of smoke in other areas, that's all I mean.

MR. CROWTHER: Yes. Well, that's our first line of defense is to provide barriers that will first of all locate where redundant equipment is in relationship to each other and then where necessary provide smoke-tight separation between these areas through special dampers, doors, et cetera. We basically follow the guidance of Reg Guide 1.189 rev 1 and provide justification in the FSAR where we deviate from this. Next slide.

Elements of the fire protection program. This is nothing really unique to us. This is industry stuff, comprehensive identification, analysis of hazards, your organization of your staff, fire prevention program, suppression detection systems both automatic and manual, building design and that's basically your fire area, subdivision of the plant into various fire areas and then your safe shutdown analysis to demonstrate that you can achieve and maintain safe shutdown in the event of a fire. Next slide.

This slide and the next slide kind of summarize what goes into a fire hazards analysis. Again, this is nothing unique to our plant. It's industry stuff. You talk about the physical construction and layout of the buildings, talk about the combustibles on a fire, generally on a fire area basis but it might -- there's a couple of areas where we subdivide into fire zones and that's the annulus and then the containment.

Here we talk about the various fire protection equipment, both manual and automatic, and as well as the detection and alarm. And there's the analysis of the postulated fire in each fire area assuming that automatic manual fire protection is not functioning and the ability to shut down -- effect on safe shutdown equipment. And then talk about concern about life safety, release of contamination and impairments of operations assuming the operation of installed fire extinguishing equipment. Make sure that the extinguishing agent doesn't affect your safety-related equipment.

MEMBER STETKAR: John, when is it appropriate to -- I was trying to look forward in your presentation. I couldn't quite find it quickly. When is it appropriate to ask you about how you dealt with multiple spurious operations in your fire hazards analysis?

MR. CROWTHER: Oh, I didn't think that would come up.

(Laughter)

MEMBER STETKAR: I'm sure you didn't do any prep work on that. Is it now or do you have something later?

MR. CROWTHER: We do talk about fire safe shutdown at the end. Just to give you a little more of my background, I am what we call a classical fire protection individual. I'm at best one question deep on fire safe shutdown and multiple spurious, but Rich Bashall is with us here and he can speak to that.

MEMBER STETKAR: If it's appropriate to discuss it now I'd prefer to do that. If you'd like to wait until you get to the safe shutdown we can do it then. The reason I bring this up is, and I'll quote from the FSAR, the FSAR talks about the fact that you have fiberoptic cables and things like that. It says, "Therefore, fire-induced failures of fiberoptic wiring leading to spurious component actuations are not considered credible for the U.S. EPR plant." Okay. I can perhaps, given what I know about fiberoptic cables, I can perhaps support that notion for cable fires. I can't support that notion for fires that may affect digital instrumentation in control system rooms. So my question is how did you do treat multiple spurious operations that could be initiated from fires in those locations.

MR. BASHALL: I'll introduce myself first.

MEMBER STETKAR: Sure.

MR. BASHALL: My name is Richard Bashall. I've been in the commercial nuclear business for over 33 years. I would probably say that about 90 percent of that was involved with post fire safe shutdown analysis and I have the scars to prove it. I've been with AREVA about almost five years. Prior to that I was with another consulting firm for nine years involved with safe shutdown issues. And prior to that I worked for Public Service Electric & Gas Company's Salem and Hope Creek performing various duties including being responsible for the island fire protection program for about five or six years.

I have a BS EE degree from the Norton College of Engineering now known as NJIT or New Jersey Institute of Technology. I'm a registered PE in New Jersey and prior to that I've got some experience wiring switchgear and some conventional fleet Navy experience.

The answer to your question is this question's been asked in an RAI. At the time the way the question was worded was basically rev 1 of Reg Guide 1.189 and NEI 00-01 don't speak to multiple spurious operations. What's your plan? I'm paraphrasing. Our response to that was we will utilize the NRC-endorsed guidance when our shutdown analysis formally begins. Reg Guide 1.189 is now in rev 2, discusses multiple simultaneous spurious operations. We also have an open item on this. I haven't seen the formal question from the staff, I've seen a draft that basically asks us to update them on what our position is.

MEMBER STETKAR: NEI 00-01 rev 2 also now speaks to multiple spurious --

MR. BASHALL: Yes.

MEMBER STETKAR: -- and doesn't limit the number of multiple spurious operations that you need to consider.

MR. BASHALL: Yes. We've also been asked a question --

MR. TESFAYE: I'd like to make a correction there. I mean, all the open items in this SE we've sent you the final RAI. So there are no open items based on draft RAI questions.

MR. BASHALL: Okay. I just, I personally haven't seen the formal question. I know what it's going to be.

MEMBER STETKAR: Okay.

MR. BASHALL: Okay, and we'll respond to that.

MEMBER STETKAR: But I mean from what I hear you say is that it's still in a state of flux and your position is you'll comply with whatever guidance is available.

MR. BASHALL: Correct. Whatever the NRC-endorsed guidance is.

MEMBER STETKAR: Okay.

MR. BASHALL: Okay? Now we've been asked

a question about spurious signals from digital equipment due to smoke intrusion, et cetera. Our position on that is that we're going to take credit for the failure modes and effects analysis performed by the I&C group which includes detectable and non-detectable failures and spurious signals. That was our answer to that RAI question.

MEMBER STETKAR: Okay, maybe we'll hear more about that tomorrow because getting failure modes and effects analysis out of digital I&C systems these days, especially when you consider how thermal effects might affect those systems, not by just flames but high temperature is difficult.

MR. BASHALL: And we're also in these -- you know, the fiber eventually becomes copper through transducers, et cetera, okay?

MEMBER STETKAR: Yes. I didn't want to -- I sort of just wanted to back you up to the digital I&C rooms as there are other areas that might be susceptible.

MR. BASHALL: This is a rather involved analysis.

MEMBER STETKAR: Yes.

MR. GARDNER: You could ask this question of the I&C folks tomorrow at least in part.

MEMBER STETKAR: I may, yes. I just wanted to get some feedback. Because it's just so clear in the, at least rev 2 of the FSAR.

MR. BASHALL: We know, we're currently doing a lot of work on the existing plants on NFPA 805 and plants that stayed with Appendix R and we know where this is all going.

MEMBER STETKAR: Well but, you know, what has happened or what is happening is that both Reg Guide 1.189 and NFPA 805 at least in the area of sensitivity to multiple spurious operations and potential number are now, you know, fairly parallel. How you deal with those, whether you deal with them probabilistically or deterministically is different. But at least, you know, current versions of the guidance are more in line than they were a couple of years ago let's say.

MR. BASHALL: Yes.

MEMBER STETKAR: Okay.

MR. MCCANN: This is Ed McCann. I was a technical reviewer on this section. I'll get into what experience I have later. But anyway, also on that response it should be no credit is taken for intended -- design features to preclude spurious actuations.

MR. BASHALL: Right.

MEMBER STETKAR: Okay.

MR. MCCANN: That's important.

MEMBER STETKAR: Okay, thank you.

MR. CROWTHER: All right, next slide. This is a continuation of the previous slide. As I say, it's a typical fire hazards analysis that you see at all existing plants and we look at other hazards such as earthquakes, storms and floods, post fire recovery potential and et cetera. And also get into emergency planning coordination and then we looked at impact of fire suppression systems and smoke on the ability -- migrating from one area to the other on the ability to -- or the effects on safe shutdown equipment. Any questions on that? Next one.

Fire protection program administration. Again, nothing unique or unusual here. It's the same thing you see at existing plants. Talk about the fire protection organization, the administrative policies, the controls that you have, quality assurance, access and egress, fire brigade capability and emergency response capability. The one caveat here is that the COL applicant is responsible for writing site-specific information on the fire protection program and also a schedule for implementing it.

Now we're getting into the systems detection alarm. We provide detection in all areas of the plant where you have safety-related SSCs. The fire alarm system notifies the control room and also the building occupants of a fire condition. And the fire detection alarm is designed to comply with the applicable NFPA industry requirements contained in NFPA 72 which is the fire alarm code.

MEMBER STETKAR: John, I have to admit ignorance here because I didn't have a chance to study all of the material in the FSAR on this. Your fire detection systems include individual cabinet sensors or are they just area sensors? Thinking --

MR. CROWTHER: There are some cabinet sensors anticipated in the control room but it's mainly your --

MEMBER STETKAR: Only in the control room? Not out in the Safeguards Building?

MR. CROWTHER: No, we've taken exception to that. We provided area coverage in those but not individual in cabinet.

MEMBER STETKAR: Okay.

MR. CROWTHER: Next slide. This is your water supply. Once again, fairly typical requirements that you have for existing plants. We have a minimum of two pumps, one electric, one diesel. We actually have three pumps, one electric and two diesel. We have water supply tanks, we have two tanks that are designed to handle the highest demand. In this particular case the minimum that's contained in Reg Guide 1.189 applies which is 300,000 gallon. The actual demand is a little bit less than that but we're governed by the minimum of 300,000 so we have two 300,000 tanks. And it's all designed and arranged such that if you have the loss of one pump or what's commonly referred to as short leg out, but if you lose one section of pipe that you can isolate it and still supply the water you need to the -- to meet your highest demand. And like with the detection alarm we comply with the applicable NFPA codes which is 20 for the fire pumps, 22 for the water tanks and 24 for the underground fire mains. Next slide.

MEMBER SKILLMAN: John, before you change that slide go back to 73, please. Forty-three years fire protection, so you've seen a lot of high-end fire protection systems and you've probably seen a lot of Rube Goldbergs.

MR. CROWTHER: Yes.

MEMBER SKILLMAN: What is your view of the standards for equipment, particularly for firefighting equipment, for this design?

MR. CROWTHER: Specifically your?

MEMBER SKILLMAN: Are commercial grade fire pumps sufficient? Should the fire pumps be beyond commercial grade? Should they be something more than just a relatively high-quality component? Should they be treated as if they're safety grade? Judgment question.

MR. CROWTHER: Let me just answer in the context of what we're doing here. And what we're doing here is that we're taking commercial grade and we're going to analyze them to make sure that they do -- are capable of surviving a seismic event. Now, we're not calling them safety-related, fire protection isn't safety-related typically except where you go through containment, but everybody's got that exception. But we have not -- basically you're dealing in a commercial grade world with fire protection and I think in our opinion we could qualify through analysis that the various elements, the pumps, the tanks and the fire mains would remain functional after a seismic event.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: John, are the fire pumps themselves on your D-RAP list? Design reliability assurance program.

MR. CROWTHER: I don't -- I'm not familiar with that but I don't think so.

MEMBER STETKAR: Check. I'm not going to speculate.

MR. CROWTHER: Sure. Anything else?

MEMBER STETKAR: The reason I ask is you know there are additional reliability requirements applied to that particular equipment that's on that list that sort of between non-safety and safety-related stuff.

MEMBER SKILLMAN: Well, we've dealt with this for years and years and years early on. How do you buy a safety grade diesel? You can't. How do you get a safety grade fire pump? Well, we don't -- we really want to go to ASME Section 3 Class 1 or 2, and gee whiz, we'll just take what's available. But then there's this other idea that -- this stuff is so important and it really needs to be treated with a unique focus on the amount of protection it requires which is awesome. It's really important gear.

MR. CROWTHER: It's -- the rumor mill has it that there may be some additional requirements coming out of -- due to some incident over in the Pacific Rim. I don't remember what that was, but.

MEMBER SKILLMAN: Okay.

MR. CROWTHER: And we'll have to address that.

MEMBER SKILLMAN: Thank you, John. I wasn't trying to twist your design but I was just, you've got a lot of years of this and I was just curious in your opinion.

MR. CROWTHER: Yes.

MEMBER SKILLMAN: Thank you.

MR. CROWTHER: Fire suppression systems. I'll go to the third bullet item and because of the enhanced chain separation redundancy you don't see as many suppression systems in the U.S. EPR as you would in a typical existing plant. But we do have the diesel halls, all four diesel halls have a sprinkler system. The fuel oil storage tanks have what's called a water spray system that is an automatic system and we have the reactor coolant pumps each have a water spray system which is a manual system. And then we have a gaseous fire suppression system in the under-floor area of the main control room which is a manual system as well. And each of those systems is again designed according to their applicable NFPA codes.

MEMBER SKILLMAN: Has there been any operating experience where an under-floor gaseous suppression system has been inadvertently discharged?

MR. CROWTHER: You do -- there has been some, not a lot, but there has been some.

MEMBER SKILLMAN: And what happens?

MR. CROWTHER: Well, in this particular case we've taken that into consideration. First of all, the agent we're using isn't like a CO2 which is -- cause inhabitability problems, but we're also going to look at maintaining a fairly tight enclosure so that we don't see migration out of there. But the particular agent we're talking about, the clean agent, is not hazardous to your health in the concentration we're even discharging under the floor let alone what would leak out into the main control room or whatever.

MEMBER SKILLMAN: Thank you, John.

MR. CROWTHER: And plus it's a manual system.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: John, do you have automatic suppression on your high-voltage transformers outdoors?

MR. CROWTHER: Yes. That's not part of the design certification, that's the COL.

MEMBER STETKAR: Oh, that's part of the COL scope. Okay.

MR. CROWTHER: Yes, because it's completely separate from where the nuclear island is, it's on the other side of the turbine where the nuclear island is. Yes, it's separation and suppression for those.

MEMBER STETKAR: Okay.

MR. CROWTHER: Next slide. Manual firefighting capability. Again, nothing really unique here. We've got standpipe and hose systems throughout. We've got outside hydrants in the yard area and we have portable extinguishers throughout. And we've selected the type of extinguisher best suited for what's in the operation so that we don't create a problem with the type of extinguisher we put in there. And like with the other systems there the design of these systems is in accordance with their applicable NFPA code. Next slide.

Building features, building layout. Again, we're mainly talking about fire areas, plants broken down into fire areas. And in a few places fire zones, and that's mainly in the containment and the annulus in the reactor building. And again, we use various NFPA, applicable NFPA codes as criteria for how to test for adequacy of the design as well as the type of doors, dampers, et cetera, that we need to be placing in there. And then the general materials of construction, try to as much as possible have non-combustible and heat-resistant materials wherever practical in the plant and use the NFPA guide as guidance in specifying the requirements for these materials.

Fire protection design, other building systems. Electrical cabling, for the most part we try to use, we've used cabling that's tested in accordance with IEEE 1202. The cable is routed in electrical raceways and then we provide separation between redundant systems.

CHAIR POWERS: Are those cable specifications just that? I mean, it just says meet the flame criteria. Have they actually picked the cabling materials?

MR. CROWTHER: I'm sorry?

CHAIR POWERS: Have they actually picked the cabling materials or are they just, they'll meet that?

MR. CROWTHER: Yes, these are flame-tested requirements that they have to comply with in order to be approved.

CHAIR POWERS: But they haven't actually picked the cabling material?

MR. CROWTHER: Again I --

MR. GARDNER: They haven't picked the cable material yet.

MR. CROWTHER: No, not that I'm aware of, no. And then in the fiberoptic it really doesn't technically fall under IEEE 1202 but there is comparable if not better test criteria that for the most part that'll be used. So we'll minimize the stuff that has not been tested, "stuff," the cabling that has not been tested to make sure that it doesn't propagate.

And the HVAC system, we look at the consequences of fire in the HVAC system ability to spread it throughout the plant. We will use it to some extent in ventilating or exhausting in a fire area. Also the fire brigade will have portable smoke ejectors that they will use and we are also giving consideration should there be a failure on the part of the ventilation system to make sure that the -- it doesn't communicate smoke and gases to other areas and affect safety-related equipment.

Reactor coolant pumps. This is again an industry, the same thing you'll find in most existing plants. We have, we cover leak points with a little collection system. Then it's seismically designed and it's designed so that it'll hold the total capacity of all lube oil leaks. Next slide.

Talk a little bit about emergency lighting and communication. Their communication is covered in detail on 9.5.2 and emergency lighting in 9.5.3 but our concern really with communication is the ability of the fire brigade to communicate in the fire conditions which pretty much is mainly through the use of wireless communication and taking into consideration certain vital areas. There will be low voltage and we feel that that will take care of most if not all situations but should we run into a situation where the vital areas are maybe, where we can't use the wireless equipment then we'll be looking to have an alternative for a fixed system that'll allow communication.

And then emergency lighting is provided as necessary. Again, you're talking about being able to ingress for the fire brigade safe shutdown operations and then any emergency egress for plant occupants in the case of a fire. And again, 9.5.2 and 9.5.3 address these in much more detail.

Post fire safe shutdown capability. What you have is we have an analysis that demonstrates at least one success path of system to be able to achieve and maintain safe plant shutdown and then the performance goals which are based on Section 5 of 1.189. Our reactivity control, achieve and maintain cold shutdown reactivity conditions. Reactor coolant makeup functions, maintain primary system inventory, decay heat removal, process monitoring, necessary process variables and then support functions, cooling, power, et cetera.

And the, as we talked a little bit before, the U.S. EPR will follow the guidance of NEI 00-01. And some of the advantages of the U.S. EPR is we've got, we've subdivided a good part of the plant, for example, four Safeguards Building, one per division. We've got two diesel halls which are separated into separate, two fire areas, one for each of the divisions. The essential servicewater cooling towers, those are again separated by distance and fire barriers from each other. And then another advantage is no 125-volt dc air-operated valves. That eliminates concerns about hot shorts, shorts through ground. And then we have a remote shutdown station in accordance with Reg Guide 1.189 which is physically and electrically independent of the main control room to be able to shut the plant down should there be a fire in the main control room. I believe that's it.

MEMBER STETKAR: According to the guidance if the operators need to abandon the main control room they are always perfectly successful doing everything that they're required to do from that remote shutdown location, is that correct?

MR. CROWTHER: Absolutely. Yes.

MEMBER STETKAR: Okay. Is that the only location that the safe shutdown analysis includes credit for ex-control room operator actions?

MR. CROWTHER: The only place for ex-control room, yes --

MR. BASHALL: At this time, yes.

MEMBER SKILLMAN: Every action is successful 100 percent of the time?

MEMBER STETKAR: Yes, I mean that's basically the rules for the deterministic fire analysis is that if you have a defined alternate control location the operators are 100 percent successful from that location.

MR. CROWTHER: That's the design we put in there.

MEMBER STETKAR: That's the only, the alternate shutdown, whatever it's called in this plant, the remote shutdown. That's the only location that the current analysis accounts for ex-control room actions. No other local actions.

MR. BASHALL: Yes, using the pick system they can control everything using that system.

MEMBER STETKAR: And that's -- I've forgotten the layout of the plant. I know where the control room is. Where's the remote shutdown?

MR. BASHALL: It's in the next adjacent Safeguards Building, safeguards 3.

MEMBER STETKAR: So they're in the same 2-3.

MR. BASHALL: One elevation down.

MEMBER STETKAR: Okay.

MR. CROWTHER: And there are separate fire areas, 3-hour barriers around each.

MEMBER STETKAR: I couldn't remember whether it was out in the 1-4.

MR. CROWTHER: You'd actually have to go through more than one fire barrier to get from the main control room to the remote shutdown station. The floor and then multiple walls.

MEMBER STETKAR: Is that the same ventilation system, or is it --

MR. CROWTHER: No.

MEMBER STETKAR: -- separate. Yes, because it's separate, separate towers. Okay.

MR. CROWTHER: That wouldn't work too good anyhow. You wouldn't want that to happen.

MEMBER STETKAR: No.

MR. CROWTHER: Anything else?

CHAIR POWERS: That'll do it.

MR. CROWTHER: We've got one more slide. I thought we were through. Okay, and these are kind of the exceptions, control room separation, the redundant trains isn't practical so that's where we've got the alternate shutdown. And like I said, we've got the remote shutdown station located physically and electrically separate from the main control room. And in containment it's a single fire within there so we've used the guidance of Reg Guide 1.189 to justify the ability to shut the plant down. We take into account spatial separation, physical barriers, and we've provided fire protection to the extent to guarantee that we have at least one success path available if we shut the plant down. And we have automatic detection is provided in the containment in various areas and we do have suppression systems protecting the reactor coolant pumps. Now I think I'm done.

MEMBER STETKAR: One last question, I know we're woefully short on time here. The fire hazards, this is sort of a follow-on for the multiple spurious operations. Did you look at spurious signals from in containment instrumentation?

MR. BASHALL: We will be looking at that when we do the analysis, yes.

MEMBER STETKAR: Okay.

MR. BASHALL: Oh yes.

MEMBER STETKAR: Okay. Thanks.

MR. GARDNER: Okay. Moving on to diesel auxiliary systems with Bob Day.

MR. DAY: My name's Bob Day. I'm an equipment engineer with AREVA. I've been specifying installing starting up powerful plant equipment for 34 years. I have a BS in nuclear engineering from Penn State.

CHAIR POWERS: But you wanted to go to Purdue, right?

MR. WIDMAYER: Now he does.

(Laughter)

MR. DAY: I worked for Duke Power, Duke Energy and then AREVA. And I've worked on both nuclear and fossil plants from building them and starting them up.

First system is the fuel oil system which stores and pumps filtered fuel oil to the engine following a start signal. Each diesel generator has a separate and independent fuel oil system. All fuel oil system components are located inside the diesel building with the exception of the outside fill-in tank bed lines. Redundancy of the components allow operation of the engine if maintenance is required. The storage tank, day tank components and piping ae located aboveground, all accessible for inspection and maintenance. The tanks are located in a separate room adjacent to the engine room. The tank room barrier provides missile protection for the tanks, is a spill reservoir and serves as a three-hour firewall.

CHAIR POWERS: The three-hour firewall is a product of a calculation or a product of a test? Your assertion that you have a three-hour firewall, is that the product of analysis or product of a test?

MR. DAY: I would expect it's -- where did the fire protection guys go? I would expect it's from analysis.

The volume of the storage tank and the day tank are calculated using the guidance of ANSI/ANS 59.51. The usable capacity of the storage tank allows seven days of uninterrupted operation of the engine at rated load. Usable capacity of the day tank allows two hours of uninterrupted operation of the engine at rated load. The storage tank is a vertical tank that includes an internal sump and water draw-off connection. The tank can be filled while the engine is in operation and includes remote and local level indication and sampling connections. The day tank is located above the storage tank to provide positive suction head for the fuel oil pump. This tank can also be filled while the engine is in operation.

MEMBER STETKAR: Bob, the transfer pumps from the storage tank to the day tank, you said that the day tank normally contains nominal fuel for a couple of hours of operation?

MR. DAY: It's got two hours.

MEMBER STETKAR: Two hours.

MR. DAY: The low level signal is about an hour's capacity.

MEMBER STETKAR: Okay. When the transfer pumps come on do they cycle on and off between high and low level or do they just come on and you recirc back?

MR. DAY: They come on at low level and then turn off when you get to the high level.

MEMBER STETKAR: So if I'm going to run this diesel for 24 hours those pumps are going to cycle on and off a number of times.

MR. DAY: Yes.

MEMBER STETKAR: Or a pump. You have two pumps so whatever --

MR. DAY: Yes. So you can switch them back and forth. It depends on which one you put in.

MEMBER STETKAR: But they do cycle. You don't -- they don't just come on and you just recirc the extra stuff back to the tank.

MR. DAY: No.

MEMBER STETKAR: Okay.

MEMBER SKILLMAN: Robert, is there a -- let me back up. Can you describe the fuel oil other than oil that is in these two tanks? Was there an underground reserve for the set-aside tank for security reasons?

MR. DAY: No.

MEMBER SKILLMAN: This is all there is? This is the oil that's available for the diesel engines?

MR. DAY: Yes. There's a storage tank and a day tank for each engine.

MEMBER SKILLMAN: Question, please, about the fuel oil storage tank. I'm assuming with seven weeks run time for a large engine this is a fairly generous --

MR. DAY: Seven days.

MEMBER SKILLMAN: Seven days. It's a fairly generous tank.

MR. DAY: Yes.

MEMBER SKILLMAN: What provisions are in the tank to enable cleaning goo cloud, other stuff, off the bottom? What design provisions do you have that you can actually clean this tank online?

MR. DAY: Well, the usable capacity includes the space at the bottom that you would have for water and for sediment buildup, and then you've got another set of capacity, or outside the usable capacity for suction head. And you can always recirc out the tank out to like a temporary filtering station if your samples start showing that you've got problems in the tank. There are connections that you can --

MEMBER SKILLMAN: Is there installed equipment to do that or will you have to hook up --

MR. DAY: You would have to hook up a temporary filter station outside. Now, you can, through the transfer pumps you could pump through the filters and then recycle back to the tank.

MEMBER SKILLMAN: Thank you.

MR. DAY: But you would still be -- you wouldn't be taking out, the pumps aren't going to take suction out of the immediate sediment layer. They're going to be taking suction out above that.

MEMBER SKILLMAN: So if you wanted to go after the sediment or --

MR. DAY: You'd have to take out the temporary connection.

MEMBER SKILLMAN: You're going to have to go to a temporary.

MR. DAY: And the other thing you can do is there's a water draw-off connection. And what you can do is just keep drawing off and draw off the dirty oil too. Because there will be a sump in the bottom of the tank with a pipe that goes down into it.

MEMBER SKILLMAN: Thank you.

MR. DAY: The next system is cooling water which provides cooling for the engine turbine charger, intercoolers, generator bearings and the governor. The system dissipates heat from these components to the essential service water system maintaining system temperature within engine operating limits during operation. Each diesel generator has a separate and independent cooling water system located inside the diesel building. System includes two subsystems, jacket water cooling and the intercooler cooling. Each subsystem has its own heat exchanger to dissipate heat to the essential service water system. The jacket water subsystem includes the non-safety related portion which provides heated water to the engine to maintain the engine at a set temperature during standby. The preheat system is used to reduce stress on the mechanical portions of the engine during emergency starts. The two systems are connected to a common expansion tank which allows expansion of the water due to temperature variations. The tank is located above the rest of the system components to facilitate air removal.

The expansion tank provides usable capacity for seven days of engine operation at rated load. The tank includes a fill connection which automatically provides demin water upon low level. It also includes a manual fill connection if the demin water system is unavailable. It would essentially be, you would have to mainly fill it during emergency operations since the demin water system is non-safety related. During operation the engine preheat system is off and cooling water circulated by the engine-driven water pumps. When the engine is in standby the preheat pump circulates heated water to the jacket water subsystem to minimize cold start wear.

The next system is starting air which

provides dry compressed air to start the diesel generator. Starting air is not required once the diesel is running. The safety-related portion of the system includes the air receiver inlet check valves and isolation valve. The air receiver is used to store the compressed air in the starting air valves. The non-safety related portion of the system provides dry compressed air to the receivers. Each diesel generator has a separate and independent starting air system located inside the diesel building.

The system includes two trains of compressors, filters and air dryers which can be operated separately or at the same time. Air from the engine room is used as an intake to the compressors. To pass the receiver tanks is sufficient for five starts of the engine from the low air pressure alarm point without recharging the receiver tanks. The compressors are capable of recharging the air receivers within 30 minutes after five starts.

The next system is the lube oil system. The safety-related portion of this system provides filtered lube oil to the moving parts of the engine during engine operation. The non-safety related portion of the system provides pre-lubrication to the engine and maintain a minimum lube oil temperature when the engine is on standby. Each diesel generator has a separate and independent lube oil system located inside the diesel building. The system dissipates heat from the lube oil to the essential service water system, maintaining system temperature within the engine operating limits during operation.

The keep-warm pump and heater circulate lube oil and maintain a minimum oil temperature when the engine is on standby. During engine operation the keep-warm pump and heater are off and lube oil circulated by the engine-driven pumps.

The system includes a lube oil makeup tank. The volume of the tank is calculated using the guidance of ANSI/ANS 59.52. Usable capacity of the makeup tank allows seven days of uninterrupted operation of the engine at rated load. Lube oil is provided to the engine sump from the tank by gravity through a solenoid valve which is activated by sump level. The lube oil makeup tank can be filled while the engine is operating.

The next system is the air intake and exhaust system. The safety-related air intake system provides filtered combustion air to the engine. The exhaust gas system provides a safety-related path for engine exhaust products to be discharged to atmosphere through a rupture disk. The system also includes a normally used non-safety related exhaust path through the emission controls equipment, a silencer and a vent stack. Each diesel generator has a separate independent intake air and exhaust gas system. All safety-related components are located inside the diesel building.

Combustion air is taken from outside the diesel building through a louver in the building wall near the top of the building. Combustion air is routed through duplex filters, a silencer and an air heater before entering the turbo charger.

MEMBER STETKAR: Bob, are the outside -- the combustion air intake louvers normally open? You say it's, you know, I'm looking at the drawing. It comes in through a louver and goes down through a set of filters and some dampers and then you finally get to --

MR. DAY: I think it's like a, it's not really a movable louver, it's like a grill.

MEMBER STETKAR: Yes, I was going to -- if it was movable I was going to ask about freeze protection.

MR. DAY: Protecting for missiles.

MEMBER STETKAR: Okay, but it's just a

normally open --

MR. DAY: Yes.

MEMBER STETKAR: -- hole in the wall. Protected hole in the wall. Okay.

MEMBER SKILLMAN: Would you go back one, please? Robert, say more about the rupture disk, please? The rupture disk.

MR. DAY: That's the safety-related exhaust path. Normally when the diesel's running the exhaust gas goes out and it's going to go through an emissions control equipment removal and an SER through the exhaust silencer and then out, vented out a stack. And that just, what kind of emission control equipment is site-specific based on their air permit and how long they can run the engine without it. The safety-related exhaust path is, the rupture disk is set by the diesel manufacturer from the standpoint of if something goes wrong with the emissions control or the silencer and you lose that path or it becomes blocked or something then the rupture disk goes. And that just goes out through a louver, out through actually the room where the building exhaust air exhaust was on that one figure. That room is actually cut in half and half of it, the air exhaust from the building goes out and the other half is where the safety-related exhaust, and it goes out through a fixed louver out the side of the building on the opposite side of the building from the intake.

MEMBER SKILLMAN: Okay, thank you. I understand.

MR. DAY: And like I said, the combustion air intake is located on the opposite side of the diesel from the exhaust gas discharge point. Normal flow path for the exhaust gas is through the emission control equipment and a silencer before being released to atmosphere. Mission control equipment may consist of particulate removal and/or NOx reduction equipment depending on the permanent requirements of the installation site. The emission control equipment is located outside the diesel building. The exhaust rupture disk and vent stack provide a safety-related exhaust path should the exhaust flow be restricted due to a system or equipment failure downstream.

MEMBER STETKAR: Bob, just one quick one. I'm still -- when the diesels start are the intake, combustion air intake dampers also normally open?

MR. DAY: Tony, you want to?

MEMBER STETKAR: I'm -- they're, you know, exposed to cold air basically because the intake air heater isn't until downstream of the intake air silencer and the filters and everything. So what I'm asking about is do you have any equipment in that combustion air flow path that needs to move, you know, to supply combustion air to the engine? And if so, is that equipment exposed to potentially low temperatures such that, you know, you could get ice formation or binding on the equipment? And this actually happened at places in really cold environments. That's why I was asking about the exterior intake louvers, whether they actually have to open or not.

MR. DAY: Those are --

MEMBER STETKAR: If those are fixed that's fine, but the next thing I ran into were the combustion air, you know, intake dampers basically, in those lines.

MR. DAY: You want to help me out on this one, Tony? There are essentially butterfly valves on the intakes. They're inside the building. So there is going to be some warming there.

MEMBER STETKAR: I don't know where they're -- sometimes there are big air plenums, you know, that are nominally in the building.

MR. DAY: The heater is downstream of the first set of valves.

MEMBER STETKAR: Yes.

MR. LITTLE: The valves that are in the intake are normally open valves.

MEMBER STETKAR: They are normally open.

MR. LITTLE: They're there for emergency shutdown to shut off the air supply to the engine.

MEMBER STETKAR: Okay. Fine. That's fine. Thanks.

MR. GARDNER: Okay, well that's the last of this but we did have a couple of quick go-backs to answer some of your questions that you asked earlier. I think one you asked just in the last couple of minutes was the fire barrier?

MS. SLOAN: Let me make -- this is Sandra Sloan from AREVA. Let me just make one comment. One is we appreciate your time. I think we recognize at this point that we perhaps misjudged the amount of material we could present and maybe the level of interest that we've gotten so I'll say that. I would ask you to indulge us for a few minutes more. I will say that you've asked a lot of really good questions during the course of the meeting.

I will say for sure one of the things I'm very proud of when I go anywhere with my AREVA engineering colleagues is that they want to be very sure that the answer they give you is the absolute right answer. So you've heard them on several occasions qualify their answers a little bit or indicate that they needed to follow up. So what they've been doing is they've been following up and double-checking what they knew to make sure that the answer that they give you right now is the correct answer. So what I would propose is to bring a few of those folks back and address as many of the questions as we have been able to follow up on from your earlier questions. So if I could ask the people who will answer the questions maybe to go back to the table.

MR. TESFAYE: He's ready.

MS. SLOAN: He's ready, okay. We'll start.

MR. CROWTHER: This is John Crowther, fire protection lead. Same resume as I had an hour ago.

(Laughter)

MR. CROWTHER: The -- do you have the slide that the question came up on?

MR. GARDNER: Well, I think it was on the diesel slide on whether or not the fire barrier --

MR. CROWTHER: Is it separation between the tank room and the diesel hall, is that?

MR. GARDNER: The three-hour barrier.

MR. CROWTHER: Three-hour barrier. That

is a three-hour barrier not be evaluation, but a three-hour barrier between those. Is that what the question was?

MR. GARDNER: It was whether it was by analysis or by testing.

MR. CROWTHER: By testing. It's a reinforced concrete wall between there. There is a door on the upper level going in there but that would be an approved fire door, listed fire door and the wall, reinforced concrete wall would be per testing and industry guidance.

MR. GARDNER: So does that answer your question, Dr. Powers?

CHAIR POWERS: Well, it just provokes the whose test and where.

MR. GARDNER: Like whether the wall itself has been tested?

MR. CROWTHER: You mean physically?

CHAIR POWERS: Yes. Who tested it and where?

MR. CROWTHER: Oh. It's a reinforced concrete wall and basically based on industry code and industry practice anything that's 6 and a quarter inches thick gives you a three-hour rating on a reinforced concrete wall and that is much more -- I don't know the exact --

CHAIR POWERS: Okay, well --

MR. CROWTHER: -- much more than --

CHAIR POWERS: That's what I mean by it's the product of analysis. Which is fine. I mean, I'm just curious. I know what you've done now and thank you very much.

MR. CROWTHER: You're welcome.

MR. GARDNER: Did you have some questions you wanted to respond to?

MS. LINDSTROM: Yes. One of the --

MS. SLOAN: Say your name.

MS. LINDSTROM: Jean Lindstrom. One of the questions was on the severe accident sampling system when you asked to -- the understanding of my question is what is it designed to as far as.

MEMBER SKILLMAN: Source term.

MS. LINDSTROM: Yes. And it's -- we can handle up to -2.5 E^{+16} Bq per cubic meter. And we dilute it down to 1 to 1,000 of that.

CHAIR POWERS: You can handle up to what? Two times --

MS. LINDSTROM: 2.5 E^{+16} Bq's per cubic meter. Becquerels per cubic meter.

CHAIR POWERS: Okay, like 1,000 curies per cubic meter.

(Laughter)

MS. LINDSTROM: Less than that. So that's in the liquid --

CHAIR POWERS: It's slightly less than 1,000 curies per cubic meter which is --

MS. LINDSTROM: That is the design of the system.

CHAIR POWERS: Okay. Now, let's see. The AST or even the TID 14844 gets you 10,000 curies per cubic meter.

MS. LINDSTROM: Does that answer your question?

CHAIR POWERS: Well, it answers my question but it just provokes the next one. If I have a design basis source term you either used AST or TID 14844 and that only gave you 10,000 curies per cubic meter and your system is designed to sample less than 1,000.

MS. LINDSTROM: Less than 1,000.

CHAIR POWERS: So now what do you do? I mean the answer is wait two hours and then you're down to less than 1,000 curies per cubic meter, but that means you don't have any information for the first two hours. So you're not going to use any of that information to make --

MS. LINDSTROM: But it is an on-safety system.

CHAIR POWERS: So you're not going to use any of that information for making any emergency action or alert notifications.

MS. LINDSTROM: The system doesn't need to be operable until 24 hours after an incident anyway. So --

CHAIR POWERS: In which case it's fine.

MS. LINDSTROM: It's just a management tool.

CHAIR POWERS: Now I know. Thank you.

MS. LINDSTROM: Okay. I have one more question and one of your questions was on the controls of the pressurizer. Going to the reactor coolant drain tank. And the -- we do have an inch line which is a high flow, a half-inch which is a low flow and that is more of a normal and a startup indication or flow path. The valve that you're talking about to the reactor coolant drain tank, about it over-pressurizing, on a high --

MEMBER SKILLMAN: I'm sorry. Let me stop you there for a second. You said you have an inch line which is the high flow --

MS. LINDSTROM: Half-inch --

MEMBER SKILLMAN: -- and a half-inch line which is the low flow.

MS. LINDSTROM: And then there's a vacuum pump line.

MEMBER SKILLMAN: And there's a vacuum pump line. I'm looking at the drawing right now and as far as I can tell the inch line is directly connected also. So I'm not sure.

MS. LINDSTROM: The high flow and the low flow are teed together.

MEMBER SKILLMAN: Yes. So how does -- if those valves are open how do the valves care whether or not the flow is coming through the half-inch line or the 1-inch line? They don't know.

MS. LINDSTROM: It's an orifice. There's an orifice in those lines.

MEMBER SKILLMAN: Oh there is, okay.

MS. LINDSTROM: Yes. So there's an orifice in the high flow and the low flow.

MEMBER SKILLMAN: Okay.

MS. LINDSTROM: The valve to the reactor coolant drain tank will close on a high reactor coolant hot leg pressure. So that's how we'll not over-pressurize the reactor coolant drain tank, sending the flow to the pressurizer relief tank. And there's an interlock between the valve to the reactor coolant drain tank and the pressurizer relief tank. One will close, one will open on a high pressure.

MEMBER SKILLMAN: On a high pressure.

MS. LINDSTROM: On the reactor hot leg, reactor coolant hot leg.

MEMBER SKILLMAN: On a high pressure.

MS. LINDSTROM: High pressure.

MEMBER SKILLMAN: But not on a normal pressure.

MS. LINDSTROM: No because the reactor coolant drain tank can take a normal pressure.

MEMBER SKILLMAN: The reactor coolant drain tank is --

MS. LINDSTROM: They purge during a normal operation.

MEMBER SKILLMAN: No, no, no. Does -- let me walk you through a scenario.

MS. LINDSTROM: Okay.

MEMBER SKILLMAN: I get a plain vanilla safety injection for whatever reason. I'm not talking about a design basis large LOCA here, I'm talking about a safeguards actuation from let's call it a feedwater line break. Maybe that's even too severe.

Does the vent line from the reactor coolant drain tank close on a, I think you guys call it a stage 1 containment isolation signal?

MS. LINDSTROM: That's -- we'll have to get back to you on that.

MEMBER SKILLMAN: And if the answer to that is yes --

MS. LINDSTROM: I think that's a question on the --

MEMBER SKILLMAN: -- I now don't have a high pressure in my hot leg, I've got a normal pressure in my hot leg, like 2,500 pounds.

MS. LINDSTROM: I don't know that that's going to be outside the scope of the drain system but we can take it as an action item.

MEMBER SKILLMAN: Okay, but I'm still -- I mean, that's sort of what I'm interested in.

MS. LINDSTROM: Correct. We'll have to take that as a reactor coolant.

MEMBER SKILLMAN: I was hoping you were going to say that those two lines to the reactor coolant drain tank closed on any safeguards actuation signal but from what you said that doesn't sound to be the case.

MS. LINDSTROM: And it's a non-safety NSAQ signal.

MEMBER SKILLMAN: Okay, so it's not even a safety signal.

MS. LINDSTROM: It's not a safeguards signal, it's an NSAQ signal.

MEMBER SKILLMAN: Okay. I think you may want to go back and think about those. You understand the concern. The concern is if the normal gas event line from the reactor coolant drain tank because it's a containment isolation line, if that gets a signal to close on any I'll call it plain vanilla safeguards actuation where it's stage 1 containment isolation signal you will now isolate the exhaust path from the reactor coolant drain tank allowing the reactor coolant drain tank to pressurize to whatever the pressurizer gas space pressure is. Quickly. And if it opens, you know, I suspect it's got a rupture disk or a vent line or something that's going to open, you now have a LOCA flow path and you're not going to get any high pressure after that so you're going to have a LOCA flow path out into the containment. Small, you know, it's not a big LOCA flow path.

MS. LINDSTROM: So go to the IRWST.

MEMBER SKILLMAN: It'll go to the IRWST but it indeed is --

MS. LINDSTROM: It is a path.

MEMBER SKILLMAN: It is a pathway.

MS. LINDSTROM: Yes.

MR. GARDNER: So we still owe an answer.

MS. LINDSTROM: So we still owe an answer for the pressurizer controls on that.

MEMBER SKILLMAN: Well, it's either the pressurizer, but also look at the, you know, the vent line from the reactor coolant drain tank. Because I don't know whether those valves get a signal. I'm assuming they do because they're non-safety related containment penetration.

MS. LINDSTROM: On the reactor coolant drain tank on a normal operation we can vent, not through a safety valve but we can vent to the IRWST. There's a normal vent path.

MEMBER SKILLMAN: Okay, yes, I didn't see any drawings of the RCDT so I don't know how --

MS. LINDSTROM: Actually I think there is one in the FSAR under the vent and drain system.

MEMBER SKILLMAN: Is there? Okay.

MS. LINDSTROM: And the other -- on the relief valve it goes to the reactor building pool overflow and the IRWST combined.

MEMBER SKILLMAN: Okay.

MS. LINDSTROM: But we do have a direct path that we can align to go to the IRWST.

MEMBER SKILLMAN: Yes. I saw -- yes, I see that here.

MS. LINDSTROM: Okay.

MEMBER SKILLMAN: Set valve.

MS. LINDSTROM: Okay, so I think that's in the first. Is that the reactor coolant system?

MEMBER SKILLMAN: It's actually -- it's a blowup of the reactor coolant system from Chapter 5.

MS. LINDSTROM: Okay, there's also one for the vent and drain system in Chapter 9.

MEMBER SKILLMAN: Okay, I'll look for that. Thanks.

MS. LINDSTROM: Chapter 9 figures. Should be the first drawing.

MEMBER SKILLMAN: That's fine. You know, the piping arrangement at the moment is less important than understanding how all of those valves may work.

MS. LINDSTROM: We still have the open question for the slope.

MR. GARDNER: Steve?

MR. HUDDLESTON: This is Steve Huddleston and I have some information to add to some of the questions. Initially there was a question posed about the restart of the fans if they were in reverse rotation. And as I understand it the question was about the delay time on the fan, and whether that was tested. It does turn out we have an ITAAC on the delay time.

MEMBER STETKAR: You do. Okay.

MR. HUDDLESTON: Yes, we do.

MEMBER STETKAR: Thank you.

MR. HUDDLESTON: Further there was a question about the fail position of the transfer valves and the CCW system. And the fail position is as-is.

MEMBER STETKAR: It is as-is.

MR. HUDDLESTON: But they're dual-powered.

MEMBER STETKAR: From different divisions?

MR. HUDDLESTON: Yes.

MEMBER STETKAR: Okay, I'll have to think more about that. Thanks.

MR. HUDDLESTON: Okay. There was a question about cooldown, if we had an issue with cooldown if all four trains start in an accident. And I would answer that the operators would have the ability to selectively take out trains, adjust equipment, adjust the fans, even stop the fans. So there would be potential for operators to nullify any adverse conditions that might be caused by all four trains cooling.

MEMBER SKILLMAN: Simultaneously.

MR. HUDDLESTON: Right.

MEMBER SKILLMAN: Thank you.

CHAIR POWERS: Have they trained on that?

MR. HUDDLESTON: I'm sorry?

CHAIR POWERS: Do they train on that?

MR. GARDNER: That would be something that would be in the program of the -- versus the design collection. One would be the owner.

CHAIR POWERS: Is somebody told to include that in the training program?

MEMBER SKILLMAN: How do we capture that? It sounds like maybe a simple question but I really think it's somewhat complex. So if Dr. Powers' question is the right question, how do we make sure it's captured so that it does get incorporated in the training when the procedures are written?

MR. GARDNER: Well, we talked about a procedure generation package earlier, the whole series of the way procedures get written.

CHAIR POWERS: That's how to do it. It isn't what to do.

MR. GARDNER: I would say that's probably going to be the applicant addressing that question versus the design certification. I understand the question. I'm not sure we're the right party to answer that question.

MEMBER SKILLMAN: I think we want to make sure the item's captured so that it's not forgotten.

MR. HUDDLESTON: I have one more item here. There was a question about the safety chilled water system and the question was around if there was a break in the safety chilled water system given that it's cross-tied if operators were unable to secure the break and pressure was lost in the safety chilled water system would that mean that we lost our ability to -- for cooling. We have an FMEA and a review of the FMEA shows that scenarios similar to that were looked at. And the answer in the FMEA is that under the worst case circumstance were we to lose two running trains, say 1 and 2, while we had either 3 or 4 in maintenance we'd still have one train that was lined up to cool two divisions. So we would have one train remaining to cool two divisions which is our requirement.

MEMBER STETKAR: Okay.

MR. TESFAYE: If I may, can I go back to the too much cooling? I think the staff will write an

RAI to document the requirement for the operator training.

MEMBER SKILLMAN: Thank you. That would be fine.

MR. MAASS: All right. This is Fred Maass. I've researched a couple of questions, one of which was that I think I heard during another presentation was, the question was where are the CVCS pumps actually located, if they were in separate rooms or in a large open area. They do have their own rooms, each one. They're adjacent to each other in the fuel building. Another question was --

MEMBER STETKAR: Well, if -- let me just follow up on that. If you do lose a fuel building ventilation system those rooms will heat up if the pumps are running, or a pump is running.

MR. MAASS: I would imagine so, yes. They're not safety-related pumps, so.

MEMBER STETKAR: Okay, thanks.

MS. MCCONATY: So do you -- oh, sorry.

MR. MAASS: Go ahead.

MS. MCCONATY: So is the question still open you want to know?

MEMBER STETKAR: Well, it's, you know, in terms of survivability of the CVCS pumps there has been quite a bit of discussion about power supplies to those pumps and capability of aligning those pumps under, you know, accident conditions to provide assurance of makeup flow and things like that. On the other hand, if the room is going to get real hot and the pump motors are going to fail a lot of those other assurances are somewhat -- seem somewhat moot. So the question is, you know, if you're spending a lot of effort in the design space to -- although the pumps are non-safety related there's still a lot of effort made to keep them available. They're sort of semi, if I can use the term semi-safety related pumps. But if you pretty easily do away with ventilation or cooling for those rooms it seems that you may have defeated some of that purpose. So I don't know if it's a question. It just seems to be an observation that, because there is some separate cooling for these rooms perhaps powered from the station blackout diesel or whatever, you know, taking credit for those pumps in terms of some sort of long-term function under station blackout conditions may not be feasible. Unless I'm misinterpreting something.

MS. MCCONATY: Is there a heat-up for those rooms in the station blackout period.

MEMBER STETKAR: I have no idea how big

the rooms are or anything like that. That's the --

MR. GARDNER: We've got the question.

MEMBER STETKAR: That's the other part of the question.

MS. MCCONATY: Right.

MR. GARDNER: Did you have any more, Fred?

MR. MAASS: One question about the boron 10 concentration is it's all enriched boron 10.

CHAIR POWERS: All enriched. There's only one grade of boron.

MR. MAASS: There's only one grade of boron.

CHAIR POWERS: Anywhere. They never get lost. There's no chance you'll buy the wrong kind of boron. You sure?

MR. MAASS: Yes. Now, depending on which section of the FSAR you read I know some of our fuel company does do analysis and references natural boron equivalents when they do some of their analysis, so.

MEMBER SKILLMAN: Okay. I will research and accept your answer but I certainly was led in a different direction from the writeup. But I thank you for your answer.

MR. MAASS: Okay.

MEMBER SKILLMAN: And I'll continue to

follow up on my end. Okay.

MR. STACK: Darrell, excuse me. I've got two other ones.

MR. GARDNER: Let me get Susan real fast.

MR. STACK: Okay.

MR. GARDNER: She's got just one.

MS. MCCONATY: Right, I've got one. I'm Susan McConaty. You asked the question what was the unfiltered in-leakage assumed in the dose calculation for the control room envelope. And I've got that here. That's 40 CFM boundary leakage plus 10 CFM for ingress and egress from the control room.

CHAIR POWERS: What we have encountered with the existing reactors of course is that the unfiltered in-leakage progressively creeps up over time. Is there any provision in the design for alerting for this slow creep-up of unfiltered in-leakage?

MS. MCCONATY: I would have to check the dose calc and see the rest of their assumptions.

CHAIR POWERS: Some of the control rooms had -- have or had over the course of operations heroic increases in unfiltered in-leakage and I just wondered if you made any provision in your design to alert or avoid that.

MR. GARDNER: This question may be answered in the tech specs too, Dr. Powers, where they test the performance of the system.

CHAIR POWERS: Yes. The problem is that we had tech specs on the control rooms too and people just forgot to run that test or something. I'm familiar with the issue.

MR. STACK: I think if I understand your follow-on question it's are we checking this.

CHAIR POWERS: Yes, I mean is there anything that keeps it from -- I mean, this is a pretty hefty in-leakage relative to where it's specified in the PASS but very realistic in-leakage. I don't have any troubles with the numbers. It's just that you don't want them to get 10 times that and we certainly have had control rooms with 10 times their tech spec unfiltered in-leakage.

MR. GARDNER: Okay. Okay, Tim?

MR. STACK: Next up, Tim Stack from AREVA again. Two items for you. First, on the question on the fire water system whether it was in the D-RAP program. It was evaluated for inclusion in the D-RAP program. It was determined not to be risk-significant. That included the tanks, the detection suppression, all of it. It was determined to be not risk-significant, but it was in fact evaluated for the purposes of the D-RAP program.

MEMBER STETKAR: I'm not even -- okay. But the factual answer is is it was evaluated and excluded --

MR. STACK: Determined to be not risk-significant.

CHAIR POWERS: So we want to flag that one for when we discuss D-RAP.

MEMBER STETKAR: Yes.

(Laughter)

MEMBER STETKAR: That's everything, pumps, valves, tanks.

MR. STACK: Pumps, tanks, valves, deluge.

MR. WIDMAYER: You mean when we talk about D-RAP again.

MEMBER STETKAR: Again, yes. We've already talked about it once.

MR. STACK: And the second item, we had discussion earlier with regards to cooling of the RCP seals and the methods we've chosen to cool the seals as well as managing RCS inventory. And for our purposes for AREVA we've chosen to use safety grade thermal barrier cooling of the RCP seals as the mechanism we're choosing. We have not chosen to provide redundant safety grade seal injection. In the case of seal injection if we had seal injection going we can always terminate seal injection. There are isolation valves in the seal injection path. We can always turn off the CVCS pumps as needed and we have safety grade isolation of the letdown paths so we can manage RCS inventory. We're not in a position where we would continuously add inventory to the RCS that we can't manage.

MEMBER SKILLMAN: I understand your answer. Thank you.

MR. STACK: And that's all I had. Kevin?

MR. CONNELL: Yes, there was one other clarification too from this morning's GSI-191 discussion. The question was the refueling water storage that we would have in the in-containment, the IRWST.

MEMBER SKILLMAN: Yes.

MR. CONNELL: It just, our normal way of flooding up the canal in this point would be through the low pressure safety injection pumps, through the RCS system. The RCS system would then flood the canal and we would then do the refueling. Of course, afterwards the cleanup of that water would be through our fuel pool purification system before it would be then put back into the IRWST.

MEMBER SKILLMAN: So you actually pumped it from the IRWST with -- up through the reactor coolant system, flood over to your refueling level.

MR. CONNELL: Correct.

MEMBER SKILLMAN: When you're done you --

MR. CONNELL: Clean it up.

MEMBER SKILLMAN: -- back to your clean water.

MR. CONNELL: And run it back to our IRWST.

MEMBER SKILLMAN: Back to the basement.

MR. CONNELL: Correct.

MEMBER SKILLMAN: So you keep it in the basement all the time.

MR. CONNELL: Yes.

MEMBER SKILLMAN: During refueling.

MR. CONNELL: Correct.

MEMBER SKILLMAN: Thank you. Okay, thank you.

MR. CONNELL: Thanks.

MEMBER STETKAR: If the fire protection -- I have to go back and refresh my memory on criteria for D-RAP because there's risk significance and then there are separate issues that you look at for station blackout for fire protection and for ATWS. And under none of those conditions?

MR. STACK: John, what I did is I've looked back through our documentation and it was determined to be not risk-significant. We can obviously revisit that in the future when we look at Chapter 18 in the future again.

MEMBER STETKAR: Seventeen. It's either 17 or 19, one of those two. Okay. But right now it's not on the list.

MR. STACK: Right now it is not on the list.

MEMBER STETKAR: Okay, thanks.

CHAIR POWERS: Gentlemen and ladies.

MR. TESFAYE: Thank you very much, Dr. Powers, for letting us finish our presentation today. That was extremely important to us.

CHAIR POWERS: Oh yes, I mean understand I come from the early days of the ACRS where we often went till midnight, so.

(Laughter)

MR. WIDMAYER: There's still time.

CHAIR POWERS: I'm sure we'll come up with additional questions that Sloan has to stay here and answer.

MEMBER STETKAR: The latest in the last four and a half years since I've been on the committee as a newcomer was only about 9:30 to 10 o'clock at night I think, so.

CHAIR POWERS: There was one time when I was on the other side of the table that I got to testify before the ACRS at midnight.

(Laughter)

CHAIR POWERS: I'm determined to get even for that.

MS. CLARK: All right.

MR. TESFAYE: Go ahead.

MS. CLARK: Hi, my name is Phyllis Clark and I'm the project manager for Chapter 9, Section 9.2.5 through -- I mean, well 9.2 through 9.5. I have a BS in physics and a master's in nuclear engineering. I've been in the industry about 21 years, been at the NRC for about 3.

CHAIR POWERS: And you -- did you go to Purdue?

MS. CLARK: No, I didn't go to Purdue.

CHAIR POWERS: But you wanted to, right?

MS. CLARK: Yes, I wanted to.

(Laughter)

MS. CLARK: All right. I'm going to make

my section pretty brief. These are the technical reviewers for these sections. And let's see, the next four slides contain the number of questions and the number of open items.

CHAIR POWERS: My goodness, you have a lot of questions.

MS. CLARK: Yes, actually, yes, we did. We had a total number of 480 questions and currently we have 29 open items in several sections. Well, 29 total in the SE, Safety Evaluation. The next six slides contain the open items, the 29 open items with a brief description of each open item. I'm just going to page through those real fast. And unless you have any questions concerning the brief descriptions we're going to proceed to the next --

CHAIR POWERS: I guess I'd like a little more understanding of the issue associated with RAI 476. Clarify the differences between non-safety related and safety-related portions of this system. I can understand why the question came up. I wonder what kind of answers are you looking for there?

MR. TESFAYE: Dr. Powers, can we discuss that when the technical staff --

CHAIR POWERS: We can.

MR. TESFAYE: -- gets started? This is

just for --

MEMBER SKILLMAN: We can go through the sections one at a time then, pick up the RAI.

MR. TESFAYE: Yes. Any of this RAI stuff that you would like to discuss I think the technical staff.

MS. CLARK: Okay. So, we'll go to the first presentation which will be Larry Wheeler for Section 9.2.

MR. WHEELER: Good afternoon. I'm Larry Wheeler, a reactor system engineer with the balance of plant branch. I have over 30 years of nuclear experience, been with the NRC just over 3 years. Before the NRC I have over 27 years of plant experience at a BWR/6 and a 3-loop PWR Westinghouse. Between both plants I have over 10 years of on-shift STA experience. I also have a PWR SRO certificate. Pre-1981 I worked for Bechtel for three years as a designer. I went to the University of Akron. I have a mechanical degree. Next slide.

Essential service water system, component cooling water systems, alternate heat sink, safety chilled water systems, all have different SRPs but the GDCs are the same. The staff review focused on these SRPs, GDCs, including 10 CFR 20-14.06. Next slide.

One of the main challenges was compliance to GDC 4 and how water hammer is addressed for the ESWS. FSAR revision 1 was silent on water hammer design features and did not adequately address testing for water hammer. In FSAR revision 1 the applicant stated that the hydraulic transient analysis would be performed to confirm the integrity of the ESW piping to withstand the effects of water hammer. Through a series of RAIs the applicant added to the revision 3 of the FSAR. Important design features for the prevention of water hammer which includes air release valves which provides a path to remove air during pump starts and vacuum breakers that prevent vacuum formation. And in addition, the non-safety related keep-fill system was added at the cooling tower riser. While the ESW system is in standby it is possible for the water riser to drain. Thus the riser line is monitored for proper water level. If the riser water level is too low a main control room alarm will sound. Then the operator is dispatched. He's directed to refill the piping system. Chapter 14 testing was added. Testing will verify there's no evidence of water hammer. For example, pump starts, pump trips with pump restart. Next slide, please.

Similar to the ESWS system the water

hammer considerations for CCWS was reviewed also with respect to GDC 4. The staff was concerned with the 10-second closure time of the fast-acting hydraulic valves. The applicant stated in rev 3 of the FSAR that the 10-second closure time of the common header switchover valves and the valves -- excuse me, the fast-acting hydraulic operated isolation valves for the non-safety related CCWS users is not considered an instantaneous closure that would create a large pressure wave in the system.

The FSAR revision 3 added Chapter 14 testing. Pre-operational testing will verify no noise, pipe movement, support damage, leakage, pressure spikes or waves for 22 different system sequences. For example, train swaps, pump starts and stops, idle pump starts on SI-simulated signals and containment isolation signals. Next slide, please.

The other CCWS challenge was related to SRP 92 guidance on surge tank sizing and system leakage. A seismic source of water makeup was needed for the surge tank. When the surge tank needed to accommodate system leakage for seven days without makeup. The original design required manual operator action with the water source being the fire protection system to support seven days. Through a series of

RAIs the applicant added to rev 3 of the FSAR boundary valve seat leakage requirements. That's now defined in Chapter 3. New design assumes no safety-related water makeup for seven days, includes the 750 gallon reserve for seven days per tank. This includes the margin above the calculated system leakage. It has the tech spec surveillance. This is a 31-day verification that the system does not leak less than 4 gallons per hour and adds a connection via fire water. That's a seismic cap too and that's for a post seven days. Next slide, please.

MEMBER SKILLMAN: Larry, should we -- go back to that slide, please. Should we assume from the 750, that's 750 gallons per surge tank?

MR. WHEELER: Yes, you have four surge tanks, four divisions and each one is 750.

MEMBER SKILLMAN: Yes, sir. Got it. Thanks.

MR. WHEELER: Okay. Challenge for the ultimate heat sink are related to testing of the safety-related cooling towers. Since the mechanical draft cooling towers are required to operate post DBA out to 30 days the staff needed assurance that the cooling towers are able to remove the design basis heat load without exceeding the maximum specified temperature limits. FSAR revision 3 states that analysis will demonstrate that the cooling towers are capable of removing the DBA heat loads and would be documented in the cooling tower design report. That report will include performance curves, recorded temperatures for the worst case weather data, basin water temperature trending for 30 days, effects of concentrated impurities in the basin. It includes all assumptions, the analytical methods and uncertainties.

Cooling tower testing is also addressed in tier 1 ITAAC. Cooling water testing is addressed in Chapter 14. It will test cooling tower performance during hot functional testing along with the RHR system, CCWS systems and ESWS system.

There is one open item related to the ultimate heat sink and that's for the maximum wet bulb temperature and whether the wet bulb temperature should be addressed in tech spec 3.7.9. The concern is if the site wet bulb temperature is exceeded which is not directly monitored are the four trains of ultimate heat sink still operable.

MEMBER STETKAR: Larry, before you leave the ultimate heat sink something in the SER caught my attention. There was a discussion about AREVA's analysis and assumptions regarding the minimum level in the cooling tower basin to support 72 hours design basis heat loads without makeup. And it's Section 9.2.5.4.1 of the SER concludes that -- with the following quote, "The staff believes this margin is sufficient based on operational experience." What operational experience did you use? What specific operational experience is there?

MR. WHEELER: I might need some help with Ryan. Do you remember the basis for that?

MR. EUL: Yes. My name's Ryan Eul. I was also a reviewer previously for this section. That exact wording was chosen by the lawyers during chapter day because --

MEMBER STETKAR: Okay. I'm not a lawyer, I'm an engineer so I'm asking you an engineering question.

MR. EUL: The experience -- the operational experience we used was they have a 10 percent volume margin and why that's adequate was based on the fact that we had looked at, we had taken, looked at some of the cooling tower historical data and some margins that we looked at that were non-safety and safety-related cooling towers, and we felt that having that much additional volume margin, you know, is sufficient basically.

MEMBER STETKAR: Let me ask you then a non-adjudicatory but sort of uninformed engineering question. Did the staff perform an independent analysis of the cooling tower volume requirements under design basis heat load input for 72 hours to confirm that the AREVA minimum water level is sufficient?

MR. EUL: Yes, we did.

MEMBER STETKAR: Okay.

MR. EUL: We did do the independent audit. But at the end of the day we had to come up with what was the sufficient number beyond that and that's where the wording you saw came into play. If some would say is 8 percent margin enough, is 10 percent margin enough, is 12 percent margin enough I think that is where the legal team decided that wording. But there was an independent audit done and we did look at those calculations.

MEMBER STETKAR: Okay. So thanks.

MR. TESFAYE: I want to add something here. I think what the lawyers did was ask the same question that you're asking.

MR. EUL: Yes, they did.

MR. TESFAYE: So we have to give a reason why certain things are acceptable.

MEMBER STETKAR: The answer I was looking for is that you did do an independent audit of their calculation to confirm.

MR. EUL: Yes, we did. We went to drift losses, evaporation losses, all the standard engineering assumptions that you would use from the cooling tower performance data and we looked at those calculations.

MEMBER STETKAR: I'm good with that. As long as there's some margin above that and you actually checked the calcs I'm fine. Thanks.

MR. WHEELER: Keep in mind that, you know, their safety-related makeup that, you know, there's safety-related makeup that is available before 72 hours. The operators at the plant aren't going to wait 72 hours and one second and say oh, now I can flip on my safety-related makeup.

MEMBER STETKAR: No, I recognize, but the calculation that was done was to show that even without that you had adequate margin, you had adequate inventory for a minimum of 72 hours under design basis heat loads.

MR. WHEELER: All right, next slide, please? One of the safety chilled water system challenges was compliance with GDC-4 and how water hammer is addressed. The applicant adequately addressed water hammer in FSAR revision 2 which added clarification. Design features included the pressurized expansion tank with nitrogen. Specified closing valve speeds are slow enough to prevent damage pressure increases. And then similar to the ESW and CCWS Chapter 14 testing, testings to verify no evidence of water hammer. Next slide, please.

Another safety chilled water system challenge was related to SRP 9.2.2 guidance on surge tank leakage and system leakage. FSAR revision 2 and 3 was modified to add the 100 gallon water reserve for 7 days. This includes margin above the calculated system of leak rights, assumes no safety-related water makeup for seven days, tech spec surveillance 3.7.9.4, surveillance requirements. That's a 24-month surveillance, less than 0.5 gallons per hour. And also defense-in-depth makeup from non-safety related fire protection, that's a CAP 2 water supply.

CHAIR POWERS: Let me just clarify, you meant -- you said 0.5 gallons per hour.

MR. WHEELER: 0.5 gallons per hour. I'm sorry. Okay. So that concludes for the ESWS, CCWS and safety chilled water. Applicable regulation requirements are satisfied. The exception to that is the ultimate heat sink and we're still looking at the response from AREVA on the wet bulb related to tech specs.

MEMBER STETKAR: You're okay on safety chilled water system with a pipe break out there taking out two divisions?

MR. WHEELER: It meets the NRC regulations and guidance, yes.

MEMBER STETKAR: Okay.

CHAIR POWERS: I personally would like to thank you, Mr. Wheeler, for reminding me of the water hammer issue.

MR. WHEELER: Okay.

CHAIR POWERS: Well, I mean it's just something that's so easy to forget. I simply forgot it and I'm glad -- his diligence reminded us of that.

MEMBER STETKAR: They did -- there was a lot of stuff. I read all of that stuff and there was a lot of really good questions on the water hammer issues, draining lines.

MR. WHEELER: On these four systems that I just mentioned we had close to 200 RAIs. So a lot of dialogue between AREVA and the staff.

CHAIR POWERS: Good.

MR. WHEELER: That's it.

CHAIR POWERS: You're up, Jim.

MR. O'DRISCOLL: Good afternoon. My name is Jim O'Driscoll. I'm here to provide subcommittee discussion on issues related to Section 9.4 air conditioning, heating, ventilation and air conditioning. I'm a graduate of the State University of New York Maritime College with a BE in mechanical engineering. I have a master's degree in mechanical engineering from Manhattan College. I have seven years' industry experience as a system engineer at Indian Point Energy Center. In 2007 I joined the NRC as a project manager in the Division of Policy and Rulemaking in the Office of Nuclear Reactor Regulation. And then I joined the Office of New Reactors in 2008. In my current position as a reactor systems engineer in the Division of Safety Systems Risk Assessment, Containment and Ventilation Branch. Next slide.

The EPR FSAR Chapter 9.4 contains 14 safety-related and non-safety related ventilation systems. I used the standard AREVA plan Sections 9.4.1 through 9.4.5 to perform my review of the subchapters 9.4.1 through 9.4.14 using the applicable regulations and general design criteria shown. The SER with open items is based on revision 2 of the FSAR and the RAI responses received before June 2011. And there remain 13 open items discussed in the 9.4 SER. Next slide.

I'm going to talk about a couple of issues that I think are important out of those 13. This first issue is related to the main control HVAC system and other safety-related HVAC systems and systems that are important to safety. The applicant provided performance requirements for the safety-related HVAC systems in regards to the room temperature range, the design construction, inspection and maintenance. However, detailed information regarding the sizing of the systems and the design heat loads was not provided in the FSAR. The staff found that during facility operation the verification of important performance requirements including the adequate sizing of safety-related HVAC systems is assured via technical specifications and surveillance requirements. For example, surveillance requirement 3.7.11.1 verifies the ability of each train of the control room air conditioning system is able to remove the design heat load. However, the staff found that there is no verification of the ability of the HVAC system to remove the as-built heat loads conducted as a condition of the 10 CFR Part 52.103(g) finding.

So, in question 9.4.1-1 the staff asked for sufficient ITAAC to verify the capability of the safety-related HVAC systems to remove the design heat load. And the RAI applies to HVAC systems that are safety-related and for non-safety related systems that provide HVAC during normal operation to spaces that contain safety-related equipment sensitive to temperature. And these systems are the control room air conditioning system, fuel building ventilation system, the Safeguards Building ventilation system, the safeguards building electrical division ventilation system and the emergency power generation building ventilation system, and the essential service water pump building ventilation systems. Any questions on that? Okay. Next.

Okay, the next issue is based on the review of the safety-related and non-safety related functions of the containment building ventilation system. The staff determined that the safety-related function of the low volume purge subsystem as described in the FSAR was unclear. The staff issued RAI 277 question 9.4.3-3 which requested the applicant clarify the safety function of the subsystem. In a June 30, 2011 response the applicant provided markups of FSAR tier 1 and tier 2 to clarify the functions of the control building ventilation system. The staff reviewed the response and the associated markups and determined that more information was required. So we have issued RAI 509 question 9.4.1.7 where we ask for further clarification on the design basis accident function and to also justify the physical arrangement based on that function.

MEMBER STETKAR: Jim, this just prompted something that I hadn't thought about before. You said only the low flow purge exhaust system is categorized as safety-related, not the high flow?

MR. O'DRISCOLL: That's correct. As far as containment ventilation systems is concerned the containment building ventilation system subsystem that is associated with low flow is -- because that consists of containment isolation valves and an ESF filtration train as opposed to high flow which are just large valves. It's really a containment isolation system.

MEMBER STETKAR: But are the containment isolation valves for the high flow safety-related?

MR. O'DRISCOLL: Oh, yes. Yes. Sorry.

MEMBER STETKAR: Okay, fine. I got you. I understand, thank you.

MR. O'DRISCOLL: Next slide. Those are

the only two issues I chose to speak about. If there's any other questions, please.

MR. TESFAYE: Dr. Powers had a question on one of the open items in your section, I believe.

CHAIR POWERS: Well, I think I understand where he's going here so I think we can just go ahead.

MR. TESFAYE: Okay.

MR. MCCANN: My name's Edward McCann. I went to Milwaukee School of Engineering with a BS in electrical engineering. And then a master's in physics from Stevens Institute of Technology. And I had 18 years of systems experience in pipe stress and hangers, and then I worked in Newport News ship-building and I was a piping engineer there which is the same kind of work. Then I started work at Calvert Cliffs and I worked there for 15 years and was doing electrical, fire protection and Appendix R engineer. That's where fire protection came in. Thanks a lot.

A lot of these really we kind of touched on already. These are the hot points I was going to talk about, items of interest or unique areas. And one is the communication exclusion zones. We're using the radios and the low power so typically you wouldn't have an issue but just in case you did they come up with these exclusion zones. But you can get signals that will cause spurious actuations from communication systems. Just in case, you know, a few steps would make a difference they said that they would if they had to have another system that would be free of fire effects in case that the radios, you had to go so far away to use them which is very unlikely.

Then for the emergency lighting the unique issue was for the main control room and RSS they're using a special emergency lighting system in lieu of the 8-hour battery pack lights that you have. Here it's, basically it receives power from redundant emergency diesel generator backed uninterruptible power supply. So it's got power, period. So that's a pretty good thing.

And then we touched on the multiple spurious. And there, basically they were saying as they said before, AREVA said before that the intended use in their latest guidance, and there's an RAI out there. They asked them to commit to revision 2 of the Regulatory Guide and the NEI document.

And then another hot item was digital equipment. And I was worried about heat and fires and smoke and essentially they were trying to come up -- they did say, AREVA did say that they had did this analysis and it failed certain ways, right? But besides that they said they're not taking any credit for additional equipment features to preclude any fire-induced spurious actuation. So given the situation they're going to take the spurious actuations.

Now to limit the issue with smoke control they have a smoke confinement system for various credit for post fire safe shutdown. That's over and above what most designs do. They're also going to do a smoke effects analysis which is also over and above what a lot of plants are doing. And the other two bullets are just normal smoke dampers, fire barriers type, smoke control procedures. This is normal type stuff. And there's an ITAAC related to the mitigation of propagation of smoke between structures, enforced structures.

CHAIR POWERS: Do we have an understanding of how optical fiber cables behave in fires?

MR. MCCANN: There was some testing done by the Navy and Research was there to watch it. And essentially it's extremely difficult to get hot shorts.

CHAIR POWERS: I'm not surprised at that. Is there anything else they do?

MR. MCCANN: Right, that's the main point.

CHAIR POWERS: But they, I mean when we first started testing copper cables we didn't think hot shorts were very important either until we did the tests and found lots of things.

MR. MCCANN: Yes, but at least we have copper to copper. All you have to do is this. Now in fiber you have to have a perfect joint.

CHAIR POWERS: Yes, I'm just wondering do they do anything else that would surprise one.

MR. MCCANN: Not as far as I know.

CHAIR POWERS: Not as far as you know. Okay.

MEMBER STETKAR: AREVA's answer regarding the fire protection equipment on the D-RAP list quite frankly was a bit surprising to me. I honestly expected they would come back and say well, you know, it's not safety-related but certainly it's on our D-RAP list because it satisfies the criteria of importance. Did you in your review look at that issue or think about that issue?

MR. MCCANN: I know at Calvert Cliffs it's a big contributor of fire, okay, of risk. But here -- okay.

MEMBER STETKAR: That's true, fire may be a much smaller contributor to risk here but in addition to fires themselves, the fire, I believe there are connections from the fire system that can supply other functions. I'm not so much concerned about a particular significant figure numerical risk significance measure that may come out of the PRA. I'm more concerned about the process for populating the D-RAP list which is ostensibly used as the PRA as one set of input but also input from an expert panel of people who look at broader issues that may not be explicitly quantified in a PRA model. Now, I was curious whether in your review of the fire protection system and its relative importance to the rest of the plant looked at that process at all. It's not a Chapter 9 process, it's more of a Chapter 17 or 19 or whatever those chapters. It's 17 I guess is where the list actually lives. I was just curious because I quite honestly was a little bit surprised by their response.

MR. MCCANN: I would say no.

MEMBER STETKAR: Okay, thanks.

MR. MCCANN: They look at testing, initial testing in the ITAAC.

MEMBER STETKAR: We'll look at it, you know, I guess and revisit it in Chapter 17. Thanks.

MS. CLARK: All right, that concludes the staff's presentation for Group 1 Section 9.2 through 9.5. Any further questions?

MEMBER SKILLMAN: Yes, I do. I'm curious why we didn't explore at least several of the RAI 492 questions relative to the chemical volume control system. There are several that have to do with ammonia, with verification of boron. So I'm curious why we didn't address those in this session, please.

MR. TESFAYE: We do have the technical reviewers here if you want to discuss any particular RAI.

MEMBER SKILLMAN: I would like to know why the hydrogen control range is acceptable. It's different from at least what I'm accustomed to. So I'm curious to know about that.

MR. SASTRE: My name is Eduardo Sastre. I was the technical reviewer for CVCS. I'm going to pass it to our contractor which is the person that rates the issue, Dr. Litman.

MR. LITMAN: Good afternoon, Bob Litman. I had the same question. The EPRI guidelines are pretty clear on what the hydrogen control limits should be and they're operating, or they plan to operate outside those control limits. And there's no, they haven't presented any evidence that shows that

that's an acceptable range to do it.

The EPRI control limits for hydrogen are based on a couple of things, most of which is suppression of oxygen but also those control limits are set at 25 to 50 cc's per kg to potentially avoid any oxygen intrusion events which could occur. And so it's been industry practice and it's been reiterated many times in the EPRI committee meetings. And I've been part of the primary water chemistry guidelines. In the first five revisions I was part of the guidelines committee and that fact was reiterated. And there's been a lot of evidence that the minimal amount of hydrogen needed to operate the plant and keep the oxygen level at a minimum is probably on the order of two to three cc's per kg. However, and this is the big however, you can't exclude the possibility of an oxygen intrusion event in any time during the operation of the plant, and that could be extremely significant, liberating large amounts of crud into the reactor coolant system, causing problems with control rod drive, et cetera. So I had the same concern.

MEMBER SKILLMAN: So this is dispositioned to an open item?

MR. LITMAN: Yes.

MEMBER SKILLMAN: And we're going to get

more information later from somebody?

MR. TESFAYE: Yes, this is a Phase 4 activity. We'll ask the question. AREVA will provide the response to this question and then when we come back to the committee in Phase 5 we'll discuss all the open items and how they are closed.

MEMBER SKILLMAN: Understand. Catch them in Phase 5. Let them go until then?

MR. TESFAYE: No, actually we process them in Phase 4 and the presentation will be in Phase 5.

CHAIR POWERS: It's when we get it next. Yes, they're in their -- we're in Phase --

MR. WIDMAYER: Make yourself good notes like Mr. Stetkar and --

MEMBER SKILLMAN: Catch them later.

MR. WIDMAYER: Yes.

MEMBER SKILLMAN: Thank you.

MR. LITMAN: My pleasure.

MS. CLARK: Any additional questions?

CHAIR POWERS: Members have any additional questions they'd like to pose? Thank you very much.

MR. TESFAYE: Thank you very much for finishing at 5:45. Now I can catch my carpool.

(Laughter)

CHAIR POWERS: Well, I thank everybody for extraordinary presentations and we'll gather again tomorrow to discuss an issue of very limited interest, probably no controversy at all, right? We are recessed till tomorrow morning.

(Whereupon, the foregoing matter went off the record at 5:44 p.m.)

UNISTAR NUCLEAR ENERGY

Presentation to ACRS
U.S. EPR™ Subcommittee
Calvert Cliffs Nuclear Power Plant Unit 3
FSAR Chapter 18, Human Factors Engineering
November 14, 2011

Introduction

- RCOLA authored using ‘Incorporate by Reference’ (IBR) methodology.
- To simplify document presentation and review, only supplemental information, site-specific information, or Departures/exemptions from the U.S. EPR FSAR are contained in the COLA.
- AREVA U.S. EPR FSAR ACRS Meeting for Chapter 18, Human Factors Engineering occurred on August 18, 2011.

Introduction

- One Human Performance Monitoring Program Departure and no Exemptions from the U.S. EPR FSAR for Calvert Cliffs Unit 3, Chapter 18
- No ASLB Contentions
- Five COL Information Items
- No Open SER Items
- Two Confirmatory SER Items

Introduction

- Today Cyril Roden, UniStar - Instrumentation & Controls Supervisor, will present the Calvert Cliffs Unit 3 FSAR Chapter 18.
- Today's Presentation was prepared by UniStar and is supported by AREVA (U.S. EPR Supplier).
  - Tom Roberts, UniStar – Director Operations, Maintenance & Services
  - Scott McCain, UniStar – Emergency Preparedness Engineer
  - Desmond Raymond, AREVA – Technical Manager
  - Robbie Hoke, AREVA – HFE Design Certification Lead
  - Dominick LoGalbo, AREVA – HFE Consultant Ops Analysis
  - The focus of today's presentation will be on site-specific information that supplements the U.S. EPR FSAR.

Chapter 18, Human Factors Engineering Agenda

- Human Factors Engineering
  - COL Information Items
  - Human Performance Monitoring Program Departures
- Conclusions

Human Factors Engineering COL Information Items

- <u>Human Factors Engineering</u>
  - UniStar Nuclear Operating Services, LLC will execute the NRC approved Human Factors Engineering (HFE) program as described in U.S. EPR FSAR Section 18.1.

Human Factors Engineering COL Information Items

- Emergency Operations Facility (EOF)
  - Modifications to the existing Calvert Cliffs Unit 1 & 2 EOF to accommodate an interface with Calvert Cliffs Unit 3 will be consistent with the U.S. EPR HFE Program described in U.S. EPR FSAR Chapter 18 and NUREG-0696.
  - Implementation of the Human Factors Engineering Program EOF design requirements will be verified by ITAAC 6.2 Part 10 Table 2.3-1 of the Calvert Cliffs Unit 3 COLA.
- Operational Support Center (OSC)
  - The OSC will be designed for Calvert Cliffs Unit 3 and will not be shared with Calvert Cliffs Units 1 & 2.
  - The OSC will be designed consistent with the U.S. EPR HFE Program Management plan referenced in U.S. EPR FSAR Chapter 18.

Human Factors Engineering COL Information Items

- Staffing Levels and Qualifications
  - Staffing levels and qualifications of plant personnel specified in the Calvert Cliffs Unit 3 FSAR Chapter 13 conform to regulatory requirements.
  - Results of staffing and qualifications analysis shall be verified by the implementation of ITAAC 5 of Tier 1 Table 3.4-1 of the U.S. EPR FSAR.
    - The staffing and qualification analysis is based on Human System Interface (HSI) design features as described in the task analysis (TA) Implementation Plan.

Human Factors Engineering COL Information Items

- <u>HFE Principles and Site Procedures</u>
  - HFE principles and criteria are incorporated into the program for site procedures consistent with the guidance of the operational guidelines described in Section 13.5 of the Calvert Cliffs Unit 3 FSAR.

- <u>HFE Principles and Training Program</u>
  - HFE principles and criteria are incorporated into the development training program scope, structure and methodology consistent with the guidance described in Section 13.2 of the Calvert Cliffs Unit 3 FSAR.

Human Factors Engineering
Human Performance Monitoring
Departure

- Human Performance Monitoring (HPM) Program - Departure
  - The U.S. EPR HPM is replaced by the UniStar HPM Program entirely.
  - The key differences are summarized below:
    - An Operational Focus Aggregate Index is used to trend performance of key variables that can impact Operations Human Performance
      - ✓ Aligns with INPO 09-011, Achieving Excellence in Performance Improvement.
    - UniStar Corrective Action Program is utilized:
      - ✓ To track HFE issues in lieu of a separate program (HFE issue tracking system)
      - ✓ Operational feedback is utilized

Human Factors Engineering Human Performance Monitoring Departure

- Human Performance Monitoring Program - Methodology
  - The UniStar Nuclear Energy Human Performance Monitoring Program meets the requirements of NUREG - 0711.
  - The methodology for monitoring, tracking and trending human performance consists of:
    - Corrective Action Program and Issue Tracking
    - Design Change Control Process
    - Probabilistic Risk Assessment
    - Plant Maintenance and Inspection Programs
    - Operational Focus Aggregate Index

Chapter 18, Human Factors Engineering Agenda

Human Factors Engineering

- COL Information Items/
- Human Performance Monitoring Program Departure

Conclusions

Conclusions

- Five COL Information Items, as specified by U.S. EPR FSAR, are addressed in Calvert Cliffs Unit 3 FSAR Chapter 18.
- No ASLB Contentions.
- The Departure from the U.S. EPR Human Performance Monitoring Program implements the requirements of NUREG - 0711.
- No SER Open Items.
- All RAI responses have been submitted.
- There are two SER Confirmatory Items.

Acronyms

- ACRS – Advisory Committee on Reactor Safeguards
- ASLB – Atomic Safety & Licensing Board
- COL – Combined License
- COLA – COL Application
- EOF – Emergency Operations Facility
- FA – Functional Allocation
- FRA – Functional Requirements Analysis
- FSAR – Final Safety Analysis Report
- HA – Human Action
- HFE – Human Factors Engineering
- HPM – Human Performance Monitoring
- HSI – Human System Interface
- IBR – Incorporate by Reference
- INPO – Institute of Nuclear Power Operations
- ITAAC – Inspection Test & Acceptance Criteria
- MCR – Main Control Room
- OSC – Operational Support Center
- RCOLA – Reference COL Application
- RG – Regulatory Guide
- SER – Safety Evaluation Report
- SME – Subject Matter Expert
- SSCs – Structures, Systems and Components
- TA – Task Analysis

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

UniStar Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 COL Application Review

Safety Evaluation Report

CHAPTER 18: Human Factors Engineering

November 14-15, 2011

Order of Presentation

- **Surinder Arora** – Calvert Cliffs COLA Lead PM
- **UniStar** – RCOL Applicant
- **Tanya Ford** – Chapter 18 PM
- **Technical Staff**

Major Milestones Chronology

07/13/2007	Part 1 of the COL Application (Partial) submitted
12/14/2007	Part 1, Rev. 1, submitted
03/14/2008	Part 1, Rev. 2, & Part 2 of the Application submitted
06/03/2008	Part 2 of the Application accepted for review (Docketed)
08/01/2008	Revision 3 submitted
03/09/2009	Revision 4 submitted
06/30/2009	Revision 5 submitted
07/14/2009	Initial Review schedule milestones published
09/30/2009	Revision 6 submitted
04/12/2010	Phase 1 review completion milestone
12/20/2010	Revision 7 submitted
August 2011	ACRS Subcommittee review complete on Chapters 2 part 1, 4, 5, 6, 8,10, 11,12, 15, 16, 17 & 19

ACRS Phase 3 Review Plan

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

FSAR CHAPTERS BY COMPLETION DATES

Chapter(s)	Completion Date	Subcommittee Meeting
8	1/6/2010	2/18/2010
4 5 12 17 19	3/24/2010 3/22/2010 3/19/2010 3/12/2010 4/19/2010	4/20/2010 4/20/2010 4/20/2010 4/20/2010 5/21/2010
10 11 16	6/11/2010 10/30/2010 10/11/2010	11/30/2010
2 (Part 1)	10/29/2010	1/12/2011
6	4/1/2011	4/5/2011
15	7/22/2011	8/18/2011
7 18	10/17/11 10/28/11	11/14-15/2011
1, 2 (Part 2), 3, 9, 13 & 14	Various	Meeting dates to be finalized

Technical Staff Review Team

- **Technical Staff**

  Operator Licensing & Human Performance Branch

  - ♦ **Paul Pieringer**
  - ♦ **James Bongarra**

- **Project Management Staff**
  - ♦ **Surinder Arora**
  - ♦ **Tanya Ford**

Overview of COLA Review

SRP Section/Application Section		No. of Questions	Number of OI
18.8	Procedure Development	1	0
18.12	Human Performance Monitoring	1	0
Totals*		2	0

*Note: Open Item count does not include the Generic Open Item RAI 222, Question 01-5, which was created to track changes to the U.S. EPR Design Certification.

Calvert Cliffs Unit 3 Site-Specific Items

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Confirmatory Items (2)**
  - Procedure Development (Section 18.8)
  - Human Performance Monitoring (Section 18.12)

Topics of Interest

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- HFE design for EOF conforms to NUREG-0696 guidance.
- ITAAC 5 verifies that staffing levels derived from task and staffing analyses remain bounded by regulation.
- Procedures and Training are Operating Programs and are addressed in SRP Chapter 13.
- Human Performance Monitoring program submitted as a deviation but it is consistent with EPR's monitoring program. Both are well described in their respective submittals.

Acronyms

ACRS – Advisory Committee on Reactor Safeguards

COL – Combined License

COLA – Combined License Application

CCNPP – Calvert Cliffs Nuclear Power Plant

EOF – Emergency Operations Facility

EPR – Evolutionary Pressurized Reactor

FSAR – Final Safety Analysis Report

HFE – Human Factors Engineering

IBR – Incorporated by Reference

ITAAC – Inspections, Tests, Analyses, and Acceptance Criteria

OI – Open Item

PM – Project Manager

RAI – Request for Additional Information

RCOL – Reference Combined License

SAR – Final Safety Analysis Report

SER – Safety Evaluation Report

SRP – Standard Review Plan (NUREG-0800)

U.S. EPR Design Certification: Overview of GSI-191 Approach

November 14, 2011

Introduction

- The objective of this presentation is to provide an overview of the U.S. EPR approach for addressing the issues identified in GSI-191, Assessment of Debris Accumulation on PWR Sump Performance
- This presentation consists of:
  - Overview of the plant design
  - Strainer head loss testing program
  - Fuel assembly downstream effects testing program

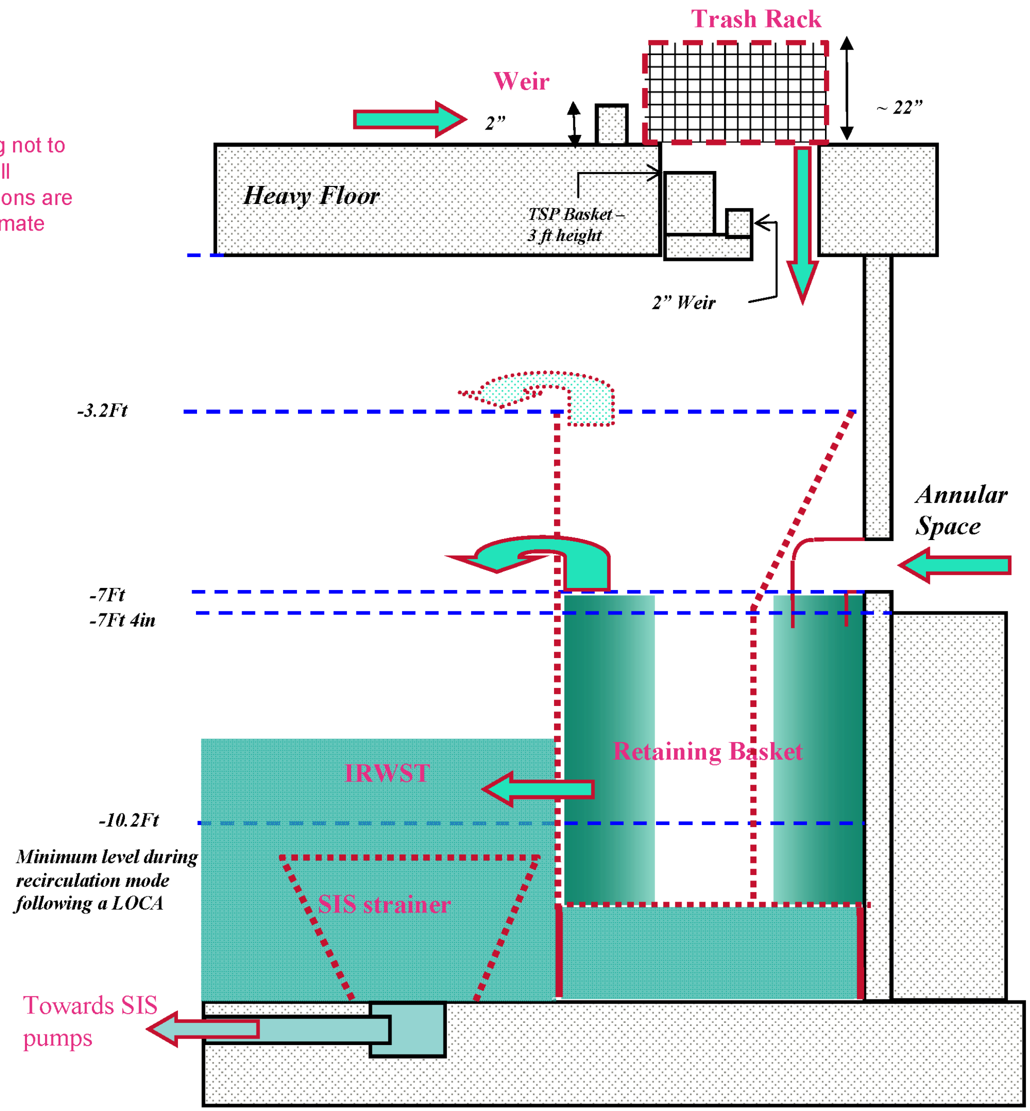
Basic Design Approach

- Design based on operating plant experience
- A key feature is the In-Containment Refueling Water Storage Tank (IRWST)
  - Functionally equivalent to the external refueling water storage tank (RWST) found in the current fleet of PWRs
  - Locating the IRWST inside containment and immediately below the RCS loop vaults permits an effective solution to the issue of post-accident debris blockage and ECCS (Emergency Core Cooling System) sump clogging
- Robust, three-tiered debris retention system
  - Weir
  - Retaining basket
  - Strainer
- Low fiber plant
- Cleanliness program

Proprietary

Debris Retention System

Drawing not to scale, all dimensions are approximate



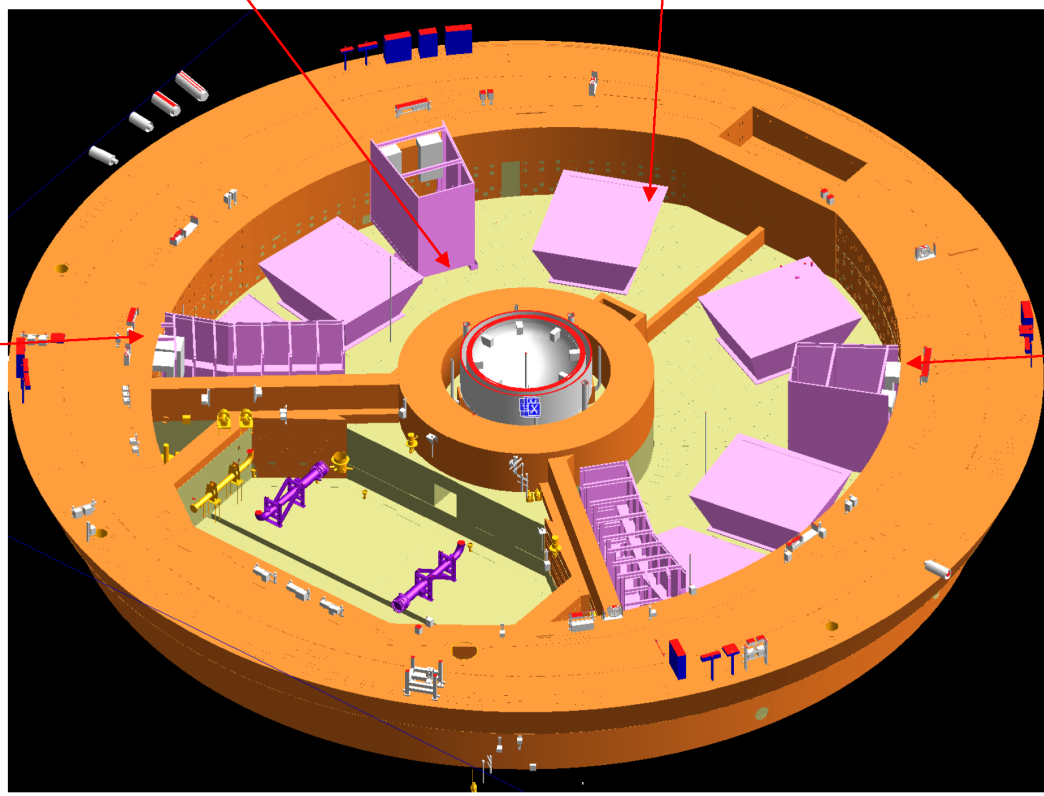
Proprietary

Location of Strainers and Baskets in IRWST

IRWST

ECCS
Strainer (typical of 4)

Single compartment
Retaining
Basket
(typical of 2)

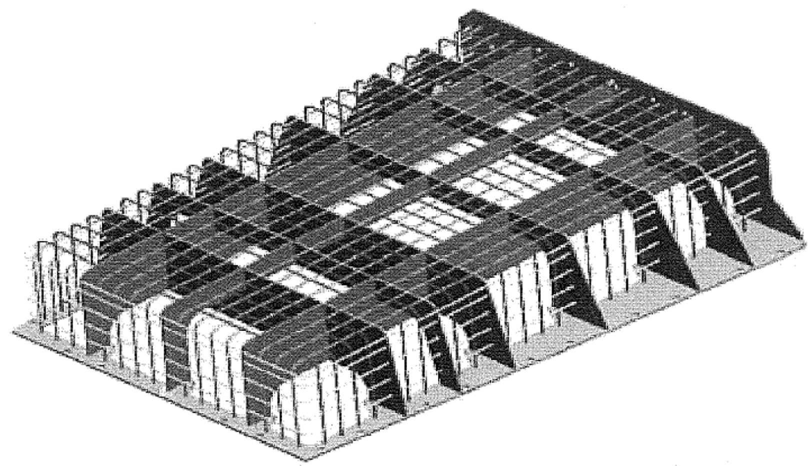


Double Compartment
Retaining
Basket (typical of 2)
Trash rack above
(typical of 4)

Defense-in-Depth: Flow from Heavy Floor

- A large area, low flow velocity region in each of the four RCS loop vaults that promotes debris settling.
- A set of four protective weir/trash rack structures to retain large debris in the RCS loop vault.
  - 4” x 4” grid structure
  - 2” weir

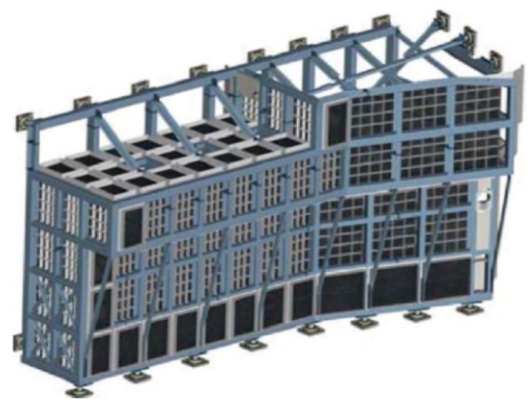
Trash Rack



Proprietary

Defense-in-Depth: Retaining Basket

- **Four retaining baskets in the IRWST. Each retaining basket is located under each weir/trash rack port to catch and retain any small debris that is carried through the trash racks by ECCS recirculation flow.**
  - **Two single compartment, two double compartment baskets**
  - **Minimum filtering area approximately 721 ft2**
  - **Minimum volume approximately 1589 ft3**
  - **0.08” x 0.08” mesh screen**



Proprietary

Defense-in-Depth: IRWST

- Large area, low flow velocity region within the IRWST promotes settling of fine debris that passes through the retaining baskets.
  - Minimum inventory approximately 433,250 gallons

Defense-in-Depth: Strainer

- **Four large surface area three-dimensional flat screen sump strainers in the IRWST, each protecting one of the four ECCS pump suction sumps located in the floor of the IRWST.**
  - **Minimum filtering area approximately 690 ft2**
  - **0.08” x 0.08” mesh screen**
- **Four 100% safety injection trains**

Strainer

Design Concept

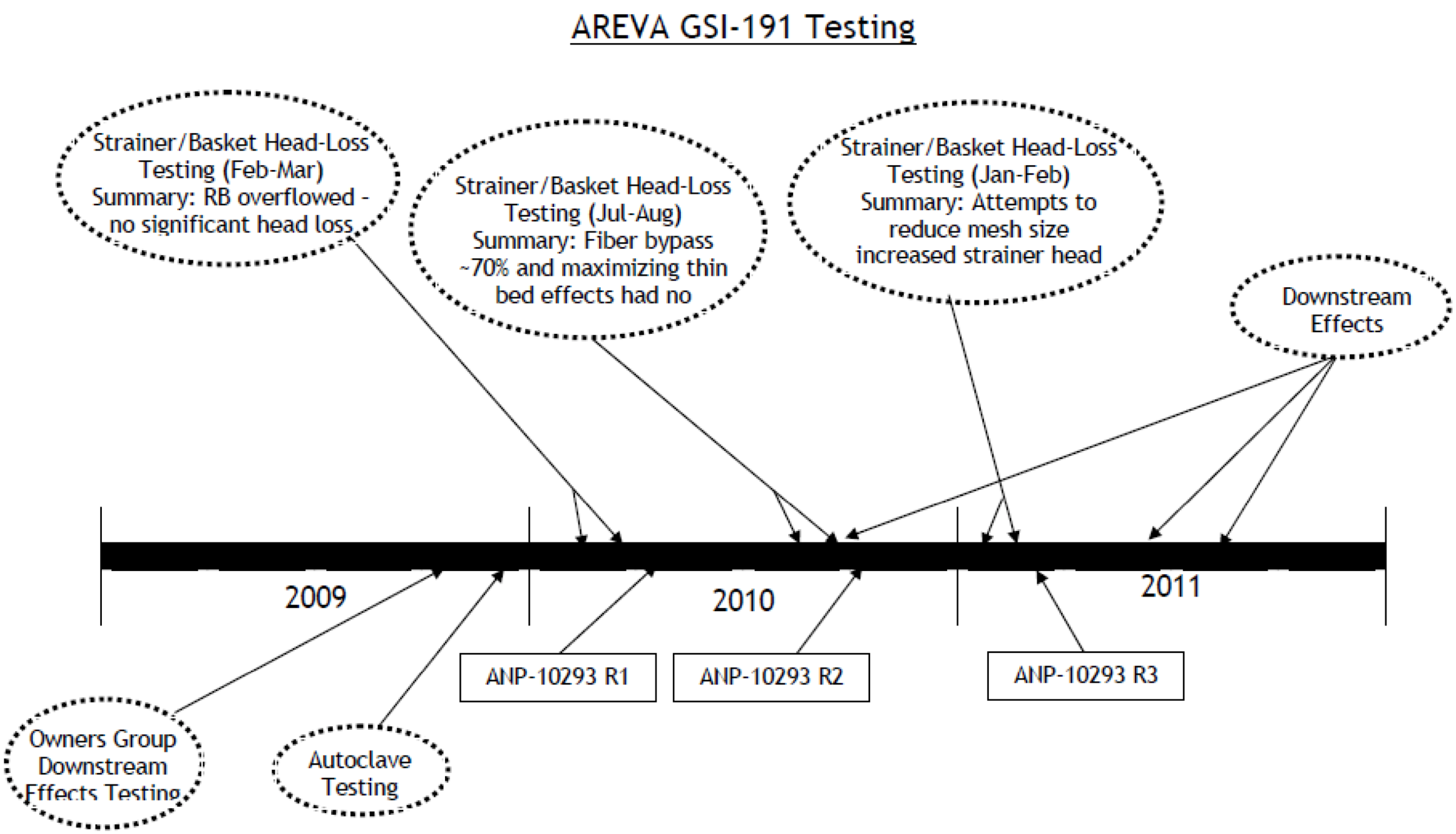
- **Additional features that contribute to the overall effectiveness of the system include:**
  - Retaining basket area sized to overlap trash rack portal area
  - A gap between the top of the retaining basket and the bottom heavy floor
  - Retaining basket screen mesh size is equivalent to the strainer screen mesh size
  - Inverted side screens on the sump suction strainers
  - Elimination of fibrous insulation in the zones of influence (ZOIs)
  - Non-safety-related backflush capability

Comprehensive Test Program

- Chemical debris confirmatory testing
  - Validation of chemical debris analysis
- Strainer/retaining basket head loss testing
  - Safety injection pump net positive suction head confirmation
- Fuel assembly downstream effects testing
  - Long term core cooling assurance

Proprietary

Test Timeline



Strainer/Retaining Basket Head Loss Testing

Proprietary

Strainer/Retaining Basket Head Loss Testing

- **Objective**
  - Ensure measured differential pressure (dp) across the strainer maintained adequate NPSH for the safety injection pumps
  - Conservatively measure the amount of debris that reaches downstream components including the fuel assemblies
- **Five types of tests were performed**
  - Debris transport
  - Clean strainer head loss
  - Design basis debris load
  - Thin bed
  - Fiber only

Proprietary

Strainer/Retaining Basket Head Loss Test Scaling

Scaling	
Vertical (e.g. test tub, retaining basket and strainer, screen approach velocity)	**Full height**
Flow area (e.g. volume and filter surface).	**~1:10**
Flow rate (e.g. recirculation flow)	**~1:10**

- **The main reasons for this scaling concept are:**
  - **Screen surface approach velocity identical in test and plant**
  - **Vertical direction: 1:1 scaling is necessary to model the phenomena during the tests because it gives similar dissipation and turbulence conditions for the test loop compared to the plant.**
  - **Horizontal directions: a reduced scaling can be used provided that friction between debris in suspension in the water flow and the pool walls are negligible. Width of the pool must be large enough to avoid disrupting the debris transportation between the retaining baskets and the strainer.**

Test Purpose / Description

- **Debris Transport Test**
  - Assess the ability of selected debris to transport
  - Consists of RMI, tape, glove, plastic chain link, and other miscellaneous debris
  - Results: no debris transport outside the retaining basket
- **Clean Strainer Head Loss Test**
  - Measure dp across clean strainer as reference for other tests
- **Design Basis Debris Load Test**
  - Measure dp across strainer
  - 100% of the design basis debris
  - Results: retaining basket overflowed, no significant dp measured across the strainer

Test Purpose / Description

- **Thin Bed Test**
  - Historically: Ensure that a higher head loss across the strainer is not possible using less fiber to form a "thin bed"
  - For the U.S. EPR: Change fiber batch sizes to defeat the retaining basket defense and load the strainer with as much debris as possible to maximize head loss
  - 100% of the design basis debris
  - Results: retaining basket did not overflow, no significant dp measured across the strainer
- **Fiber Only Test**
  - Quantify fiber that bypasses the retaining basket and strainer
  - Maximizes fiber bypass to be used as input to fuels testing
  - 100% of the design basis fiber
  - Results: determined bypass for fuel assembly downstream effects testing

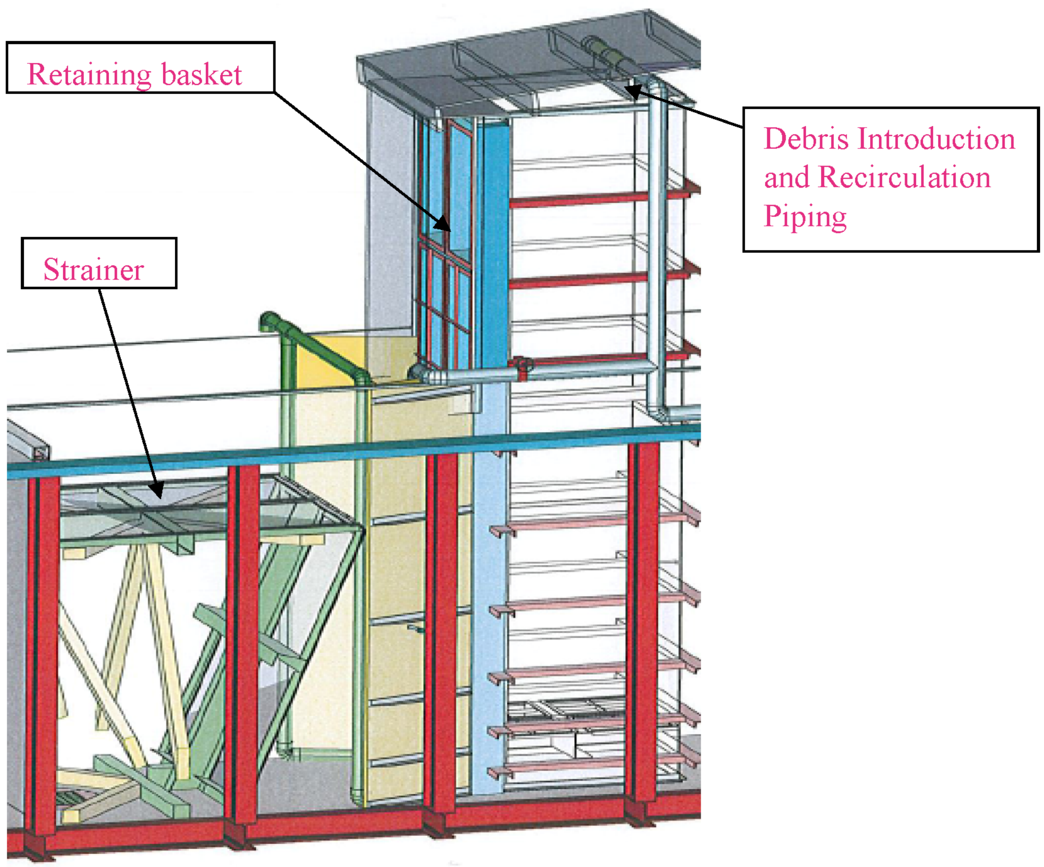
Debris Source Term

- Zones of influence for insulation and coating types evaluated
  - Reflective Metal Insulation (RMI) – 2D
  - Qualified coatings – 4D
  - Inorganic zinc coatings – 10D
  - Jacketed Nukon® with standard bands – 17D
- The U.S. EPR design has eliminated the use of fibrous insulation in the zone of influence so only fiber is latent
- Chemical debris
  - Used OLI StreamAnalyzer™ to predict aqueous speciation, pH, and precipitate formation vs. time for the materials entering the IRWST
  - Performed autoclave testing to validate analysis results
  - Yielded the following precipitates: aluminum oxyhydroxide, calcium phosphate, sodium aluminum silicate

Proprietary

Strainer/Retaining Basket Test Facility

- Test set-up



Summary of Strainer/ Retaining Basket Tests Performed

- 50 small scale sensitivity tests and 15 large scale tests were performed between Feb 2010 and Feb 2011
- Test acceptance criterion for strainer head loss remained within acceptable NPSH margin
- Recorded fiber bypass fraction from fiber only bypass testing
- Test results were reported in Technical Report ANP-10293P, Revision 3
  - No significant head loss across the strainer was observed during any test with the U.S. EPR design configuration (approximately the same as the clean strainer head loss)
  - Bypass fraction was measured at < 70%

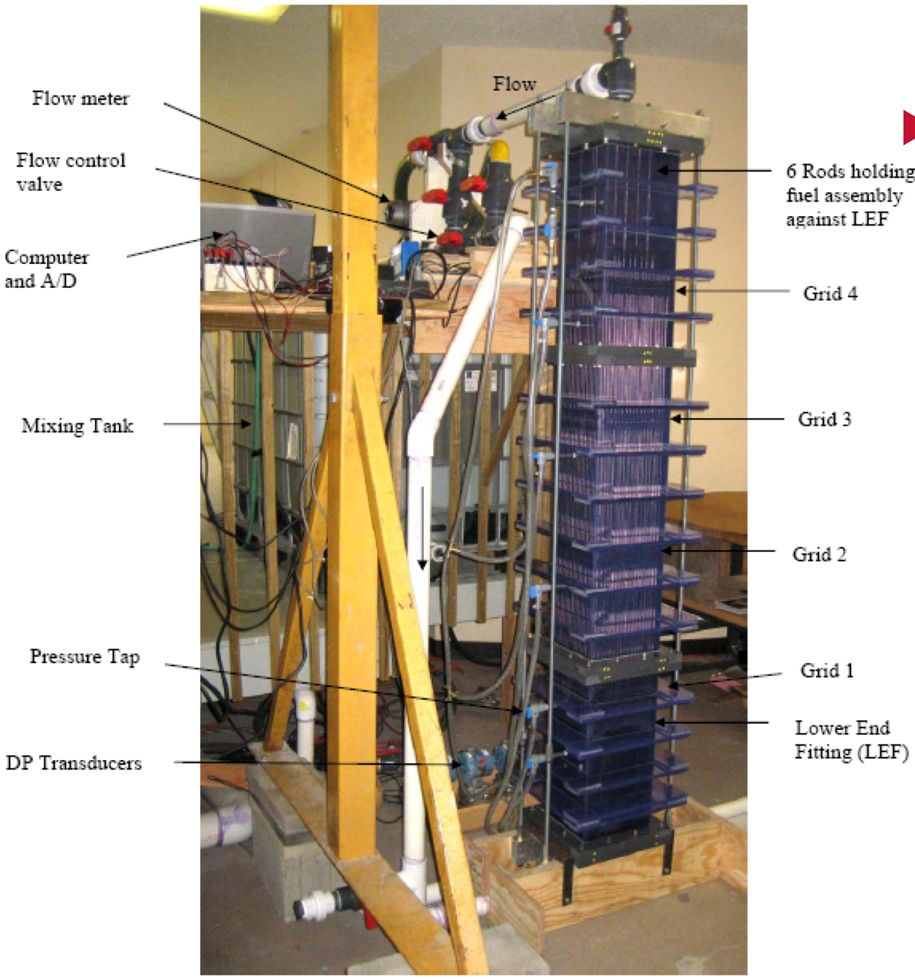
In-Vessel Downstream Effects (Closed Session)

Testing Inputs

- Strainer bypass fraction used was 70% based on testing
- Latent debris (design) is limited to 150 lbs
  - 10.2 lbs of fiber (6.8%)
  - 139.8 lbs of dirt and dust (93.2%)
  - Sets requirements for COL applicant cleanliness program
- Latent fiber debris tested was:
  - [
    ]
  - [
    ]

Proprietary

Fuel Assembly Downstream Effects Test Facility

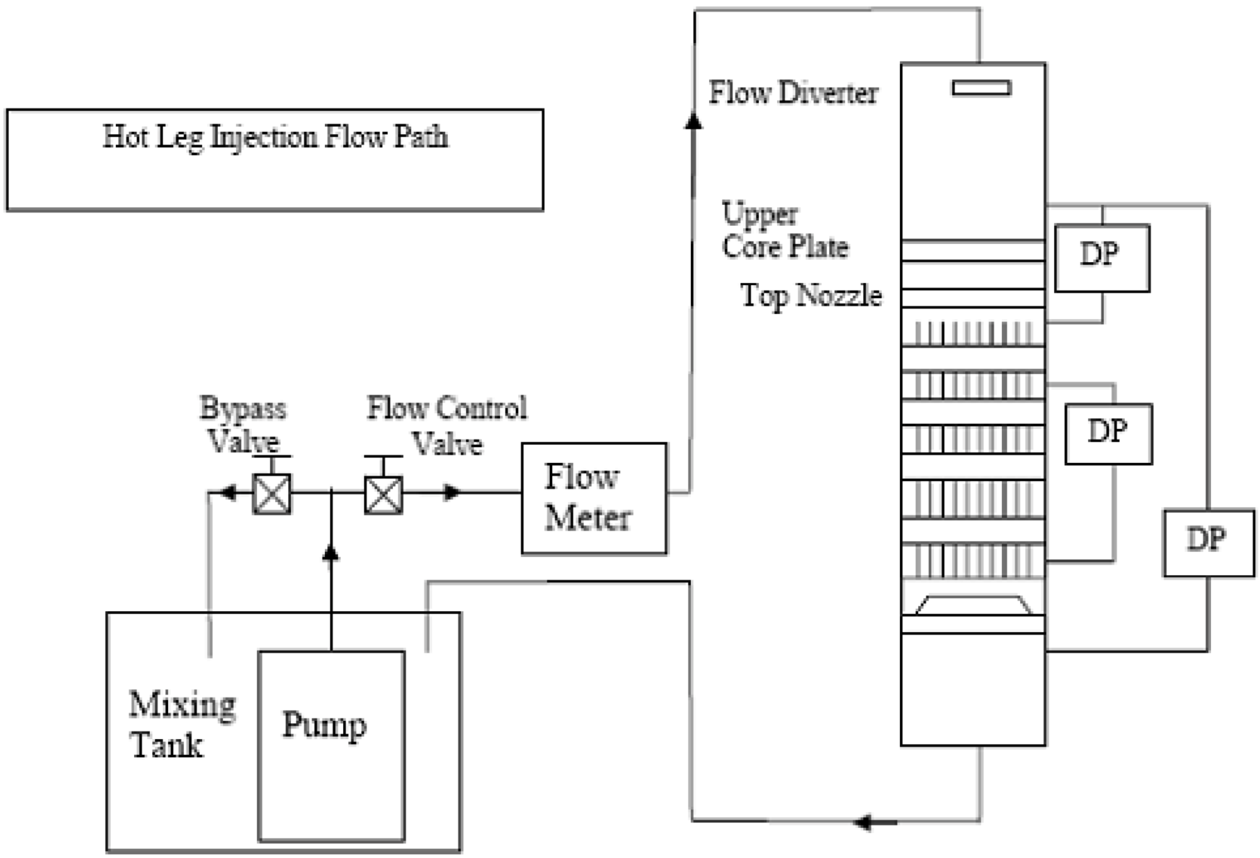


- Facility layout

Proprietary

Fuel Assembly Downstream Effects Test Facility

- Test set-up



Scenarios Considered

- **Four scenarios were considered in the testing matrix**
  - **Hot Leg Break (HLB) / Cold Leg Injection (CLI)**
  - **Cold Leg Break (CLB) / CLI**
  - **CLB / Hot Leg Injection (HLI)**
  - **HLB / HLI**
- **[**

]

Acceptance Criterion

- [

]

Acceptance Criterion

- Margin to acceptance criteria as a function of Darcy's equation exponent

[ ]

Tests Performed

- Testing was performed by:
  - Introducing debris (particulate, fiber, and chemicals) in the mixing tank
  - Monitoring flow
  - Monitoring differential pressure across:
    - Fuel assembly lower end fitting
    - Spacer grids
    - Entire fuel assembly
- Test results will be reported in Technical Report ANP-10293P, Revision 4

Tests Results

- [

 ]

Proprietary

Conclusion

- Robust, defense-in-depth, design that evolved from existing plant designs
- Used comprehensive and conservative test approach
  - All debris into one strainer/basket
  - Actions taken to prevent settling
  - All fiber introduced as "fines"
  - No credit taken for filtering effect of strainer bed during FA testing
- Obtained acceptable results with margin for both strainer head loss and fuel assembly downstream effects

Acronyms

CLB	cold leg break
CLI	cold leg injection
COL	combined license
dp	differential pressure
ECCS	emergency core cooling system
FA	fuel assembly
FG	FUELGUARD™
FPC	fiber particulate chemical
GSI	generic safety issue
HLB	hot leg break
HLI	hot leg injection
IRWST	in-containment refueling water storage tank
NPSH	net positive suction head
RB	retaining basket
RCS	reactor coolant system
RMI	reflective metal insulation
SIS	safety injection system
ZOI	zone of influence

Presentation to ACRS U.S. EPR Subcommittee Design Certification Application FSAR Tier 2 Chapter 9

(excluding Section 9.1)

November 14, 2011

EPR™ by AREVA

AREVA

Chapter 9 ACRS Meeting Agenda

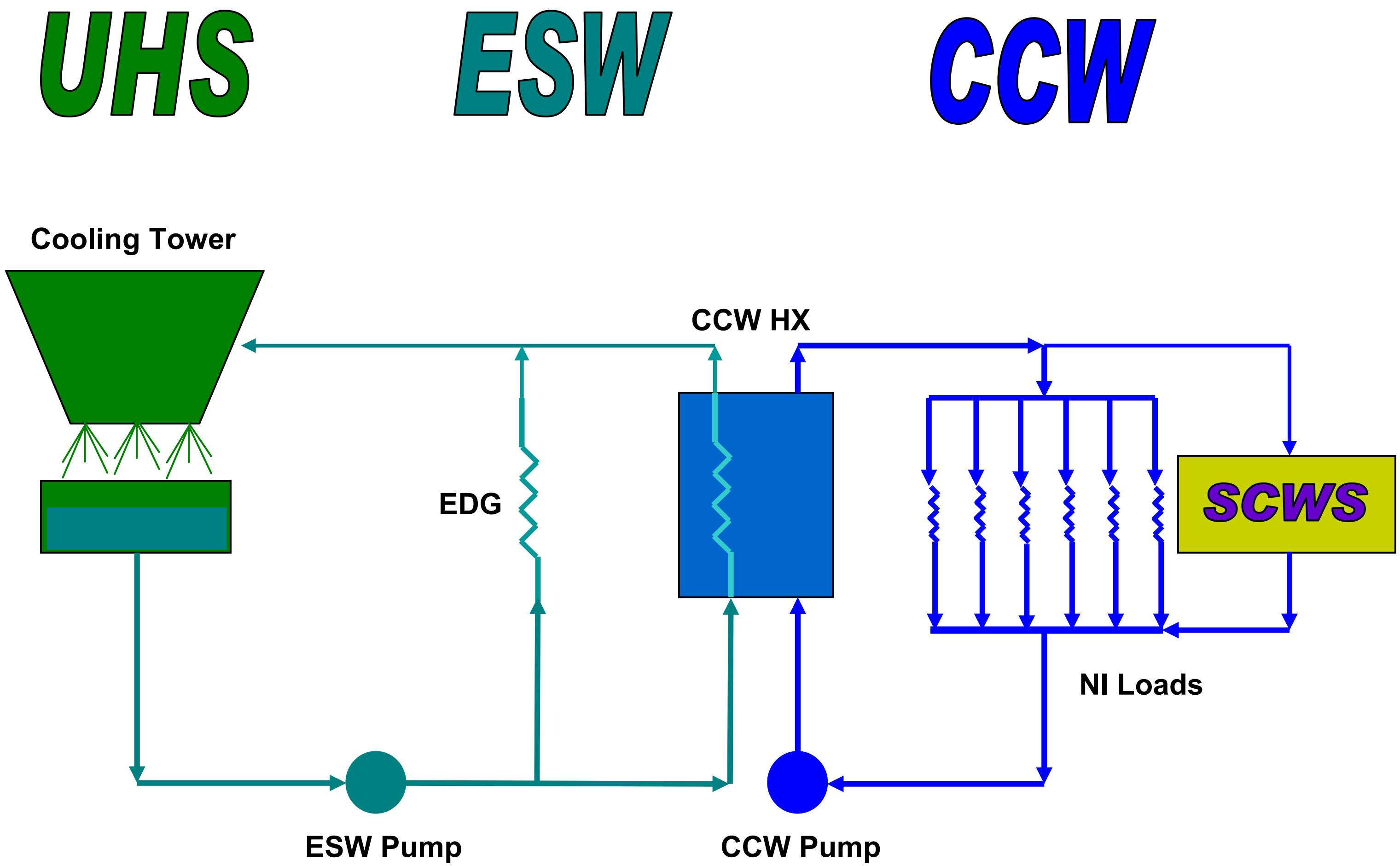
▶ Introduction and Overview of U.S. EPR	Darrell Gardner
FSAR Chapter 9 Auxiliary Systems	
▶ Water Systems (9.2.1, 9.2.2, 9.2.5, 9.2.8)	Steve Huddleston
▶ Process Auxiliaries (9.3.2, 9.3.3)	Jean Lindstrom
▶ CVCS (9.3.4) and Extra Borating System (6.8)	Fred Maass
▶ Air Conditioning, Heating, Cooling and Ventilation Systems (9.4)	Susan McConaty
▶ Fire Protection (9.5.1) (Including Appendix 9A Fire Protection Analysis)	John Crowther
▶ Diesel Generator Subsystems (9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8)	Robert Day

U.S. EPR FSAR Water Systems

▶ Essential Service Water System	9.2.1
▶ Ultimate Heat Sink	9.2.5
▶ Component Cooling Water System	9.2.2
▶ Safety Chilled Water System	9.2.8

Steve Huddleston
Supervisory/Advisory Engineer
Mechanical Engineering

Chapter 9 Presentation Scope



Section 9.2.1 - Essential Service Water

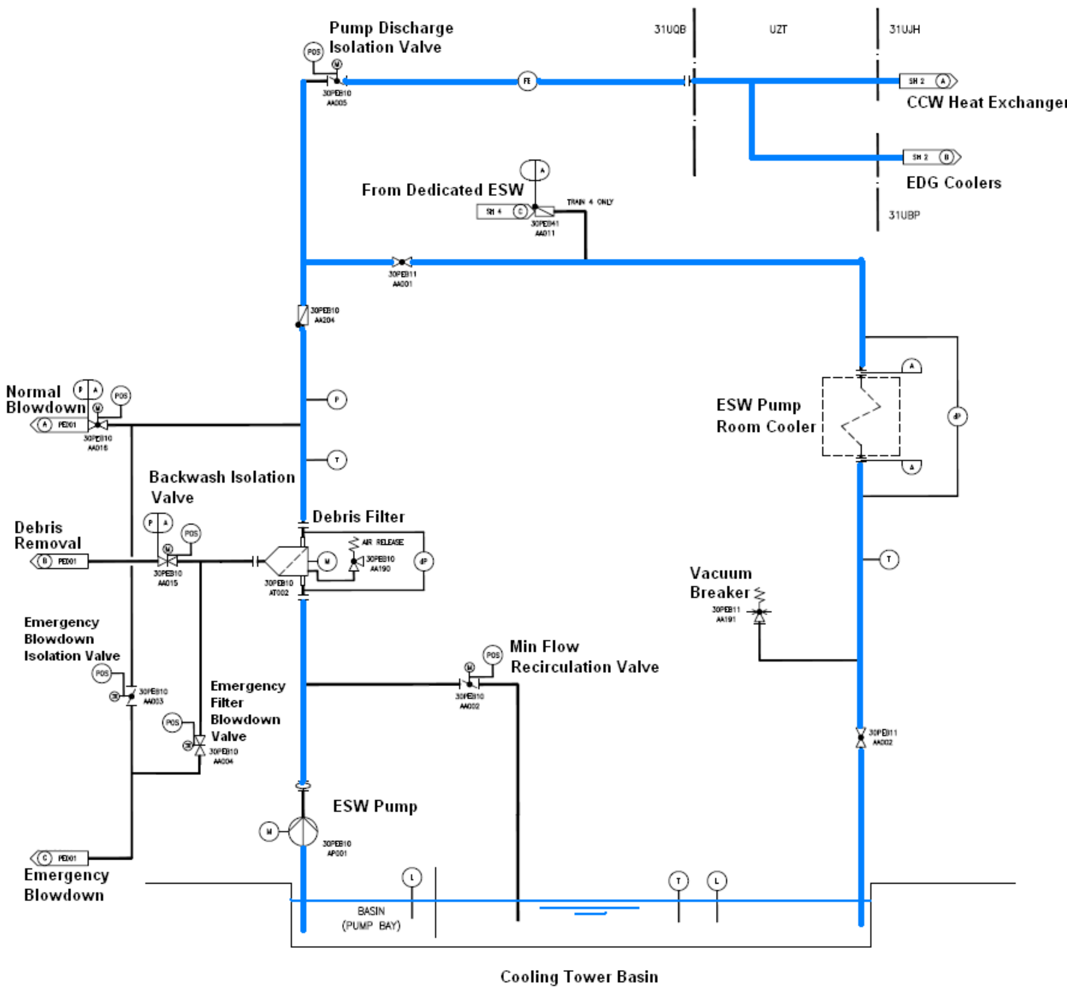
- **The essential service water system (ESWS) consists of**
  - four separate, redundant, **safety-related** trains, that operate during
    - normal operation
    - safe shutdown and cooldown of the reactor
    - following a design basis accident (DBA)
      - Two trains can achieve safe shutdown
  - one dedicated, **non-safety-related** train that removes containment heat from the dedicated cooling chain (SAHRS) during severe accidents

Section 9.2.1 - Essential Service Water

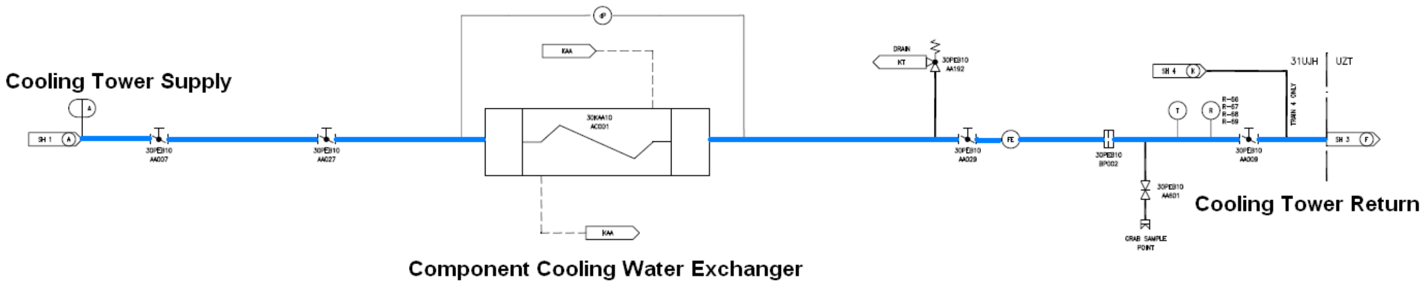
- **The safety-related ESWS receives cooled water from the Ultimate Heat Sink (UHS) cooling tower basin to cool:**
  - Component cooling water system (CCWS) heat exchangers (HXs).
  - Emergency diesel generator (EDG) HXs.
  - ESW pump room coolers.

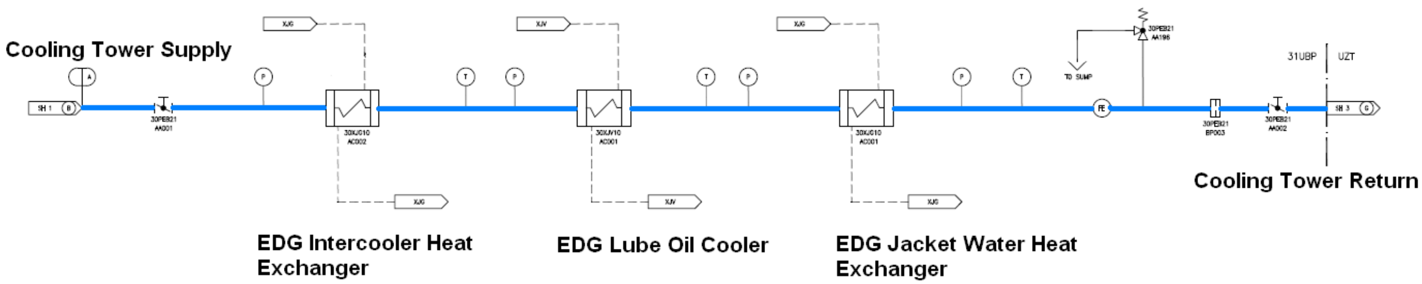
- **The ESW heat load is released to the UHS cooling towers through evaporation and direct air to water cooling**

Section 9.2.1 - Essential Service Water

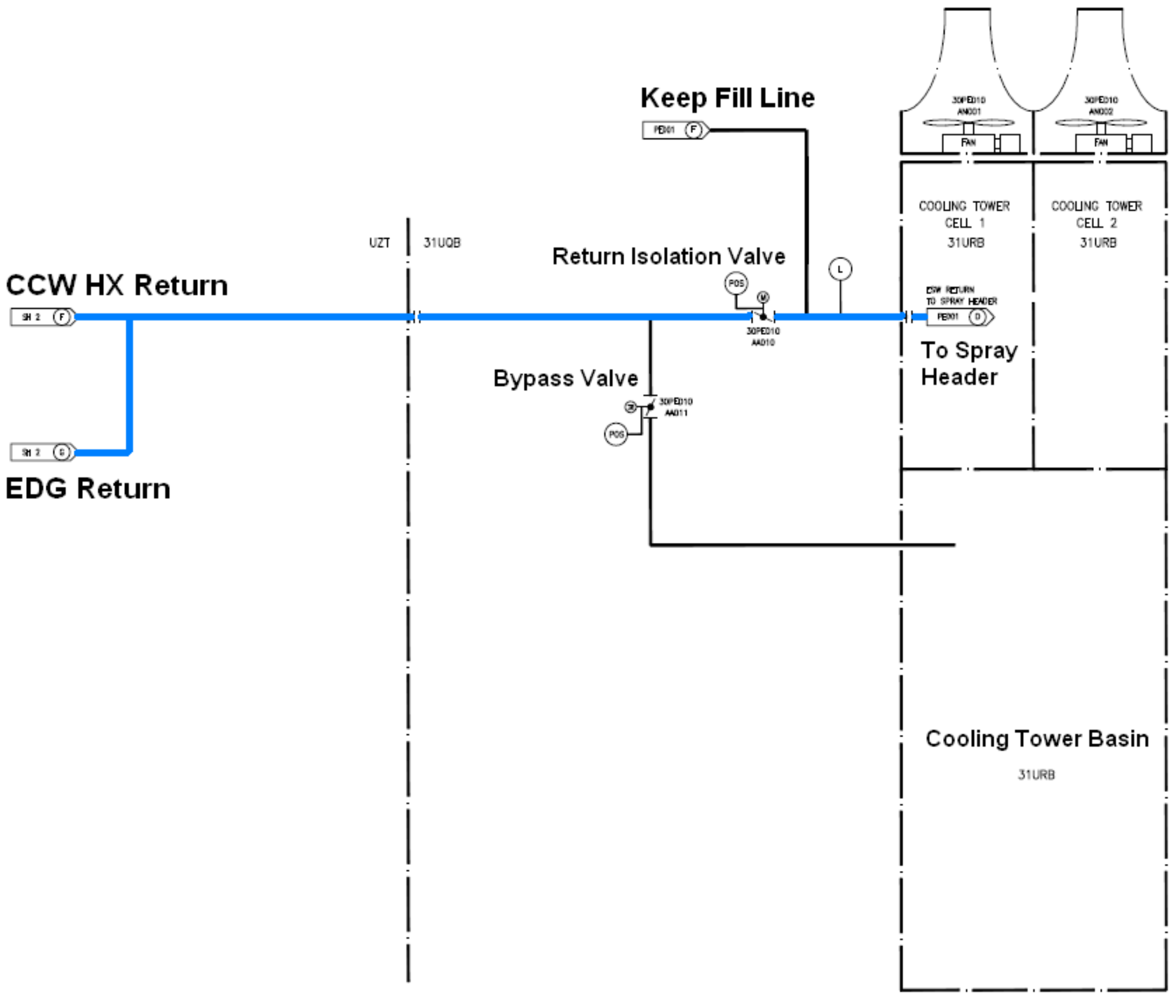


Section 9.2.1 - Essential Service Water





Section 9.2.1 - Essential Service Water



Section 9.2.1 - Essential Service Water

Non-Safety Dedicated Train

- The non-safety dedicated train pumps water from the Train 4 UHS cooling tower basin during severe accidents.
- The Dedicated ESWS pump train is powered by Division 4 Class 1E electrical buses or by a station blackout diesel generator (SBODG).

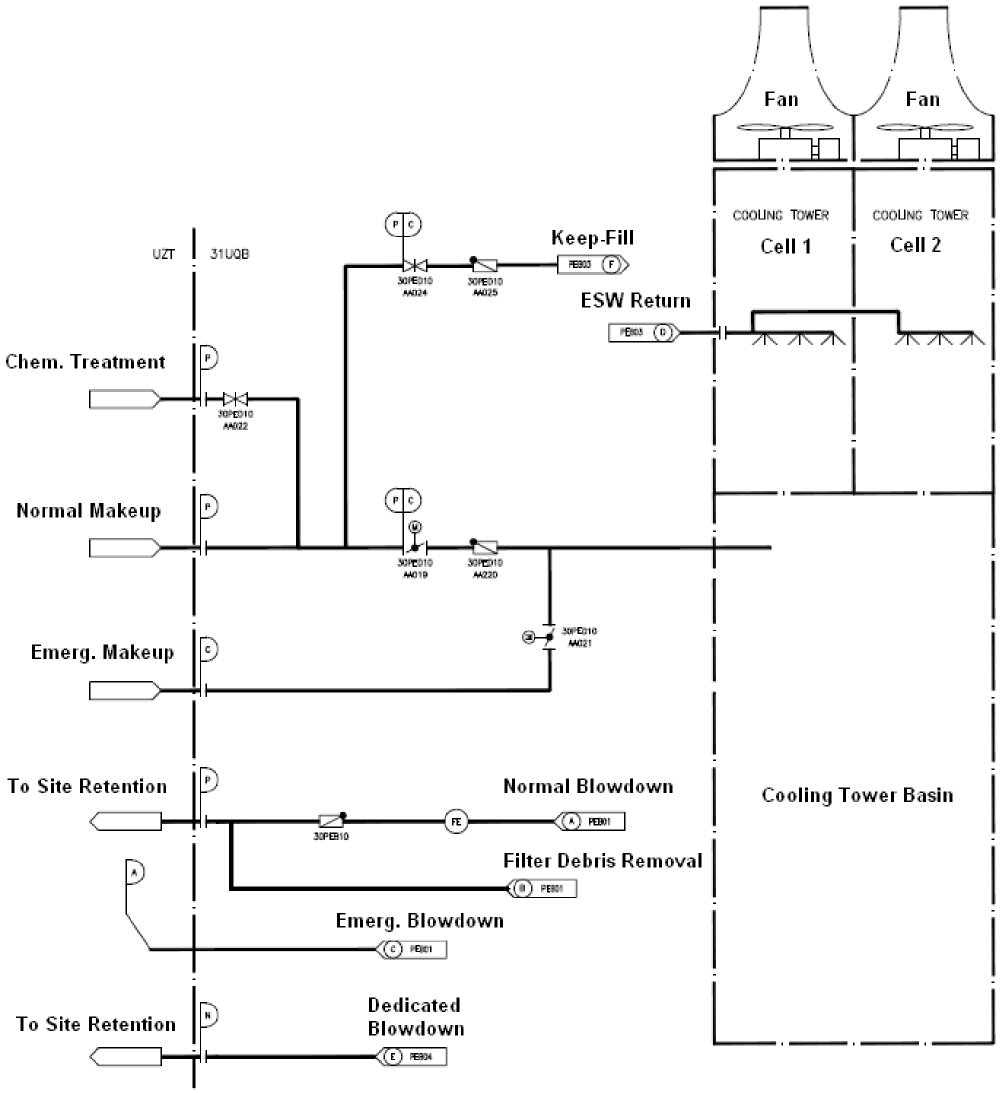
Section 9.2.5 - UHS

- The ultimate heat sink (UHS) consists of four separate, redundant, safety-related trains that reject heat from the ESWS during:
  - Normal operation
  - Cooldown / shutdown conditions
  - DBA post accident
- Two UHS trains are required to achieve a safe shutdown under DBA

Section 9.2.5 - UHS

- Each UHS consists of a mechanical draft cooling tower with two fans, spray nozzles, tower fill, drift eliminator, piping, valves, controls and a cooling tower basin.
- Each tower contains two 50% fans.
  - Powered from EDG during DBA
- The Train 4 cooling tower fans can be powered by an EDG or station blackout diesel generator (SBODG).
- Each cooling tower basin is sized to provide a minimum 72-hour supply of cooling water with sufficient level for pump NPSH to ESW under DBA conditions without makeup – COL applicant provides post 72 hour make-up source.

Section 9.2.5 - UHS



Section 9.2.2 - CCWS

- **Each train of the 4 train component cooling water system (CCWS) is a closed loop system that removes heat from safety and non-safety-related components.**
- **CCW transfers heat to the ESW system by a shell and tube heat exchanger.**
- **2 CCW trains are required for DBA heat removal.**

Section 9.2.2 - CCWS

Safety-Related Loads

- **Safety Injection and Residual Heat Removal System Cooling**
- **Reactor Coolant Pump Cooling Thermal Barrier Cooling**
- **Safety Chiller Cooling**
  - The CCWS provides chiller heat removal to Trains 2 and 3 of the Safety Chilled Water System during normal operation and DBA conditions
- **Spent Fuel Pool Cooling**

Section 9.2.2 - CCWS

- **Non-Safety-Related Loads**
  - **The following operational loads are cooled by CCW:**
    - Containment Building Ventilation System Coolers
    - Nuclear Island Drain and Vent System Primary Effluents Heat Exchanger
    - Coolant Treatment and Storage System and Coolant Degasification System Coolers
    - Operational Chilled Water System Chillers
    - Liquid Waste Processing System Users
    - Solid Waste Storage System Users
    - Chemical and Volume Control System Charging Pumps
    - Nuclear Sampling System Sample Coolers
    - Steam Generator Sampling System Sample Coolers
    - Chemical and Volume Control System High Pressure Heat Exchangers
    - Reactor Coolant System Pump Motor Air and Bearing Coolers
    - Steam Generator Blowdown System Second Stage Coolers

Section 9.2.2 - CCWS

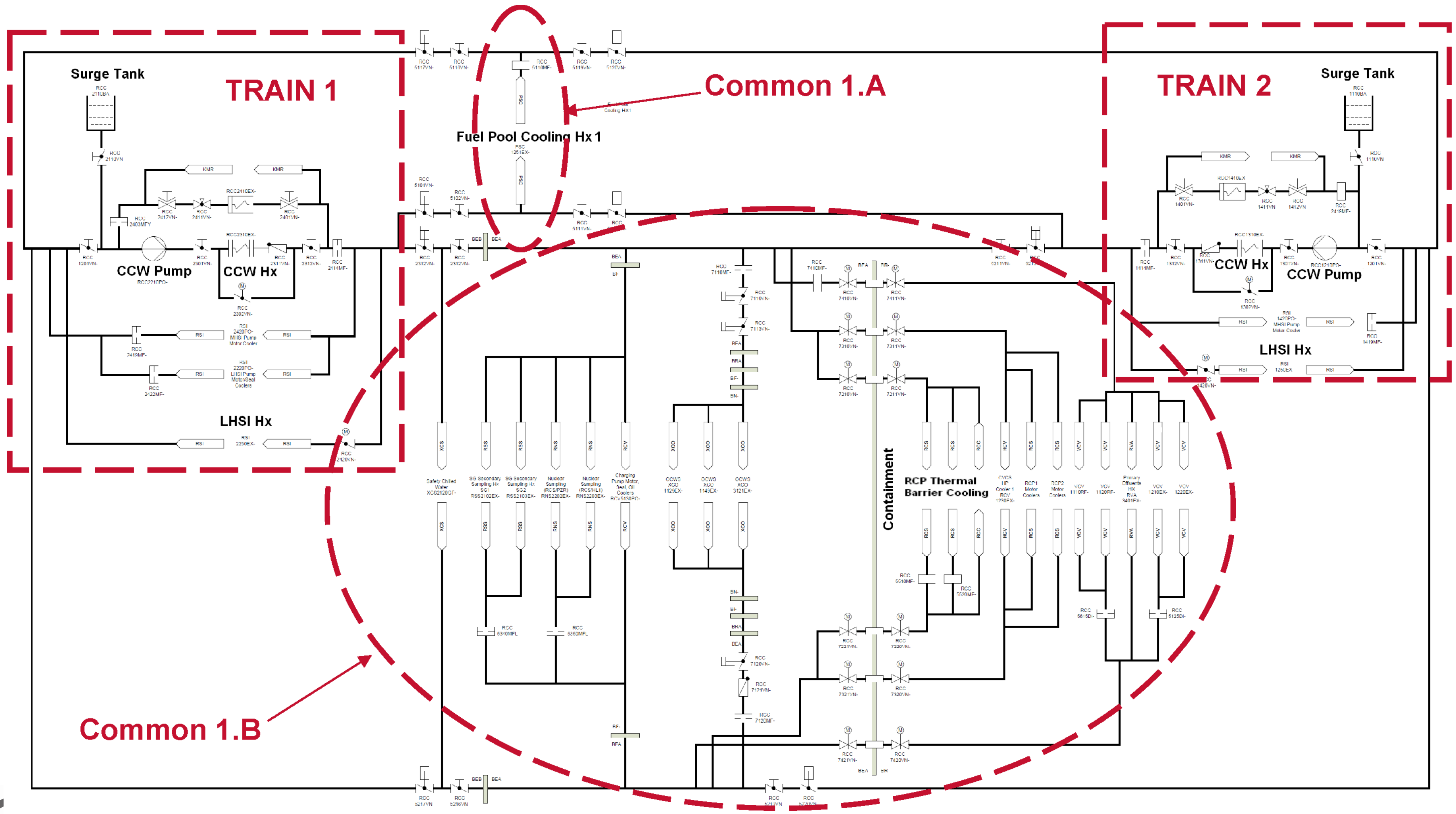
Dedicated CCWS for Severe Accident

- A single non-safety-related CCWS train that cools the severe accident heat removal system (SAHRS).
- Normally fed from offsite power by Class 1E electrical Division 4.
- Capable of receiving power from Division 4 EDG or the SBODG.

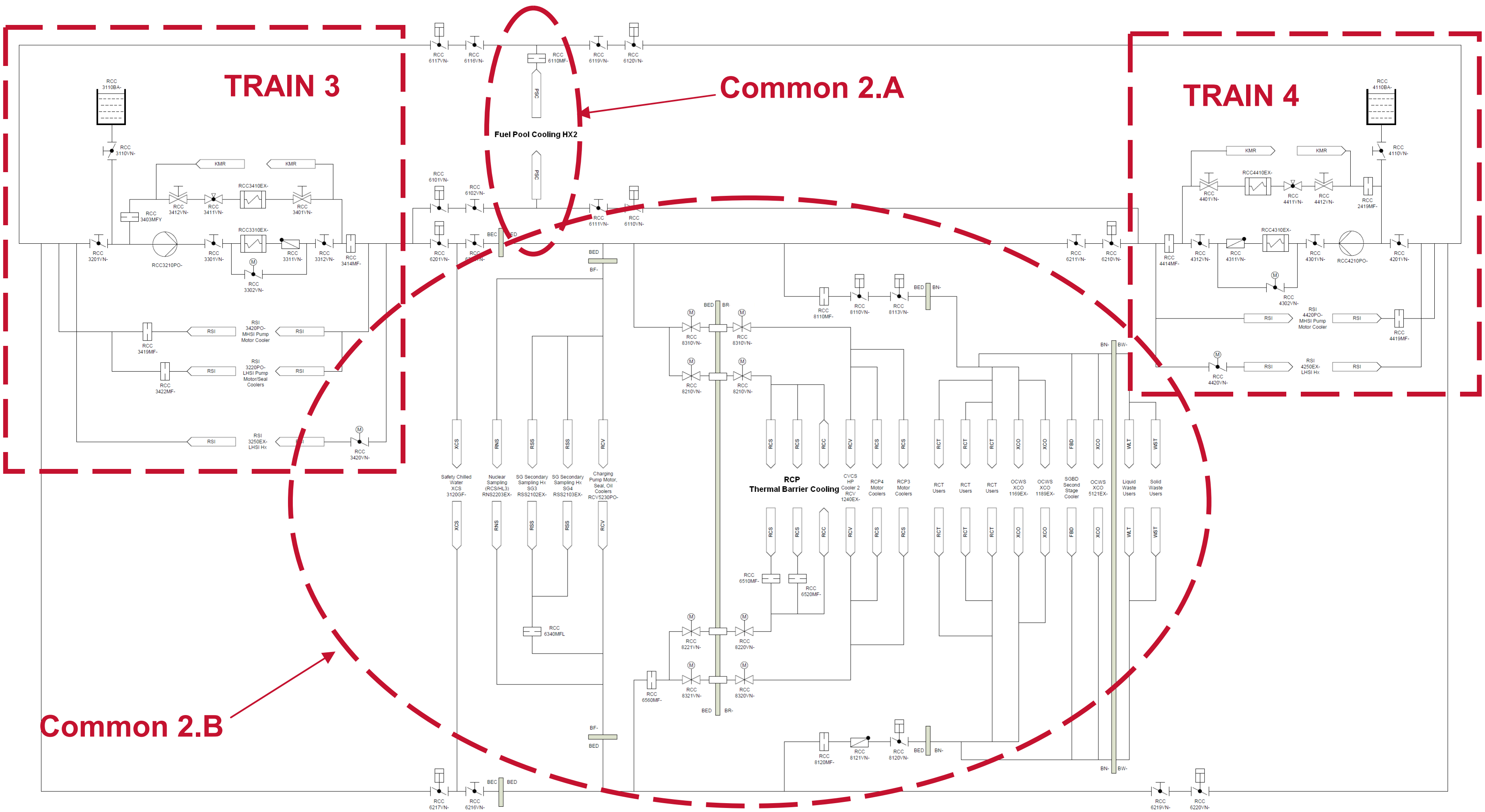
Section 9.2.2 - CCWS

- **CCWS Safety-Related Main Trains**
  - **Each physically separate CCWS Safety Train includes:**
    - CCW Supply Pump
    - CCW Heat Exchanger (cooled by ESWS)
    - Surge Tank – maintains level for pump NPSH
    - Isolation valves for separation of the safety train from the Common Headers
- **CCWS Common Headers 1 and 2**
    - Common Headers 1 and 2 are further sub-divided into “a” and “b” headers
    - Common 1.a and 2.a cools Fuel Pool Cooling (FPC) Trains 1 and 2, respectively
    - Common 1.b and 2.b cools multiple safety and non-safety loads
    - Either Common 1.b or 2.b can provide RCP Thermal Barrier cooling

Component Cooling Water System
Trains 1 and 2 (Side 1)



Component Cooling Water System
Trains 3 and 4 (Side 2)



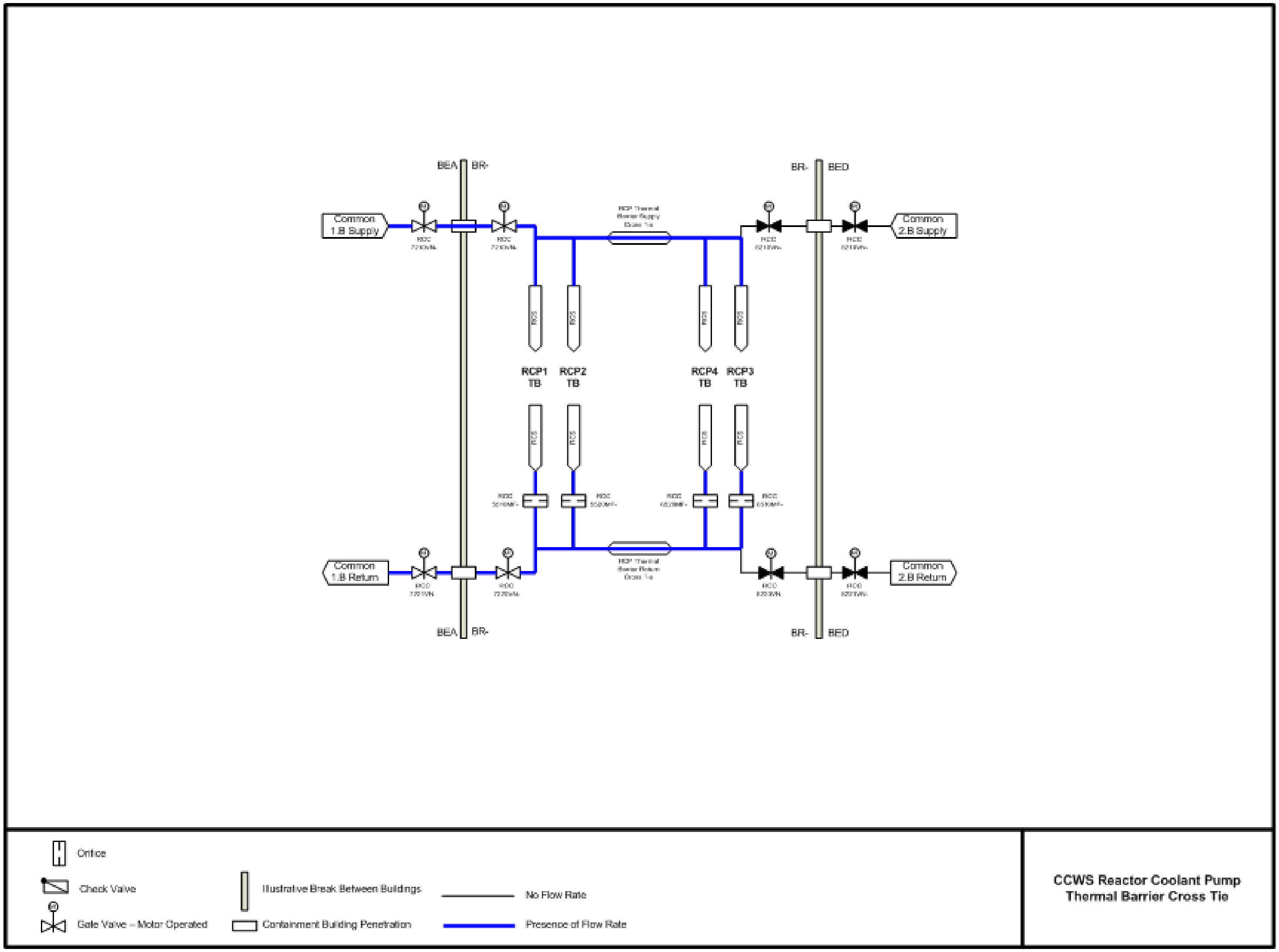
Section 9.2.2 - CCWS

- **RCP Thermal Barrier Cooling**

  - **All four RCP thermal barriers are supplied by either the Common 1.b or 2.b header.**

  - **Containment isolation valve interlock ensures only one common header can be aligned to thermal barrier cooling at a time.**

CCWS Reactor Coolant Pump Thermal Barrier Cross Tie



Section 9.2.8 - SCWS

- **The 4 trains of the safety chilled water system (SCWS) supply chilled water to:**
  - Safety-related HVAC systems
  - Low head safety injection system (LHSI) pumps and motors in Trains 1 and 4
  - Fuel building ventilation system (FBVS)

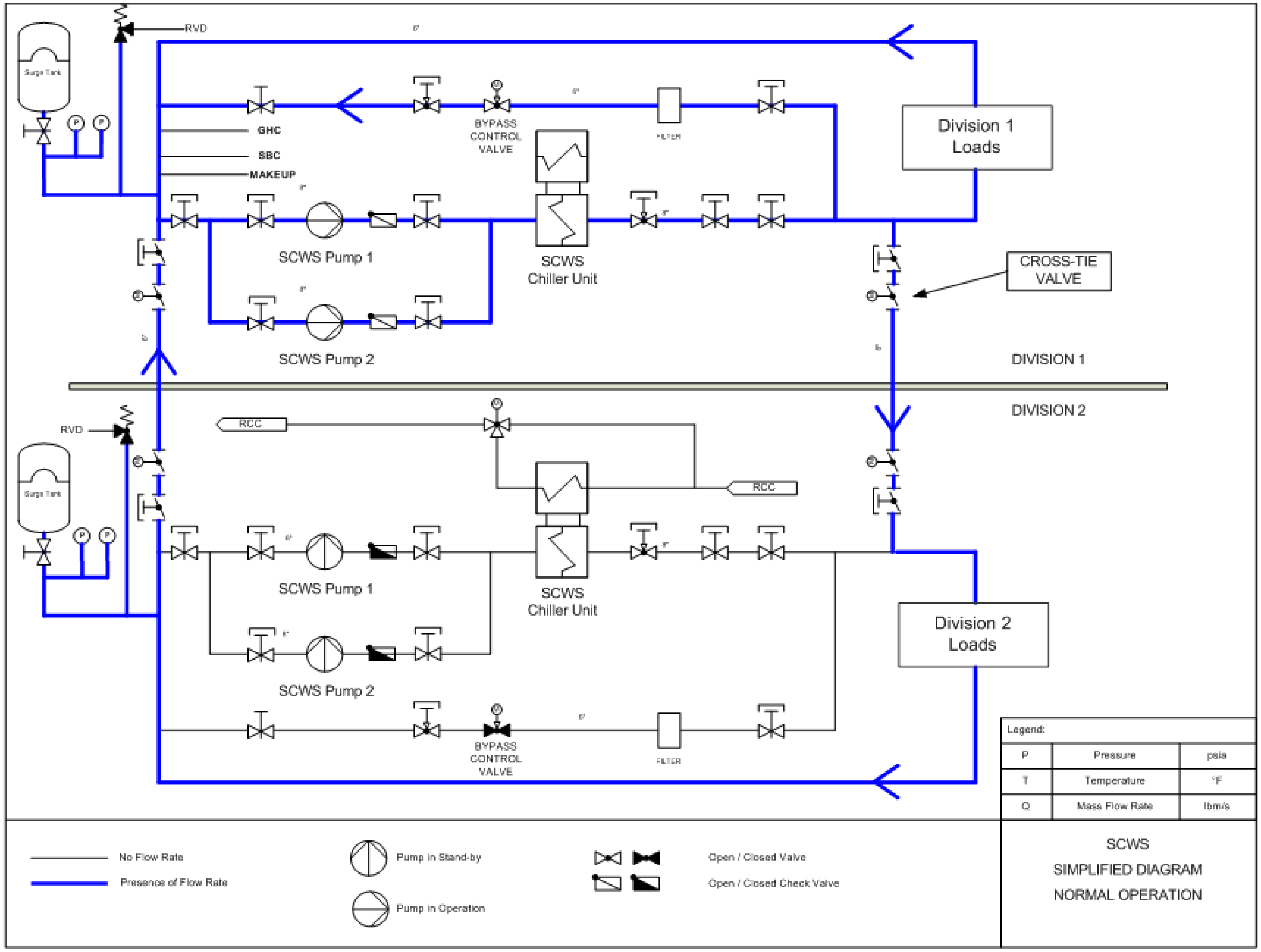
- **Each train consists of a refrigeration chiller unit, two pumps and expansion tank.**

- **One chiller train is sized to meet the cooling load of two trains.**

Section 9.2.8 - SCWS

- Trains 1 and 4 use air-cooled chillers.
- Trains 2 and 3 use CCW cooled chillers.
- Each train is located within its own Safeguard Building.
- Pumps, refrigerating units and other electrical equipment within each train are backed-up by the corresponding 1E EDG.
- Divisions 1 and 4 are also backed-up by the SBODGs.
- Cross-Tie Valves
  - One SCW chiller operates cross-tied to supply two trains.
  - The valves are divisionally-powered.

SCWS – Simplified Diagram Normal Operation



U.S. EPR FSAR Process Auxiliaries (9.3.2 and 9.3.3)

Jean Lindstrom

Engineering Supervisor

Mechanical Engineering

Sections 9.3.2 and 9.3.3 - U.S. EPR FSAR Process Auxiliaries

- **9.3.2 Process Sampling System**
  - Nuclear Sampling System (NSS)
  - Secondary Sampling System (SECS)
  - Severe Accident Sampling System (SASS)

- **9.3.3 Equipment and Floor Drainage System**
  - Recyclable Effluents
  - Process Drains
  - Type 1 Floor Drains
  - Type 2 Floor Drains
  - Type 3 Floor Drains

Note: SASS is similar to the Post Accident Sampling System (PASS) in current operating plants.

Section 9.3.2 - Process Sampling System

- **Purpose**

  The process sampling systems provide centralized and local facilities for obtaining liquid and gaseous samples for the purpose of determining the physical and chemical characteristics and control parameters by measurements and analyses for:

  - Nuclear Sampling System
    - Active systems (e.g., Reactor Coolant)
    - Slightly Active systems (e.g., Fuel Pool)
    - Gaseous systems
    - Corrosion products
  - Secondary Sampling System
    - Steam Generator Blowdown
    - Turbine Island (i.e., steam-condensate-feedwater cycle)
  - Severe Accident Sampling System
    - Containment Atmosphere
    - In-containment Refueling Water Storage Tank (IRWST)

Notes:

1. Hydrogen monitoring system is described in FSAR Chapter 6.
2. PERMSS (process and effluent radiological monitoring and sampling systems) are described in FSAR Chapter 11.

Section 9.3.2 - Process Sampling System

Safety Functions

- **Nuclear Sampling System**
  - Maintains containment isolation (RCS samples)
- **Secondary Sampling System**
  - Maintains containment isolation (Steam generator blowdown samples)
- **Severe Accident Sampling System**
  - Maintains containment isolation (Containment atmosphere samples)

Non-Safety Functions

- **Provides methods to sample process streams for analyses of:**
  - chemical
  - physical
  - microbiological
  - radiological properties

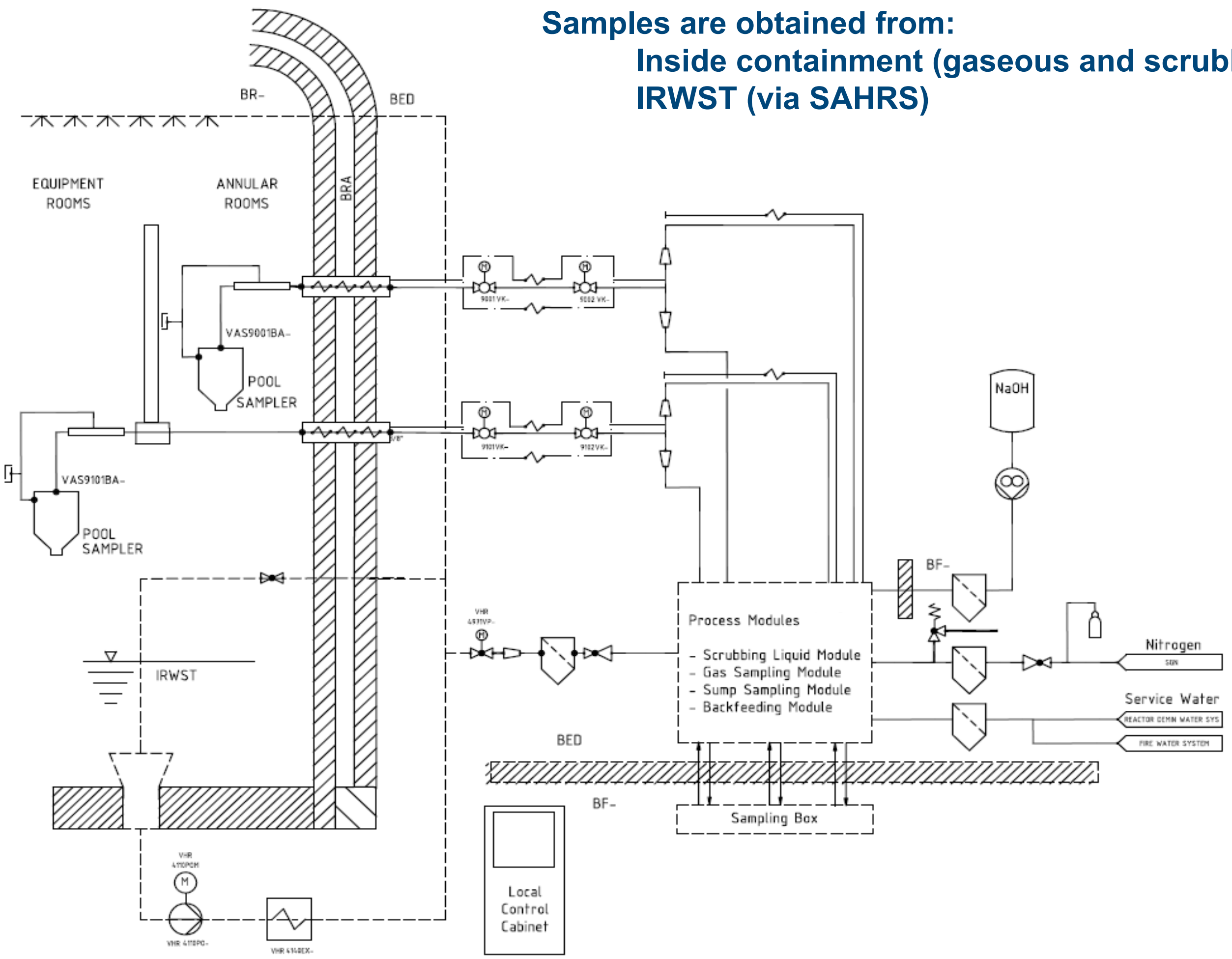
Section 9.3.2 - Process Sampling System

Severe Accident Sampling System (SASS)

Samples are obtained from:

- **Inside containment (gaseous and scrubbing liquid).**
- **IRWST (via SAHRS)**

(18' level)



Section 9.3.3 - Equipment and Floor Drainage System

Purpose

Collects, temporarily stores and discharges radioactive fluids from the nuclear island (NI) area to other plant systems in a controlled manner. The NIDVS operates during normal power, start-up and shutdown conditions.

Subsystems include:

- **Recyclable Effluents (primary drains and vents)**
- **Process Drains**
- **Type 1 Floor Drains (controlled area, low boron concentration)**
- **Type 2 Floor Drains (controlled area, no boron)**
- **Type 3 Floor Drains (non-controlled area)**

Notes:

1. Equipment and Floor Drain System is referred to in the EPR as the Nuclear Island Drain and Vent System (NIDVS).
2. The nuclear island consists of: Reactor Building, Safeguard Buildings, Fuel Building, Access Building, Nuclear Auxiliary Building and Radioactive Waste Processing Building.
3. Flooding is addressed in FSAR Chapter 3.
4. Turbine Building discharge is addressed in FSAR Chapter 11.

Section 9.3.3 - Equipment and Floor Drainage System

Safety Functions

- **Maintains containment isolation.**
- **Flooding detection inside the Reactor Building, Safeguard Buildings and Fuel Building.**
  - Trips the essential service water system (ESWS) pump and closes the ESWS pump discharge valve in the affected Safeguard Building (SB)

Non-Safety Functions

- **Provides hold-up of radioactive effluents to allow batch operations.**
- **Evacuates potentially radioactive gases in the reactor coolant system.**
- **Cools primary system effluent to avoid demineralizer resin damage in the coolant purification system (CPS).**
- **Re-injects contaminated liquid samples collected in the Nuclear Auxiliary Building (NAB) to the Reactor Building (RB) to delay their treatment.**
- **A tool to aid in identifying the location of reactor coolant leakage within the Reactor Building.**

Section 9.3.3 - Equipment and Floor Drainage System

Design Features

- Effluents are classified according to whether or not they can be recycled.
- Effluents are collected according to their origin (primary drains, process drains, floor drains).
- Leakage to reactor containment from identified sources are collected and monitored separately from unidentified leakage.
- Piping is principally arranged for gravitational flow from the drain collectors to the drain tanks.
- Connected to a variety of systems by means of temporary or permanent connections.

U.S. EPR FSAR Process Auxiliaries (9.3.4 and 6.8)

Fred Maass
Manager, NI Systems Engineering

Section 9.3.4 - CVCS

- **Chemical and Volume Control System**
  - Maintains the reactor coolant water inventory via the pressurizer level control system.
- **Operational Functions**
  - The CVCS is the source of water for RCS purification, degasification, makeup and RCP seal water injection.
- **Safety-Related Functions**
  - Provides RCS Pressure Boundary Integrity.
  - Provides Boron Dilution Mitigation (Section 15.4.6).
  - Provides RCS Overfill Protection (Section 15.5.2).
  - Provides Containment Isolation.

Section 9.3.4 - CVCS

Non-Safety-Related Functions

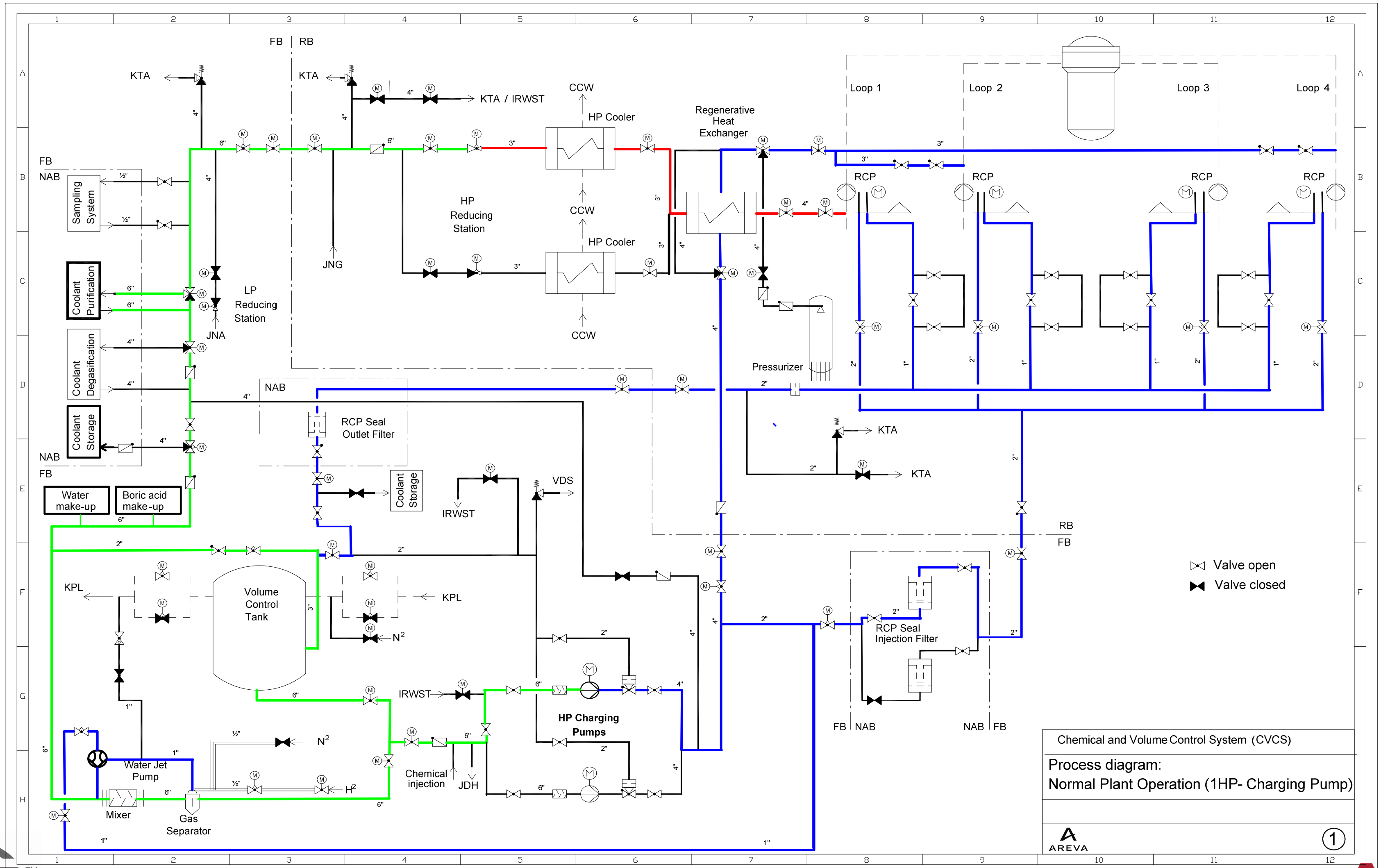
- Provides reactivity control during normal plant operations by adjusting the RCS boron concentration.
- Provides RCS water inventory control by maintaining a constant charging flow and adjusting the letdown flow to account for RCS volume changes due to temperature variations.
- Provides RCP seal water injection to the #1 seal and provides a return path for RCP seal #1 leakoff.
- Provides cooled reactor coolant for chemical and radiological control.
- Provides for the addition of chemicals for pH control and hydrogen for oxygen control in the RCS.
- Provides auxiliary spray to the pressurizer to control RCS pressure when the RCPs are not operating.

Section 9.3.4 - CVCS

Unique Features

- **Hydrogenation Station**
  - Reduces hydrogen concentration in coolant by direct injection into CVCS pump suction
  - Allows use of nitrogen overpressure on volume control tank
- **Volume Control Tank**
  - Designed as surge tank and not in primary flow path
- **High Pressure Reducing Station**
  - Throttles letdown flow to maintain pressurizer level with constant charging flow
- **Alternate Power for Charging Pumps from SBODGs during SBO Conditions**

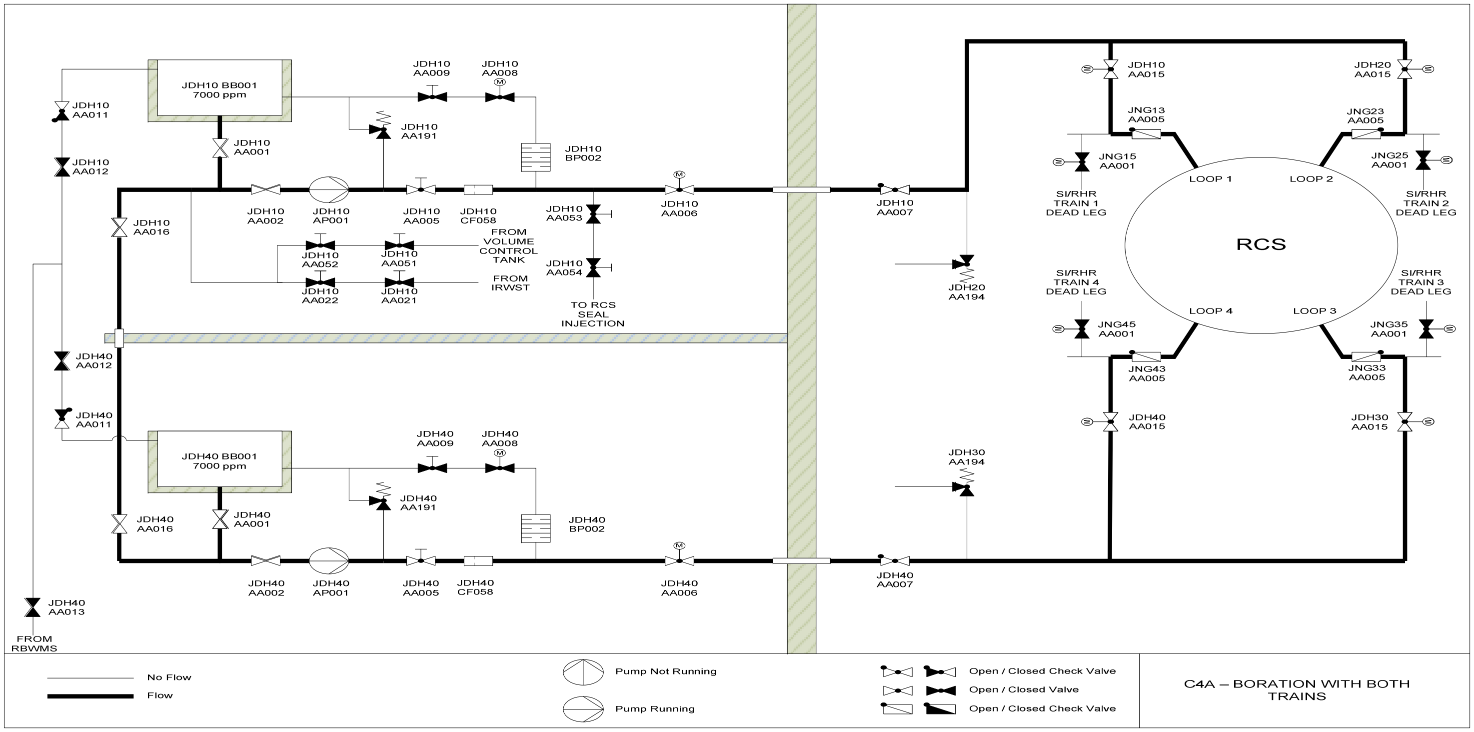
Section 9.3.4 - Chemical and Volume Control System



Section 6.8 - Extra Borating System (EBS)

- **Purpose**
  - Provide a safety-related source of concentrated boric acid to support plant cooldown
- **Safety Functions**
  - Reactivity Control – For anticipated operational transients and postulated accidents, the EBS ensures that the RCS can be properly borated, regardless of RCS pressure, to reach a safe shutdown state, cold shutdown (Mode 5)
  - Reactor Coolant Pressure Boundary Integrity
  - Containment Isolation
- **Non-Safety Functions**
  - None

Section 6.8 - Extra Borating System (EBS)



U.S. EPR FSAR
Air Conditioning, Heating, Cooling and Ventilation Systems (9.4)

Susan McConaty
Advisory Engineer
Mechanical Engineering

Topics

- 9.4.1 Main Control Room Air Conditioning System
- 9.4.2 Fuel Building Ventilation System
- 9.4.3 Nuclear Auxiliary Building Ventilation System
- 9.4.5 Safeguard Building Controlled Area Ventilation System
- 9.4.6 Electrical Division of Safeguard Building Ventilation System
- 9.4.7 Containment Building Ventilation System
- 9.4.9 Emergency Power Generating Building Ventilation System
- 9.4.11 Essential Service Water Pump Building Ventilation System

Section 9.4.1 - Control Room Air Conditioning System (CRACS)

- **Purpose**
  - **Maintains controlled environment in the Control Room Envelope (CRE) for personnel and equipment operation.**

- **Safety Functions (Accident Operation)**
  - **Maintains Control Room Habitability per guidelines of GDC 19 and RG 1.78, and demonstrates CRE integrity to provide radiation protection per guidelines of RG 1.197 and SRP Section 6.4.**
  - **Maintains positive pressure within the CRE ≥ + 0.125 in w.g., with respect to adjacent areas.**
  - **Provides HEPA & Iodine filtration of outside inlet air and re-circulated air from the CRE to remove potential airborne radioactive particulate and iodine during a DBA, for clean air ESF filtration per RG 1.52.**
  - **Isolates CRE from outside air upon detection of toxic gas (COL applicant is responsible for evaluating site-specific information).**

Section 9.4.1 - Control Room Air Conditioning System

Non-Safety Functions (Normal Operation)

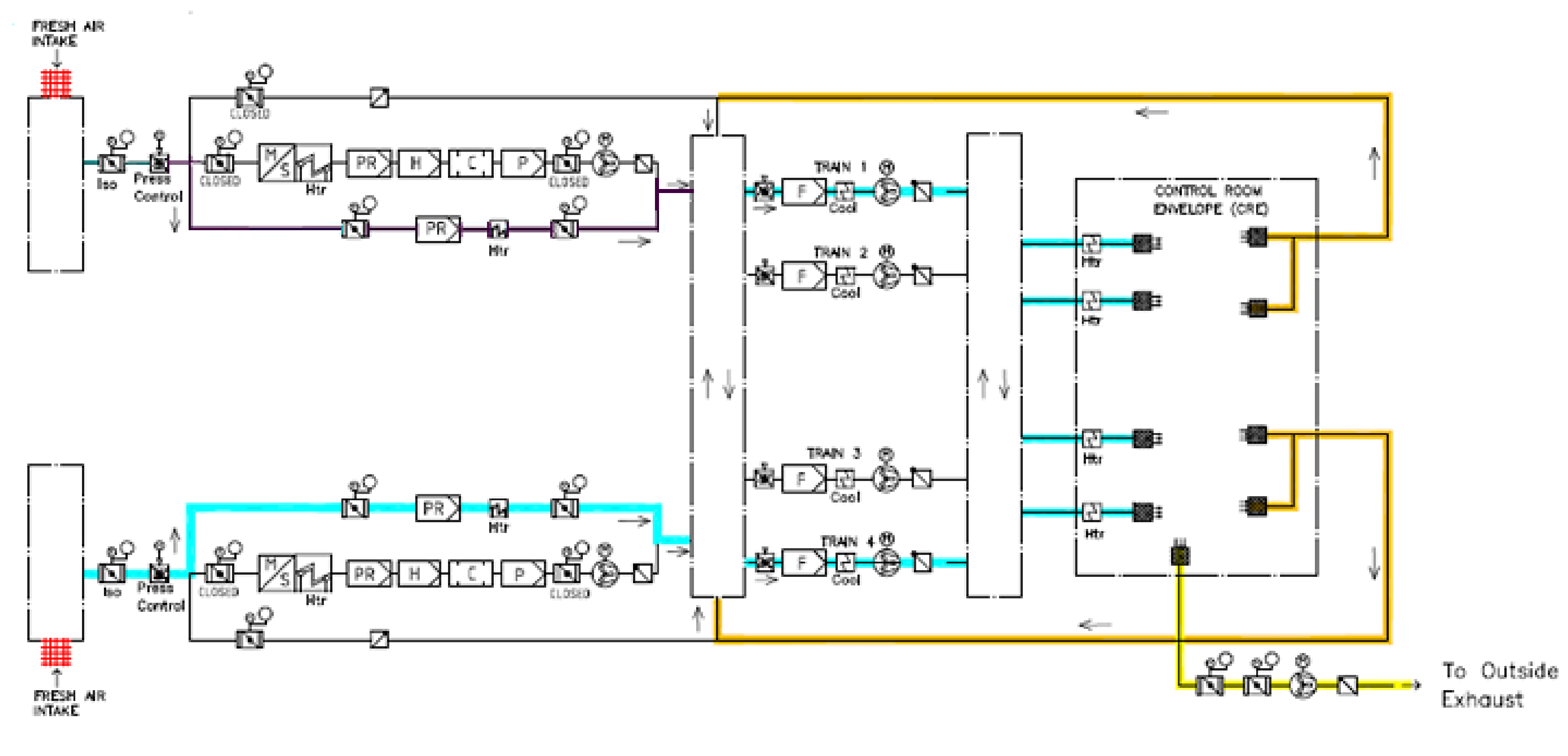
- Provides outside ventilation air for personnel within the CRE.
- Maintains ambient conditions for personnel and equipment within the CRE.
- Maintains pressure within the CRE slightly above that in adjacent areas.

Design Features

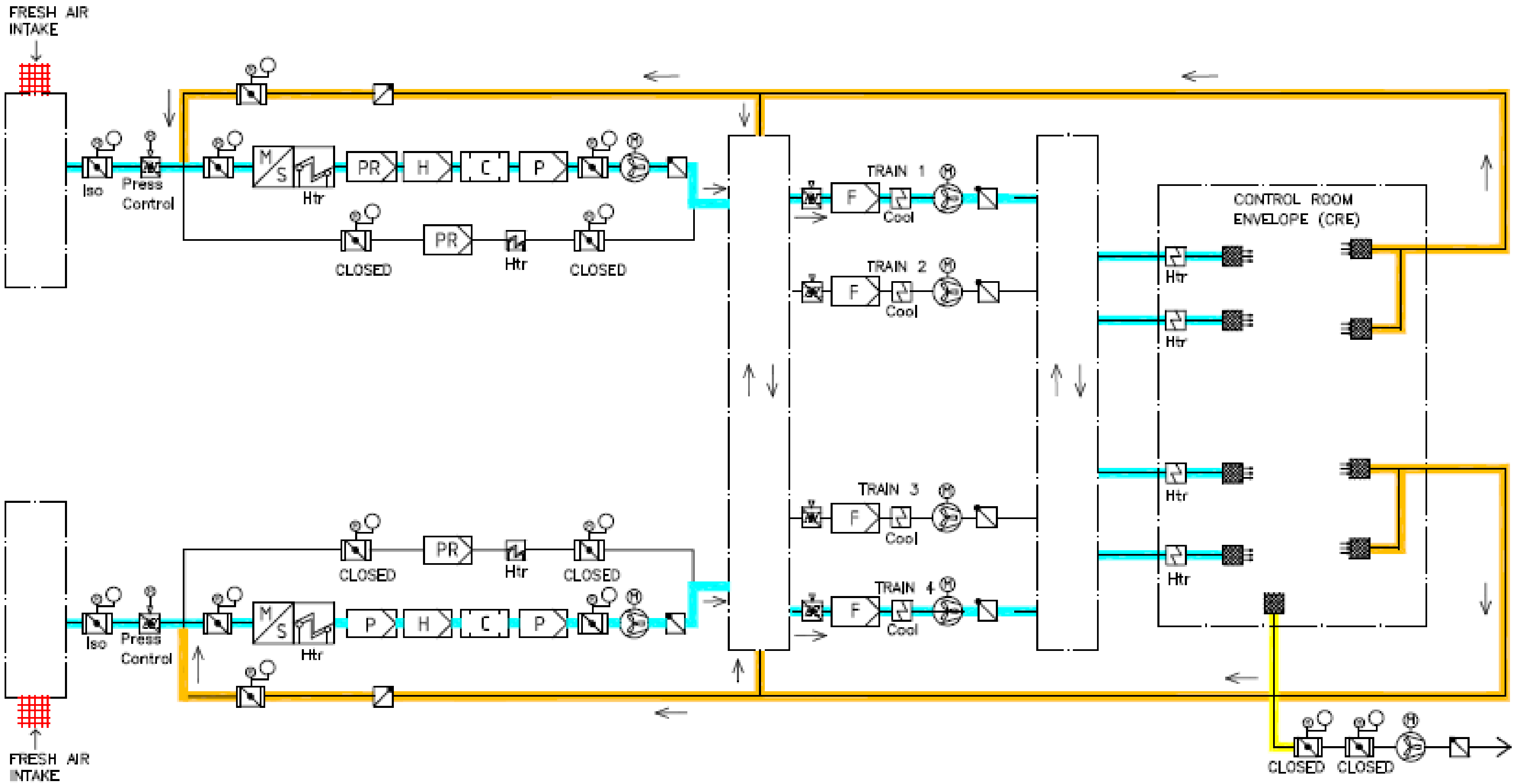
The Control Room Envelope consists of the following:

- Main Control Room
- Technical Support Center
- Restrooms and Kitchen
- Computer Rooms
- HVAC Equipment

CRACS (Normal Operation)



CRACS (Accident Operation)



Section 9.4.2 - Fuel Building Ventilation System

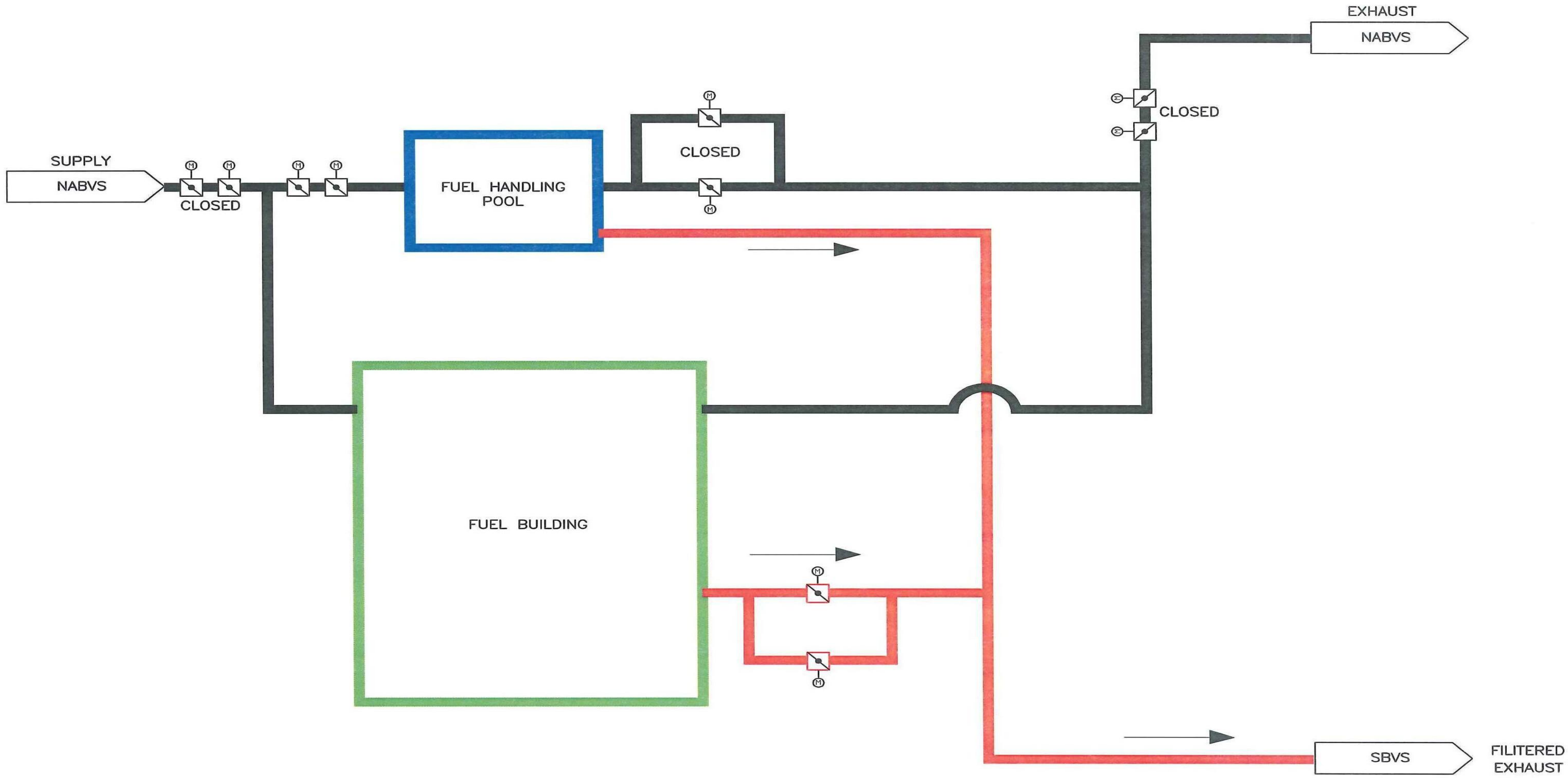
- **Safety Functions**
  - **Maintains FB at a pressure ≤ - 0.25 inch w.g., with respect to the outside environment.**
  - **Provides exhaust filtration for potentially contaminated airborne particulate, prior to discharge to the vent stack, per guidelines of GDC 60.**
  - **Maintains temperature in boron rooms using electric heaters, greater than minimum design temperature (68ºF), to prevent crystallization of boron solution.**
  - **Maintains temperature in fuel pool and extra borating pump rooms using recirculation coolers, less than maximum design temperature (113ºF), for acceptable operation of equipment.**

Section 9.4.2 - Fuel Building Ventilation System

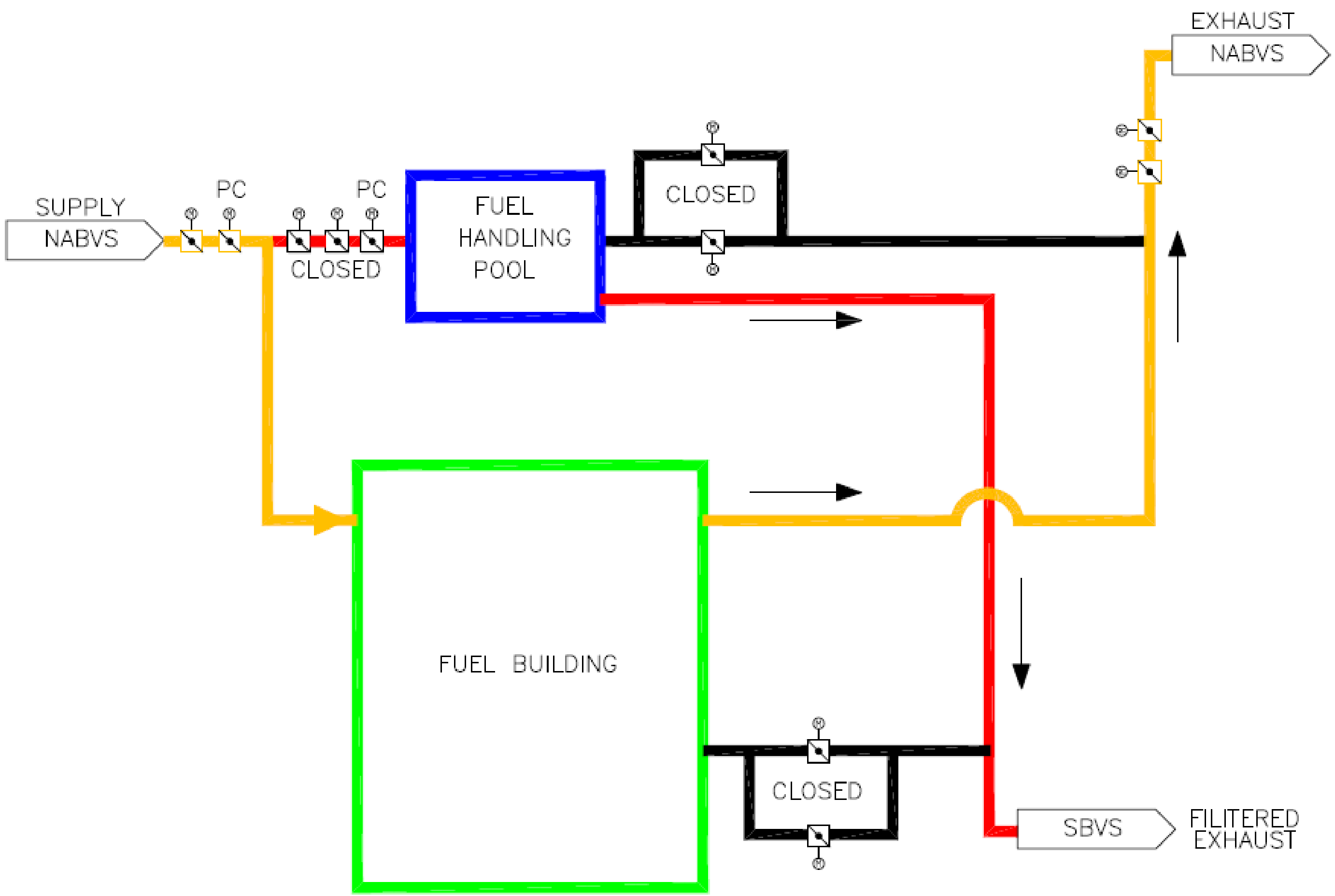
▶ Non-Safety Functions

- Maintains ambient conditions in FB, with air supplied and exhausted by the NABVS.
- Maintains FB at a pressure ≤ - 0.25 inch w.g., with respect to the outside environment, with air supplied and exhausted by the NABVS.
- Along with filtered exhaust from the NABVS, the FBVS provides HEPA & Carbon filtration of air exhausted from the FB during normal operation, per guidelines of GDC 60.
- In the event of a fuel handling accident, isolates the fuel pool hall and filters the exhaust air through the SBVS iodine filtration trains.

FBVS (LOCA Alignment)



FBVS (Fuel Handling Accident)

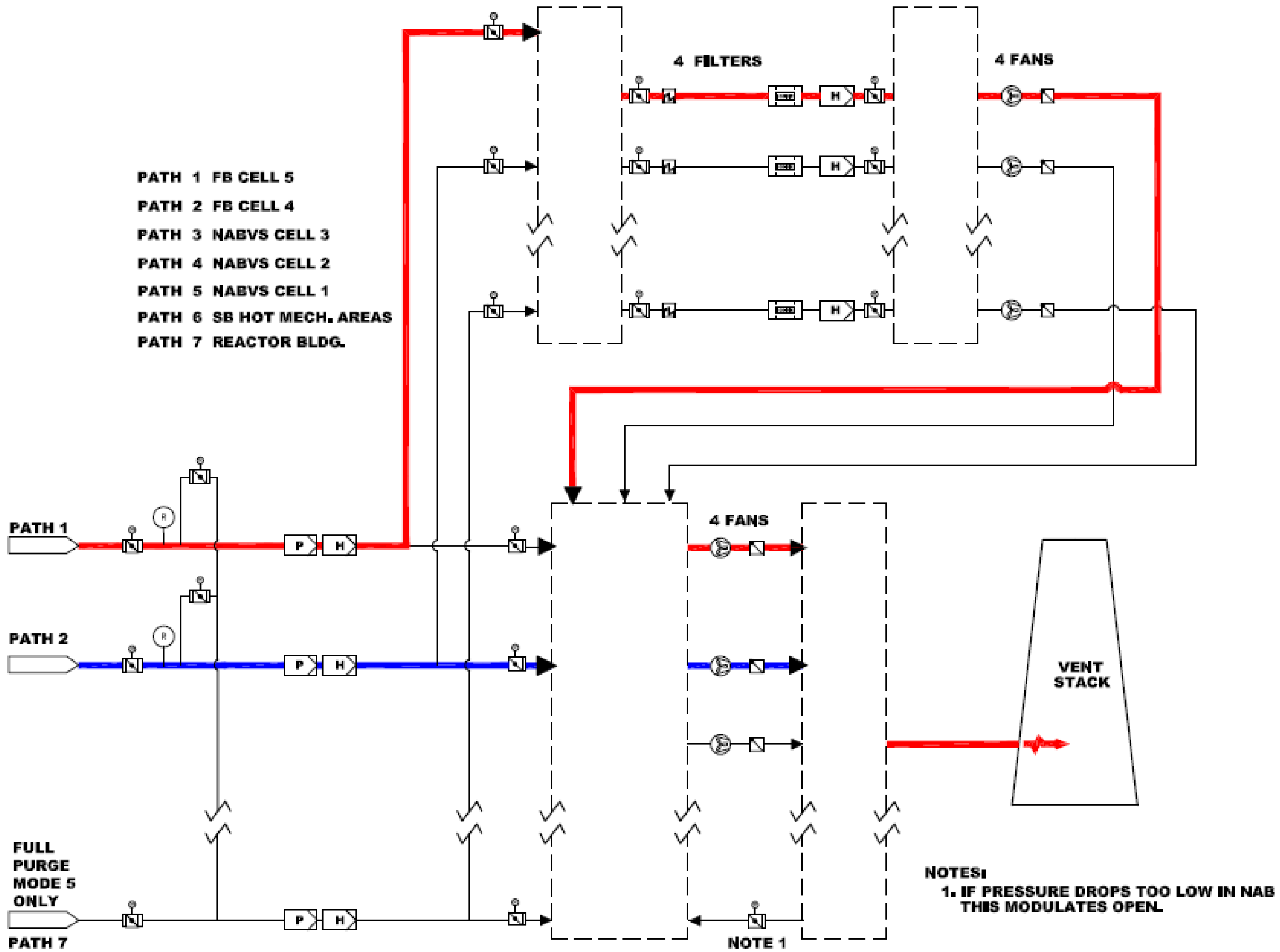


Section 9.4.3 - Nuclear Auxiliary Building Ventilation System (NABVS)

- **Safety Function**
  - None
- **Non-Safety Functions**
  - Provides conditioned supply and exhaust air to the Nuclear Auxiliary Building (NAB), FB and Annulus to maintain ambient conditions for personnel and equipment. Exhausts the SB Controlled Area during normal plant operation.
  - Maintains NAB, FB, SB Controlled Area and Annulus at a pressure ≤ - 0.25 inch w.g., and provides exhaust filtration during normal operation per guidelines of GDC 60 and clean air filtration guidelines of RG 1.140.
  - Provides conditioned supply and exhaust air to the containment ventilation full flow and low flow purge system during a plant outage.
  - Provides conditioned supply air to the containment ventilation low flow purge system during containment access.

Nuclear Building Exhaust Ventilation System

(3 of 7 paths shown)



Section 9.4.5 - Safeguard Building Controlled Area Ventilation (SBVS)

Safety Functions

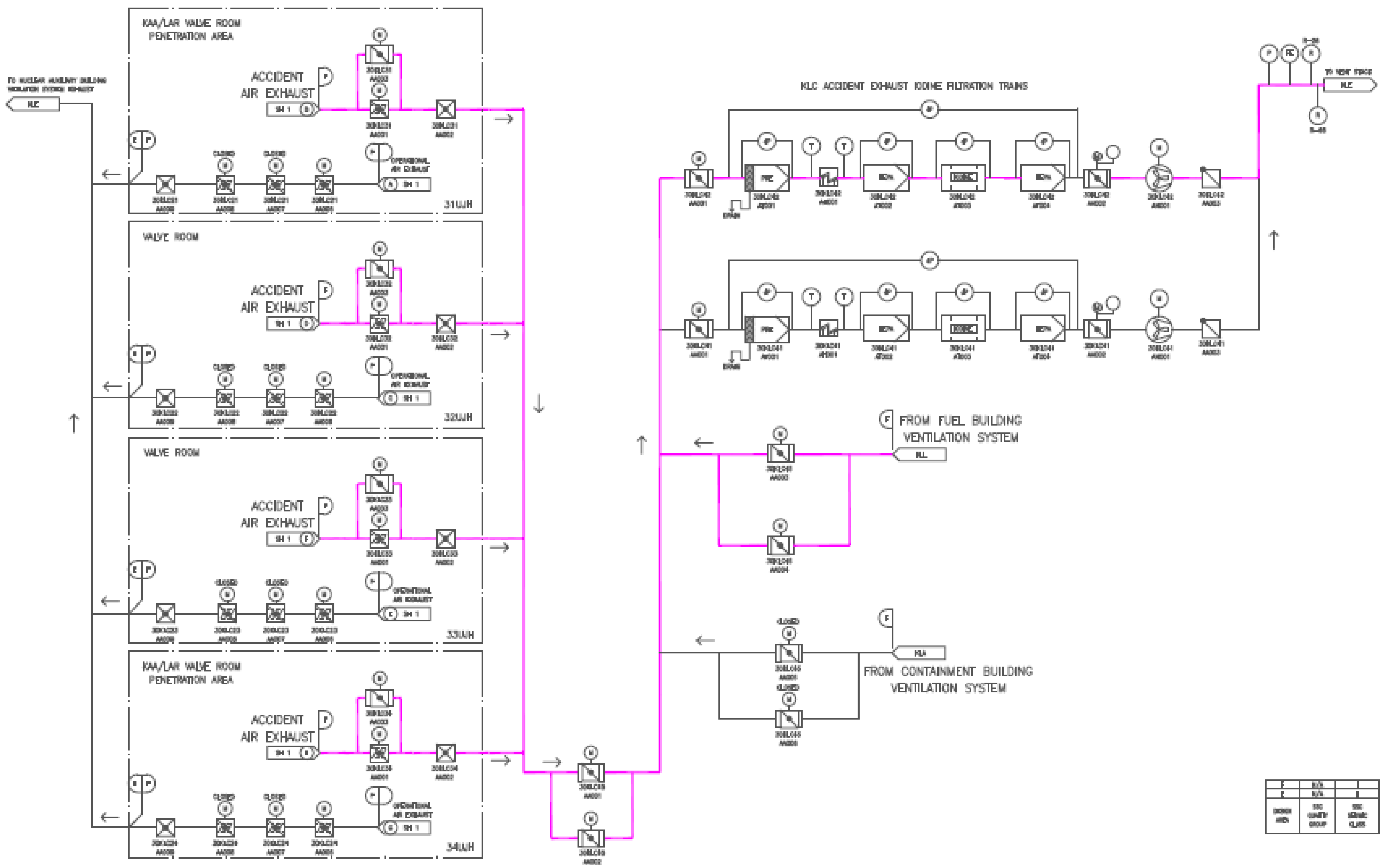
- **Maintains SB Controlled Area at a pressure $\leq$ - 0.25 inch w.g., with respect to adjacent areas, during accident operation.**
- **Provides HEPA & Iodine filtration for air exhausted from the SB Controlled Area and FB prior to being discharged from the vent stack, per guidelines of RG 1.52 for post accident ESF atmosphere cleanup, and per guidelines of GDC 60 for control of releases of radioactive material from containment following an accident.**
- **Maintains ambient conditions within the Controlled Areas of the SB for equipment operation (recirculation cooling units).**

Section 9.4.5 - Safeguard Building Controlled Area Ventilation

Non-Safety Functions

- **Maintains ambient conditions for personnel and equipment.**
- **During a fuel handling accident in the FB, maintains pressure in the fuel handling area ≤ - 0.25 inch w.g., with respect to the outside environment, provides exhaust HEPA & Iodine filtration, and meets guidelines of GDC 61, GDC 62 and RG 1.52 for post accident ESF atmosphere cleanup.**
- **During normal operation, maintains pressure in SB Controlled Area ≤ - 0.25 inch w.g., with respect to the outside environment, provides exhaust HEPA & Iodine filtration via the NABVS, and meets guidelines of GDC 60 for atmosphere cleanup.**

SBVS (Accident Operation)



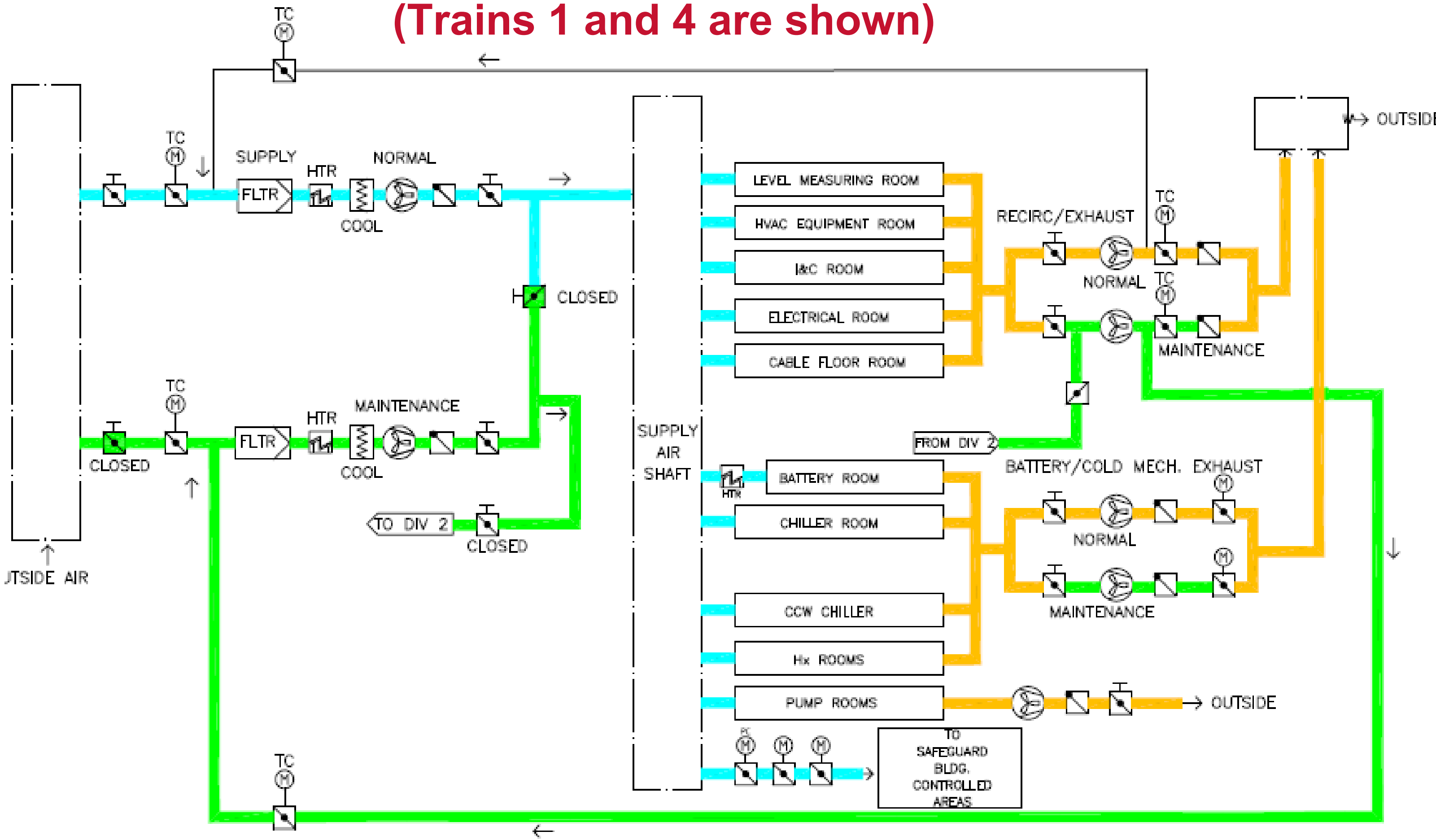
Section 9.4.6 - Electrical Division of the Safeguard Building Ventilation System (SBVSE)

- **Safety Functions**
  - **Maintains ambient conditions in SB electrical and non-contaminated mechanical rooms (component cooling water, emergency feedwater pumps, safety chilled water) for equipment operation.**
  - **Provides ventilation air for battery rooms to maintain hydrogen levels ≤ 1% by volume per guidelines of RG 1.128.**
  - **Provides cooling to maintain ambient conditions within battery rooms.**

- **Non-Safety Functions (Normal Operation)**
  - **Provides ventilation and maintains ambient conditions in SB electrical and non-contaminated mechanical rooms for personnel and equipment operation.**
  - **Provides ventilation and cooling within battery rooms.**
  - **Provides ventilation air for personnel in SB Controlled Areas.**

Section 9.4.6 - Electrical Division of the Safeguard Building Ventilation System

(Trains 1 and 4 are shown)



Note: Trains 2 and 3 are the same except for the maintenance train (Green).

Section 9.4.7- Containment Building Ventilation System (CBVS)

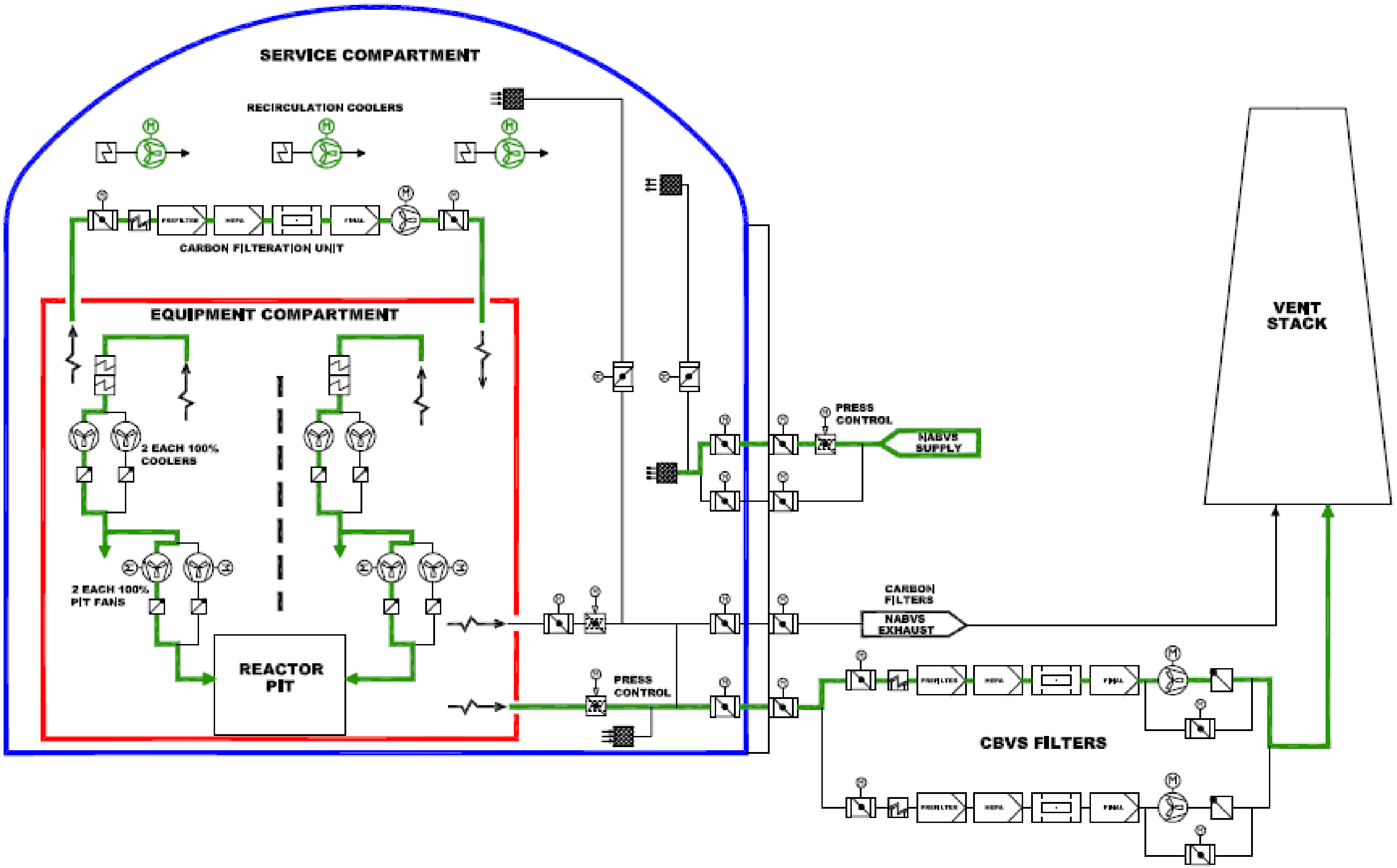
Safety Functions

- Provides containment isolation and meets guidelines of GDC 56 for primary containment isolation.
- Provides HEPA & Iodine filtration of air exhausted from containment, exhaust air filtration meets guidelines of RG 1.52, and guidelines of GDC 41, 42 and 43 to reduce the amount of radioactive material released to the environment.

Non-Safety Functions

- Provides a low flow purge of containment for access during normal plant operation.
- Provides HEPA & Iodine filtration of potentially contaminated airborne radioactive materials from containment equipment and service compartments during normal operation (internal filtration subsystem), and during a fuel handling accident in containment (low flow purge subsystem).
- Provides cooling for equipment and service areas within containment (containment cooling subsystem).
- Reactor pit fans supply cool air to reactor pit area to maintain temperature ≤ 150ºF to prevent degradation of the concrete.
- Maintains pressure in containment ≤ - 0.25 inch w.g. during fuel handling.
- Provides conditioned air to the containment during plant outages (full flow purge).

CBVS Normal (Low Flow Purge)

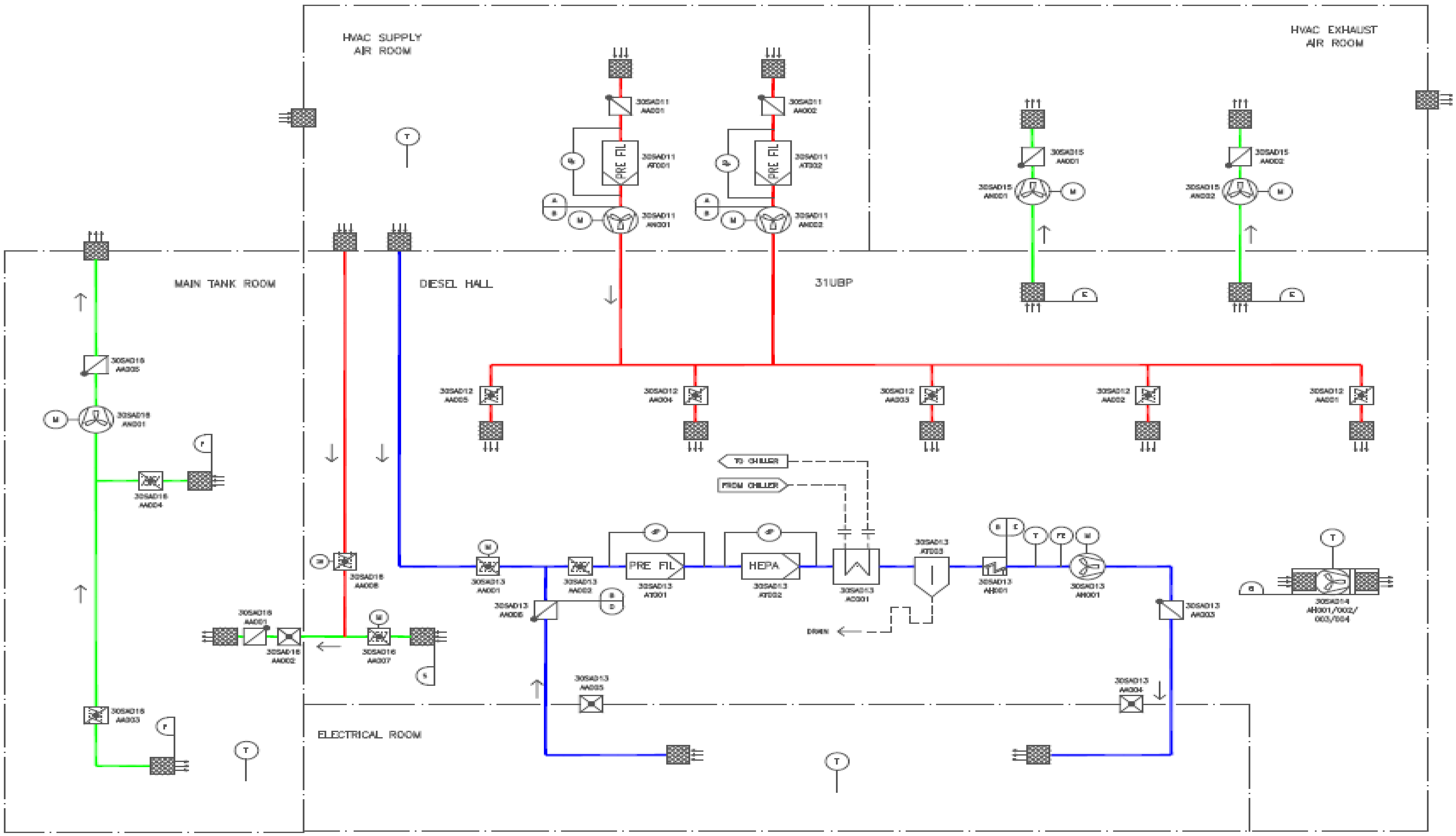


Section 9.4.9 - Emergency Power Generating Building Ventilation System (EPGBVS)

- **Safety Functions**
  - **Removes heat generated within the EDGB and maintains ambient conditions for operation of equipment within the EDGB during a design basis accident, including a loss of offsite power (LOOP).**
- **Non-Safety Functions**
  - **Maintains ambient conditions in the EPGB (diesel hall and electrical room) for personnel and equipment during normal operation.**

Section 9.4.9 - Emergency Power Generating Building Ventilation System

(Typical of all four trains)

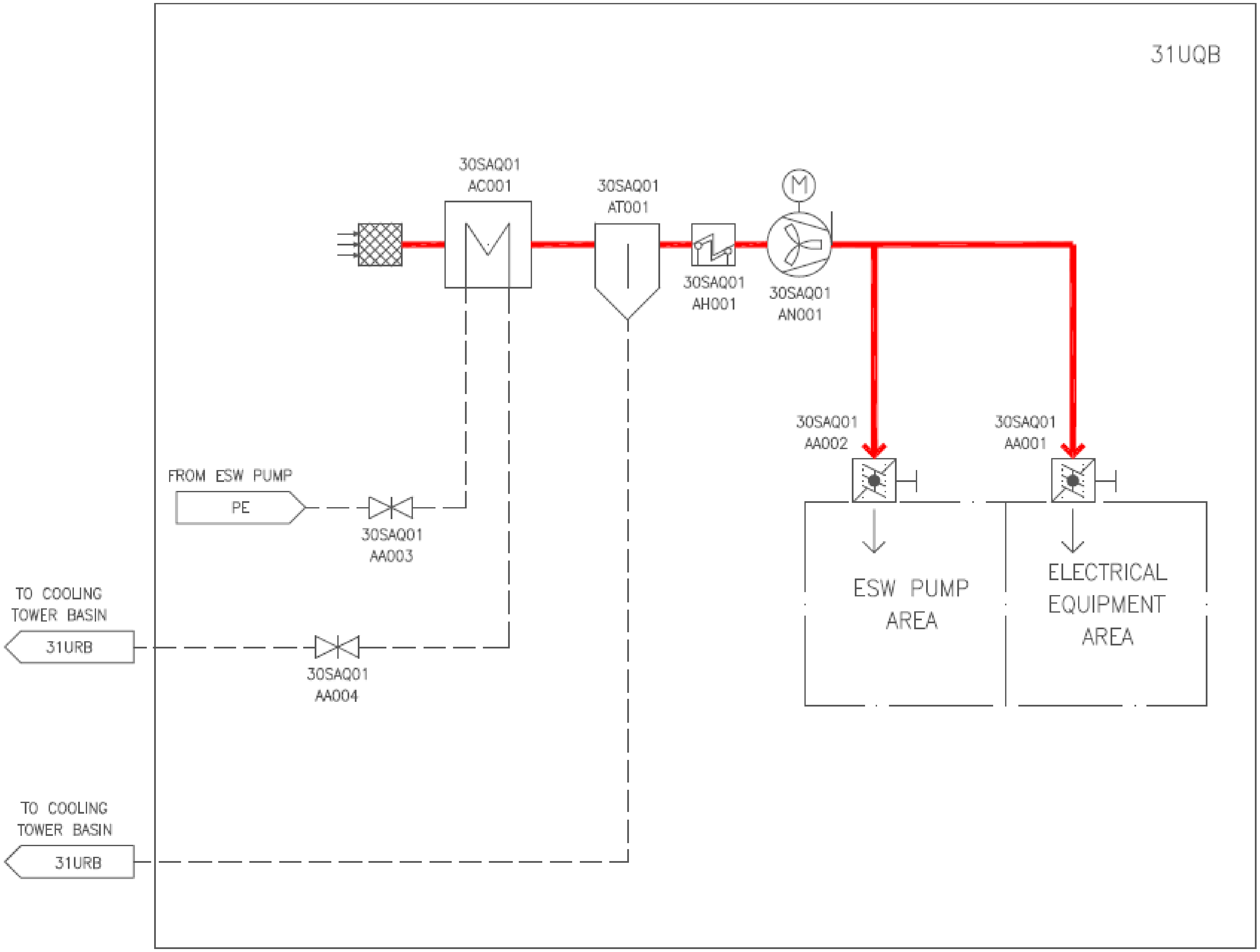


Section 9.4.11 - Essential Service Water Pump Building Ventilation System (ESWPBVS)

- **Safety Function**
  - **Maintains ambient conditions within the ESW pump room areas for the operation of equipment during a design basis accident.**
- **Non-Safety Function**
  - **Maintains ambient conditions for personnel and equipment within the ESW pump room area during normal operation.**

Section 9.4.11 - Essential Service Water Pump Building Ventilation System

(Typical of all four trains)



U.S. EPR FSAR Fire Protection (9.5.1 & Appendix 9A)

Overview of U.S. EPR Fire Protection Engineered Features

John Crowther
Project Engineer II
Fire Protection

Topics

- Fire Protection Defense-in-Depth
- Applicable Regulatory Requirements
- Elements of the Fire Protection Program
- Fire Hazards Analysis
- Fire Protection Systems and Design Features
- Post-Fire Safe Shutdown Capability

Fire Protection Defense-in-Depth

- The fire protection program minimizes the potential for fires and explosions through a combination of design and administrative controls
- Detection and suppression systems are provided that will rapidly detect, control, and extinguish fires
- The fire protection program provides administrative controls and design features such that a fire cannot prevent the performance of necessary safe shutdown functions or significantly increase the risk of radioactive releases to the environment
- Fire protection systems are designed so that failure or inadvertent operation will not adversely impact the ability of SSC to perform their safety functions

Applicable Regulatory Requirements

- **The fire protection program meets the requirements of NUREG-0800, Standard Review Plan 9.5.1 (including 10 CFR, Part 50, Appendix A GDC 3, GDC 5, GDC 19 and GDC 23)**
  - **The program meets (SRP) the supplementary review criteria for Advanced Reactors contained in Appendix A of SRP 9.5.1.**
  - **The program meets the requirements contained in NFPA 804 except where it conflicts with NRC regulatory guidance.**
  - **The fire PRA meets the review criteria contained in Appendix C of SRP 9.5.1.**
- **The fire protection program meets the criteria contained in SECY-90-016 and SECY-93-087:**
  - **No re-entry into the affected fire area is credited for actions or repairs.**
  - **At least one shutdown success path in containment is available.**
  - **Smoke, hot gas & fire suppressant cannot migrate to other fire areas to the extent that they could adversely affect safe shutdown capability including operator actions.**
- **Generally, the fire protection program meets the guidance in Regulatory Guide 1.189, Rev. 1. Justification is provided for alternate compliance.**

Elements of the Fire Protection Program (FPP)

- Comprehensive identification and analysis of fire and explosion hazards
- Organization and staff positions responsible for FPP management and implementation
- Fire prevention program
- Automatic detection and suppression systems
- Manual fire fighting capability
- Building design features minimize the threat of fires
- Safe shutdown analysis demonstrates that the plant can achieve and maintain safe shutdown in the event of a fire

Fire Hazards Analysis (FHA)

- **The U.S. EPR FHA document addresses the following:**
  - **Physical construction and layout of buildings and equipment, including ratings of fire area boundaries**
  - **Inventory of principal combustibles within each fire subdivision**
  - **Description of fire protection equipment, including alarm systems and manual and automatic extinguishing systems**
  - **Description and location of any equipment necessary to ensure a safe shutdown, including cabling between equipment**
  - **Analysis of a postulated fire in each fire area, including its effect on safe shutdown equipment, assuming automatic and manual fire protection equipment do not function**
  - **Analysis of the potential effects of a fire on life safety, release of contamination, impairment of operations, and property loss, assuming the operation of installed fire-extinguishing equipment**

Fire Hazards Analysis (FHA) (Continued)

- Analysis of potential effects of other hazards, such as earthquakes, storms, and floods, on fire protection systems and equipment
- Analysis of the post-fire recovery potential
- Analysis for the protection of nuclear safety–related systems and components from inadvertent actuation or breaks in a fire suppression system
- Analysis of the smoke control system and the impact smoke can have on nuclear safety and operation for each fire area
- Analysis of emergency planning and coordination requirements necessary for effective loss control, including any necessary measures to compensate for the failure or inoperability of any active or passive fire protection system or feature

Fire Protection Program Administration

- The U.S. EPR Fire Protection Program Administration addresses the following:
  - Fire Protection Organization
  - Administrative Policies
  - Fire Prevention Controls
  - Applicable Administrative, Operations, Maintenance and Emergency Procedures
  - Quality Assurance
  - Access to and Egress From Fire Areas
  - Fire Brigade Capability
  - Emergency Response Capability
- The COL applicant is responsible for providing site-specific information for the fire protection program and a schedule for implementation.

Fire Protection Systems and Design Features: Fire Detection and Alarm

- Fire detection systems are installed in all areas of the plant that contain or present an exposure fire hazard to safety-related SSCs.
- The fire alarm system provides notification to the Control Room and building occupants of fire conditions.
- Fire detection and alarm systems comply with applicable requirements established by NFPA 72 (National Fire Alarm Code).

Fire Protection Systems and Design Features: Water Supply Systems

- **Fire pumps, water supply and fire mains are sized and arranged to ensure that:**
  - **100% capacity is available assuming a single active failure of a fire pump, water supply or fire main line (design includes one electric and two diesel driven fire pumps)**
  - **Water supply systems comply with applicable NFPA codes of record:**
    - NFPA 20 (fire pumps)
    - NFPA 22 (water tanks)
    - NFPA 24 (fire mains)

Fire Protection Systems and Design Features: Fire Suppression Systems

- **Automatic and manual fire suppression systems are installed based on the results of the FHA in the following areas:**
  - **Automatic actuated water based suppression in the Emergency Diesel Generator Diesel Engine Halls and Emergency Diesel Generator Fuel Oil Storage Tank Rooms**
  - **Manual actuated water based suppression systems for the RCPs**
  - **Manual actuated gaseous suppression system for the MCR under floor area**
- **Fire suppression systems comply with applicable NFPA codes of record:**
  - **NFPA 13 (sprinkler systems)**
  - **NFPA 15 (water spray systems)**
  - **NFPA 2001 (clean agent systems)**
- **Enhanced train separation and redundancy reduce the need for fire suppression systems to meet overall fire protection program objectives.**

Fire Protection Systems and Design Features: Manual Fire Fighting Capability

- **Manual fire fighting capability is provided throughout the plant to limit the extent of fire damage**
  - **Standpipes and hose stations are able to reach any location that contains, or could present, a fire exposure hazard.**
  - **Outside hydrants provide effective hose stream protection for onsite locations, where fixed or transient combustibles could jeopardize equipment.**
  - **Portable extinguishers are located throughout the facility and are the type needed based on the hazards in the area.**
- **Manual fire fighting capability complies with applicable codes of record:**
  - **NFPA 10 (fire extinguishers)**
  - **NFPA 14 (Standpipes and hose systems)**
  - **NFPA 24 (fire hydrants)**

Fire Protection Systems and Design Features: Building Design

- **Building layout**
  - **Fire areas are established to minimize the probability and effect of fires and explosions by utilizing passive fire barriers to subdivide the plant into separate fire areas and zones (fire zones are located inside containment and the annulus).**
  - **Structural fire barrier designs are based on:**

    NFPA 251/ASTM E 119 fire endurance test protocol.
  - **Fire door designs are in accordance with NFPA 80.**
- **Materials of construction**
  - **Noncombustible and heat resistant materials are used wherever practical throughout the plant.**
  - **NFPA 221 is used as guidance for specifying requirements for the design and construction of fire barriers.**

Fire Protection Systems and Design Features: Other Building Systems

- Electrical cable and raceway construction
  - Cables meet the flame test criteria of IEEE 1202
  - Cables are routed in metal raceways and are separated so that a fire cannot damage redundant shutdown systems
- HVAC systems are designed to:
  - Limit the consequences of a fire by preventing the spread of the products of combustion to opposite/adjacent division areas
  - Provide a means to ventilate, exhaust, or isolate fire areas as required
  - Consideration is given to the consequences of fire induced failure of ventilation systems causing loss of control for ventilating, exhausting, or isolating a given fire area
- The reactor coolant pump lube oil collection system is designed to:
  - Cover all potential leak points
  - Remain functional after an SSE
  - Hold total capacity of any lube oil leaks

Fire Protection Systems and Design Features: Other Building Systems

- **Emergency lighting is provided as necessary to support:**
  - manual fire-fighting
  - safe shutdown operations
  - emergency egress during a fire event
- **The communication system design provides effective communication capability between plant personnel to support fire-fighting efforts and safe shutdown of the plant.**
- **Communication is addressed in FSAR Section 9.5.2 and emergency lighting is addressed in FSAR Section 9.5.3.**

Post-Fire Safe Shutdown Capability

- **Analysis demonstrates at least one success path of systems is available to achieve and maintain safe plant shutdown**
- **Design Meets Reg. Guide 1.189, Section 5 Performance Goals**
  - **Reactivity Control – Achieve and Maintain CSD Reactivity Conditions**
    - Rx Trip, EBS, IRWST
  - **Reactor Coolant Makeup Function – Maintain Primary System Inventory**
    - EBS, IRWST
  - **Decay Heat Removal**
    - Emergency Feedwater, RHR, Fuel Pool Cooling (Non-Power)
  - **Process Monitoring – Necessary Process Variables**
    - RCS Temp. & Press, Pzr Level, SG Level & Press, Source Range, System Status
  - **Support Functions – Cooling, Power, etc.**
    - EDGs, CCWS, SCWS, ESWS, Ventilation Systems, etc

Post-Fire Safe Shutdown Capability

- **U.S. EPR Design Follows NEI 00-01 Safe Shutdown Analysis Guidance**
- **U.S. EPR Design Advantages**
  - **4 Safeguards Buildings – 1 Per Safety Division**
  - **No 125 VDC Air Operated Valves – Eliminates concerns associated with shorts through ground**
  - **Remote Shutdown Station – Central location to control SSD equipment**

Post-Fire Safe Shutdown Capability

- Separation of redundant trains in the control room is not practical
  - An alternative safe shutdown capability is provided that is physically and electrically independent of the control room
  - Remote shutdown station meets guidance in RG 1.189 for alternate shutdown
- Containment fire area contains redundant function cables
  - Design meets the guidance in RG 1.189
  - Shutdown capability is demonstrated by a combination of spatial separation and physical barriers
  - Fire protection is provided to ensure that at least one shutdown success path is available.
  - Fire protection design features are provided for fire hazards in containment
  - Automatic fire detection as needed in containment and suppression for the reactor coolant pumps is provided

U.S. EPR FSAR Diesel Generator Subsystems

9.5.4 – Diesel Generator Fuel Oil Storage & Transfer System
9.5.5 – Diesel Generator Cooling Water System
9.5.6 – Diesel Generator Starting Air System
9.5.7 – Diesel Generator Lubricating Oil System
9.5.8 – Diesel Generator Air Intake and Exhaust System

Bob Day
Advisory Engineer
Component Engineering

Section 9.5.4 - Fuel Oil Storage and Transfer System

- **Purpose**
  - **Provide the storage capacity and transfer of fuel oil to each EDG.**
- **Safety-Related Function**
  - **Provides storage and transfers a quality fuel supply to the diesel engine following an emergency engine start signal.**
- **Non-Safety-Related Function**
  - **Transfers fuel oil from a bulk fuel oil carrier to the storage tank.**
- **Each EDG has a separate, independent fuel oil system, which is located inside the Class 1 emergency power generating building (EPGB), with the exception of the outside fill and vent locations.**
  - **The two fill connections on the building exterior are separated by distance and out of line of sight.**
  - **The two vent paths from each tank are located on the upper level of the EPGB and separated by distance and out of line of sight.**

Section 9.5.4 - Fuel Oil Storage and Transfer System

- **Layout allows accessibility for inspections, cleaning and maintenance. All piping and components are located above ground.**
- **Storage Tank and Day Tank both located adjacent to the respective division EDG, above grade, in a separate room located at each end of the EPGB. This separation:**
  - **Provides a missile barrier.**
  - **Serves as a spill reservoir.**
  - **Provides 3 hour firewall between fuel oil tanks and engine room.**

Section 9.5.4 - Fuel Oil Storage and Transfer System

Fuel Oil Storage Tank

- Inventory requirements determined in accordance with ANSI/ANS 59.51.
- Useable volume to ensure uninterrupted engine operation for 7 days of operation at rated power including allowance for periodic testing.
- Storage tank can be filled during engine operation.

Fuel Oil Day Tank

- Inventory requirements determined in accordance with ANSI/ANS 59.51.
- Useable volume to ensure uninterrupted engine operation for 2 hours of operation at rated power.
- Day tank can be filled during engine operation. Tank is automatically refilled from storage tank on low day tank level indication.

Section 9.5.5 - Diesel Generator Cooling Water System

- **Purpose**
  - **Provide the necessary cooling for the engine and turbocharger, dissipating the heat to the Essential Service Water System.**
- **Safety-Related Function**
  - **Provides cooling to dissipate heat from the diesel engine and lubricating oil to maintain temperatures within operating limits during engine operation.**
- **Non-Safety-Related Function**
  - **Maintains engine at a set temperature during standby to reduce stress on the mechanical portions of the engine during emergency starts.**
- **Each EDG has a separate, independent cooling water system, which is located inside the Class 1 EPGB.**
- **Two subsystems, jacket water cooling and intercooler cooling, which are connected to a common expansion tank.**

Section 9.5.5 - Diesel Generator Cooling Water System

- **Cooling Water Expansion Tank**
  - Expansion tank provides sufficient reserve capacity for operation of EDG for at least 7 days at rated power with normal anticipated minor water loss.
  - Expansion tank located at a higher elevation than the rest of the system to facilitate air removal from the system. Tank allows for expansion of the cooling water due to temperature variations.
  - Expansion tank has an auto fill connection from the demineralized water system for non-emergency operation and a manual fill port for emergency operation.
- **During engine operation, the cooling water preheater and preheat circulation pump are off. Cooling water is circulated by the engine-driven jacket water pump and engine-driven intercooler water pump.**
- **When the engine is in standby mode, the preheater and preheat circulation pump circulate cooling water to establish quick starting times and short load acceptance times to minimize cold start wear.**

Section 9.5.6 – Diesel Generator Starting Air System

- **Purpose**
  - **Start the EDG by using compressed air to rotate the engine until combustion begins and it accelerates under its own power. Starting air is not required for continued EDG operation once the engine is running.**
- **Safety-Related Function**
  - **Provides stored capacity of compressed air to start the EDG. System downstream of, and including the air receiver inlet check valves, is safety-related.**
- **Non-Safety-Related Function**
  - **Provides dry compressed air to the starting air receivers. System upstream of air receiver inlet check valves, including air compressors, filters and air dryers, is non-safety-related.**
- **Each EDG has a separate, independent starting air system, which is located inside the Class 1 EPGB.**

Section 9.5.6 - Diesel Generator Starting Air System

- **System consists of:**
  - **Two electric motor driven compressors.**
  - **Two sets of filters and air dryers.**
  - **Two starting air receivers.**
- **Ambient air from the engine room is compressed, filtered, dried and stored in the starting air receivers.**
- **The starting air capacity for each EDG is sufficient for a minimum of five engine starts, from the low pressure alarm setpoint, without recharging the receiver tanks.**
- **Compressors capable of recharging the air receiver within 30 minutes following five start attempts.**

Section 9.5.7 - Diesel Generator Lubricating Oil System

- **Purpose**
  - **Store and supply clean lubricating oil to moving parts of the engine, provide pre-lubrication to the engine, and regulate the lube oil temperature.**
- **Safety-Related Function**
  - **Provides essential lubrication to engine wearing parts during emergency operation and maintains lube oil temperature within operating limits.**
- **Non-Safety-Related Function**
  - **Provides pre-lubrication to the engine and maintains oil in a warm condition when the engine is on standby to facilitate quick starting.**
- **Each EDG has a separate, independent lubricating oil system, which is located inside the Class 1 EPGB.**
- **The lube oil system relies on the Essential Service Water System to reject heat.**

Section 9.5.7 - Diesel Generator Lubricating Oil System

- **When the engine is in standby mode, keep warm pump and heater circulate the lube oil and maintain a minimum oil temperature.**
- **During engine operation, the keep warm pump and heater are off and lube oil is circulated by the engine driven lube oil pumps.**
- **Lube Oil Makeup Tank**
  - **Inventory requirements determined in accordance with ANSI/ANS 59.52.**
  - **Useable volume of the tank provides uninterrupted engine operation for 7 days at rated power including allowance for periodic testing.**
  - **Oil is transferred from the tank to the engine sump by gravity through a solenoid valve actuated by a level control switch in the engine sump.**
  - **Makeup tank can be filled during engine operation.**

Section 9.5.8 - Diesel Generator Air Intake and Exhaust System

- **Purpose**
  - Provide the EDG with combustion air from the outside and discharge the exhaust gas through the emission equipment and silencer to the outside.
- **Safety-Related Function**
  - Provides filtered combustion air to the EDG and provides a path for exhaust products to the environment under emergency operating conditions.
- **Non-Safety-Related Function**
  - Provides emission and noise control of the engine exhaust.
- **Each EDG has a separate, independent combustion air and exhaust system. Safety-related components and piping are located inside the Class 1 EPGB.**
- **Combustion air is taken from outside the EPGB near the top of the building through a louver in the building wall. Combustion air travels through a filter, silencer and heater before entering the turbocharger.**

Section 9.5.8 - Diesel Generator Air Intake and Exhaust System

- **Air intake louver located on the opposite side of the building from the exhaust discharge point to preclude mixing exhaust gas with the combustion air.**
- **Exhaust gas is directed through non-safety-related gas emission equipment and silencer before being discharged.**
- **Exhaust bypass rupture disc and bypass exhaust stack provide a safety-related exhaust path in the event a system failure downstream restricts exhaust flow.**

Acronyms

ANS	American Nuclear Society
ANSI	American National Standards Institute
CBVS	Containment Building Ventilation System
CCW	Component Cooling Water
CDS	Coolant Degasification System
COL	Combined License
CPS	Coolant Purification System
CRACS	Main Control Room Air Conditioning System
CRE	Control Room Envelope
CSSS	Coolant Supply and Storage System
CTS	Coolant Treatment System
CVCS	Chemical and Volume Control System
DBA	Design Basis Accident
EBS	Extra Borating System
EDG	Emergency Diesel Generator
EPGB	Emergency Power Generating Building
EPGBVS	Emergency Power Generating Building Ventilation System
ESF	Engineered Safety Feature
ESW	Essential Service Water
ESWPBVS	Essential Service Water Pump Building Ventilation System
FB	Fuel Building

Acronyms

FBVS	Fuel Building Ventilation System
FHA	Fire Hazards Analysis
FPC	Fuel Pool Cooling
FPP	Fire Protection Program
FPPS	Fuel Pool Purification System
GWPS	Gaseous Waste Processing System
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation and Air Conditioning
HX	Heat Exchanger
IRWST	In-Containment Refueling Water Storage Tank
LHSI	Low Head Safety Injection
LOOP	Loss of Offsite Power
MCR	Main Control Room
NAB	Nuclear Auxiliary Building
NABVS	Nuclear Auxiliary Building Ventilation System
NFPA	National Fire Protection Association
NI	Nuclear Island
NIDVS	Nuclear Island Drain and Vent System
NSS	Nuclear Sampling System
ORP	Oxidation-Reduction Potential
PASS	Post Accident Sampling System

Acronyms

PERMSS	Process & Effluent Radiological Monitoring and Sampling Systems
RB	Reactor Building
RBWMS	Reactor Boron and Water Makeup System
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
SAHRS	Severe Accident Heat Removal System
SASS	Severe Accident Sampling System
SB	Safeguard Building
SBO	Station Blackout
SBODG	Station Blackout Diesel Generator
SBVS	Safeguard Building (Controlled Area) Ventilation System
SBVSE	Safeguard Building Ventilation System (Electrical)
SCW	Safety Chilled Water
SECSS	Secondary Sampling System
SIS	Safety Injection System
SSC	Structures, Systems and Components
SSE	Safe Shutdown Earthquake
UHS	Ultimate Heat Sink

AREVA

Presentation to the ACRS Subcommittee

AREVA U.S. EPR Design Certification Application Review

Safety Evaluation Report with Open Items

Chapter 9: Auxiliary Systems
Group I – Sections 9-2 to 9-5

November 14-15, 2011

Technical Staff Review Team

Balance of Plant Branch

- **Larry Wheeler**
- **Ryan Eul**
- **Raul Hernandez**
- **Robert Radlinski**
- **Edward McCann**

Containment and Ventilation Branch

- **James O'Driscoll**

Component Integrity Branch

- **Eduardo Sastre**

Electrical Engineering Branch

- **Amar Pal**

Reactor Systems, Nuclear Performance, and Code Review Branch

- **John Budzynski**
- **Shanlai Lu**

Instrumentation and Control Branch

- **Deanna Zhang**

Health Physics Branch

- **Jean-Claude Dehmel**

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Project Managers:

- **Getachew Tesfaye**
- **Phyllis Clark**
- **Peter Hearn**

Overview of DCA

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SRP Section/Application Section		**No. of Questions**	**Number of OI**
9.2.1	Station Service Water System	51	0
9.2.2	Reactor Auxiliary Cooling Water Systems	122	0
9.2.4	Potable and Sanitary Water Systems	1	0
9.2.5	Ultimate Heat Sink	38	1
9.3.1	Compressed Air System	7	0

Overview of DCA

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SRP Section/Application Section		No. of Questions	Number of OI
9.3.2	Process and Post-accident Sampling Systems	17	2
9.3.3	Equipment and Floor Drainage System	10	4
9.3.4	Chemical and Volume Control System (PWR) (Including Boron Recovery System)	26	6
9.4.1	Control Room Area Ventilation System	7	6
9.4.2	Spent Fuel Pool Area Ventilation System	3	1
9.4.3	Auxiliary and Radwaste Area Ventilation System	6	4

*The safety evaluation for these Sections was not delivered in the Phase 2 SE for Chapter 6.

Overview of DCA

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SRP Section/Application Section		No. of Questions	Number of OI
9.4.4	Turbine Area Ventilation System	2	0
9.4.5	Engineered Safety Feature Ventilation System	4	2
9.5.1	Fire Protection Program	88	3
9.5.2	Communications Systems	12	0
9.5.3	Lighting Systems	20	0
9.5.4	Emergency Diesel Engine Fuel Oil Storage and Transfer System	25	0

Overview of DCA (continued)

SRP Section/Application Section		No. of Questions	Number of OI
9.5.5	Emergency Diesel Engine Cooling Water System	7	0
9.5.6	Emergency Diesel Engine Starting System	12	0
9.5.7	Emergency Diesel Engine Lubrication System	11	0
9.5.8	Emergency Diesel Engine Combustion Air Intake and Exhaust System	11	0
Totals		**480**	**29**

Description of Open Items

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **RAI 518, Question 09.02.05-38**: Address possible technical specification surveillance for wet bulb temperature in Technical Specification 3.7.9.
- **RAI 223, Question 09.03.02-14**: Provide clarification of how tanks that were not part of the PSS would be sampled to comply with SRP Section 9.3.2 and provide specific information on the nature of decontaminating fluids used in the NSS.
- **RAI 185, Question 09.03.02-11**: Identify the system used to obtain containment gas samples in the event that the containment radiation monitor is out of service.
- **RAI 476, Question 09.03.03-7**: clarify the differences between non-safety-related and safety-related portions of the system.
- **RAI 476, Question 09.03.03-8:** Modify the FSAR to provide limit on ferrite in Mo bearing cast austenitic stainless steels to address thermal aging embrittlement.
- **RAI 476, Question 09.03.03-9**: Specify the "redundancy, location, and physical separation" being credited in the FSAR in order to comply with GDC 2.

Description of Open Items

United States Nuclear Regulatory Commission
Protecting People and the Environment

- **RAI 520, Questions 09.03.03-10**: Update this SE with respect to compliance with Part 20.1406 during Phase 4 review.
- **RAI 492, Question 09.03.04-21**: Provide a more rigorous technical evaluation of this hydrogen control range that demonstrates why it is acceptable to maintain RCS hydrogen below the EPRI Guidelines Action Level 1 limit.
- **RAI 492, Question 09.03.04-22**: Describe the exact mechanism of how nitrogen purging of the VCT maintains hydrogen concentration in the RCS and what equations would be used to determine the theoretical hydrogen concentration in the RCS.
- **RAI 492, Question 09.03.04-23**: Describe how ammonia build up in the RCS will affect demineralizer performance.
- **RAI 492, Question 09.03.04-24**: Change the FSAR Tier 2, Section 9.3.4.2.1 to match the December 5, 2008, response to RAI 125, Question 09.03.04-15, Parts 1 and 2.
- **RAI 492, Question 09.03.04-25:** Describe the pre-operation functional test of the evaporator system in the FSAR.

Description of Open Items

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **RAI 492, Question 09.03.04-26**: Describe the method for determining the B-10 assay frequency in the FSAR.
- **RAI 277, Question 09.04.01-1**: Provide more detailed information for each safety-related ventilation system.
- **RAI 461, Question 09.04.01-3**: Revise FSAR Tiers 1 and 2 to satisfy the Tier 1 design commitment to maintain hydrogen control below a numerical criteria.
- **RAI 461, Question 09.04.01-4:** Clarify the description of the Smoke Confinement System (SCS).
- **RAI 461, Question 09.04.01-5**: Clarify what toxic gas sensor design functions and design features are to be reviewed by the staff in the design certification, considering COL Information Items 6.4-1, 6.4-2, and 6.4-3, where a COL applicant is to provide this information.
- **RAI 509, Question 09.04.01-6**: Clarify the FSAR Tier 1 mark up provided with the response to RAI 277 Question 09.04.01-1.

Description of Open Items

- **RAI 509, Question 09.04.01-7**: Clarify the role of the CBVS in a design-basis accident and justify why the physical arrangement of the CBVS low volume purge system satisfies single failure criteria if the CBVS low volume purge system is required to function to clean up the post accident containment atmosphere.
- **RAI 277, Question 09.04.02-1:** Clarify the safety classification of the FBVS heaters.
- **RAI 277, Question 09.04.03-2:** Clarify the inconsistency between the piping and instrument diagram and the FSAR design basis description for the main steam and feed water valve room ventilation system.
- **RAI 461, Question 09.04.03-4:** Clarify FSAR Tier 2, Figure 9.4.3-3 to indicate that the plant stack is SSC Seismic Category 1 and SSC Quality Group B. Also Clarify the Seismic and Quality Classification breaks for the vent stack as they are shown in the FSAR in the same manner for several Systems/ P&IDs.
- **RAI 461, Question 09.04.03-5**: Clarify how and when duct and housing leak tests will be performed on the NABVS and RWBVS.

Description of Open Items

- **RAI 461, Question 09.04.03-6**: Provide details of the access building and the ABVS to justify why the Supervised area of the Access Building is not subject to GDC 60.
- **RAI 461, Question 09.04.05-3**: Justify why the SBVSE is not subject to GDC 60 and Revise Figure 9.4.6.1 to include the missing air intake supply air fan.
- **RAI 461, Question 09.04.05-4**: State in FSAR Tier 2, Section 9.4.9.1 that the design is subject to GDC 17, and summarize how the requirements of GDC 17 have been met.
- **RAI 517, Question 09.05.01-86:** Document the use of RG 1.189 Revision 2 and the endorsed sections of NEI 00-01 Revision 2 in the FSAR for Post-Fire Safe Shutdown Circuit Analysis Methodology.
- **RAI 518, Question 09.05.01-87:** Revise FSAR Section 9.5.1 to be consistent with CCNPP3.

Description of Open Items

- **RAI 519, Question 09.05.01-88**: Revise FSAR Tier 1 Section 2.1.1.1 and Table 2.1.1-8 to provide the fire barrier ratings for the above structures or reference a figure that has the ratings and to ensure RG 1.189 Containment separation guidance is used properly.

Presentation to the ACRS Subcommittee

SER/OI Chapter 9 Section 9.2

Water Systems

Larry Wheeler

November 14-15, 2011

9.2.1 Essential Service Water System (ESWS)
9.2.2 Component Cooling Water System (CCWS)
9.2.5 Ultimate Heat Sink (UHS)
9.2.8 Safety Chilled Water System (SCWS)

- **Applicable Regulations and Review Guidance:**
  - SRP 9.2.1, 9.2.2, & 9.2.5
    - GDC 2 - Design Bases for Protection against Natural Phenomena
    - GDC 4 - Environmental and Dynamic Effects Design Bases
    - GDC 5 - Sharing of Structures, Systems, and Components
    - GDC 44 - Cooling Water (heat transfer)
    - GDC 45 - Inspection of Cooling Water System
    - GDC 46 - Testing of Cooling Water System
    - 10 CFR 52.47(b)(1) - ITAAC
  - 10 CFR 20.1406 - Minimization of Contamination

ESWS-Challenges

- **ESWS Water Hammer Considerations**
  - FSAR Revision 1 silent on water hammer design features and testing
  - Applicant to perform hydraulic transient analysis, confirms ESWS integrity to withstand the effects of water hammer

  - Revision 3 added:
    - Description of air release valves & vacuum breakers
    - Keep fill system with mechanical draft cooling tower (MDCT) riser water level alarms
    - Chapter 14 testing – tests to verify there is no evidence of a water hammer

CCWS-Challenges

United States Nuclear Regulatory Commission
Protecting People and the Environment

- **CCWS Water Hammer Considerations**
  - Staff concern; 10 second closure time of fast acting hydraulic valves for CCWS train cross connects
    - Applicant stated; fast valve closure time not considered to be an instantaneous closure that would create large pressure waves in the system
    - FSAR Revision 3 added Chapter 14 testing –tests to verify there is no evidence of a water hammer

CCWS-Challenges

- **CCWS Surge Tank Sizing and System Leakage**
  - FSAR original design had non-safety related makeup from Fire Protection to support 7 days of makeup
  - Revision 3 of the FSAR includes;
    - Valve seat leakage defined in FSAR Table 3.9.6-2
    - Assumes no safety related makeup for 7 days
    - 750 gallon water reserve for 7 day per tank
    - TS SR 3.7.7.2 – 31 day verification < 4.0 gallon per hour leakage
    - Defense in depth – connections via firewater (seismic II) post 7 days

9.2.5 UHS-Challenges

- **Uncertain verification of MDCT performance**
  - ITAAC and initial start-up testing added for FSAR Revision 3
    - Includes Cooling Tower Design Report
      - Performance curves
      - Recorded temperature – worst case meteorological data
      - Basin water temperature trending (30 days)
      - Includes effects of concentrated impurities in MDCT basin
      - Includes all assumptions, analytical methods & uncertainties

- **Open Item - Technical Specification 3.7.9; applicant to address possible TS surveillance for wet bulb temperature**

9.2.8 SCWS-Challenges

- **SCWS Water Hammer Considerations**
  - FSAR R/2 modified to add clarification:
    - Pressurized expansion tanks with nitrogen
    - Specified closing valves speed- slow enough to prevent damaging pressure increases
    - Chapter 14 testing – tests to verify there is no evidence of a water hammer

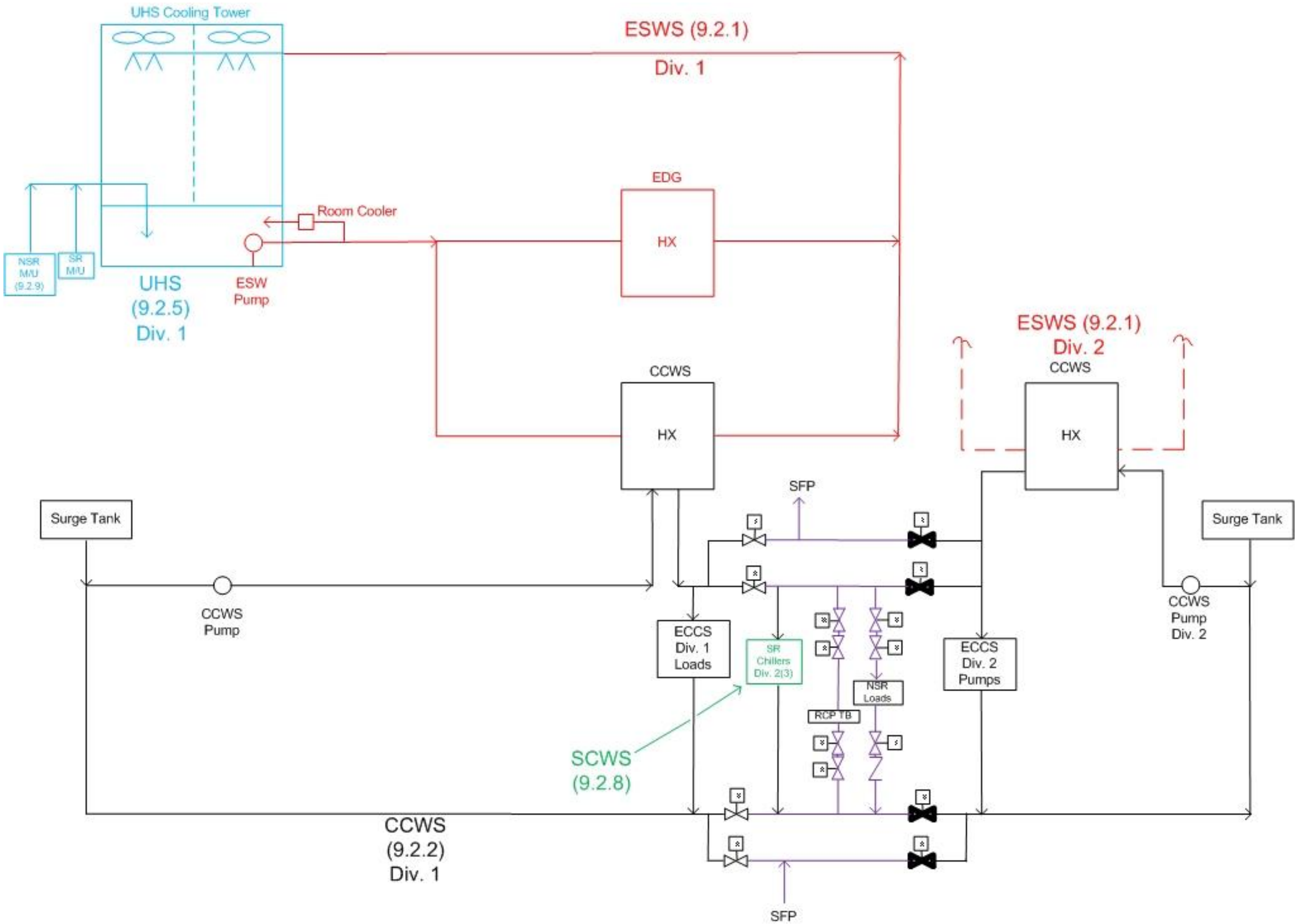
9.2.8 SCWS-Challenges

- **SCWS Surge Tank Sizing and System Leakage**
  - FSAR Revision 2 & 3 modified to add clarification:
    - 100 gallon water reserve for 7 day
    - Assumes no safety related makeup for 7 days
    - TS SR 3.7.9.4 leakage verification (24 months), < 0.5 gallon per hour
    - Defense-in-depth makeup from nonsafety-related Fire Protection (seismic Cat. II)

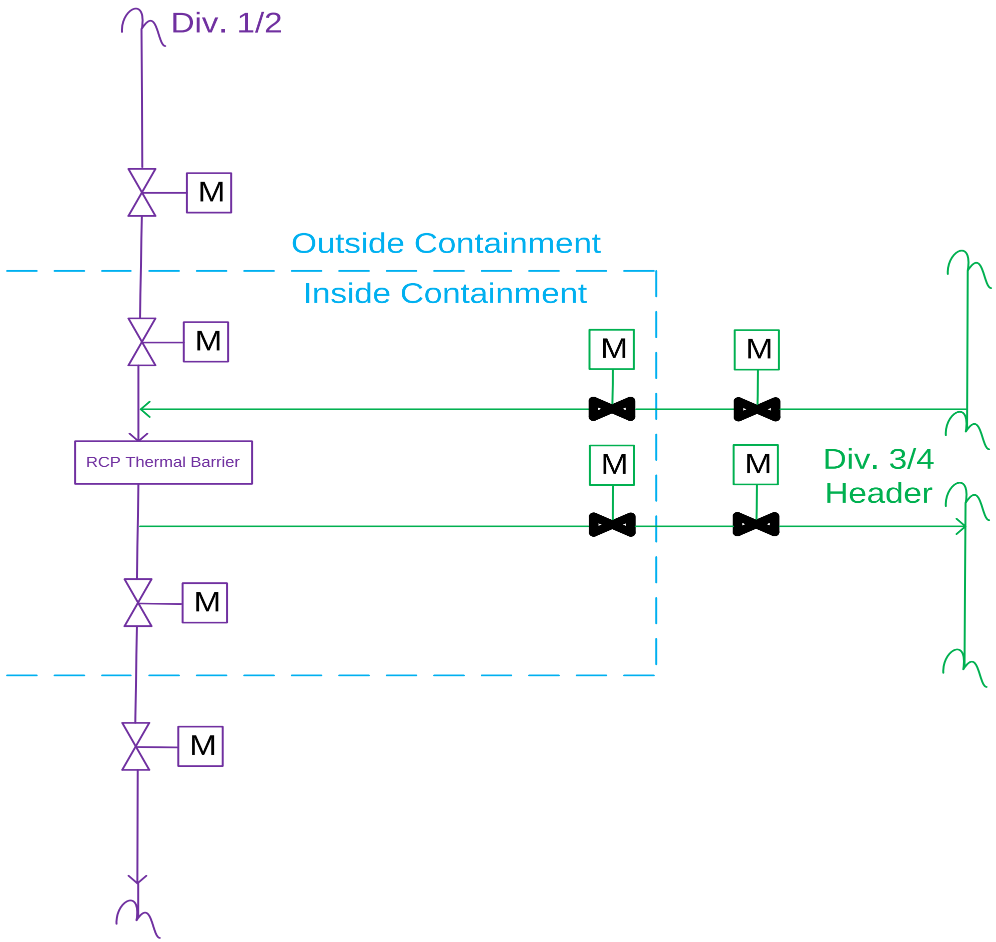
- **Staff Conclusions for ESWS, CCWS and SCWS**
  - Applicable Regulatory Requirements are satisfied
- **Staff Conclusions for UHS**
  - Applicable Regulatory Requirements are satisfied with the exception of resolution of open item related to TS and wet bulb considerations
- **Questions?**

Backup slide
EPR ESWS, CCWS, UHS, SCWS Simplified Drawing

United States Nuclear Regulatory Commission
Protecting People and the Environment



Backup slide
CCWS Thermal Barrier Cross-tie



United States Nuclear Regulatory Commission

Protecting People and the Environment

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

SER/OI Chapter 9 Section 9.4

Air Conditioning, Heating, Cooling and Ventilation Systems

James O'Driscoll

November 14-15, 2011

Area of Review

United States Nuclear Regulatory Commission
Protecting People and the Environment

SRP Sections

9.4.1 Control Room Air Conditioning System

9.4.2 Spent Fuel Area Ventilation System

9.4.3 Auxiliary Building Ventilation System

9.4.4 Turbine Building Ventilation System

9.4.5 Engineered Safety Feature Ventilation System

- Applicable Regulations and Review Guidance
  - GDC 2 – Design Bases for Protection against Natural Phenomena
  - GDC 4 – Environmental and Dynamic Effects Design Bases
  - GDC 5 – Sharing of structures systems and components
  - GDC 17 – Electric Power Systems
  - GDC 19 – Control Room
  - GDC 60 – Control of Releases of Radioactive material
  - GDC 61 – Fuel Storage and Handling and Radioactivity Control
- 10 CFR 20.1406 – Minimization of Contamination.

Technical Topics of Interest
Section 9.4.1 – MCR HVAC

Clarify method by which the capacity of the safety-related ventilation systems are verified.

Staff Evaluation

- Adequate sizing of safety-related systems is assured through the surveillance requirements.
- There are no ITAAC that verify HVAC capacity to support the 10 CFR 52.103(g) finding.
- RAI applies to FSAR Sections 9.4.1,2,5,6,9, and 11.
- Open Item:

  RAI 277, Question 09.04.01-1: Requests that the applicant provide sufficient ITAAC to verify that the safety related ventilation systems are designed with sufficient capacity to remove the design heat load for all modes of operation and environmental conditions within the site envelope.

Clarify The Safety-Related function of the Containment Building Ventilation System.

The description of the safety related function of the CBVS in Tier 1 and Tier 2 of the FSAR is unclear. The description of what portions of the CBVS are safety-related is unclear.

Staff Evaluation

- Based on the response to RAI #277 Question 09.04.03-3, the staff understands that only the low-flow purge exhaust subsystem outside of containment is designated as safety-related. The FSAR and Tier 1 remain unclear as to what is the safety related function of the CBVS low volume purge subsystem.
- Open Item

  RAI 509, Question 09.04.01-7: Requests that the applicant clarify the safety- related function of the CBVS in Tier 1 and Tier 2. Clarify what Technical Specification Surveillance requirements are needed to verify operability of the CBVS low volume purge exhaust trains.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Presentation to the ACRS Subcommittee

SER/OI Chapter 9 Section 9.5.1 Fire Protection System

Edward McCann

November 14-15, 2011

ACRS Subcommittee Presentation SER/OI Chapter 9 Section 9.5.1 Issues of Interest

- Communication: Exclusion Zones - An alternative means of communications via one of the fixed communication systems is provided that is free of fire effects if needed.

- Emergency Lighting: Special emergency lighting system in the MCR and RSS - Receives power from redundant emergency diesel generator backed uninterruptible power supplies, thus providing continuous illumination.

- Multiple Spurious: It is the intent of the U.S. EPR design to follow the NRC endorsed/issued spurious actuation guidance in effect when the U.S. EPR post-fire safe shutdown analysis is formally initiated .

  - In RAI 517, Question 09.05.01-86 stated that the applicant should document the use of RG 1.189 Revision 2 and the endorsed sections of NEI 00-01 Revision 2 in the FSAR for Post-Fire Safe Shutdown Circuit Analysis Methodology.

ACRS Subcommittee Presentation
SER/OI Chapter 9 Section 9.5.1
Issues of Interest

- Digital Equipment: No credit is taken for digital equipment design features to preclude fire-induced spurious actuations . However, credit is taken for the lack of hot shorting for fiber optic cables.

- Smoke Control :
  - Smoke Confinement System for areas credited for post fire safe shutdown
  - Smoke Effects Analysis
  - Smoke dampers, fire barriers, manual smoke control procedures, and automatic sprinklers where applicable
  - There are ITAACs related to mitigation of the propagation of smoke for structures

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Chapter 9 Group I Sections

Questions?